SCIENTIFIC/TECHNICAL REPORT submitted to EFSA

CHIP: Commodity based Hazard Identification Protocol for emerging diseases in plants and animals[1]

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ABSTRACT

This project comprised the development of a commodity-based hazard identification protocol for biological hazards in plants and animals as a decision support tree programmed in Excel. The content of the decision tree is based on the results of a systematic review of pest and pathogen characteristics, a review of risk assessment schemes and on expert judgement. Application of the protocol results in an indication of the level of likelihood of entry of animal and plant pathogens/pests in the area of destination associated with the commodity/pathway, and it guides the decision regarding potential actions to be undertaken in the search for existing and emerging pathogens/pests. The decision tree consists of three levels. Level 0 concerns whether the commodity itself can turn into a pest, whether it can contain pests and pathogens, and whether it contains additional material that can be contaminated. The likelihood that a commodity contains pests and pathogens depends on the likelihood of pest association and survival before the commodity is transported to the country of destination, and the likelihood that the pest/pathogen will come into contact with local hosts in that country. In level 1, the likelihood of pest association and survival is elaborated and assessed for each pest/pathogen category, whereas in level 2 the likelihood that a biological hazard comes into contact with local host is assessed in greater detail. The decision tree is extended with a [commodity list derived from Combined Nomenclature (CN) classification with relevant characteristics, and a pathway model which enables the risk assessor to provide and structure the relevant information. The decision tree was tested and demonstrated by six commodities: three of plant origin and three of animal origin.

KEY WORDS

Emerging risks, decision tree, commodities, biological hazards, plant health, animal health

SUMMARY

INTRODUCTION AND OBJECTIVES

The risks posed by exotic plant and animal pathogens/pests are increasing due to increased worldwide trade, climate change, etc. Furthermore, technologies to detect pests and diseases have improved considerably (see e.g. www.qdetect.org), enabling risk managers to intervene in trade processes. Parallel to these developments, the field of methodology development for risk analysis of new plant and animal pathogens/pests is emerging. In plant health during the last decade, both EPPO (European and Mediterranean Plant Protection Organization) (EPPO 2011) and EFSA (EFSA 2010) have developed pest risk assessment schemes, which are largely comparable. In animal health, guidelines for import risk analysis have been developed by the OIE (OIE 2004), and a risk assessment scheme for vector-borne diseases is being developed in the Netherlands (Vos et al. 2011). These assessment schemes are agent- or organism-based, which implies that they can be applied only to identified pathogens/pests. However, the fact that trade is a major pathway for the entry of exotic plant and animal pathogens/pests increases the need for a protocol to determine the risk profile of commodities.

METHODOLOGY

The decision tree was developed in a structured process that consisted of the following stages:

1. Preparatory research. This comprised:
   a. The development of a pathway model to enable the risk assessor to collect and structure all necessary information regarding the production, processing, transport and storage processes that affect the likelihood of the entry of pests/pathogens into the country of destination.

   b. The compilation of a commodity list. All commodities of plant and animal origin were selected and stored in a database, including characteristics that affect the likelihood of pest/pathogen association with the commodity, survival during transport and storage, and potential contact with local hosts after entry into the country of destination

   c. An extensive review of scientific literature on pest/pathogen characteristics that affect the likelihood of commodity contamination, survival of the pest/pathogen during commodity processing and transport, and the likelihood of infecting a local host once introduced. This resulted in the following basic pest/pathogen characteristics to include in the decision support tree:
      1. The location where the pest/pathogen survives on the commodity
      2. The capacity to withstand treatments designed to eliminate pests/pathogens on commodities.

   d. A review of risk assessment schemes, which resulted in a list of risk factors that experts generally agreed upon and can be combined with the results of the systematic review for inclusion in the decision tree.

   e. A review of hazard identification protocols to identify best practices for developing a hazard identification protocol in order to prevent pitfalls in the development of a decision support tree for the CHIP project.

2. In the second stage, the decision tree was developed on the basis of the following principles:
   a. The use of the decision tree is triggered by a trade signal. Trade signals can be generated by sudden changes in commodity type, country of origin and the volume of the traded commodity. Therefore, the traded volume was not included in the decision tree.

   b. The decision tree has a modular structure. This enables the risk assessor to perform a quick analysis and, if necessary, an in-depth analysis, but is not intended to replace a full import risk assessment. Level 0 comprises an assessment on the basis of the traits of the commodity: state of the product and its intended use. Level 1 consists of traits of the production and post-harvest processes that determine the likelihood that the commodity has been infested by any

pathogen/pest before it is transported to the country of origin. Level 2 consists of a comparison between the countries of origin and destination and pest/pathogen characteristics that enable the infestation of local hosts.

c. The modules are kept as simple as possible, which means that the traits of commodities and pests are summarized. Addressing them individually would make the decision tree extremely complex and suggest a level of detail that could not be justified. Empirical evidence about the effect of each characteristic of a commodity and a pest/pathogen on the likelihood of entry is lacking (see Appendix 3). Furthermore, the decision tree is used as a tool to prioritize risk assessment. This requires a robust rather than a sophisticated approach: namely an approach that easily and roughly separates the wheat from the chaff.

d. The decision tree is restricted to the likelihood of the entry of pest and pathogens associated with agricultural commodities. Establishment, spread and impact are not included in the protocol. If the likelihood of entry of a certain pest or pathogen is high, the recommendation will be to conduct a full organism-based risk assessment in which those aspects are addressed. When building the decision tree, the following approach was applied. The decision tree integrated the results of the preparatory work as described before. The development of the decision tree was based on expert judgement and, where possible, on the results of the reviews. The characteristics with the most discriminating power were put the highest in the decision tree.

3. The results of this study were presented to and discussed with six international experts in two expert meetings.

4. The decision support tree was tested with six case studies: Pacific oyster from China, poultry from Thailand, sausage casings from Algeria, litchis from Madagascar, tomato seed from Mexico and trees from Canada.

RESULTS

The decision support tree has the following characteristics:

1. It is generic, which means that it can be applied to all commodities of plant and animal origin.

2. The decision tree has a modular structure to facilitate both quick and in-depth assessments.

3. The program, which is in Excel, can be applied freely by stakeholders. The decision tree was described and documented in a user manual and the results were justified in the report.

4. The decision tree is applicable for the rapid screening of commodities in the EU. It considers the pathway starting from the country of origin to entry into the EU.

5. The characteristics with the most discriminating power are highest in the decision tree.

6. Three levels of likelihood are distinguished: high, moderate and low.

The decision tree was programmed in Excel. The case studies resulted in some adjustments. For the likelihood of survival during transport and storage, it soon turned out that this level did not have extra discriminatory power, because the survival of pests/pathogens is mainly determined by the state of the product and the preservation methods used, which stay the same during transport and storage, and therefore the transport and storage time does not have much influence. A few questions were reformulated. The case studies repeated with the final version of the decision support tree show consistency between the results of level 0 and level 2. A manual has been developed to assist the risk assessor to apply the model. All results are summarized in a report containing all questions, answers, scores, conclusions and decision rules.

DISCUSSION

The decision tree is a prototype model. This implies that the emphasis in the development is on the structure rather than the content. The combination of plant and animal pests and pathogens in one model has proved to be possible. The major hurdle was the use of different terminology in each domain when referring to the same thing. The content needs additional research because the results of the systematic review are of limited importance. This is due to the lack of empirical evidence. The number of studies in which this has been studied is limited and they always focussed on certain pest/pathogen categories. However, it became apparent that the likelihood of pest/pathogen survival due to exposure to all potential circumstances during production, processing, storage and transport is the most crucial aspect to be addressed in the decision tree. Those relationships were mainly based on the expertise of the project team and the involved experts. However, this basis is rather limited, since it requires expertise both on all pest/pathogen categories and on the length of the period and intensity of the treatments the commodity is exposed to. Therefore, it is highly recommended to revise the scores on the basis of scientific literature review.

Although in this project the focus was on pests and pathogens that can cause diseases in animals or plants, the structure of the decision tree can also be applied to zoonoses and other biological hazards threatening human health. Level 1 will to a large extent be the same, although it must be noted that biological hazards affecting human health will in most cases not cause problems to plant and animal health. Level 2 will focus on the likelihood that commodities come in direct contact with humans, either by use of the commodity or by consumption. Furthermore a comparable decision support tree can be developed to assess the likelihood that commodities are contaminated with chemical hazards, threatening human health.

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APPENDICES

BACKGROUND

According to Article 34.1 of EFSA's Founding Regulation, 'the Authority shall establish monitoring procedures for systematically searching for, collecting, collating and analysing information and data with a view to the identification of emerging risks in the field within its mission'. According to EFSA's Scientific Committee, an emerging risk to human, animal and/or plant health is understood as a risk resulting from a newly identified hazard to which a significant exposure may occur, or from an unexpected new or increased significant exposure and/or susceptibility to a known hazard. Using this definition, an emerging disease can be defined as a newly identified disease that has the potential to spread among populations, or a new presentation of a known disease appearing in a new geographical area or in new host species.

It is widely acknowledged that trade is a major pathway for the introduction of emerging diseases into the EU. Recent work published by EFSA (EFSA-Q-2009-00854) concluded that the Eurostat Comext database could assist in the identification of emerging risks in combination with data coming from other sources, including the UN Comtrade database. An increase of the volume of a given product over time to a specific Member State or the entire EU, new trade partners, and new food or feed commodities entering the EU were identified as possible signals that may require expert investigation for potential emerging risks. Consequently, once a significant change in trade patterns for a particular food or feed commodity has been detected, there is a requirement to perform a risk assessment for that commodity.

Exotic pathogen/pest specific import risk assessment methodologies are well developed in animal and plant health; recent examples include citrus black spot fungus, pinewood nematode and epizootic haemorrhagic disease. In these cases, the risk assessment was based on a known pathogen. Considering the role of trade as a driver for emerging diseases, there is a need to develop a biological hazard identification protocol for traded commodities. This would include the identification of characteristics for commodities and pests/pathogens that can be used to determine risk and a methodology for the classification of commodities that represent a genuine risk for the emergence of plant and animal disease. This project focused on the development of a methodology for the first step in risk assessment – hazard identification – based on a traded commodity.

An exotic pathogen/pest is defined as a species not known to be found within the EU that causes disease in plants or animals

TERMS OF REFERENCE AS PROVIDED BY [REQUESTOR]

CONTEXT AND SCIENTIFIC BACKGROUND OF THE CALL

OBJECTIVES OF THE CALL FOR PROPOSALS

1) To develop a commodity-based hazard identification process suitable for biological hazards in plants and animals

2) To develop robust decision tree that can be applied in a timescale suitable for emerging risks.

3) To share state-of-the-art methods for biological hazard identification in the fields of plant and animal health.

STRUCTURE AND ESSENTIAL REQUIREMENTS OF THE PROPOSAL

Work Package 1: Development of a biological hazard identification protocol for imported commodities

1.1 Perform a systematic review of European or Member State country specific regulations for import/trade on the definition of commodities. Develop a harmonized list of commodities. Describe each commodity by a number of characteristics that influence the commodity's import risk (for example, source, species, parts traded, processing)

1.2 Perform a systematic review of known (existing or past) trade risks and associated commodities. Review existing classifications of import risks and develop a harmonized classification of biological hazards based on pathogen/pest characteristics (for example, species, taxonomy, host range, life cycle, transmission strategy, conditions for survival, growth and reproduction, genetic variability, virulence).

1.3 Provide a risk-based classification of commodities according to the determining characteristics described above. Provide a scientific justification for the selection of these characteristics and the proposed risk classification.

1.4 Develop a decision support tree based on the results of work packages 1.1–1.3 to identify the risk class for new commodities with unknown (emerging) hazards. A decision tree is a schematic (pictorial) representation of the relationship between decisions, risks and outcomes. It can be used as a tool to evaluate alternative strategies and make decisions. The decision tree breaks down a series decisions into smaller, simpler, more manageable, independent segments. These segments are represented as branches of a tree.

In the proposal, the applicants are invited to propose refinements or alternative strategies for the development of a commodity-based biological hazard identification protocol.

Work Package 2: Case studies

The decision support tree should be validated using case studies; the commodities selected for case studies should include a live aquaculture species, a meat product, a milk product, a live plant, a fruit/vegetable, a seed. As a result of the case studies, the methodology in work package 1 should be refined.

The proposal should include suggestions of the traded commodities to be used in the case studies and the reasons for proposing these commodities.

Work Package 3: Participation in Workshop

The Workshop would focus on the presentation of the outcomes of the project and would include an open discussion with participants at the meeting.

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Contractor/Beneficiary:	LEI Wageningen UR Stichting Dienst Landbouwkundig Onderzoek (Stichting DLO)
Contract/grant title:	Commodity based hazard identification protocol for emerging diseases in plants and animals
Contract/grant number:	EFSA/AMU/2010/01

1. INTRODUCTION AND OBJECTIVES

1.1. INTRODUCTION

Risks caused by exotic plant and animal pathogens/pests increase due to increased worldwide trade, climate change, etc. Furthermore, technologies to detect pests and diseases have improved considerably (see e.g. www.qdetect.org), enabling risk managers to intervene in trade processes. Parallel to these developments, the field of methodology development for risk analysis of new plant and animal pathogens/pests is emerging. In plant health during the last decade, both EPPO (European and Mediterranean Plant Protection Organization) (EPPO 2011) and EFSA (EFSA 2010) have developed pest risk assessment schemes, which are largely comparable. In animal health, guidelines for import risk analysis have been developed by the OIE (OIE 2004), and a risk assessment scheme for vector-borne diseases is being developed in the Netherlands (Vos et al. 2011). These assessment schemes are agent or organism based, which implies that they can be applied only to identified pathogens/pests. However, the fact that trade is a major pathway for the entry of exotic plant and animal pathogens/pests increases the need for a protocol to determine the risk profile of commodities. A pathway is defined as any means that allows the entry or spread of a pest (FAO 2006). Such a protocol guides risk managers in their decision to inspect commodities to identify or monitor existing and new hazards.

EFSA requested the implementation of this protocol as a decision tree. In this report the decision tree is described and justified on the basis of reports from the project work packages included in Appendices 1 to 5. A pest or pathogen is a biological hazard if it is able to enter a pathway at some point, survive subsequent stages in the pathway, spread into the environment after entry into the EU, and cause damage in the environment where it is released. Application of the protocol results in an indication of the level of likelihood of the entry of animal and plant pathogens/pests in the area of destination associated with the commodity/pathway, and it guides the decision regarding potential actions to be undertaken in the search for existing and emerging pathogens/pests. The decision support tree is not intended to replace an import risk assessment, since it is only a tool for initial screening and prioritization for commodities. The protocol does not result in an indication of the potential impact caused by the pathogens/pests, but is limited to the likelihood of entry. Determining the potential damage is the subject of the subsequent organism-based risk assessment. Specification means that the monitoring can be limited to certain hosts or pathogens/pests. In the case new pathogens/pests are found, a risk assessment for the specified organism has to be applied in order to quantify the risks associated with these pathogens/pests. The identification protocol of the organism itself was beyond the scope of this project.

1.2. OBJECTIVES AND REQUIREMENTS

The objectives of this project were:

1) To develop a commodity-based hazard identification process suitable for biological hazards in plants and animals.

2) To develop a robust decision tree that can be applied in a timescale suitable for emerging risks.

3) To share state of the art methods for biological hazard identification in the fields of plant and animal health.

According to the terms of reference, the protocol had to fulfil the following requirements:

1. It must be generic. That means that it can be applied to all commodities of plant and animal origin.

2. The data necessary and available for making decisions on the one hand and the time to perform an analysis on the other hand, determine the required level of detail of the analysis. Therefore, the decision tree will have a modular structure to facilitate both quick and in-depth assessments.

3. The decision tree will be developed as a tool programmed in Excel, that can be applied freely by stakeholders, together with the documentation in which the decision tree is described (manual) and the results are justified (report).

4. The decision tree is suitable for the rapid screening of commodities in the EU. It considers the pathway starting from the country of origin to entry into the EU.

5. In this project it was agreed not to incorporate spread and impact, but to stop the analysis after the entry of the pest/pathogen into the importing country.

1.3. STRUCTURE OF THE REPORT

This report is structured as follows. The methodology is described in Chapter 2. In Chapter 3 the decision tree is described. Chapter 4 concludes the report with a discussion and recommendations. In the appendices, all results of the work packages contributing to the development of the decision tree are described.

2. METHODOLOGY

In this chapter, we refer to appendices that describe the results of the work packages that were used to develop the decision tree. Table 2.1 presents an overview of the appendices.

Table 2.1: Overview of appendices to this report

Appendix 1	**Modelling a pathway**
Appendix 2	Review of EU and Member State regulations on the definition of commodities
Appendix 3	Animal and pest/pathogen characteristics and introductions; a systematic literature review
Appendix 4	Pest risk assessment schemes and standards; a comparison of different guidelines
Appendix 5	Review of hazard identification protocols
Appendix 6	Manual for the decision support tree
Appendix 7	Case studies
Appendix 8	Reports of expert meetings

The decision tree was developed in a structured process that consisted of the following stages:

1. In the first stage, preparatory research was executed. This comprised:

   a. Development of a pathway model. The objective of the pathway model is to enable the risk assessor to collect and structure all necessary and available information regarding the production, processing, transport and storage processes, affecting the likelihood of entry of pests/pathogens in the country of destination. The pathway model is described in Appendix 1 and is also programmed in Excel.

   b. Compilation of a commodity list. Based on the results of a preceding EFSA project, this task investigated which trade data classification should be used for monitoring trends in trade developments in the EU (EFSA, 2010b). It is recommended to use the CN classification, since this classification is used by EU Member States to report trade statistics. This classification can be accessed by following this link:

   http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm?TargetUrl=LST_NOM_DTL&StrNom=CN_2012&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC

The CN classification was selected because it is the most comprehensive commodity classification used throughout the EU. It has a logical structure based on the state of the product (fresh, processed, etc.). It corresponds to most other trade databases and therefore offers the possibility of combining the actual trade data with the risk assessor's work. Because the CN classification is at some points too aggregated for use in identifying hazards to specific products, it is recommended to maintain flexibility on the part of the risk assessor. The classification of products and the identified risks based on the naming in the classification can serve as a starting point or reference. The CN classification is built up of chapters, headings and subheadings. The choice of the level of detail needed for analysis rests with the risk assessor. When the product is the starting point for the analysis, it is recommended to start at the most disaggregated level at 8 digits. Furthermore, it contains the highest resolution for trade data. The results are described in Appendix 2.

All commodities of plant and animal origin are selected and stored in a database. On the basis of information available in the CN database of Eurostat, a number of characteristics affecting the likelihood of pest/pathogen association with the commodity, survival during transport and storage, and potential contact with local hosts after entry into the country of destination are added. It is recommended to include the database in the decision support tree in Excel.

c. Systematic review. Scientific literature was extensively reviewed on pest/pathogen characteristics that affect the likelihood of commodity contamination, survival of the pest/pathogen during commodity processing and transport, and the likelihood of infecting a local host once introduced. The review resulted in a limited number of characteristics, which are reported in Appendix 3. As a result, the following basic pest/pathogen characteristics are assessed by the questions in the decision support tree:

    1. The location where the pest/pathogen survives on the commodity
    2. The capacity to withstand treatments designed to eliminate pests/pathogens on commodities.

However, since no information about the relative importance of these characteristics is available, prudence is called for the importance of these characteristics compared to characteristics derived from other sources and included in the decision support tree.

d. Review of risk assessment schemes. In order to gain further insights into pest/pathogen characteristics that facilitate the introduction of a pest/pathogen through international trade, a review of all pest/pathogen risk assessments that have so far been performed is recommended as a logical next step. The objective of this study is to review existing guidelines for pest risk assessment (both organism- and pathway-initiated; plant and animal health) for pest/pathogen characteristics that should be considered when assessing the likelihood of entry. The review resulted in 60 risk factors that experts have generally agreed upon (see Appendix 4) and that can be combined with the results of the systematic review for inclusion in the decision tree. Reviewing guidelines for pest risk assessments turned out to be useful for finding pest/pathogen characteristics, and also commodity-, country- and pathway-related characteristics (risk factors), for assessing the likelihood of entry, establishment and spread of pests/pathogens. The review resulted in a long list of characteristics. When developing the decision tree, all characteristics on the list were evaluated for their usefulness in the decision tree. Not all characteristics have been included in the decision tree. This depended on the discriminatory power of each characteristic.

e. Review of hazard identification protocol. The objective of this review was to identify best practices for developing a hazard identification protocol in order to prevent pitfalls in the development of a decision support tree for the CHIP project. The review was focused on data-based hazard identification protocols in comparable policy areas such as food safety and human health. The results are described in Appendix 5. The conclusion was that for the development of a generic commodity-based hazard identification protocol, it is necessary to associate any commodity with potential pests/pathogens and the pathways. This requires a categorizing step for both commodities and potential pests/pathogens and an identifying step establishing the association between the category of commodity and the category of hazards.

With regard to the protocol in general, it was recommended that:

- the objectives of the hazard identification protocol should be defined according to the principles and criteria of relevant regulations and standards;
- the protocol should be reviewed by a multidisciplinary group with members from the industry, academia and inspection agencies;
- the protocol should be regularly updated with new information on commodity pathways and pathogens.

With regard to the decision support tree in particular, it was recommended that:

- the structure of the decision support tree should be made in accordance with the official categorization of the commodities and the pathogens;
- the full range of hazard types should be considered and the outputs of the hazard identification process fully documented;

- the decision support tree should be illustrated with typical commodities, pathogens and the pathways. The principles of the decision support tree should be well documented and explained;
- the underlying logic and relationships of the decision support tree should be supported by scientific evidence and take into account of uncertainties.

2. In the second stage, the decision tree was developed on the basis of the following principles:

   a. The use of the decision tree is triggered by a trade signal. Trade signals can be generated by (sudden) changes in commodity type, country of origin and the volume of the traded commodity. Therefore, the traded volume is not included as part of the decision tree.

   b. The decision tree has a modular structure. This enables the risk assessor to perform a quick analysis, and if necessary an in-depth analysis, but it is not intended to replace a full import risk assessment.

   c. The modules are kept as simple as possible. That means that the traits of commodities and pests are summarized. Addressing them individually would make the decision tree extremely complex and suggests a level of detail that cannot be justified. Empirical evidence about the effect of each characteristic of a commodity and a pest/pathogen on the likelihood of entry is lacking (see Appendix 3). Furthermore, the decision tree will be used as a tool to prioritize risk assessment. This requires a robust rather than a sophisticated approach: namely an approach that easily and roughly separates the wheat from the chaff.

   d. The decision tree is restricted to the likelihood of entry of pest and pathogens associated with agricultural commodities imported into the European Union. Establishment, spread and impact are not included in the protocol. If the likelihood of entry of a certain pest or pathogen is high, the recommendation will be to conduct a full organism-based risk assessment, in which those aspects are addressed.

When building the decision tree, the following approach was applied. The results of the preparatory work as described in the appendices have been integrated in the decision tree. This implies that both the pathway model (Appendix 1) and the commodity list (Appendix 2) are linked to the decision tree, but not automatically. Both tools serve as a source or tool to collect and structure information that can be used to fill in the questionnaire. The characteristics as derived in the systematic review (Appendix 3) and the review of the risk assessment guidelines (Appendix 4) that are related to commodities will be included in the decision tree. However, since the list of pest and pathogen characteristics is limited, which means that they do not cover all relevant aspects, and no information about the relative importance of each characteristic is available, the decision tree is primarily structured according to the whole process of production, harvest, processing, transport and storage that the commodity passes through. This implies that the emphasis in the decision tree lies on pest/pathogen association and survival until the commodity arrives at the destination country and upon contact with local hosts thereafter. The development of the decision tree is based on expert judgement and where possible on the results of the reviews. The characteristics with the most discriminatory power are put the highest in the decision tree.

Three levels of likelihood are distinguished: high, moderate and low. In all cases, application of the decision tree results in a recommendation either to stop the analysis or to conduct full organisms risk assessments for those pests that are likely to enter the country of destination with the commodity and that have not previously been subject to risk assessment.

After answering the questions, the risk assessor can generate a report in which all answers, corresponding likelihoods, the decision rules and the conclusion are presented. This report can be used to derive the most important aspects that determine the final conclusion.

3. The results of this study were presented to and discussed with six international experts in two expert meetings. The emphasis was on the structure of the decision tree, the aspects addressed in the decision tree, and the likelihoods for each aspect per pest/pathogen categories. Reports were made of these meetings (Appendix 8). The comments and recommendations of the experts were processed.

4. The decision support tree should be illustrated with typical commodities, pathogens and the pathways. Therefore, the decision support tree was tested and demonstrated by six case studies (Appendix 7). The animal cases were Pacific oyster from China, poultry from Thailand and sausage casings from Algeria; the plant cases were litchis from Madagascar, tomato seeds from Mexico and trees from Canada. The testing was applied to evaluate whether the model works correctly and is internally consistent. The reliability of the results was assessed on the basis of expert judgement by the team members.

3. DESCRIPTION OF DECISION TREE

3.1. OUTLINE OF THE STRUCTURE

The decision tree has three levels. Level 0 comprises an assessment on the basis of the traits of the commodity – that is, state of the product and intended use – and has three possible outcomes. The two traits cover in principle all relevant aspects of the pathway. In the case of low likelihood, there is no need to continue the analysis. In the case of high likelihood it is recommended to go directly to individual organism-based risk assessments, without intermediate analysis. In the case of moderate likelihood, it is recommended to elaborate the pathway and to apply levels 1 and 2, following the whole pathway sequentially.

Level 1 consists of traits of the production and post-harvest processes that determine the likelihood of the commodity being infested by any pathogen/pest before it will be transported to the country of destination. Those traits dominate the pathway and pest/pathogen traits, which are only relevant if the commodity is infested by a pathogen/pest. E.g. if an infested product is preserved by heating, eliminating all pests and pathogens associated with the commodity, and it is hermetically packed, physical circumstances during transport and storage and intended uses of the commodity do not influence the likelihood of infestation of local hosts with pests/pathogens associated with the commodity. If infestation is unlikely, there is no need to continue the analysis. If infestation is likely, level 2 should be applied, which consists of a comparison between the countries of origin and destination and pest/pathogen characteristics enabling the infestation of local hosts. This leads to the structure for levels 0, 1 and 2 as outlined in figure 3.1.

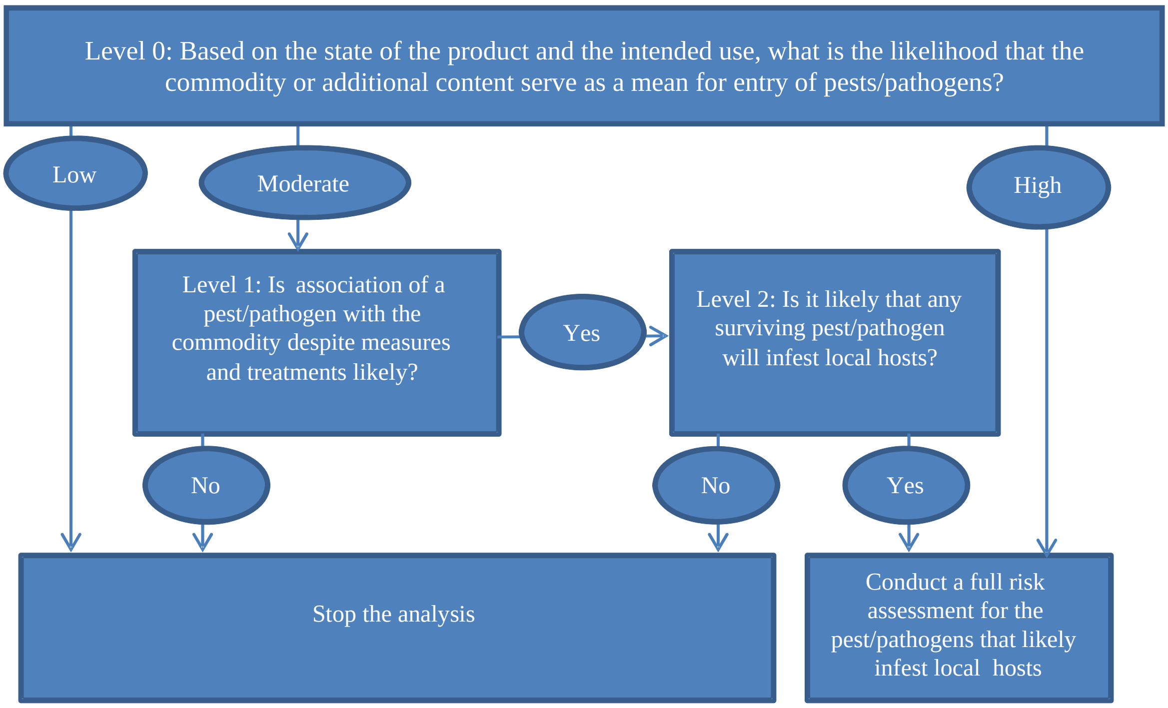

Figure 3.1: Generic outline of the decision tree

Section 3.2 presents the decision tree regarding the main commodity traits (level 0). Section 3.3 contains the description of level 1 regarding production and harvest characteristics. In section 3.4, level 2 – which is based on country comparison, pest/pathogen and commodity traits – is discussed. In section 3.5 we explain the scoring systems and how the scores can be combined. In section 3.6, the decision tree is presented by the questions to be answered, and the recommendations which action should be undertaken depending on the answers.

3.2. LEVEL 0: STATE OF THE PRODUCT AND INTENDED USE

A commodity can be associated with a biological hazard in three ways:
1. The commodity itself can turn into a pest. This can only be the case with the entry of live plants and animals. Examples are water hyacinth (2008) and the muskrat (Leppakoski et al., 2002).
2. The commodity contains biological hazards. In this case the pest/pathogen is directly linked to the commodity.
3. The commodity contains additional material that is contaminated with a pest or pathogen. On the basis of the expertise of the authors and experts, the following categories of additional material were selected: wood (packaging material), water (flowers, aquatic commodities), intestines (animal products) and soil.

A combination of the above-mentioned options is also possible. Therefore, for each commodity all three questions have to be answered.

The commodity turns into a pest

To assess whether the commodity can become an invasive alien species requires a full risk assessment. Alien species are species that have been able to colonize distant biogeographic regions outside their historical range (Prinzing et al., 2002). They become invasive alien species when they manage to spread over a large region (Richardson et al., 2000). They become a pest if they threaten biodiversity. A full risk assessment is only necessary if the commodity is new to the country. A full organism risk assessment is beyond the scope of this project, and will therefore not be applied.

The commodity contains biological hazards

In accordance with the discussion of features of commodities in Appendix 5 (RS5), the likelihood that a commodity serves as a means to bring exotic pests or pathogens into contact with local hosts depends on two aspects:
1. The most dominant aspect is the state of the product, because it largely determines the extent to which pests and pathogens survive the processes that result in the state of the product. Six main states are distinguished: live, fresh, frozen, preserved, processed and industrial. This division is directly derived from the CN classification as applied in Eurostat, which is recommended to use for deriving trade signals (see Appendix 2).
2. The second aspect is intended use, because this aspect determines to a large extent the likelihood that the associated pests and pathogens come in contact with local hosts. Seven potential uses are distinguished: propagation/multiplication/production, ornamental use, human consumption, agricultural input, feed, processing for food and processing otherwise (Appendix 2). This division is based on information available in Eurostat, which contains the following categories: ‘not suitable for human consumption’, ‘feed’, ‘human consumption’, ‘for manufacturing’, and ‘industry’. A split has been made in the category ‘not suitable for human consumption’ on the basis of our expertise in order to differentiate risk levels.

Both aspects cover in principle the most relevant aspects, which will be processed in more detail in the levels 1 and 2. In table 3.1 all existing combinations as applied in Appendix 2 are presented. The subdivision of the commodities on the basis of these aspects is consistent with the subdivision as elaborated in ISPM 32 (FAO, 2009), but contains more detail. Table 3.1 shows that not every combination is possible. State of the product and intended use are also correlated. The more the product is treated, the fewer potential uses are left.

Furthermore, the level of likelihood has been attributed to each combination. This attribution took place on the basis of expertise of the CHIP team members and made consistent with levels 1 and 2, in which these aspects return and are dealt with in greater detail. This implies that the likelihood in level 0 is summarized from the likelihoods as judged by experts per pest/pathogen category in levels 1 and 2. Alive commodities are considered to have a high likelihood if they are used for agricultural or ornamental purposes, and moderate otherwise. Fresh or chilled commodities are considered to have a high likelihood if they are used for agricultural purposes, and moderate otherwise. Frozen and processed are considered to have a moderate likelihood. Preserved commodities are considered to have a low likelihood level, unless the intended use is feed and the commodity is not cooked, in which case it has a moderate likelihood.

Table 3.1: Likelihood of entry of any pathogen/pest by a commodity based on state of the product and the intended use

State of the product	Intended use	likelihood level
alive	propagation/multiplication/ production	high
	ornamental use	high
	agricultural input	high
	direct human consumption	moderate
	processing for food	moderate
fresh or chilled	propagation/multiplication/ production	high
	ornamental use	moderate
	feed	high
	direct human consumption	moderate
	processing for food	moderate
	processing for other purposes	moderate
frozen	direct human consumption	moderate
	processing for food	moderate
	feed	moderate
preserved	direct human consumption	low
	feed	low (cooked) moderate (otherwise)
	processing for food	low
processed	direct human consumption	moderate
	processing for food	moderate
	feed	moderate
	processing for other purposes	moderate

Pest and pathogens in alive, fresh or chilled commodities usually survive transport and storage. In those cases, the level of likelihood will be high if the commodity will be used in agricultural processes – such as propagation/multiplication, feed and agricultural input – or for ornamental purposes. Examples are the entry of wood borers with trees imported from China (Plantenziektenkundige Dienst, 2010), and foot and mouth disease (Doyle, 2010). The level will be moderate if the commodity is used otherwise. In those cases, direct links with agricultural processes are unlikely and the commodity perishes, because it is directly consumed or consumed after processing. Exceptions are zoonotic agents, which are a risk to human health. However, human pathogens are primarily subject to human health risk monitoring systems, which are beyond the scope of this project. In this project, we focused on emerging diseases for plants and animals. If human health were included, the likelihoods in table 3.1 would change; for example, the likelihood of consumption of fresh commodities would be high.

The commodity contains additional content

If the commodity contains additional content it is recommended to conduct a pathway analysis for pests and pathogens that can be associated with the material. In all cases (wood, water, intestines and soil), the likelihood is considered high. Examples of pests introduced or spread by additional material (EPPO and CABI, sa), for soil *Meloidogyne chitwoodi* (EPPO and CABI, sa) and for intestines Foot and Mouth Disease (Henderson and Brooksby, 1948). The only exception is if wood is treated against pest according to the guidelines listed in ISPM 15 (2008). In that case, the likelihood is low. The results are listed in table 3.2.

Table 3.2: Level of likelihood associated with additional content

Additional content	Level of likelihood
Wood, treated	Low
Wood, wood products untreated	High
Water	High
Intestines	High
Soil	High

3.3. Level 1: production and post-harvest processes

If Level 0 results in moderate likelihood, it is recommended to elaborate the pathway. This implies that the pathway model as described in Appendix 1 has to be filled in. This pathway model serves as a basis for answering the questions in levels 1 and 2.

The aspects addressed in level 1 concern the likelihood that potential pests/pathogens are associated with the commodity and survive the treatments, processes and physical circumstances that the commodity is subject to before it is transported to the country of destination. For each aspect, the source is indicated. When no source is mentioned, the aspect is based on expert judgement. The most important elements to include are:

1. Production systems and production types: do they enhance infestation and the multiplication of pests/pathogens (FAO, 2004; OIE, 2004; USDA, 2000)? This aspect focuses on physical barriers that prevent pests and pathogens from coming into contact with the commodity. Three potential routes can be distinguished:
   a. By water. It is assumed that tap water, rainwater and deep groundwater (water pumped up and cleaned by reverse osmosis) does not contain pests and pathogens. Polluted water contains pathogens such as bacteria, fungi, viruses and protozoa and soil related organisms such as nematodes. An example is *Ralstonia solanacearum* (EPPO and CABI, sa).
   b. By air. It is assumed that most pest and pathogens can be associated with a commodity via the air. Examples are flying arthropods. Also viruses and bacteria can be associated via the air with hosts, when they are transmitted by vectors or aerosols. Exceptions are worms in animals. Only the production of commodities in closed buildings with air filtering systems will reduce the likelihood of contact between pests and pathogens and commodities. Air filtering systems are fully effective in preventing contact with arthropods.
   c. By physical contact. Any pest and pathogen can be transmitted by physical contact between polluted material such as soil, machinery, visitors and a commodity. An example is the nematode *Meloidogyne chitwoodi* (EPPO and CABI). If this contact is absent, no transmission of any pest/pathogen by this route will take place.

2. Measures to control pests/ pathogens:
   a. Pest/pathogen management, post-harvest treatments, cultural and commercial procedures at the place of origin. The measures taken by the producer are intended to prevent the commodity being exposed to pests and pathogens or to control the pests and pathogens. However, it must be noted that these measures can be effective to prevent damage by reducing the pest/pathogen density below the economic injury level, which is the lowest level of pest/pathogen density that will cause economic damage (Pedigo, 1996). Therefore, it is assumed that those measures will not be effective in making the commodity free from nematodes, bacteria, fungi and viruses, and only partly effective against arthropods and protozoa (FAO, 2004). Measures that are effective

against individual pests/pathogens, such as vaccination (Biosecurity Australia, 2007) and production in hazard free areas (Biosecurity New Zealand, 2006) have been excluded from the list. Although they indicate a well-developed health system reducing infestation levels, these measures do not affect the likelihood of infestation with any pest/pathogen.

b. Regulated pathway or not (e.g. inspections and quarantine before export) (DEFRA, 2009; FAO, 2004). An example is the Australian system AQIS (http://www.daff.gov.au/aqis), which provides information on required export conditions for commodities. If a pathway is regulated, commodities are subject to inspections, and possibly quarantine, before they are transported to the country of destination or after entry. Inspections are limited to a relevant list of quarantine and quality diseases. Therefore, inspections and quarantine measures are not fully effective. Organisms that cannot be observed visually and can be present without symptoms, can easily go undetected.
c. Packaging effective against contact between pests/pathogens and the commodity. Before a commodity is stored and/or transported, it will be packed. The way commodities are packed determines whether pests/pathogens still have access to them. Commodities that are packed in open pallet boxes, paper boxes, etc. are not isolated from the environment. Commodities that are hermetically packed in plastic, or in closed containers, are not accessible to pests/pathogens. Especially pest and pathogen categories that can move independently (such as flying arthropods) from a vector or host, can come into contact with commodities that are not isolated from the environment. Therefore, there is a moderate likelihood that flying arthropods and microorganisms such as bacteria and fungi, as well as viruses that are transmitted by a vector, can come into contact with commodities that are not hermetically packed.

3. Procedures affecting the state of the commodity as described in level 0 such as temperature treatment, mixing, smoking, etc. (FAO, 2004) (Appendix 2). The objective of these procedures is to prepare the commodity for the final use and to conserve the commodity, if necessary. Conservation implies the reduction or elimination of contaminants. Therefore, the state of the commodity largely determines the potential presence of pests and pathogens. Live, fresh or chilled products are usually not subject to procedures that eradicate pests and diseases. Most pests and pathogen categories are able to survive freezing, except worms in animals and protozoa. Preserving techniques are applied to protect the commodity against quality loss for several months or even years. Therefore they are applied to eradicate most pests and pathogens. However, most techniques are not fully effective in eradicating any pest. Adding additives like salt, sugar and vinegar are assumed to be effective against weeds, arthropods, worms and nematodes, fungi, non-spore forming bacteria and protozoa, and only partly against spore forming bacteria and viruses. The application of sulphur dioxide is comparable but less effective against weeds and protozoa. Cooking, drying, roasting and smoking are assumed to be effective against weeds, arthropods, nematodes, worms and fungi. Cooking is also effective against most other organisms, with the exception of some spore forming bacteria (Havelaar et al., 2010). Smoking is less effective against worms, because it does not always reach the inner parts of the commodity. Other preserving and preparing techniques are assumed to be effective against weeds, arthropods and nematodes. Dying, bleaching and impregnating are assumed to also be effective against worms and fungi. However, the effectiveness of all preserving and preparing techniques also depends on the length and the intensity of the application. It is assumed that all techniques will be effectively applied. Processing implies the application of physical power and is not intended to conserve products. It will reduce the risk of relatively large pest and pathogen categories, but not the pest and pathogen categories such as bacteria, fungi and viruses.

The risk assessor has to assess whether the above mentioned elements are applied. The likelihood of survival of each pest and pathogen category depending on each element is listed in table 3.3 (level of protection during production), table 3.4 (measures applied during and after production and harvest) and table 3.5 (commercial procedures affecting the state of the commodity).

Table 3.3: Relationships between likelihood of pest/pathogen association with commodity due to level of protection during production

NB: Likelihood (H=High, M=Moderate, L=Low) regards the likelihood of association of any pest/pathogen of that category after application of the production condition or measure

		Likelihood of infestation								
Barriers to association with the commodity		**Weeds**	**Arthropods**	**Plant nematodes**	**Worms in animals**	**Bacteria non-spore forming**	**Bacteria spore-forming**	**Fungi and fungal like organisms**	**Viruses**	**Protozoa and other one-cell parasites**
Use of unpolluted water (tap water, rainwater, deep groundwater) for production of the commodity	Yes	L	L	L	L	L	L	L	L	L
	No	M	L	H	M	H	H	H	H	H
Production of the commodity in a closed building (e.g. stable/glasshouse/etc.) with air filter system for incoming air	Yes	M	L	M	L	M	M	M	M	L
	No	H	H	H	L	H	H	H	H	M
Physical contact between commodity and outside environment (e.g. wildlife, unsterilized soil, grass)	Yes	H	H	H	H	H	H	H	H	H
	No	L	L	L	L	L	L	L	L	L

Table 3.4: Relationships between likelihood of pest/pathogen association with commodity after measures applied during and after production and harvest

NB: Likelihood (H=High, M=Moderate, L=Low) regards the likelihood of association of any pest/pathogen of that category after application of the production condition or measure.

Effectiveness of measures applied	**Options**	**Weeds**	**Arthropods**	**Plant nematodes**	**Worms in animals**	**Bacteria non-spore forming**	**Bacteria spore-forming**	**Fungi and fungal like organisms**	**Viruses**	**Protozoa and other one cell parasites**
Measures applied during production and harvest	To make the commodity pest/pathogen free	L	L	L	L	L	L	L	L	L
	To prevent damage to the commodity	L	M	H	L	H	H	H	H	M
	No measures applied	H	H	H	H	H	H	H	H	H
Commodity subject to pest/pathogen regulations aimed at checking commodities for the presence of pests and pathogens	Yes	L	L (arthropods on surface commodity) M (arthropods inside commodity)	M	L	M	M	M	M	M
	No	H	H	H	H	H	H	H	H	H
Packaging effective in preventing infestation	Yes	L	L	L	L	L	L	L	L	L
	No	M	L (non-flying arthropods) H (flying arthropods)	L	L	M	M	M	M	L

Table 3.5: Response of pest and pathogens groups to state of the product

		Likelihood of survival of pest/pathogen per category								
Commodity status	**Detailed**	**Weeds**	**Arthropods**	**Plant nematodes**	**Worms in animals**	**Bacteria non-spore forming**	**Bacteria spore-forming**	**Fungi and fungal like organisms**	**Viruses**	**Protozoa**
Live		H	H	H	H	H	H	H	H	H
Fresh/chilled		H	H	H	M	H	H	H	M	M
Frozen		H	H	H	L	M	H	H	M	L
Preserved or prepared	Salted, pickled, in brine	L	L	L	L	L	M	L	M	L
	By sulphur dioxide gas, in sulphur water or in other preservative solutions	H	L	L	L	L	M	L	M	M
	In vinegar or acetic acid	L	L	L	L	L	M	L	M	L
	Added sugar, sweeteners or spirit	L	L	L	L	L	M	L	M	L
	Cooked (in water, steamed, or in oil)	L	L	L	L	L	M	L	L	L
	Dried	L	L	L	L	M	M	L	M	M
	Roasted	L	L	L	L	M	M	L	M	M
	Smoked	L	L	L	M	M	M	L	M	M
	Dying, bleaching, impregnating	L	L	L	L	M	M	L	M	M
	Otherwise preserved or prepared	L	L	L	M	M	M	M	M	M
Processed	Milling, crushing, grounding, pellets	L	M	H	M	H	H	H	H	H
	Mixing, emulsifying, homogenizing	M	M	H	H	H	H	H	H	H
	Otherwise processed	M	M	H	H	H	H	H	H	H

Table 3.6: Likelihood of entry and infestation of local host of pest/pathogen per category

Climatic and seasonal match	**Option**		**Likelihood of entry and infestation of local host of pest/pathogen per category**							
		Weeds	**Arthropods**	**Plant nematodes**	**Worms in animals**	**Bacteria non-spore forming**	**Bacteria spore-forming**	**Fungi**	**Viruses**	**Protozoa**
Climatic match between country of origin and country of destination	(EU),Yes	H	H	H	H	H	H	H	H	H
	No	L	M	M	H	M	H	M	Non-vector borne: H Vector borne: M	M
Seasonal match between country of origin and country of destination	Yes	H	H	H	H	H	H	H	H	H
	No	H	M	H	H	H	H	M	Non-vector borne: H Vector borne: M	M
Detection at border										
Is the commodity placed in quarantine after entry and/or inspected?	Yes	H	L if pest on surface of commodity, otherwise H	H	H	M	H	M	H	H
	No	H	H	H	H	H	H	H	H	H
Infestation of local host										
Independence of movement of pest/pathogen	No effective packaging	M	L (non-flying arthropods) H (flying arthropods)	L	L	M	M	M	M	L
	effective packaging	L	L	L	L	L	L	L	L	L

3.4. LEVEL 2: INFESTATION OF LOCAL HOSTS

If the level of risk associated with the pathway characteristics is high or moderate for certain pest/pathogen categories, the likelihood of infestation of local hosts with pests and pathogens has to be analysed (level 2). This depends on two aspects: ease of detection and ability to infest local hosts. The following elements in the decision tree have to be addressed:

4. Matching conditions between country of origin and country of destination
    a. Climatic match (EPPO, 2009). If the climate differs between the country of origin (e.g. a tropical climate) and the country of destination (e.g. a moderate climate), it is likely that most pests and diseases will not survive. The likelihood depends on the mode of transmission. For example, pests and pathogens living inside animals that are transmitted by direct contact between animals will not suffer from climatic differences. Climatic differences along the north–south orientation are more important than differences along the east–west orientation. If the country of destination is the EU, climatic differences are assumed to be of minor importance, because the variability within the EU is larger than that between the EU and the country of origin. Climatic differences are most important for those pest/pathogen categories that are directly exposed to climatic conditions, such as weeds, arthropods, nematodes and fungi, and vector-borne diseases.
    b. Seasonal match (FAO, 2004). Climatic conditions also play a role when the climatic conditions differ at arrival time from the climatic conditions in the growing season in the country of origin. This is the case when commodities are produced on the other side of the equator.

5. Likelihood of detection of the pest/pathogen at the border of the importing country. EU import requirements oriented at safeguarding food safety can be found at http://ec.europa.eu/food/international/trade/index_en.htm. If the detection of pests is impossible or difficult, there is a high likelihood that the pest/pathogen will enter the EU, without any applied measures to protect local hosts. The likelihood depends on:
    a. Location of the pest on the commodity (Colunga-Garcia et al., 2010; Kliejunas et al., 2003; McCullough et al., 2006; White et al., 1992): are they located on the surface or only inside the commodity. E.g. wood boring insects, bacteria and viruses are inside the commodity.
    b. Distinction from similar organisms (EPPO, 2009): if the organisms cannot be distinguished from endemic organisms, they will not be detected.
    c. Detection/testing at the border (size of organism, cryptic nature) (EPPO, 2009; Kliejunas et al., 2003): most micro-organisms such as bacteria, fungi and protozoa cannot be visually detected. Application of more advanced detection methods imply the search for specified known organisms.
    d. Quarantine of commodity at risk (ii): during a period of quarantine under normal climatic conditions, organisms can multiply, increasing the likelihood of detection. However, the importance of this measure should not be overestimated. Commodities that are not suspected will not be kept in quarantine. Furthermore, if kept in quarantine, the intention is not to enable all potential pests and diseases to come to expression (which requires a long period of quarantine), but to safeguard agriculture and the environment from being infested with a known quarantine pest or pathogen during the period of detection until the results are present. Therefore, quarantine is not expected to be effective against unknown pathogens and pests. The only exceptions are arthropods living on the surface of the commodity, and to a lesser extent bacteria and fungi.
    e. Symptoms of expression (EPPO, 2009; Kliejunas et al., 2003). Unknown pests and diseases that are latently present will not be detected.
    f. Distinction of symptoms (EPPO, 2009). If symptoms are expressed that cannot be distinguished from symptoms of endemic pests and diseases, no detection of exotic organisms will take place.

Most elements influencing the likelihood of detection do not make a distinction between pest and pathogen categories. Therefore they cannot be included in the decision tree. The only exception is arthropods living on the surface of the commodity.

6. Likelihood of contact between imported pest/pathogen and local host. The likelihood depends on:
   a. Independence of movement of pest/pathogen (vector dependency, wind dispersal, etc.) (Anderson et al., 2004): flying arthropods, fungi, some bacteria and vector-borne viruses can spread independently from the movement of the commodity, and therefore have the potential to bridge the distance between the commodity and local hosts that do not come in contact with each other.
   b. Direct contact with local host.
      1. Directly from the commodity (EPPO, 2009; FAO, 2004)
      2. By waste if the commodity is processed or consumed. (EPPO, 2009)
   c. Direct contact with local hosts depends on the intended use of the products, which is already included in level 0. Commodities intended for agricultural purposes (propagation/multiplication/production, agricultural input and feed) imply a high likelihood. Commodities for ornamental use imply a moderate risk, because they can be used outdoors. Other commodities intended for direct human consumption, processing for consumption or processing otherwise are considered to have a low likelihood for bringing pests into contact with local hosts. Waste is explicitly addressed because remains of organic products can easily contain pests and diseases. Waste gets its own destination after (preparation for) consumption or processing. The likelihood of infestation by waste can be higher than infestation by the commodity. If the waste is composted, it can serve as agricultural input and directly infest local hosts. Therefore, waste of commodities intended for direct human consumption is considered to have a moderate likelihood.

Those questions have to be answered on the basis of the elements listed in table 3.6. In this table, both the likelihoods of entry related to climatic match and seasonal match and the likelihood of detection at the border and the infestation of local hosts are assessed for each pest/pathogen category, except for direct contact with local host. Both questions for direct contact with local host (commodity itself and waste) have to be answered separately.

3.5. SCORING SYSTEMS AND DECISION RULES

The scores need to be summarized in order to draw a general conclusion about the likelihood of infestation of local hosts with any pathogen pest. This requires decision rules for the combination of scores. These scores have to be combined in two dimensions:
1. Vertically: for each pathogen/pest category, the scores of the questions have to be combined.
2. Horizontally: the scores of the pathogen/pest categories have to be combined to draw a conclusion for all pathogens and pests.

Priority has been given to the vertical summary. Afterwards, those summarized scores are horizontally summarized.

Vertical summary: In most cases likelihoods of those questions have to be multiplied. The score of the combined question can in no case be higher than the scores of the questions separately. Therefore, we apply the matrix approach that is based on the minimum rule (table 3.7). The summary of the scores of two or more questions is the lowest score of both individual questions. For example, if the likelihood of pest association after the measures against pests and pathogens is still high, but measures aimed at controlling commodities such as inspection and quarantine measures turn out to be effective, resulting in a low likelihood, combining both likelihoods (high x low) results in a low likelihood.

Table 3.7: Matrix based on minimum rule

Scores	Low	Moderate	High
Low	Low	Low	Low
Moderate	Low	Moderate	Moderate
High	Low	Moderate	High

Horizontal summary (summary of likelihoods of each pest/pathogen category to a likelihood for any pest/pathogen): the likelihood that a commodity is infested with any pathogen/pest is at least as high as the highest likelihood of the infestation of a commodity with a pest/pathogen category. For example, if the likelihood of infestation with arthropods is low, with bacteria is moderate and with viruses is high, the summary is that the likelihood of infestation with any pest is high. In other words, if we know that there is a high likelihood that the commodity is infested with viruses, the overall likelihood that the commodity is infested with any pest/pathogen will not be reduced by a low likelihood for infestation with arthropods. Therefore, the matrix based on the maximum rule (table 3.8) has to be applied to summarize the likelihoods.

Table 3.8: Matrix based on maximum rule

Scores	Low	Moderate	High
Low	Low	Moderate	High
Moderate	Moderate	Moderate	High
High	High	High	High

In three cases, the likelihoods of two or more questions have to be compared instead of multiplied. In this case the highest score of both questions has to be applied, according to the matrix approach that is based on the maximum rule (table 3.8). This is the case when parallel routes for infestation exist. The first case regards different routes for infestation of the commodity: by water, air and physical contact with the environment in level 1. The second case regards in level 1 the combination of packaging effective against infestation after production and harvest and the other aspects in level 1. The reason is that infestation can take place during production and harvest, as well as afterwards, after pest management and control procedures have taken place. The third case concerns the combination of the likelihoods of direct contact with potential hosts either by the commodity or by the waste (level 2).

Consequences of the model outcomes

In table 3.9 the model outcomes and the recommendations are listed

Table 3.9: Model outcomes and recommendations

Scores	**Level 0**	**Level 1**	**Level 2**
Low	Stop the analysis	Stop the analysis	Stop the analysis
Moderate	Proceed with level 1	Consider to proceed with level 2	Consider to conduct full risk assessments
High	Conduct full risk assessments	Proceed with level 2	Conduct full risk assessments

If full risk assessments are recommended a list of pests/pathogens that fulfil the criteria have to be composed. The criteria are that the likelihood of a pest/pathogen category is at least moderate and that the biological hazards have not previously been subject to risk assessment. Collection of information can take place on the basis of databases such as Crop Protection Compendium of CABI (www.cabi.org) for plant pests and pathogens, and the World Animal Health Information Database (WAHID) for animal pests, available at the website of the OIE (www.oie.int), inspection reports of the Food and Veterinary Office (http://ec.europa.eu/food/fvo/index_en.cfm), and direct contact with inspection agencies in the country of origin.

3.6. PRESENTATION OF THE DECISION TREE

In appendix 6, a manual of the decision tree is presented. Furthermore, each question is explained by the following aspects:

1. The level of the analysis, ranging from 0 to 2
2. The questions to be answered
3. The potential scores, including the scoring system
4. Where to find the information required to answer the questions
5. Examples of answers
6. Remarks highlighting important aspects
7. Continuation: which action should be undertaken depending on the score.

Level 0 contains the questions whether the commodity:

1. Can turn into a pest
2. Can contains pests and pathogens
3. Contains additional content that can be contaminated by pests and pathogens.

Levels 1 and 2 are specifications of the second question. Therefore, question 3 is placed at the end, although it belongs to level 0.

When applying the decision support tree, it is likely that the risk assessor will be confronted with uncertainty. That is the case if he/she lacks the information and expertise required to answer the question. Therefore, we recommend that if the assessor is uncertain and lacks the information sources to answer the questions quickly, he/she should choose the highest potential likelihood level and proceed with the analysis. After completing the whole decision tree and taking into account the result, it can be assessed whether the question is crucial for the final result and thus deserves further attention.

In figure 3.2 the flow chart of the decision tree is presented. This flow chart shows the routing followed through the decision tree, depending on the choices made by the risk assessor. This is discussed in greater detail in Appendix 6 (manual for the decision tree).

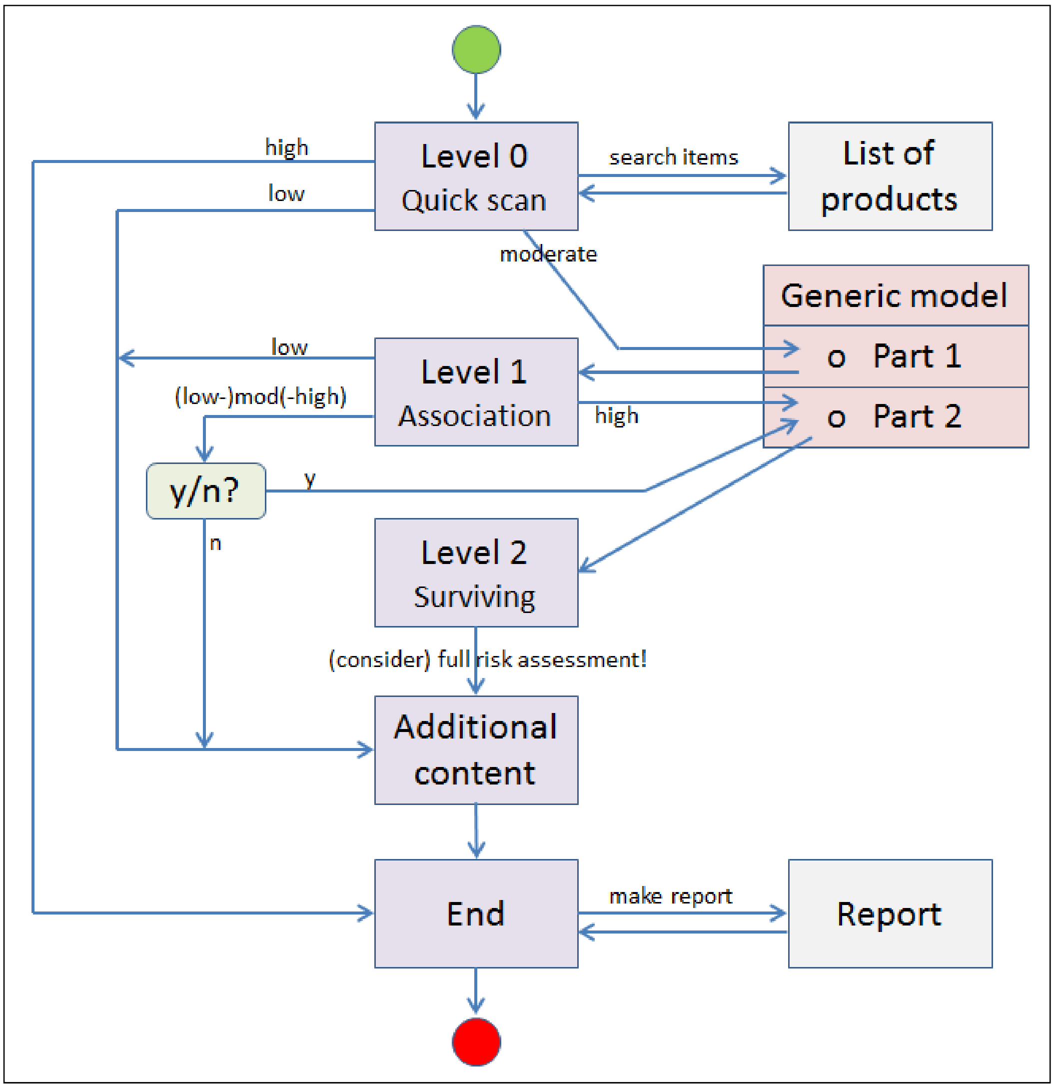

Figure 3.2: Flow chart of the decision support tree

4. DISCUSSION AND RECOMMENDATIONS

One of the challenges of this project was to combine the risk analysis of biological hazards of plant and animal origin in one model. Until now, the fields of risk analysis of plant and of animal pests and pathogens were totally separated. However, we encountered few difficulties in combining these fields. The major hurdle was the use of different terminology in each domain when referring to the same thing. However, the way biological hazards come into contact with commodities and become manifest in the country of destination is largely comparable. These challenges were overcome and the development of a pathway model representative for both domains is the result of this achievement.

Before the decision tree was constructed, the variables that had to be included in the decision tree were identified. The main sources were a review of FAO standards and existing assessment schemes for plant and animal pests and diseases (Appendix 4), and a systematic review of scientific papers in which the relationship between pest and pathogen traits and entry is addressed (Appendix 3). These sources correspond with the recommendations made in Appendix 5 to develop the decision support tree in accordance with the principles and criteria of relevant regulations and standards and supported with scientific evidence.

However, the results of the systematic review were of limited importance for identifying variables for the decision tree, because of the lack of empirical evidence. The number of studies in which this has been studied is limited and they always focussed on certain pest/pathogen categories. Furthermore, those studies are mostly not limited to entry, but also include invasiveness, establishment, spread and/or impact. However, it became apparent that the likelihood of pest/pathogen survival due to the conditions of production, processing, storage and transport as addressed in table 3.5 was the most crucial aspect to be addressed in the decision tree. Those relationships were mainly based on the expertise of the project team and the involved experts. However, this basis is rather limited, since it requires expertise both on all pest/pathogen categories and on the length of the period and intensity of the treatments the commodity is exposed to. Therefore, it is highly recommended to revise the scores on the basis of scientific literature review. According to guidelines for performing systematic reviews developed by EFSA (EFSA, 2010a), the following research question is proposed for a systematic review to address this information gap: 'What is the likelihood that pest and pathogen categories survive processes affecting the state of the commodity as proposed in table 3.2 in the report on CHIP?' It is also recommended to update the decision support tree with new information on commodity pathways and pathogens.

The decision tree contains questions that originate from the review of risk assessment schemes and the systematic review, but is not based solely on these reviews. The project members developed the tree based on logical thinking, and the implementation of results of the systematic review and the risk assessment scheme review. Updates of the decision tree were based on experiences with examples and after meetings with experts from different disciplinary backgrounds (risk analysis, entomology, food safety etc.), in accordance with one of the conclusions of the review of hazard identification protocols (Appendix 5), namely that a protocol should be reviewed by a multidisciplinary group with members from industry, academia and inspection agencies. Therefore, most aspects are mainly based on expertise. The general agreement on those aspects was enhanced by the fact that most PRA schemes have not been developed independently from each other. Some of the pest/pathogen characteristics were also found in the systematic review of scientific literature (Appendix 3), although sometimes described in other words, partly based on empirical evidence. For example the characteristics 'reproductive strategy' and 'genetic adaptability' mentioned in the PRA guidelines, describe the same as 'gene activation', 'genetic mutation speed' and 'high genetic variability' from the systematic review.

Different draft versions were tested with case commodities (Appendix 7). This resulted in a number of adjustments. The transport and storage stage was removed, as it soon turned out that this level did not have additional discriminatory power, because the survival of pests/pathogens is mainly determined by the state of the product and the preservation methods used, which stay the same during transport and storage, and therefore the transport and storage time does not have much influence. Furthermore, questions were reformulated and in one case divided into three sub-questions. In addition, one question got three answer categories instead of two.

In general, the decision support tree worked quite well. Ideally, PRA schemes are tested empirically to identify the significance and impact of each aspect addressed in the scheme simultaneously. However, this is practically impossible. It requires a huge sample of organisms about which there are no data. The reason is that PRA schemes are applied to justify measures. If these measures are successfully applied, no data will be generated to test the scheme, which is most often the case. Therefore, expertise will be the main source for identifying relevant pest and pathogen characteristics in future.

The decision tree has a modular structure: level 0 covers the whole pathway, while levels 1 and 2 contain more detail. However, level 0 is also used as the first screening, which serves as a basis for recommending further analysis or full risk assessments. The results of the case studies showed consistency between the results of level 0 and the final results (Appendix 7). Furthermore, we also concluded that within pest/pathogen categories, survival time can be very different. This kind of question can be addressed in a full risk assessment oriented at a specific pest or pathogen.

We chose not to address uncertainty separately. This would have required additional decision rules how to include uncertainty in the final conclusion, which would have greatly complicated the decision tree . Furthermore, it would suggest a level of detail that is inconsistent with the objective to prioritise commodity. We therefore recommend that if the assessor is highly uncertain and lacks the information sources required to answer the questions quickly, he/she should choose the highest potential likelihood level and proceed with the analysis. After completing the whole decision tree and taking into account the result, it can then be assessed whether the question is crucial for the final result and thus deserves further attention. If it is not crucial, and choosing highest or medium likelihood level both do not result in a high likelihood after completing the whole decision tree, then there is no point in composing a long list of potential pests and pathogens, and performing full risk assessments. This kind of sensitivity analysis can be applied by changing the answer of the question about which the risk assessor is uncertain and compare the final results of the decision tree for both answers. If changing the answer also changes the final result, it is recommended to collect additional information in order to reduce the uncertainty.

Decision rules have to be applied consistently throughout the decision tree. This results in a tension between level 0 and level 1. In level 1, the relation between treatment of the commodity and pathogen/pest survival is much more differentiated than in level 0. The results for each state of the product are summarized by taking the highest likelihood of all pest/pathogen categories by application of the maximum rule matrix. The consequence is that table 3.1, in which the summary of table 3.5 is incorporated, loses discriminating power, because many combinations of state of the product and intended use have the likelihood ‘moderate’. If the link between level 0 and level 1 is skipped and all frozen, preserved and processed commodities have a low likelihood of pathogen/pest entry, it can be the case that continuing the analysis with levels 1 and 2 (which is not recommended) will result in high likelihood of pest/pathogen entry. This result can be acceptable, since the main aim of the decision tree is to differentiate between the commodities with the highest likelihood of introducing a pest/pathogen into the importing country, and commodities with a lower likelihood. The decision tree is meant as a quick selection tool, and is therefore not very detailed, which implies that some mistakes can be made. If there is any doubt about the results of the decision tree, it is recommended to look first at the report in the decision tree tool, to apply sensitivity analysis by following the decision rules in order to detect the most crucial aspect in the final result, and try to understand why the answers result in the found conclusion. If that does not help, then it is advised to carry out a full risk assessment for the commodity.

For future extension of the risk assessment toolkit, it is recommended to explore the use of actual trade data in combination with notifications, product information and other data. Past trade information can serve both as a means of identifying priorities for risk assessment and for calculating the potential damage from failure to contain risks. For trade analyses purposes, several tools have been developed that could serve as a source of inspiration for future risk assessment tools, including trade data (see e.g. http://www.trademap.org/light/SelectionMenu.aspx)

In section 3.2 it is discussed that zoonotic agents are processed equally to other animal pests and pathogens. However, the structure of the decision tree can also be applied to zoonoses and other biological hazards threatening human health. Level 1 will to a large extent be the same, although it must be noted that biological hazards affecting human health will not always cause problems to plant and animal health. Level 2 will focus on the likelihood that commodities come into direct contact with humans, either by use of the commodity or by consumption. So EFSA could formulate the following objectives:

‘1) To develop a commodity-based hazard identification process suitable for biological hazards affecting human health.
2) To develop a robust decision tree that can be applied in a timescale suitable for emerging risks.
3) To share state-of-the-art methods for biological hazard identification in the field of human health.’

Another possible follow up is to develop a decision support tree to assess the likelihood that commodities will be contaminated with chemicals, affecting human health. The following objectives could be formulated:

‘1) To develop a commodity-based hazard identification process suitable for chemical hazards affecting human health.
2) To develop a robust decision tree that can be applied in a timescale suitable for emerging risks.
3) To share state-of-the-art methods for chemical hazard identification in the field of human health.’

The decision support tree has been programmed in Excel. However, adjustments in Excel run the risk of causing bugs. Therefore, if the current structure of the decision tree is accepted for use by EFSA and national inspection agencies, it is recommended to reprogram the decision support tree in a computer language that supports the maintenance of the decision support tree by the programmer.

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APPENDICES

APPENDIX 1: MODELLING A PATHWAY

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1 INTRODUCTION AND OBJECTIVE

A pathway is defined as 'any means that allows the entry or spread of a pest' (FAO, 2006). In this project a decision tree was developed that enables a risk analyst to assess the likelihood that a commodity serves as a means for entry of a pest or pathogen. This requires the estimation of the likelihood of association of pests and pathogens with the commodity, and the likelihood that pests and pathogens in/on the commodity do not survive treatments. These likelihoods depend on all processes that the commodity is subject to during all stages of production, post-harvest processing, storage and transport to the country of destination.

There is a large variety in the production and trade chain of commodities. There are differences not only between plant and animal pathways, but also within these groups. For a number of existing commodities imported into the EU, a 'typical' pathway can be characterized. In order to make a comparison of pathways possible and to identify risks within a pathway consistently, a structured and generic description of a pathway is needed.

The objective of this task was to develop a structured approach that helps to identify all aspects affecting the type and level of risk associated with a certain pathway. This generic scheme for describing pathways had to capture all stages and activities that are relevant to specific agrarian products (cases). Critical points in the pathway were the basis of the questions in the decision tree, and the information in the scheme helps the user to answer the questions.

This report describes the development of the generic scheme that can be used to elaborate the commodity-based pathways. The development was based on six case studies. The result is a generic scheme. A manual explaining how to use this scheme is included in the manual of the decision support tree (Appendix 6).

2 MATERIALS AND METHOD

The development of the generic scheme started with the selection of six specific commodities to serve as examples for modelling the pathway: three pathways for plant commodities and three pathways for animal commodities. The six pathways/commodities were:
Import of citrus fruits from Argentina
Import of chrysanthemum cuttings from Africa
Import of orchids (cut flower) from Thailand to the Netherlands
Import of salami
Import of horses
Import of cheese

Selection criteria for the choice of the cases were:
It includes both plant and animal commodities
that are subject to different production chains
that contain different potential pests and pathogens,
that are produced on different continents
that include commodities that have previously been notified as containing pests and/or pathogens.

Work started by developing pathway descriptions for each group of cases (animal, plant) according to formats derived from previous work (Benninga et al., 2010; Swanenburg et al., 2001), without any restriction on the structure. Pathway descriptions were very diverse not only between the two groups, but also within groups. Pathway descriptions were constructed as a table.

Next, all six pathways were combined to form a generic scheme for describing pathways. During the development of the generic scheme, stages of pathways not represented by the included commodities were concocted to make it generic. A first prototype of the generic scheme was discussed by the project members. Necessary adaptations to the generic scheme were then made and the scheme was tested on both plant and animal cases. Afterwards, comments from experts and members of the EFSA steering committee were processed. Finally, the scheme was adapted to support the decision support tree in order to guarantee a direct relationship with the pathway scheme and the questions in the decision support tree.

3 RESULTS

The resulting generic scheme for describing pathways is presented below. The basic principles of this generic scheme for describing pathways are:

The scheme is designed for import of commodities from third (i.e. extra-EU) countries into the EU.

A pathway includes only one border (from a third country into the EU). If more border crossings are present in a production chain, a separate pathway should be described for each border crossing.

A pathway describes the route of one specific commodity (e.g. salami), not of all the ingredients/raw materials.

A pathway describes the route in a sequential, chronological order.

All activities in the pathway can be captured in the production, harvest, collection from farm, processing and international transport stages. All these stages are subdivided into elements such as transport, processing and packaging. Due to the demarcation of the project, the distribution stage in the country of destination is not included. Every pathway can be described by the use of optional and/or repetitive stages and events. For example, peppers produced at farm, collected at farm level, then combined to region level, then combined to country level, before shipping them to importing countries. Also an optional/repetitive ‘processing’ stage was used for both horses and salami. For horses, this stage has a repetition of zero (i.e. it is optional and thus not used), while for salami three repetitions were used (slaughtering the animals – cutting the meat – producing salami). Horizontally, critical conditions can be indicated at each stage/sub-stage as well as at control points (checks and treatments).

The manual (Appendix 6) provides more detailed information as well as guidance on how to use this scheme.

Scheme generic pathways for animals, plants and animal/plant products

Commodity: << name of commodity>> Country of origin: << name of country>> Point of entry: << point(s) of entry>>

1. In this generic scheme, the specific pathway of a commodity can be described.
2. Import of commodities from third countries (e.g. heifers from Canada to New Zealand for the pathway cheese from New Zealand to the EU): **not considered!** Each pathway includes only one cross border introduction. For each subsequent border crossing a separate pathway analysis should be considered. A pathway is the descriptive route of a commodity which is imported from outside the EU. E.g. for "salami", the raw materials (meat, garlic,...), by-products and waste are not considered as pathway commodity.
3. For each event it can be indicated whether infestation of pest/pathogen can take place, at which season, the length of the period of the event, the location where the event takes place, whether checks to monitor pests/pathogens and diseases will be executed and whether additives are supplied or whether treatment of pest/pathogen takes place. In this scheme the risk on biological hazards is not analysed.
4. All events are **sequential**, they may be **optional** (i.e. **Opt** in the scheme) and they may have **repeating** cycles (i.e. **Rep** in the scheme). The symbol "x" in column "**!**" indicates additional explanatory notes which can be found in the footnote.
5. Indicate in column "**R**" (i.e. Relevant) if the stage or event is relevant for this pathway. Use for example the symbol "x".

	R	Stage	Event	Opt	Rep	Responsible party	Circumstances					Control point		!	Description stage/event
							Time *)	Space **)	Climate ***)	Additives	Other	Checks ****)	Treatment		
1		**Production**													
1.1			Stocking	**Opt**		Producer								**x**	
1.2			Growing			Producer									
1.3			Internal product movements	**Opt**		Producer								**x**	
2		**Harvest**													
2.1			Collection activity		**Rep**	Producer								**x**	
2.2			After "harvest" treatment	**Opt**		Producer								**x**	
2.3			Packaging	**Opt**		Producer								**x**	
2.4			Storage at firm	**Opt**		Producer								**x**	
3		**Collect from farm**		**Opt**	**Rep**									**x**	
3.1			Transport			Exporter/trader									
3.2			Merging (adding/mixing)	**Opt**	**Rep**	Exporter/trader									
3.3			Storage			Exporter/trader									
4		**Processing**		**Opt**	**Rep**									**x**	
4.1			Transport to industry	**Opt**		Proc.Plant /Trade									
4.2			Critical Processing	**Opt**	**Rep**	Processing plant									
4.3			Packaging	**Opt**											
4.4			Storage at industry			Processing plant									
5		**International transport**													
5.1			Transport to harbour, airport,...	**Opt**		Exporter/trader									
5.2			Storage	**Opt**		Exporter/trader								**x**	
5.3			Transport to importing country			Exporter/trader									
			POINT OF ENTRY												
5.4			Domestic transp.(customs /insp.)			Importer									
5.5			Storage (e.a. customs)	**Opt**		Importer									
5.6			Transport (Lorry)	**Opt**		Importer									
5.7			Arrival Importing company			Imp. company								**x**	
6		**Distribution**		**Opt**										**x**	
6.1			Transport (Lorry)	**Opt**		Distributor									
6.2			Merging (adding/mixing)	**Opt**		Distributor									
6.3			Splitting (divergence)	**Opt**		Distributor									
6.4			Destination or distribution to consumer or retail			Distributor									

Notes in table

*) Season or duration
**) Geographic location, open/closed (e.g. glasshouse), scattered, area, etc.
***) Temperature, humidity, yearly climate pattern, etc.
****) Official inspection can take place at PoE, at the storage of the importing company, or not at all. Besides official inspection, there are also other checks (e.g. certification by private companies).

Notes in column "!" (see manual for a more detailed description of stages and events):

1.1 E.g. plants or piglets from other firms.
1.3 E.g. move of pot plants, animals moved from one stable to another.
2.1 **Optional**, e.g. milking (dairy, goats), or shearing on wool production (sheep). There may be **repeating** collecting activities (e.g. milking, picking tomatoes).
2.2 E.g. before flowers go to cold store; scab treatment of animals.
2.3 E.g. put flowers in boxes.
2.4 Storage means that the product has to wait for a time period. The longer the period of storage, the more attention will be paid to storage conditions.
3 E.g. collecting animals, milk, flowers by traders/exporters from different firms. These 3 activities are **repeating**, i.e. there are 0 (absent!), 1 or more cycles. E.g. collecting of peppers: first at villages, then at cities, and finally at distribution points before intercontinental transport. At each collection point mixing may take place which may lead to risk of infection with pest/pathogen.
4 This **optional group** of activities are **repeating**, i.e. there are 0 (absent!, e.g. horses), 1 or more cycles. E.g. milk factory followed by cheese factory, or slaughter followed by cutting followed by salami producer. There 0 or more (R) critical processes. Destruction, handling of by-products and waste is also industry processing (one of the cycles), **only considered when these products are treated as pathway commodity**.
5.2 This storage is the process where the product is waiting at the harbour or airport till international transport (from outside EU) can take place. The storage facility can be a conditioned cell. Temperature of importance here.
5.7 Handling by customs, optional inspection.
6 E.g. Farm, Trader, Industry, Storage, Retail (shops). This might be a final destination or an intermediate destination (e.g. industry). The risk of the type destination (consumption, new production process, processing, auction/trade) depends on the characteristics of the commodity: live/dead product, (un)packed, inside/outside, (non)consumptive, domestic/re-export. If non-consumptive then a new production chain will be started (e.g. imported heifers for dairy farms; imported fruit or meat for processing)

4 DISCUSSION AND RECOMMENDATIONS

The generic scheme is based on the pathways of six commodities. We tried to capture as many aspects as possible in the generic scheme. If in practice it turns out that the generic scheme does not fit for certain commodities, it will have to be adapted.

The challenge of this work package was combining plant and animal production chains in one scheme. This was possible, because both production chains can be divided into stages and events. There were, however, discussions about the terminology, which is not the same for all processes in plant and animal chains; for example, the word 'harvest' is usually a 'plant' word that is not used much in animal chains. Therefore, all terms have been defined (in the user manual for the decision tree) for their use in this project. Further, the scheme can be adapted to a specific pathway by adding extra event rows to a stage, or by not using a stage/event row, if this stage/event is not part of this pathway.

The current scheme as elaborated in Excel has the flexibility that any information can be included. However, it does not have the dynamic character that a user might expect. For example, if the user wants to add an event, he/she has to insert a row into the scheme; there is no simple 'button' to perform this action. If it turns out that the scheme will be used often in future, it is recommended to develop the scheme in a more flexible application.

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APPENDIX 2: REVIEW OF EU AND MS REGULATIONS ON THE DEFINITION OF COMMODITIES

1 INTRODUCTION AND OBJECTIVES

This appendix is part of the EFSA research project CHIP (Commodity-based Hazard Identification Protocol for emerging diseases in plants and animals), and describes the results of Task 1.2. The objective of this task was to propose a harmonized list of commodities appropriate for hazard identification.

In order to identify relevant and practicable commodity classifications, a review of existing commodity classifications was performed. In addition, the related EU and Member States regulations on the collection and classification of trade data were studied. In 2010, EFSA published an article on the subject titled ‘Collection and routine analysis of import surveillance data with a view to identification of emerging risks’. The article concludes that ‘the Eurostat Comext database has been found to be a tool that could assist in the identification of emerging risks in combination with data coming from other sources, including the Comtrade database’.[1]

In section 1.1 of this appendix, the Eurostat Comext database is further discussed and compared with other sources of trade statistics. In Chapter 2 the selected product categories are discussed. The appendix concludes with conclusions and recommendations in Chapter 3. In comparison to other databases, extra-EU and intra-EU trade seems to be relatively well covered, whereby the focus of the project is clearly on extra-EU trade between the EU Member States and third countries. The Eurostat Comext database constitutes the most comprehensive source of comparable information about the trade flows of the EU Member States. For an overview of some critical issues, such as comparable reporting of trade data for example, see (EFSA, 2010).

2 MATERIALS AND METHODS

2.1 APPROACH TO IDENTIFYING POTENTIALLY RISKY PRODUCTS BY USING TRADE DATA CLASSIFICATION

TRADE DATA CLASSIFICATION: HARMONIZED SYSTEM VERSUS COMBINED NOMENCLATURE

The basis for the combined nomenclature of the classification of trade data (CN classification) is the harmonized system (HS classification), which is used worldwide to classify and compare trade data. The CN classification is mainly used by Eurostat and contains 21 sections divided into 97 chapters.

The chapter level of the CN classification corresponds to the 2-digit level of the HS classification, and at the more disaggregated level there are more than 1,000 HS headings (4 digits) and about 5,000 HS subheadings (6 digits). Considering the classification up to the 6-digit level, the CN and HS classification are mostly the same, that is, the same codes and formal product descriptions are used. At the further disaggregated level, however, the CN classification is more detailed than the HS classification, generally referring to CN subheadings (8 digits). As mentioned, the sections in the CN classification contains several chapters; for example, section I is about live animals and animal products and consists of Chapters 1 to 5.

The CN classification, and more specifically the CN subheadings at the 8-digit level, is suggested as the basis for the product classification used to indicate potential biological hazards and risks caused by trade in the respective products. Note that in some cases aggregating the product classification and thus trade data using HS subheadings (6-digits) or even HS headings (4-digits) may provide sufficient

[1] EFSA Journal 2010; 8(3):1531 [35 pp.], http://www.efsa.europa.eu/en/efsajournal/pub/1531.htm

information to identify potential risks due to product characteristics. That is, the description of the products provided at the disaggregated detailed level does not add information about product characteristics that relevant to identifying the potential of biological hazards or risks, that is associated with the respective product.

The product categories in the CN classification are generally arranged in order of their degree of manufacturing: raw materials, unworked products, semi-finished products and finished products. Chapters with higher numbers generally comprise the more manufactured or processed products. The same applies within chapters where more manufactured or processed products are listed under subheadings with higher numbers. In our classification according to the product characteristics associated with risk, we look at all categories of agri-food and related products, including products of animal and plant origin as well as organic and non-organic inputs.

Using the CN classification ensures that the definition of product characteristics is directly linked to trade data in the Eurostat Comext database. This link to the trade data is crucial in the identification of emerging risks, because the trade data provides information about the country of origin and the trade volume or value involved. In addition to other factors, information about the volume of the products from countries outside the EU is useful for clues about the extent and possible impact of a risk incident.

While the CN classification provides some detail of product characteristics, other databases use different and possibly more detailed product classifications. For example, the databases used by the EU Member States to report on border inspections provides more details about products of plant origin, in particular the botanical names of plants and plant families. However, the products are not always described in detail, and in some cases, notifications are given not to only one product but to a group of products. Most importantly, there is no real definition of the products and their characteristics that is applied in a systematic way (for further details about the Dutch CLIENT database of notification, see (Benninga et al., 2008)). At the EU level, the EUROPHYT (European Phytosanitary) database collects notifications and reports from the EU rapid alert system, providing information about plant health issues of imports in extra-EU and intra-EU trade. The TRACE (Trade Control and Expert) system collects data for animal health issues. For these databases, similar problems of the product classification prevail. There is the additional drawback that TRACES, CLIENT and EUROPHYT are not public databases, and no information about the trade affected is provided. The link to the trade data is missing.

We chose the CN 2008 product classification to develop our definition of product characteristics in order to identify potentially risky products, because it provides a consistent product classification and a comprehensive coverage of trade data. As mentioned, the product descriptions in the CN classification are formally constructed in a hierarchical way, and in some cases it is critical to be able to discern product characteristics at the 8-digit CN subheading level. For assigning our product characteristics, we use the explanatory texts provided by Eurostat, see (European Commission, 2008).

From the full CN classification with 99 chapters, a selection of chapters and specific headings/subheadings was made. The selection was based, as stated above, on the type of products. All agricultural or horticultural products are included, as well as all food products and products of animal or plant origin, including waste, paper and wood. In addition. the most important inputs to the agricultural and horticultural sectors (such as fertilizers and machinery) are included.

2.2 Classification criteria for risk analysis using the CN classification of trade data

Particular product characteristics are identified that could cause biological hazards. These characteristics are observable from the given product descriptions of the Eurostat Comext CN product

classification (see for example European Commission, 2008), combined with expert knowledge of products and risks. That is, we added the perspective of potential biological hazard and risk to the product classification of trade data such that products that may cause problems are identified in an easy way. We specifically differentiated between the following five groups of product characteristics:
Type of product/origin
State of the product
Type of use
Contents of the product (additional contents)
Mode of transport

Note that we do not consider the packaging of products as an additional classification criterion, since the packaging materials used are not necessarily identical for products in one product category. Although expert knowledge may suggest the most likely packaging materials, product descriptions generally do not give insights into the materials used, and consistent databases regarding packaging are non-existent. Thus, packaging cannot be used as a mutually exclusive product characteristic. Furthermore, we do not apply details of products that are given by regulations or production practices prevailing in the respective exporting countries. For example, the trade data classification does not provide information whether or not products are treated in a certain way (for example fumigation or irradiation treatment). It may be part of a pathway-commodity analysis, based on expert knowledge. For example, it is recommended to add expert knowledge on packaging to complement the trade data classification.

2.2.1 DISTINCTION BY TYPE OF PRODUCT/ORIGIN

Criteria: Animal origin
Plant origin
Other organic
Other non-organic

A first important distinction from a risk point of view is the type or origin of a product. We differentiated between four main types of products: animal origin, plant origin, other organic products and other non-organic products. Some product headings in the CN classification may contain products of multiple types. In the database that was developed in the course of the project, each 8-digit product subheading is classified according to the product types mentioned above.

2.2.2 DISTINCTION BY STATE OF THE PRODUCT

Criteria: Live products
Fresh or chilled
Frozen
Preserved or prepared
- Salted, pickled, in brine
- By sulphur dioxide gas, in sulphur water or in
- Other preservative solutions
- In vinegar or acetic acid
- Added sugar, sweeteners or spirit
- Cooked (in water, steam or e.g. pre-fried in oil)
- Dried
- Smoked
- Roasted
- Dying, bleaching, impregnating
- Otherwise preserved or prepared

Processed
- Milling, crushing, grounding, pelletizing
- Mixing, emulsifying, homogenizing
- Otherwise processed

A second main distinction of agricultural products (products of animal or plant origin) refers to the product state, discerning between live, fresh or chilled, frozen, preserved and processed products. Many fishery, agricultural and horticultural products are perishable and thus need to be cooled during transport and storage. This holds for all fresh fishery and meat products, but not for arable commodities like grains and nuts, for example. Most live floricultural products are not cooled during short-distance transport, but cut flowers are cooled in order to prevent respiration and aging.[1]

In the trade data classification, the descriptions under the subheading provide references to the product state for most products of animal or plant origin that are meant for food or feed purposes. Note that the product state 'fresh or chilled' does not give information about the cooling throughout the supply chain, nor does it imply compliance with certain handling requirements. The description only gives information about the actual product characteristics.

The state of the products naturally has implications for biological hazards. Live animals and plants generally have the highest risk regarding the spread of pathogens and pests, as many of these are dependent on live hosts for survival and growth. Also because live animals and plants are used for reproduction (breeding and propagation), and as such have a higher risk of infecting production areas. The same goes for seeds. With regard to trees, plants and flowers, plants are considered 'live' if they have roots; for example a tree for planting is a live plant but cut flowers are fresh plants. For further details see Chapter 2.2.1.

Fresh and chilled products generally refer to agricultural and fisheries products that are perishable and may be cooled (not frozen) during transport and storage. Cooling reduces the risk of multiplication, spread or infestation for some pests and pathogens, but does not reduce these risks to zero. These products are generally meant for either direct consumption (through the retail channel) or further processing. Frozen products have a considerably lower risk of carrying pests, although many pests and pathogens may remain alive for long periods of time in frozen products, but overall the risk of

1 The optimum storage temperature for most cut flowers is around 0°C, see page 5: http://postharvest.ucdavis.edu/datastorefiles/234-1373.pdf.

multiplication or spread is reduced. Irradiation (low doses) could reduce the risk, but these are considered pathway characteristics as this is not described in the trade data product classification.

In many instances the product descriptions give information about the type of preservation, preparation or processing. Preserving refers to treatments that make the product less perishable, such as preserving in salt, pickle or brine, in sulphur dioxide gas, other preservative solutions, or in vinegar or other acetic acids. Preparing refers to treatments like cooking, drying or smoking. Preservation or preparation lowers the risk of biological hazards, as usually the risk of contamination after preservation is very limited and the risk of spread (i.e. growth or development of pests or pathogens) is also restricted. Processing might reduce risks but not necessarily. Grain milling products, for example, are considered processed products, but may still carry substantial risks as they are ideal products for certain pests to live in. Note that many products undergo several treatments and many product groups include preserved or processed products in many forms or ways. Some product groups also contain both fresh and preserved products, for example '08052090 - Fresh or dried tangelos, ortaniques, malaquinas and similar citrus hybrids', or '03062339 - Shrimps of the genus crangon, whether in shell or not, live, dried, salted or in brine, incl. shrimps in shell, cooked by steaming or by boiling in water, whether or not chilled'. Other descriptions may say, for instance, 'raw or roasted', 'whether or not cooked' or 'whether or not containing added sugar or other sweetening matter'. Product categories can thus be classified as containing both fresh products and preserved products in different forms. Canned or jarred products will generally be described as being 'provisionally preserved otherwise than by vinegar or acetic acid', although exceptions may exist and also other packaging might fall under this description.

2.2.3 DISTINCTION BY TYPE OF PRODUCT USE

Criteria: Food (direct consumption)
Feed
Propagation
Agricultural input
Processing for food
Processing for other purposes (manufacturing industry)

We made a third distinction between the different uses of products. Depending on the product concerned, the product classification defines the following general categories: not suitable for human consumption, feed, human consumption, for manufacturing, industry. This information is available for some products, and we combined the information available with further information about the respective products under review. For our classification, we considered the following types of product uses: food consumption, animal feed, propagation material (e.g. animals for breeding, seeds, young plants) and other agricultural inputs, further processing for food and processing for other purposes (manufacturing).

Products used as agricultural inputs fall under the categories 'animal feed', 'propagation material' or 'other agricultural inputs', and this classification of agricultural input use seems to be particularly relevant. That is since products identified may pose a wider, indirect risk to the supply chain because they are used as inputs in agricultural and/or horticultural production. Due to the usage in agricultural and horticultural production, possible hazards could infest the production base and spread across production units as well as the natural environment.

2.2.4 DISTINCTION BY CONTENTS OF THE PRODUCT (INCLUDING MATERIAL USED)

Criteria: Soil
Water
Offal/intestines

A fourth distinction concerns the specific contents of the products. We distinguished products that contain soil, water or offal. Products containing soil have a higher chance of carrying microbes, insects, spores and other pests that live in soil. This risk is partly related to the state of the product: live plants and animals have a higher risk of carrying soil with them than e.g. fresh or preserved products. But also other products, like potatoes and leafy vegetables, may contain soil. Water may contain specific pathogens. Many products potentially contain water. However, especially fish/live fish and some products of plant origin may have water with them in relation to the packaging. In some cases (e.g. frozen fish), the water is frozen. With respect to offal (intestines), the relation to biological hazards is less clear. However, intestines generally contain more parasites and bacteria than other types of meat or offal, and thus they have a higher risk of spreading these pathogens or pests and of rotting. Note that we mention wood for packaging and storage as a characteristic of product content, but we do not include this as packaging. Many or even most products may be transported using wooden packaging material, but there is no information in the database to assess whether wood is actually used. Note that, based on expert knowledge, this information could be easily added as an additional classification criterion.

2.2.5 DISTINCTION BY MODE OF TRANSPORT

Criteria: Road
Rail
Ship
Air

A last criterion refers to the most common way of transport used for the product category. The mode of transport is not directly given by the description of the product classification, but with expert knowledge and Eurostat information about the mode of transport for extra-EU trade we can provide some insights into the most commonly used mode of transport. Eurostat reports the most commonly used mode of transport of products at the 6-digit level (HS subheading) for extra-EU trade since 2000.[1] The Eurostat data on transport modes only covers extra-EU trade and thus excludes trade across the EU Member States.

The mode of transport has implications for where products enter the EU market (harbours, airfields, etc.) and gives some further information about pathways. For some products this might bring extra evidence in combination with expert knowledge about the transport time, and the possibilities of keeping a supply chain cooled and isolated from possible biological hazards (e.g. road versus air transport).

We assessed the trade volume by mode of transport at the chapter level for EU-27 imports from Australia, Brazil, China, Egypt, India, Russia, South Africa, the United States and the extra-EU total. We selected these trading partners in order to provide a broad overview of the main modes of transport for imports from different continents. The selected trading partners represent large countries and trading partners on different continents. For specific products, however, some trading partners may be

[1] EXTRA EU-27 Trade Since 2000 By Mode of Transport (HS6) (DS_043328): http://epp.eurostat.ec.europa.eu/portal/page/portal/external_trade/data/database.

less relevant. The analysed period is 2010, and thus we used the latest information available about the trade flows. The set of aforementioned countries comprises the main trade partners exporting to the EU-27 and covers different regions worldwide with different distances between the exporting source country and the EU market. An analysis on HS heading or HS subheading level is also possible, but was outside the scope of the current task.

The modes of transport that are given in the Eurostat database are sea, rail, air, road, post, fixed mechanism, inland waterway and self-propulsion. Transport by road might be taking place in combination with ships. From the data for Brazil, for example, it is observed that some products arrive in the EU by road. The logical explanation is that products are transported by trucks that are shipped overseas. A fixed mechanism refers to a pipeline or wire, whereas self-propulsion usually means that the goods can ride, fly or sail. Evaluating the Eurostat data, most products enter the EU by sea or pipeline. In practice, there might be differences in the use of modes of transport in different seasons and for other partner countries. We do not capture this in our classification and in addition constrain the characteristic of the mode of transport to road, air, rail and sea.

3 DESCRIPTION OF THE CHAPTERS IN THE TRADE CLASSIFICATION

This chapter provides a brief description of the products included in each of the selected CN chapters and/or (sub) headings selected. Special attention is paid to specific characteristics of these products. The products are categorized according to the chosen indicators and provided to EFSA in MS Excel so that the product characteristics can be readily applied in an analysis of trade data. In such a combined trade analysis, priority products for testing and inspections could be identified to reduce the risk of infestation through trade or to assess the likely consequences of such infestations.

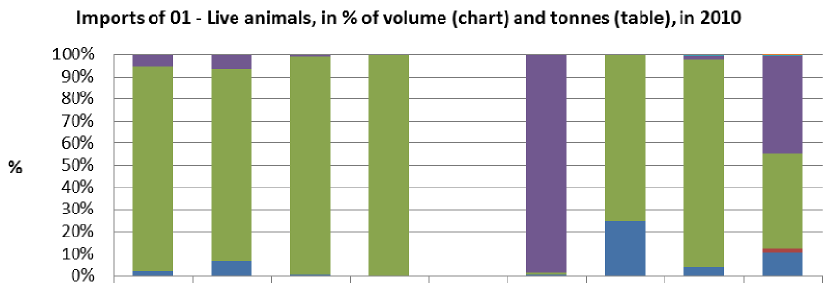
3.1 LIVE ANIMALS, MEAT, FISH, DAIRY AND EGGS

3.1.1 01 - LIVE ANIMALS

It is suggested to use the 8-digit CN 2008 product classification in order to capture the different types of animals as well as the purpose. Specifically for live animals, the number of animals of a certain type may be important information. The number of traded animals is only available at the 8-digit CN level. The CN classification gives information about whether the live animals are for slaughter or breeding. In our classification, slaughter animals are categorized as animals for further processing and breeding animals are categorized as agricultural input, more specifically propagation material (compare chapter 2.2.1).

For some product groups - such as product code ‘0106 - Live animals (excl. horses, asses, mules, hinnies, bovine animals, swine, sheep…)’ - the usage is not specifically mentioned and we consider them to be used as agricultural input and for further processing (including slaughter). The figures presented in this appendix depict the volume of imports from the selected trading partners by mode of transport. We present both the volume shares of the different modes of transport (in the charts) as well as the actual volume of the trade flows in tons (in the data tables). This enables the reader to assess also the actual size of the trade flows. The bar on the far right in the chart refers to total EU imports from non-EU countries (EU Extra trade). It thus also includes the imports from the separately mentioned countries. The data used to make these charts are the Eurostat data on EU-27 trade by mode of transport at the HS 6-digit level. It is presented here only to illustrate the modes of transport used. In the database that was constructed for the decision tree, we used the CN 8-digit classification.

The imports of live animals from countries further away from Europe mainly arrive by air; a small share are transported by either road or sea (see Figure 1). However, the number of animals imported into the EU is relatively small. They are mainly horses, both for breeding and for slaughter or other purposes, from Canada and the USA. The live animals from countries nearby, for instance from Russia, are largely transported by road.



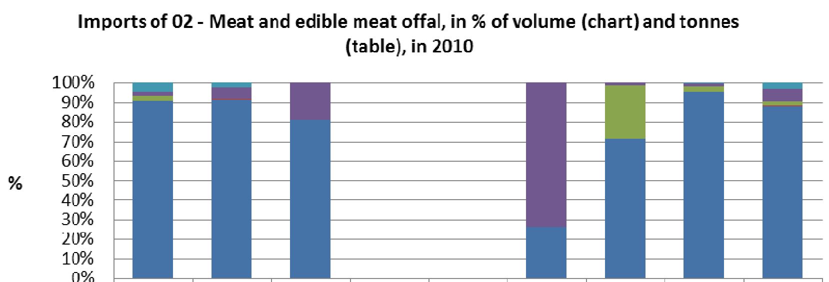
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	2
Unknown	0	0	0	0	0	0	0	9	32
Road	2	2	3	0	0	204	0	19	3262
Air	36	27	321	18	0	2	12	1252	3143
Rail	0	0	0	0	0	0	0	0	120
Sea	1	2	2	0	0	1	4	52	798

Note: Extra EU refers to EU-27 imports from non-EU members.
The EU-27 did not import live animals from India in 2010.
Source: Eurostat.

Figure 1: EU-27 imports of live animals, by mode of transport 2010

3.1.2 02 - MEAT AND EDIBLE MEAT OFFAL

Most products in this chapter are either fresh/chilled or frozen. Products are considered to be processed if the product description mentions flours and meals of meat or meat offal. If salted or in brine, products are considered to be preserved. Most products are for food consumption; a few groups are for the manufacture of pharmaceutical products. Some product groups with offal contain intestine.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	0
Unknown	1403	8008	0	0	0	0	0	41	26580
Road	665	20784	1356	0	0	518	62	259	56302
Air	619	548	0	0	0	0	1213	511	17862
Rail	0	1382	0	0	0	0	0	0	1403
Sea	27850	336104	5808	0	0	186	3178	17596	779697

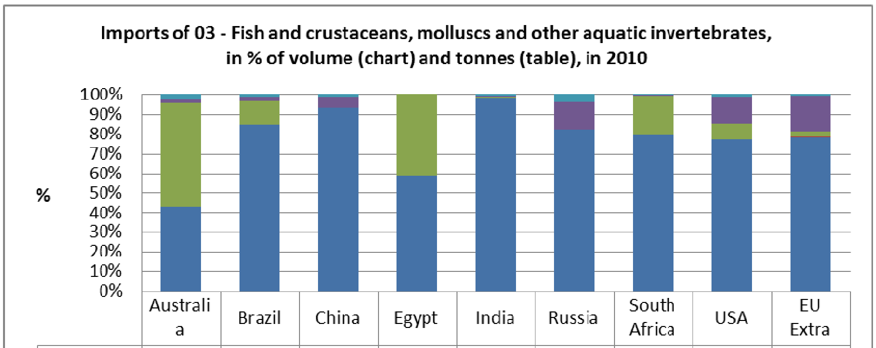
Note: The EU-27 does not import meat and edible meat offal from India and Egypt.
Source: Eurostat.

Figure 2: EU-27 imports meat and edible meat offal, by mode of transport 2010

Figure 2 shows that imports of meat and edible meat offal are mostly shipped to the EU-27 market by sea, except for imports from Russia. Due to the relatively shorter distance, more than 70 per cent of Russian meat imports are transported by road. More than 25 per cent of the total meat imports from South Africa are flown into the EU, but air freight is much less used for imports from other countries.

3.1.3 03 - FISH AND CRUSTACEANS, MOLLUSCS AND OTHER AQUATIC INVERTEBRATES

This chapter contains live fish, fish meat, crustaceans and molluscs. Common distinctions for live fish are ornamental versus non-ornamental and freshwater versus saltwater. At the 4-digit level, products are distinguished by the state of the product, mainly chilled/fresh and frozen, preserved in terms of dried, salted, in brine, smoked or cooked. A further distinction at the more disaggregated level is between the different kinds of fish, fresh and saltwater fish, and for some products the usage 'fit for human consumption' is mentioned. Most of the EU-27 imports of fishery products are transported by sea. For imports from, for example, Egypt, Australia and South Africa, airfreight is an important means of transport for fishery products (see Figure 3).



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	164
Unknown	35	150	7169	0	1269	3136	57	2351	24454
Road	28	171	25513	0	512	12110	487	25881	732113
Air	779	1210	200	318	1002	0	11044	15696	126505
Rail	0	0	72	0	0	0	0	9	9414
Sea	643	8676	460793	449	146996	72029	45132	147901	3233988

Source: Eurostat.

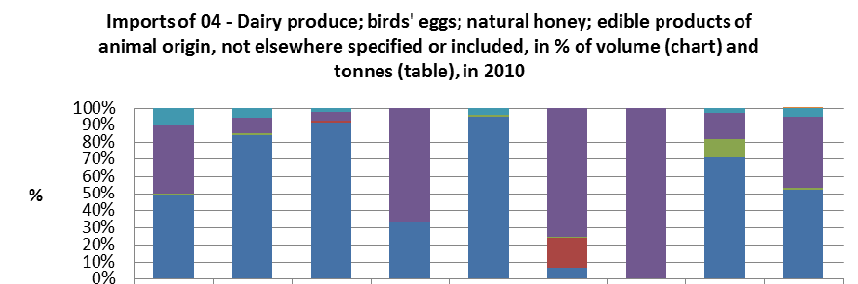
Figure 3: EU-27 imports of fish and crustaceans, molluscs and other aquatic invertebrates, by mode of transport 2010

3.1.4 04 - DAIRY PRODUCE; BIRD EGGS; NATURAL HONEY; OTHER EDIBLE ANIMAL PRODUCTS

Product categories are generally considered as being fresh, except for those that are preserved. The 4-digit level gives the details about the broad product groups of dairy and eggs. Honey is not further described. Milk is preserved by pasteurisation, and milk and other dairy products can be further processed in terms of concentrated, flavoured, or with fruit and sugar added. The distinction between different types of dairy products and the degree of concentration are made at the 4-digit level. Fat contents levels are provided either at the 6-digit or the 8-digit level. Information about volume or packages is given at the 8-digit level. The usage of dairy products is not defined.

Concerning eggs, the 4-digit level differentiates between eggs in shells and processed eggs, namely powder, egg yolk and white. At the further disaggregated 8-digit level, eggs for human consumption and eggs unfit for human consumption are defined.

As Figure 4 illustrates, imports from faraway countries mainly come by sea or road to the EU-27 market. Imports from Egypt are mainly transported by road rather than by ship. Imports from South Africa are also transported by road, and interestingly, road is the only mode of transport used.



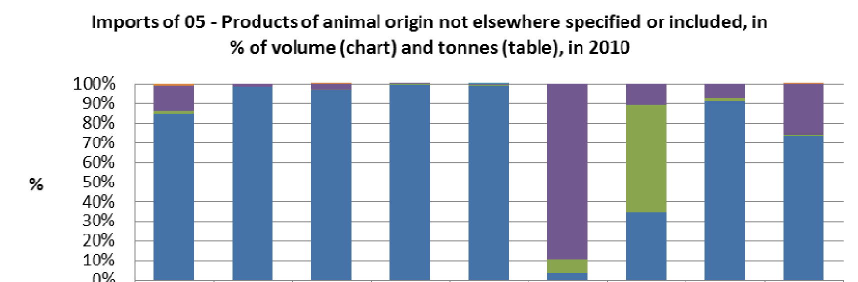
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	2
Unknown	521	488	1029	0	187	0	0	379	21794
Road	2175	728	2779	16	0	270	5	2286	155895
Air	26	105	182	0	54	1	0	1540	3120
Rail	0	0	325	0	0	60	0	0	392
Sea	2684	6958	46164	8	4063	25	0	10344	200066

Source: Eurostat.

Figure 4: EU-27 imports of dairy produce; birds' eggs; natural honey; other edible products of animal origin, by mode of transport 2010

3.1.5 05 - Products of animal origin not elsewhere specified or included

Most of the products in this chapter are fresh, while some are frozen or processed. Some of the products are for human use and others are categorized 'unfit for human consumption' and thus used for industry and manufacturing. Figure 5 shows that transport by ship is the most widely used means of transporting imports of these products, except for imports from Russia. The great majority (about 90%) of the EU-27 imports of the products from Russia are transported by road.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	4	0	6	0	0	0	0	0	56
Unknown	0	0	0	0	1	0	0	0	79
Road	79	760	1714	2	102	794	20	1150	144045
Air	10	8	151	18	95	63	101	188	3104
Rail	0	26	24	0	0	0	0	0	51
Sea	519	56834	58088	5933	28515	31	64	14842	414360

Source: Eurostat.

Figure 5: EU-27 imports of products of animal origin not specified elsewhere, by mode of transport 2010

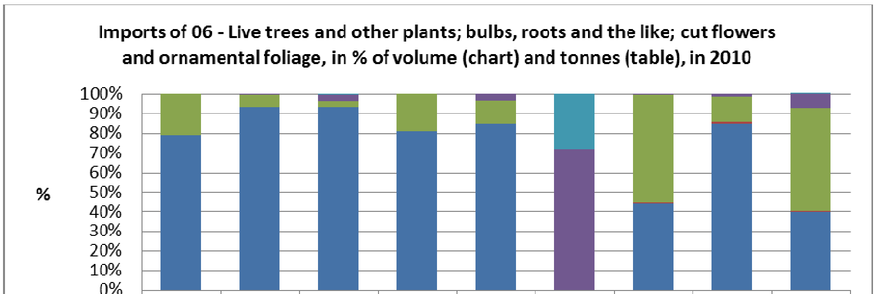
3.2 LIVE PLANTS AND PLANT PRODUCTS

3.2.1 06 - LIVE TREES AND OTHER PLANTS; BULBS, ROOTS, CUT FLOWERS AND ORNAMENTAL FOLIAGE

The products in this chapter are either live or fresh, although some dried (preserved) products are included, like dried cut flowers. The category comprises three main subheadings: 1) live trees and other plants; 2) bulbs, roots and suchlike; 3) cut flowers and ornamental foliage. The first two are considered ‘live’ whereas cut flowers are labelled ‘fresh or chilled’. Live plants (with roots) contain soil, while cuttings generally do not. Some of the products are for propagation and some are for ornamental purposes. Bulbs, tubers and roots for human consumption are excluded (‘excl. those for human consumptions’).

Figure 6 shows that more than 70 per cent of the products from Russia are transported by road; the rest is unknown. From South Africa, airfreight takes over 50 per cent of the total, and sea transport takes up the rest. From other faraway countries, sea is - as for most other products - the most important way of transport, followed by air and road.

Within subheading 0601 ‘Bulbs, tubers, tuberous roots, corms, crowns and rhizomes, …’ there is a distinction between dormant bulbs and those in growth or flowering. Subheading 0602 ‘Live plants incl. their roots, cuttings and slips; mushroom spawn, …’ contains some very diverse product groups concerning unrooted cuttings and slips including vine slips, fruit trees, rhododendrons and azaleas, and roses, indoor and outdoor (rooted) cuttings, forest trees, tree shrubs and bushes, and live outdoor plants, as well as live indoor flowering plants and live indoor plants and cacti (excluding flowering plants). The product distinction in this group is generally no more detailed than this. For cut flowers (subheading 0603), there is a distinction between roses, carnations, orchids, chrysanthemums, gladioli and others. From an economic point of view, this captures about 50 per cent of the EU import value. From a phytosanitary point of view, however, products in this group are so aggregated that it would be more useful for country-specific analysis than for product-specific analysis.

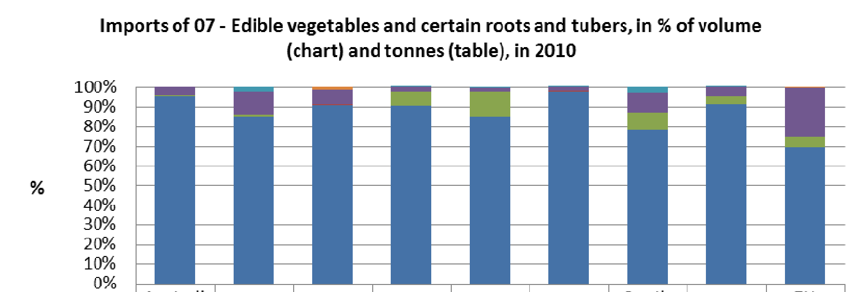


	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	0
Unknown	0	0	114	0	0	28	0	0	182
Road	0	28	801	0	207	71	36	368	29863
Air	339	357	615	410	748	0	4638	3557	224237
Rail	0	0	23	0	16	0	13	382	480
Sea	1282	5471	22425	1768	5340	0	3746	23697	171005

Source: Eurostat.

Figure 6: EU-27 imports of live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage, by mode of transport 2010

3.2.2 07 - EDIBLE VEGETABLES AND CERTAIN ROOTS AND TUBERS



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	5816	0	0	0	0	0	6690
Unknown	0	113	136	218	424	1	461	1	9931
Road	2575	613	29139	8513	1580	2074	1532	7764	960296
Air	74	53	1170	25578	12318	1	1443	6202	201563
Rail	0	0	1741	6	96	193	0	319	10899
Sea	55991	4448	382242	323812	84308	101497	12270	152914	2703179

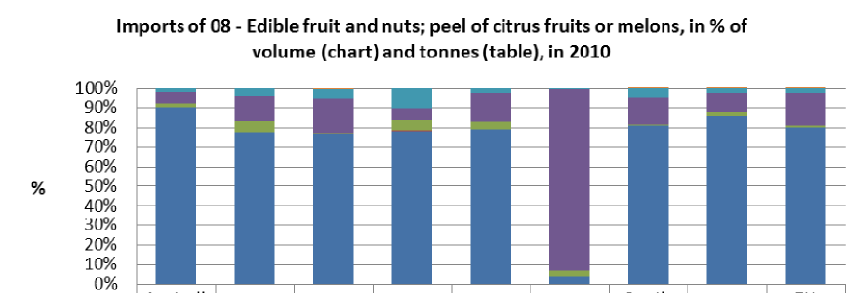
Source: Eurostat.

Figure 7: EU-27 Imports of vegetables and certain roots and tubers, by mode of transport 2010

Edible vegetables and roots and tubers are mostly fresh or chilled; some are frozen or preserved. Most products in this category are for food consumption. Only a small share of the descriptions state ‘unsuitable in that state for immediate consumption’ and will be used for further processing. It is obvious from Figure 7 that sea shipping is the most important way to transport vegetables and edible roots and tubers from faraway countries to Europe. Road and air are the second and third most important modes of transport for imports. A small share of the transport modes for imports from Brazil and South Africa are unknown.

3.2.3 08 - EDIBLE FRUIT AND NUTS; PEEL OF CITRUS FRUITS OR MELONS

Products in this chapter are mostly fresh or chilled; some are frozen or preserved. They do not contain soil (in theory). Most products, however, do contain seeds and may contain (like other products of plant origin) live organisms of various sorts that are indigenous to the land of origin. Almost all of these products are for direct food consumption; the only exception is the groups with ‘unsuitable in that state for immediate consumption’ in their description. These will first go for further processing.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	378	0	0	0	690	272	5600
Unknown	212	22195	12658	21230	2041	33	49705	10073	244514
Road	810	73849	40322	11392	12682	9389	156576	50460	2103451
Air	242	33581	377	11187	3320	320	7422	8555	135701
Rail	18	0	412	503	318	8	22	330	5441
Sea	11411	457255	178854	159018	68590	397	908417	416739	9953975

Source: Eurostat.

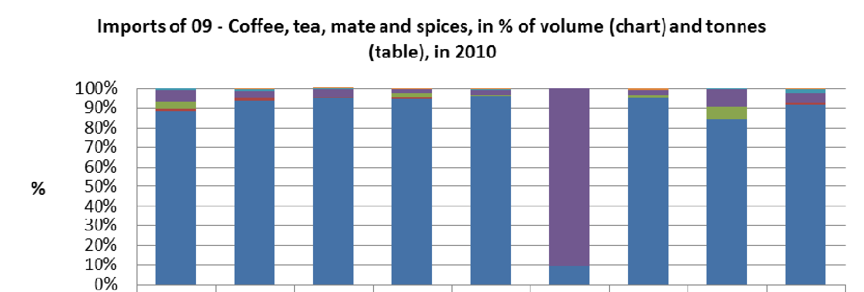
Figure 8: EU-27 imports of edible fruit and nuts; peel of citrus fruits or melons, by mode of transport 2010

Nearly 80 per cent of the transport from faraway countries to Europe is by sea. Road transport is another much used mode of transport, and a small share of imports are transported by air. Over 90 per cent of imports from Russia arrive by road; air and sea account for less than 10 per cent of the total.

3.2.4 09 - Coffee, tea, mate and spices

Most of the products can be considered fresh. Some of the products are preserved in terms of being roasted, dried or fermented, and some are processed (e.g. crushed or ground). The products are all for human consumptions, no matter whether the product is directly consumed or consumed after preservation and/or processing. For coffee, the information about roasted or not is given at the 6-digit level, and tea is divided into fermented and non-fermented at the 4-digit or 6-digit level. For tea, the volume of packages larger and smaller than 3 kg is given at the 6-digit level. The species information is about whether the spices are processed, that is, whether they are crushed or ground (6-digit level). Note that this information is not given for all species.

As illustrated in Figure 9, ship transport by sea is the most important means of transporting coffee, tea and spices, except for imports from Russia (which come by road).



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	1906	60	20	292	0	38	0	12296
Unknown	2	12062	347	0	900	0	0	13	55211
Road	15	32380	4911	113	5055	1779	133	406	184119
Air	9	78	206	101	684	0	101	285	4277
Rail	3	14654	211	102	93	0	0	0	32959
Sea	221	859772	120868	5454	180111	179	5080	3773	3047177

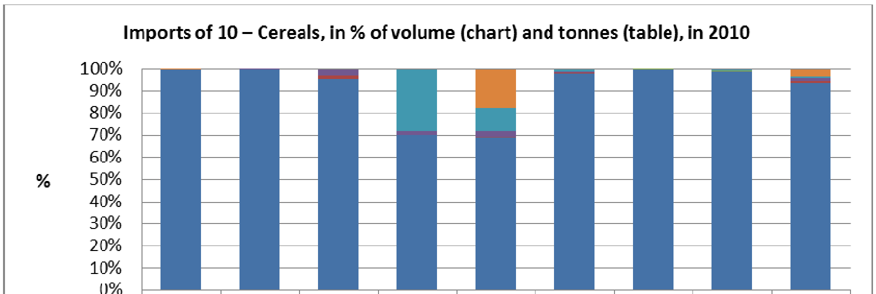
Source: Eurostat.

Figure 9: EU-27 imports of coffee, tea, mate and spices in the EU-27, by mode of transport 2010

3.2.5 10 - Cereals

Cereals are mostly fresh products, among which some are semi- or wholly-milled. Most of the products are for human consumption. Some categories state 'for sowing' and are used for propagation, while some state 'husked' and are mostly destined for further processing.

Transport from extra-EU countries to Europe is almost all by ship. From China, Egypt and India, a small share comes by road. Nearly 30 per cent of all imports from Egypt and India are transported by unknown or 'other' modes of transport. It seems rational to assume that these products are actually transported by sea.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	6	0	0	0	49036	0	0	0	306880
Unknown	0	0	0	24447	29477	2466	0	7954	92173
Road	278	10	536	1645	6752	618	0	5200	129441
Air	1	3	8	0	18	0	3	328	2365
Rail	0	0	288	0	708	1067	0	136	151242
Sea	222987	1591673	18549	60939	191927	205019	68454	1619865	9480486

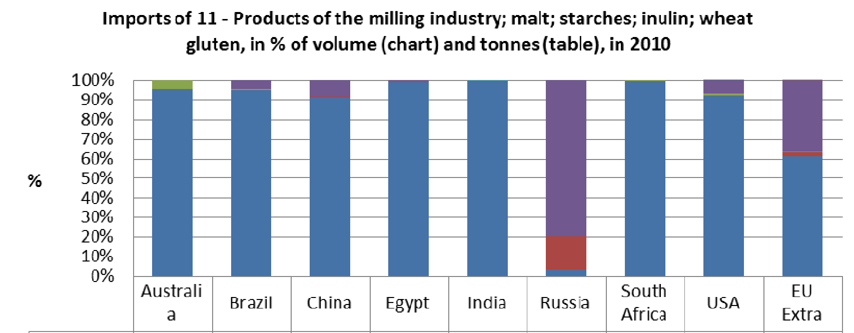
Source: Eurostat.

Figure 10: EU-27 imports of cereals, by mode of transport 2010

3.2.6 11 - PRODUCTS OF THE MILLING INDUSTRY; MALT; STARCHES; INULIN; WHEAT GLUTEN

All products of the milling industry are of plant origin and are processed. They are either for direct human consumption or for further processing in the food industry. This distinction is not entirely clear from the product descriptions, although it seems fair to assume that the following are mostly used in the food industry: '1103 - Cereal groats, meal and pellets', '1104 - Cereal grains otherwise worked, e.g. hulled, rolled, flaked, pearled, sliced or kibbled; germ of cereals, whole, rolled, flaked or ground (excl. cereal flours, and husked and semi- or wholly milled rice and broken rice)', '1105 - Flour, meal, flakes, granules and pellets of potatoes', '1106 - Flour and meal of peas, beans, lentils and other dried leguminous vegetables of heading 0713, of sago or of manioc, arrowroot, salep, jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content; …', '1107 - Malt, whether or not roasted', '1108 - Starches; inulin' and '1109 - Wheat gluten, whether or not dried'.

Over 90 per cent of the products from faraway countries are transported by sea. Small shares from Australia, Brazil, China and the USA are also transported by road or air. As Russia is relatively nearby, nearly 80 per cent of imports to the EU are by road; over 15 per cent are by rail, and the rest are by sea.



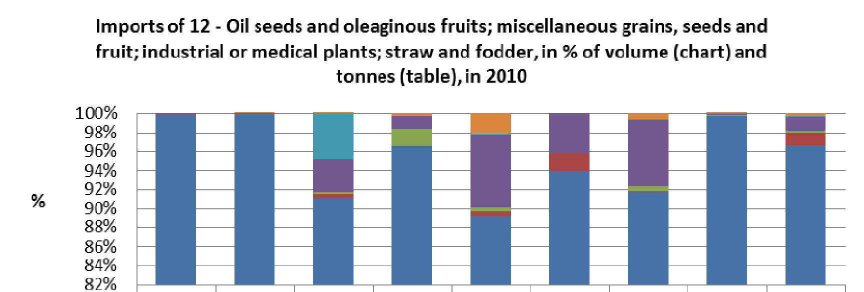
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	44
Unknown	0	0	0	0	11	0	0	1	87
Road	0	114	805	2	61	1494	0	1039	50634
Air	9	19	6	0	6	2	2	189	413
Rail	0	0	43	0	0	330	0	12	2772
Sea	217	2711	8789	242	9504	64	1499	14220	86276

Source: Eurostat.

Figure 11: EU-27 imports of products of the milling industry; malt; starches; inulin; wheat gluten, by mode of transport 2010

3.2.7 12 - OIL SEEDS, OLEAGINOUS FRUITS; SEEDS AND FRUIT; STRAW AND FODDER

Products in this category can be either fresh, processed (broken, not shelled, pellets) and/or preserved (dried). The category includes products for human consumption and animal fodder, as well as sowing material, which is classified as propagation material (compare chapter 2.2). Some product categories are also used as inputs into further industrial processing.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	50	72	74	2220	0	108	1548	48670
Unknown	0	0	11592	0	66	0	18	1242	15590
Road	1340	1518	8299	289	7735	5475	1267	4116	248405
Air	76	94	393	451	440	2	90	1517	18715
Rail	0	2175	1086	0	435	2246	23	33	243218
Sea	433093	5756584	219458	22774	90670	121687	16688	3167228	16656202

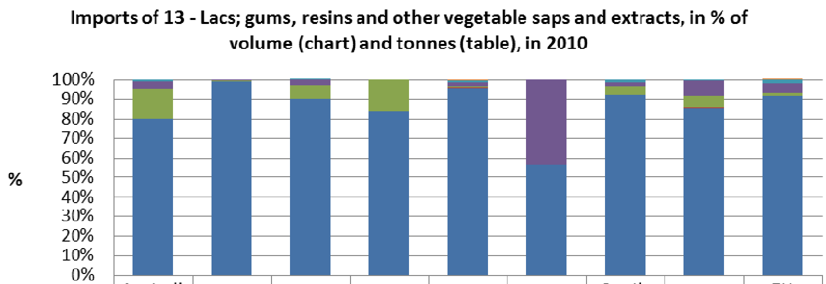
Source: Eurostat.

Figure 12: EU-27 import of oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medical plants; straw and fodder, by mode of transport 2010

Figure 12 shows the various modes of transport used to bring the products to the EU market. Overall, shipping is the most important means of transport, following by road transport. Less than 10 per cent of the EU-27 imports from outside the EU are transported by road. Rail is also used, but at only about 5 per cent, the share of imports transported by rail is surprisingly low.

3.2.8 13 - Lacs; gums, resins and other vegetable saps and extracts

The products of plant origin in Chapter 13 are generally considered 'fresh', although they might be dried or otherwise preserved in some cases. Vegetable saps, vanilla extracts, pectic saps and pectinates, and agar-agar are used for processing in the food industry. Mucilages and thickeners derived from vegetable products are considered to be not for processing in the food industry, although in practice they might be. Shipping is the most important mode of transport for both faraway countries and countries closer to Europe. For imports from Russia, road transport is almost as important as sea transport. Only a very small share of imports are transported as airfreight.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	80	0	0	0	82
Unknown	2	0	2	0	611	0	2	25	3346
Road	8	85	256	0	1125	10	4	982	10300
Air	31	83	587	6	338	0	9	674	2362
Rail	0	0	0	0	260	0	0	19	300
Sea	167	19704	7875	31	57586	13	170	9985	177883

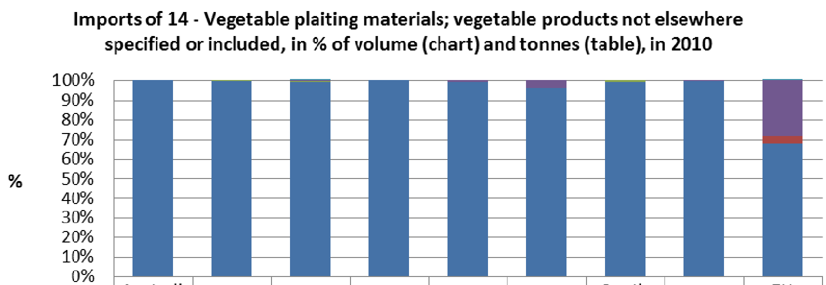
Source: Eurostat.

Figure 13: EU-27 imports of lacs; gums, resins and other vegetable saps and extracts, by mode of transport 2010

3.2.9 14 - Vegetable plaiting materials; other vegetable products

All the products in this chapter are of plant origin, primarily bamboo, rattan for plaiting, and cotton linters. Also cleaned, bleached or dyed cereal straw is in this category. Products are considered fresh or preserved (by drying or dying), although the difference does not follow from the descriptions. The product codes may be an indication of the state of the product, whereby those starting with 1401 are less likely to be further processed or preserved. The products are typically used for plaiting (other processing).

Figure 14 shows that almost all imports of Chapter 14 products from the countries mentioned in the graph are transported to Europe by sea. For the whole of the EU imports, however, nearly 30 per cent are transported by road and a small share by rail.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	0
Unknown	0	0	15	0	0	0	0	0	15
Road	0	0	298	0	229	4339	0	41	184573
Air	0	1	29	0	55	1	7	70	607
Rail	0	0	5	0	87	294	0	0	23196
Sea	27	785	57036	1489	35795	119766	714	19651	446501

Source: Eurostat.

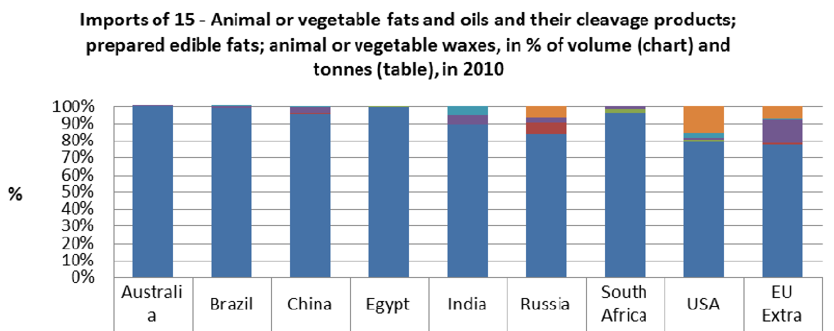
Figure 14: EU-27 imports of vegetable plaiting materials; vegetable products not elsewhere specified, by mode of transport 2010

3.3 PROCESSED AND PREPARED PRODUCTS OF ANIMAL AND PLANT ORIGIN

3.3.1 15 - ANIMAL OR VEGETABLE FATS, OILS (EDIBLE); ANIMAL OR VEGETABLE WAXES

This chapter of product categories comprises products of animal origin and plant products. Products are processed in terms of pressed, refined, emulsified or chemically modified, and this information is given at the most disaggregated level (8 digits). The product descriptions provided define the intended use of the products. If the product description states that the use excludes industrial uses, we categorized the product as being used for direct consumption, for further food processing, or as feed or agricultural input. If products are excluded from food production, they are categorized as inputs for industrial processing but not feed. Along these lines, edible mixtures or preparations are used as food and feed.

Animal and vegetable fats and oils are mainly shipped by sea. Shipping is the only means of transport for imports from Australia, Brazil and Egypt. A small share of imports from Russia are transported to the EU-27 by rail.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	21716	0	27136	759254
Unknown	0	222	74	0	8366	0	0	4382	39132
Road	3	756	342	0	8782	8474	14	2764	1407765
Air	6	42	29	8	42	6	16	1429	2563
Rail	0	0	11	0	0	22060	0	122	140127
Sea	5876	93813	10431	1788	151463	275279	769	140644	8114706

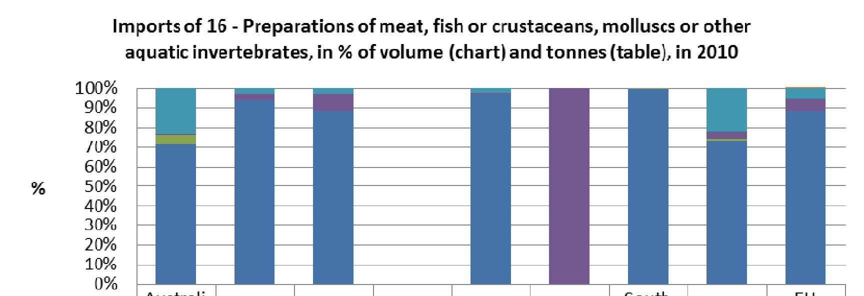
Source: Eurostat.

Figure 15: EU 27 Imports of animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes, by mode of transport 2010

3.3.2 16 - PREPARATIONS OF MEAT, FISH OR CRUSTACEANS, MOLLUSCS OR OTHER AQUATIC INVERTEBRATES

The preparations of meat, fish or other aquatic animals are either preserved or processed, or both. They are all used for direct consumption or food processing; some may be used as animal feed. Some of the fish is preserved in oil (e.g. 'in vegetable oil', 'in olive oil').

The EU-27 imports from Russia are exclusively transported by rail, while India and South Africa ship almost all of their meat preparations to Europe (see Figure 16). Overall, ships are the dominant means of transport. Note that a small share of imports from Australia and the US come to Europe by air.



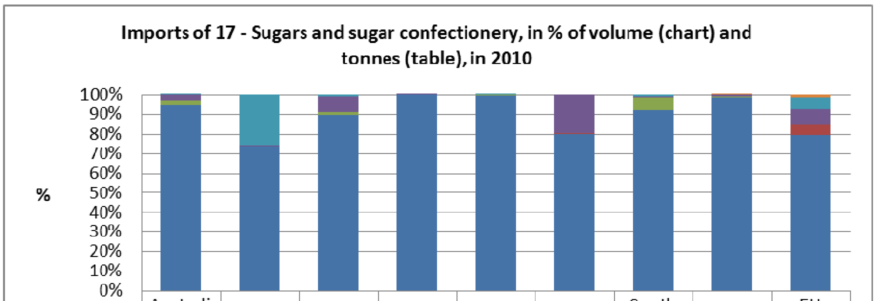
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	86
Unknown	79	7630	1706	0	311	0	0	3770	71870
Road	3	9334	5194	0	78	341	0	674	91312
Air	15	286	7	0	7	1	6	207	1736
Rail	0	20	43	0	0	0	0	0	858
Sea	245	263163	51606	0	13753	0	3437	12557	1238306

Note: The EU-27 does not import preparations of meat, fish, crustaceans, etc. from Egypt.
Source: Eurostat.

Figure 16: EU-27 imports of preparations of meat, fish or crustaceans, molluscs or other aquatic invertebrates, by mode of transport 2010

3.3.3 17 - Sugars and sugar confectionery

Chapter 17 concerns sugar and sugar products. Most of these are of plant origin, with the notable exception of lactose. Subheading 1701 contains cane or beet sugar, in raw, refined or white state, and chemically pure sucrose in solid form. Subheading 1702 consists of other sugars such as lactose, maple sugar, glucose/isoglucose, maltose, caramelized sugars and molasses, and syrups. These are mostly destined for the food industry, animal feed or bio-chemicals/biofuels. Molasses is in subheading 1703 and sugar confectionery in 1704. The last category contains processed food products only. Sugars are usually shipped by sea.



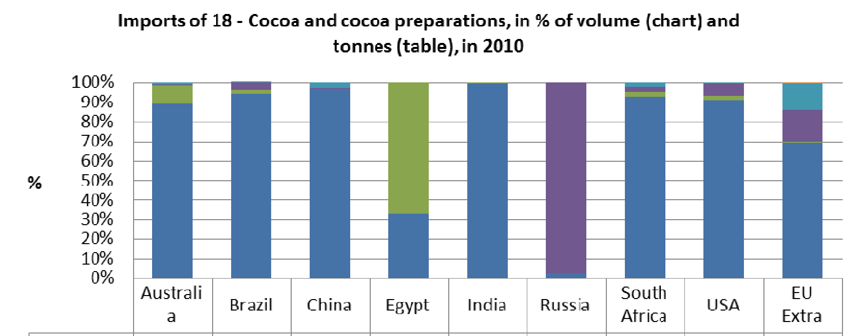
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	2	67320
Unknown	1	290355	144	0	20	0	3	3	291383
Road	31	9462	1541	8	25	5911	3	1395	339363
Air	31	29	251	8	167	0	31	677	3181
Rail	1	0	9	0	0	153	0	19	256045
Sea	1187	840523	16457	172495	124212	24060	424	180532	3712183

Source: Eurostat.

Figure 17: EU-27 imports of sugars and sugar confectionery, by mode of transport 2010

3.3.4 18 - Cacao and cacao preparations

The state of the product is given at the 4-digit level. While cacao beans are considered fresh, the other cocoa products are processed (crushed or powdered). Some of the cocoa products are used for direct consumption, for instance chocolate, but all can be used as ingredients in food processing.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	2994
Unknown	3	4	283	0	0	0	3	17	270629
Road	2	163	10	0	0	4094	3	419	294566
Air	36	92	7	2	4	3	3	155	10923
Rail	0	0	21	0	0	0	0	1	2134
Sea	342	4345	9507	1	897	103	122	6010	1328656

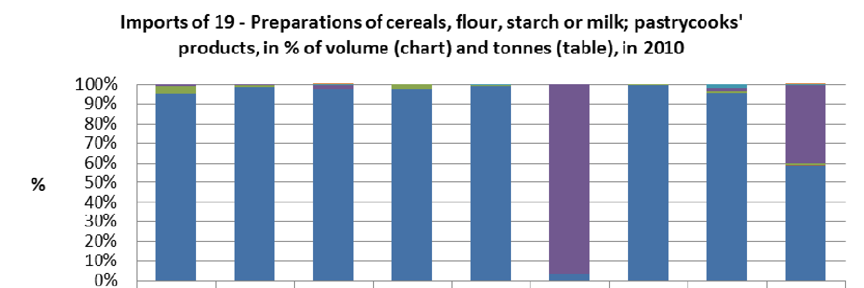
Source: Eurostat.

Figure 18: EU-27 imports of cocoa and cocoa preparations, by mode of transport 2010

While sea is the dominant mode of transporting cacao products, airfreight is mainly used to transport cacao products from Egypt to Europe (see Figure 18). For imports from Russia, road transport is most important.

3.3.5 19 - Preparations of cereals, flour, starch or milk; pastry cooks' products

Although most products in this chapter contain milk, they are labelled 'plant origin'. All products in this group are considered processed, although one description for couscous says 'unprepared'. About 60 per cent of EU imports are shipped by sea and the remainder by road.



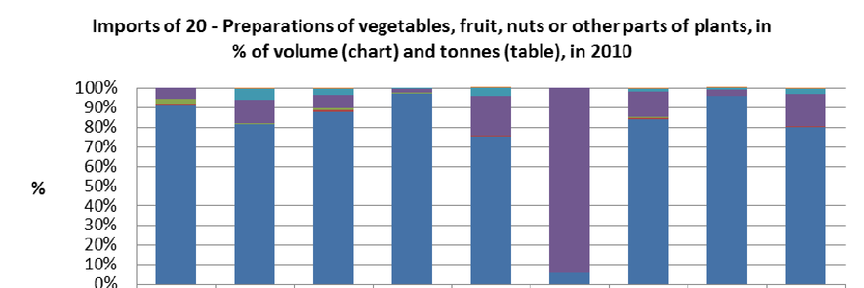
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	44	0	0	0	0	0	76
Unknown	0	0	56	0	20	0	0	387	704
Road	14	4	1995	0	15	7006	0	343	218217
Air	86	13	39	2	46	1	2	252	4343
Rail	0	0	140	0	0	6	0	0	4356
Sea	1814	1480	98944	85	7772	273	1007	22017	318792

Source: Eurostat.

Figure 19: EU-27 imports of preparations of cereals, flour, starch or milk; pastry products, by mode of transport 2010

3.3.6 20 - Preparations of vegetables, fruit, nuts or other parts of plants

The products in this chapter are all prepared in one way or another. Subheading 2001 products are vegetables prepared or preserved in vinegar or acetic acid. Subheadings 2002 and 2003 contain tomatoes and mushrooms, respectively, prepared or preserved other than by vinegar or acetic acid. Products in subheading 2004 are frozen. Subheading 2005 contains mainly canned vegetables (prepared or preserved other than by vinegar or acetic acid (excl. frozen, and tomatoes, mushrooms and truffles)). Groups 2006 to 2009 hold prepared and preserved fruits and nuts in various forms, like jams and juices. From nearby countries, for instance Russia, over 90 per cent of the products are transported by road to Europe. But from other faraway countries, shipping by sea is the most important transport mode.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	1758	1578	0	72	0	242	54	5470
Unknown	0	64539	25399	18	5062	0	1439	1163	126422
Road	248	140400	50402	197	25857	3865	12856	6956	673944
Air	110	228	4938	16	51	6	418	379	12666
Rail	1	0	6832	19	744	0	703	50	15499
Sea	3997	925355	650997	8866	96217	250	82695	187483	3354039

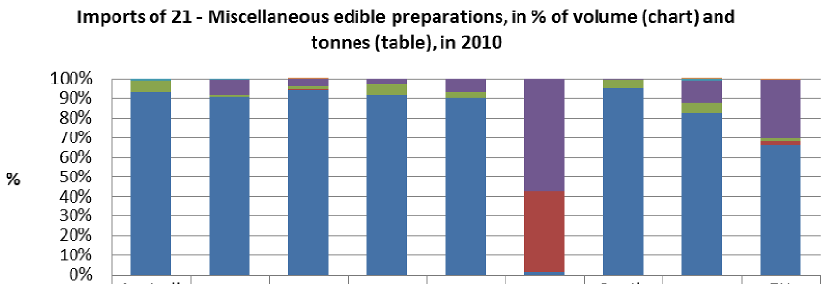
Source: Eurostat.

Figure 20: EU-27 imports of preparations of vegetables, fruit, nuts or other parts of plants, by mode of transport 2010

3.3.7 21 - MISCELLANEOUS EDIBLE PREPARATIONS

In this chapter, some miscellaneous food preparations are listed, either of animal or plant origin. However, some are neither animal nor plant origin, such as yeasts and baking powder (chemical). Edible preparations are all processed. All the products in this chapter can be used in the food industry, while some go to direct consumption (e.g. sauce and ice cream).

Over 55 per cent of the exports from Russia to Europe are transported by road, but a large share are also transported by rail. Only a small share of imports from, for example, Australia and the USA come by air, while the majority are transported by sea.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	4	0	0	0	0	26	684
Unknown	11	64	40	0	0	0	0	532	1302
Road	1	2468	2076	18	975	13860	20	8677	203895
Air	104	320	714	40	382	8	279	3911	8423
Rail	2	51	279	0	2	9831	0	69	13146
Sea	1574	27523	52825	634	12196	446	6316	61946	445710

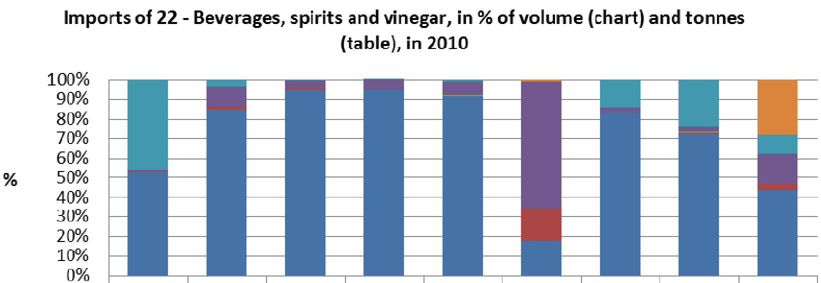
Source: Eurostat.

Figure 21: EU-27 imports of miscellaneous edible preparations, by mode of transport 2010

3.3.8 22 - BEVERAGES, SPIRITS AND VINEGAR

Beverages, spirits and vinegar are highly processed products of plant origin. They can be used for direct consumption or further food processing; some are also used for industry processing. For alcoholic drinks, information about the alcohol content is provided, and sometime also information about the bottle size. At the 6-digit level, carbonated and noncarbonated water are differentiated. Given the product description defined, the 2-digit level generally seems to be sufficient for adding the risk perspective to this group of products.

Figure 22 shows the modes of transport used for bringing beverages, spirits and vinegar into the EU-27. Not all modes of transports are defined. Overall, shipping is the dominant mode of transport, but for imports from Russia road transport is more important. Only a small share of imports are transported by rail.



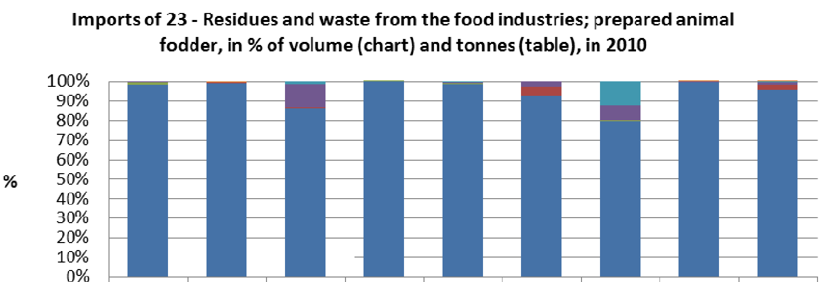
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	416	0	0	1257082
Unknown	165870	4431	64	4	20	7	43639	88395	436789
Road	3219	14679	1297	3076	222	46685	6590	9579	677970
Air	211	57	62	10	11	65	330	3441	6820
Rail	371	1508	647	0	0	12054	357	194	132471
Sea	191239	117971	35830	52239	2806	12819	251942	269699	1965969

Source: Eurostat.

Figure 22: EU-27 imports of beverages, spirits and vinegar, by mode of transport 2010

3.3.9 23 - Residues and waste from the food industries; prepared animal fodder

This chapter contains mainly flours, meals and pellets of meat and cereals, and residues from the food industry that are used in animal feed. The products that have 'offal' in the description may contain intestines. Some products, like wine lees and argol, may be used as food ingredients. Some products, like residues of starch manufacture and similar residues, beet pulp and bagasse may be used in animal feed, as feed ingredient or in other industries like biofuel production. All the products in this chapter are considered processed in some form or another. As shown in Figure 23, the majority of the imports are transported by sea.



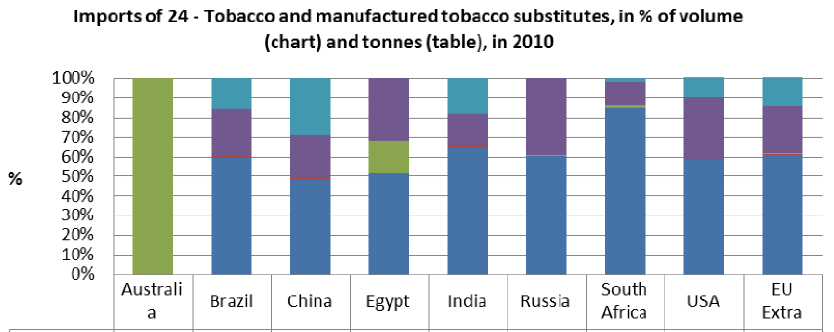
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	15594	0	0	0	0	0	4	29482
Unknown	0	27518	1675	0	96	0	164	100	64478
Road	5	7657	14302	0	395	18264	99	9417	457102
Air	46	1567	43	9	16	5	5	412	8312
Rail	0	12037	374	0	0	33899	0	1899	692410
Sea	3214	9581716	103924	109687	47387	632356	1057	2593407	29473332

Source: Eurostat.

Figure 23: EU-27 imports of residues and waste from the food industries; prepared animal fodder, by mode of transport 2010

3.3.10 24 - TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES

Tobacco products are generally processed, unless the products are classified as 'unmanufactured' in the product description. Shipping is the most important means of transport for EU-27 imports of tobacco products, closely followed by road transport (see Figure 24). All tobacco imports from Australia are transported by air to Europe, while some of the imports from Egypt are also flown into Europe.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	2	16
Unknown	0	27258	15473	0	9742	0	22	6857	87416
Road	0	41205	11731	126	9004	914	159	21253	146295
Air	1	29	192	63	80	4	21	52	1460
Rail	0	1068	263	0	223	0	0	201	3179
Sea	0	102760	25844	205	34803	1411	1118	39800	375194

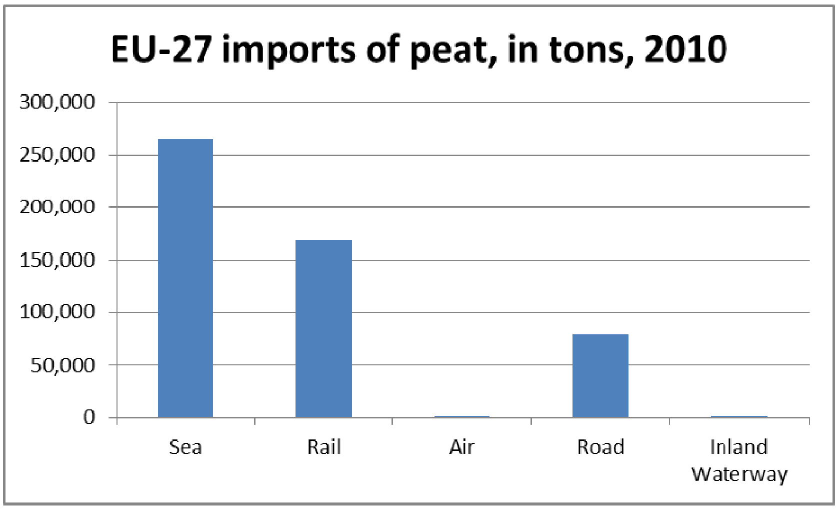
Source: Eurostat.

Figure 24: EU-27 imports of tobacco and manufactured tobacco substitutes, by mode of transport 2010

3.4 OTHER INDUSTRIAL PRODUCTS, INCLUDING MACHINERY, FERTILIZERS, TEXTILE PRODUCTS AND PAPER

3.4.1 2703 - PEAT, INCL. PEAT LITTER, WHETHER OR NOT AGGLOMERATED

In Chapter 27 'Mineral fuels, mineral oils and product of their distillation; bituminous substances; mineral waxes', peat is listed under a separate heading. Peat is imported mainly from Belarus, Russia and Ukraine. Division by modes of transport is depicted in Figure 25. A relatively large share of imports are transported by rail or road.



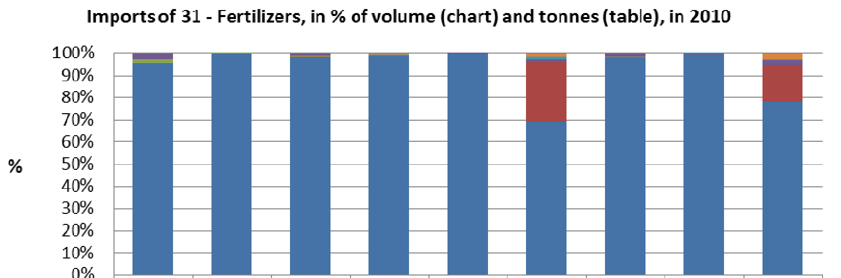
Source: Eurostat.

Figure 25: EU-27 imports of peat by mode of transport, in tons, in 2010

3.4.2 31 - FERTILIZERS

Fertilizers are used mainly as agricultural inputs, and the chapter contains both animal and vegetable fertilizers, and mineral and chemical fertilizers. Some fertilizers of animal origin are discernible as urea, while most are mixtures. Animal and vegetable fertilizers are listed under subheading 3101, whereas ammonium sulphate, ammonium nitrate and sodium nitrate, for example, are listed under heading 3102. Heading 3103 covers mineral or chemical phosphatic fertilizers (excl. those in pellet or similar forms, or in packages with a gross weight of < 10 kg), and 3104 covers mineral or chemical potassic fertilizers (excl. those in pellet or similar forms, or in packages with a gross weight of <10 kg). The last heading is: '3105 - Mineral or chemical fertilizers containing two or three of the fertilizing elements nitrogen, phosphorus and potassium; other fertilizers.'

Almost all fertilizers imported to Europe from faraway countries arrive by sea. From nearby countries, rail is also used to some extent (about 17% of total EU imports from outside the EU).



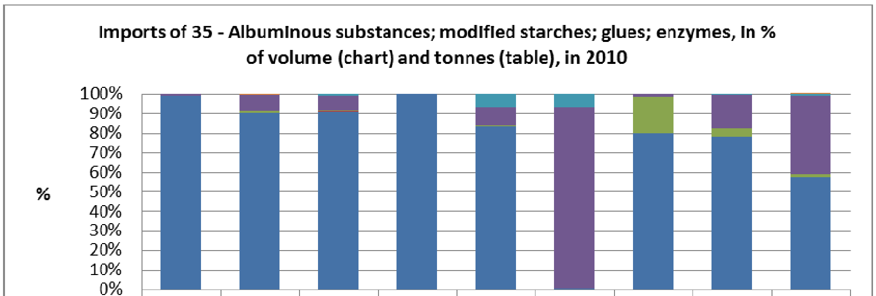
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	11994	0	55648	0	0	375024
Unknown	0	0	0	6932	0	56275	0	99	63849
Road	21	0	160	0	5	37538	79	1065	271731
Air	13	1	10	0	2	28	21	182	3592
Rail	0	0	65	0	0	1064287	0	34	2328316
Sea	749	15777	13276	2174222	4240	2735324	5621	193685	10792814

Source: Eurostat.

Figure 26: EU-27 imports of fertilizers, by mode of transport 2010

3.4.3 35 - ALBUMINOUS SUBSTANCES; MODIFIED STARCHES; GLUES; ENZYMES

All albuminous substances and other products in this product group are processed products of plant or animal origin. Some are classified as unfit for human consumption and are for industrial processing other than for food production. Other products, however are fit for human consumption (e.g. milk albumin and egg albumin) and are for use in the food industry, although direct consumption and animal feed may also be possible uses.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	80	0	0	0	0	0	0	198
Unknown	0	21	288	0	490	110	0	155	2425
Road	28	1511	3643	0	720	1521	2	14373	135490
Air	21	103	302	0	56	1	34	3254	4958
Rail	0	0	162	0	0	0	0	24	309
Sea	4732	16022	43494	881	6351	9	144	64411	195240

Source: Eurostat.

Figure 27: EU-27 imports of albuminous substances; modified starches; glues; enzymes, by mode of transport 2010

3.4.4 PART OF 38 - MISCELLANEOUS CHEMICAL PRODUCTS

Some products in Chapter 38, may be of interest to this project. Some of these products are by-products of wood pulp manufacturing, like tall oil and tar. They are listed below.

3803 - Tall oil, whether or not refined

380300 - Tall oil, whether or not refined

38030010 - Crude tall oil

38030090 - Tall oil, whether or not refined (excl. crude tall oil)

3804 - Residual lyes from the manufacture of wood pulp, whether or not concentrated, desugared or chemically treated, incl. lignin sulphonates (excl. crude tall oil, sodium hydroxide 'caustic soda' and sulphate pitch)

380400 - Residual lyes from the manufacture of wood pulp, whether or not concentrated, desugared or chemically treated, incl. lignin sulphonates (excl. crude tall oil, sodium hydroxide 'caustic soda' and sulphate pitch)

38040010 - Sulphite lyes, whether or not concentrated, desugared or chemically treated

38040090 - Residual lyes from the manufacture of wood pulp, whether or not concentrated, desugared or chemically treated, incl. lignin sulphonates (excl. sulphite lyes, crude tall oil, sodium hydroxide, caustic soda and sulphate pitch)

3805 - Gum, wood or sulphate turpentine and other terpenic oils produced by the distillation or other treatment of coniferous woods; crude dipentene; sulphite turpentine and other crude para-cymene; pine oil containing alpha-terpineol as the main constituent

380510 - Gum, wood or sulphate turpentine oils

38051010 - Gum turpentine

38051030 - Wood turpentine

38051090 - Sulphate turpentine

380590 - Crude dipentene; sulphate turpentine and other crude para-cymene; terpenic oils produced by the distillation or other treatment of coniferous woods (excl. gum turpentine, wood turpentine, sulphate turpentine and pine oil containing alpha-t

38059010 - Pine oil containing alpha-terpineol as the main constituent

38059090 - Crude dipentene; sulphate turpentine and other crude para-cymene; terpenic oils produced by the distillation or other treatment of coniferous woods (excl. gum turpentine, wood turpentine, sulphate turpentine and pine oil containing alpha-terpineol as the main constituent

3806 - Rosin, resin acids and derivatives thereof; rosin spirit and rosin oils; run gums

380610 - Rosin and resin acids

38061010 - Gum rosin

38061090 - Rosin and resin acids (excl. those obtained from fresh oleoresins)

380620 - Salts of rosin or of resin acids

38062000 - Salts of rosin or of resin acids

380630 - Ester gum

38063000 - Ester gum

380690 - Derivatives of resin acids and rosin, rosin spirit and rosin oils, and run gums (excl. rosin and resin acids and their salts, and ester gums)

38069000 - Resin acids and derivatives thereof, rosin derivatives, rosin spirit and rosin oils; run gums (excl. rosin, salts of rosin or of resin acids and ester gum)

3807 - Wood tar; wood tar oils; wood creosote; wood naphtha; vegetable pitch; brewer's pitch and similar preparations based on rosin, resin acids or vegetable pitch

380700 - Wood tar; wood tar oils; wood creosote; wood naphtha; vegetable pitch; brewer's pitch and similar preparations based on rosin, resin acids or vegetable pitch

38070010 - Wood tar

38070090 - Brewer's pitch and similar preparations based on rosin, resin acids or vegetable pitch; wood tar oils, wood creosote, wood naphtha and vegetable pitch (excl. wood tar, burgundy pitch, yellow pitch, stearin pitch, fatty acid pitch, fatty tar and glycerine pitch

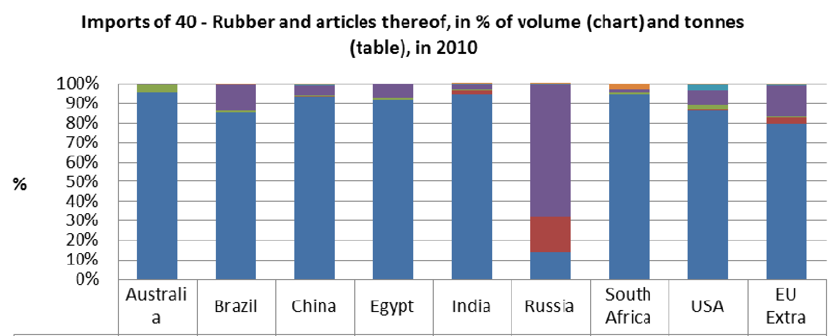
3821 - Culture media specially prepared for the development of microorganisms

382100 - Culture media specially prepared for the development of microorganisms

38210000 - Culture media specially prepared for the development of microorganisms

3.4.5 40 - Rubber and articles thereof

Chapter 40 contains both natural and synthetic rubber and rubber articles.[1] The first heading refers to natural rubber as ‘4001 - Natural rubber, balata, gutta-percha, guayule, chicle and similar natural gums, in primary forms or in plates, sheets or strip’. The chapter contains no less than 17 different headings with different sorts of rubber in different states of processing. Some subheadings refer to ‘regenerated’, ‘retreated’ or ‘used’ rubber articles. Some specific products like pneumatic tyres, inner tubes, pipes and hoses, conveyer belts, floor coverings, erasers, inflatable matrasses and hygienic or pharmaceutical articles, incl. teats, and many more, are listed separately. Imports from Russia are transported mainly by road, whereas 80 per cent of total EU imports are transported by ship.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	152	3034	0	82	114	506	1510	10628
Unknown	0	1	1862	0	580	358	0	11114	32403
Road	13	4810	41171	664	3381	240354	275	30616	738960
Air	95	473	4312	98	1297	104	191	9579	27506
Rail	0	3	2123	0	2819	64212	0	1049	158679
Sea	2424	31347	748035	8379	150232	49411	18660	338716	3754436

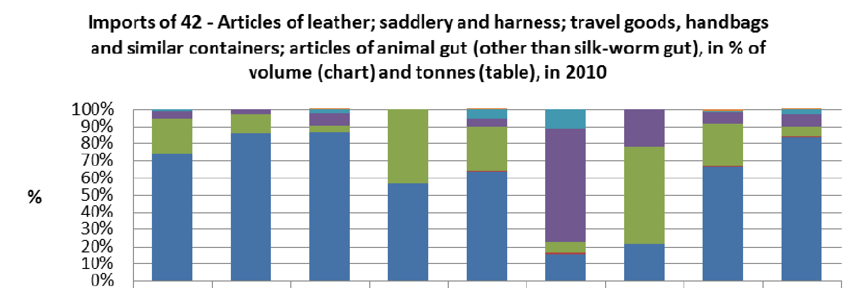
Source: Eurostat.

Figure 28: EU-27 imports of rubber and articles thereof, by mode of transport 2010

3.4.6 42 - Articles of leather and articles of animal gut (no silk-worm gut)

This chapter contains products of leather and gut. All of these products are processed in one way or another. We do not differentiate between leather and gut, but there may be reasons to do so in the future.

[1] For now, all articles in this chapter are considered of plant origin.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	128	0	22	0	0	54	250
Unknown	2	0	19717	0	2979	9	0	36	25394
Road	7	19	54366	0	2593	56	46	295	72814
Air	34	77	30377	30	14621	5	117	1201	59535
Rail	0	0	3068	0	67	1	0	9	3518
Sea	124	609	701969	39	36085	13	45	3207	817049

Source: Eurostat.

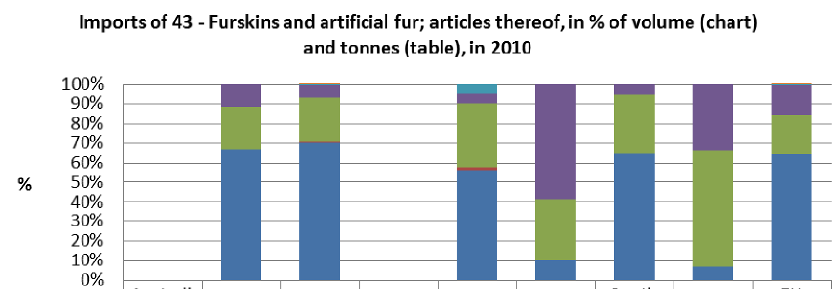
Figure 29: EU-27 imports of articles of leather; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut, by mode of transport 2010

Nearly 70 per cent of the products from Russia are transported by road. Around 15 per cent are transported by sea, and the remainder is transported by air, rail and unknown ways. Over half of the products from South Africa are transported by air; the others are by road and sea. For the other faraway countries, shipping is the most common mode.

3.4.7 43 - Fur skins and artificial fur; articles thereof

This category contains fur skins and fur articles, including artificial fur. The artificial product groups are under heading 4304 and may be of less interest to the current project. The first heading (4301) covers raw fur skins, the second tanned or dressed skins and parts or remnants thereof. The third heading covers articles of clothing, clothing accessories and other fur skin articles. Some specific products like leather gloves, footwear and headgear are not in this group but in Chapter 42 (items of clothing, clothing accessories, of leather or composition leather), Chapter 64 (footwear) or Chapter 65 (headgear). Several types of fur skins are separately discerned, most notably mink, beaver, muskrat, fox, rabbit, marmot, wildcat and seal (different types).

The most commonly used modes of transport for articles in this chapter are road, air and sea. From Russia, road is the most used means of transport, while air transport is most common for imports from the USA.



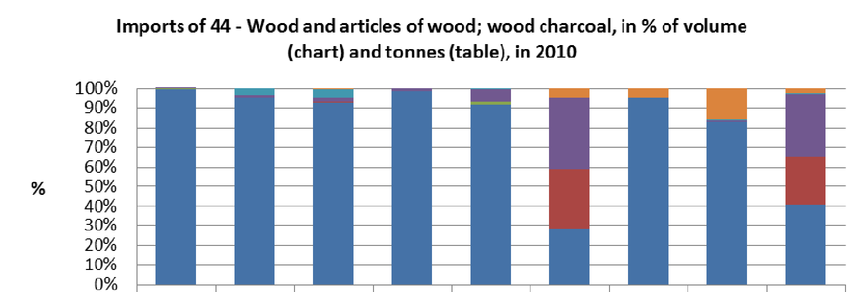
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	2	0	0	0	0	0	4
Unknown	0	0	25	0	4	0	0	0	37
Road	0	47	329	0	4	51	2	43	1424
Air	0	84	1131	0	26	27	11	76	1869
Rail	0	0	5	0	1	0	0	0	6
Sea	0	260	3524	0	45	9	24	9	6038

Note: The EU-27 does not import fur skins or artificial fur articles from Australia or Egypt.
Source: Eurostat.

Figure 30: EU-27 imports of fur skins and artificial fur; articles thereof, by mode of transport 2010

3.4.8 44 - Wood and articles of wood; wood charcoal

Wood and articles thereof are of specific interest to this project as they may carry potential pests of trees. The chapter consists of no less than 22 headings, ranging from '4401 - Firewood, in the form of logs, billets, twigs, faggots or similar; wood chips or particles; sawdust, wood waste and scrap, whether or not compressed into pellets, briquettes, logs or similar shapes', to '4420 - Wood marquetry and inlaid wood; caskets, cases and boxes for jewellery, cutlery, forks, spoons and the like, of wood; statuettes and other ornaments, of wood; interior fittings of wood (excl. furniture, lighting fixtures and parts thereof)' and '4421 - Other articles of wood n.e.s.'. This latter category amounted to 481 thousand tons in 2009 (Extra-EU-27 imports) out of a total of 25,266 thousand tons of wood imports (1.9%), of which 38 thousand tons were attributable to 'clothes hangers of wood' and 20 thousand tons to 'articles of fibre board n.e.s.'. The largest product groups in terms of import volumes are firewood (4401), wood in rough (4403), and wood sawn or cut lengthwise (4407). The first one only discerns coniferous wood as a separate group based on the tree species, whereas the latter two discern various types of trees, like various sorts of coniferous wood, meranti, tropical trees (like sapele/acajou d'Afrique/iroke, oukumé and sipo, itule, abura), oak, beech (fagus spp), poplar, eucalyptus and birch. Maple, cherry and ash are specifically discerned under heading 4407. From 4408 onwards, the chapter consists of processed or fabricated wood materials, like veneer sheets, particle board, fibre board and plywood, and products thereof.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	1386	0	0	436732	7914	237812	727930
Unknown	0	33437	65338	0	79	16141	0	4704	194467
Road	31	10704	32858	373	1094	3251210	96	12642	9890681
Air	61	511	2452	9	216	6699	44	863	13015
Rail	5	166	1986	0	20	2776278	0	282	7611248
Sea	68032	941106	1307151	31433	15114	2599854	147454	1254905	12743305

Source: Eurostat.

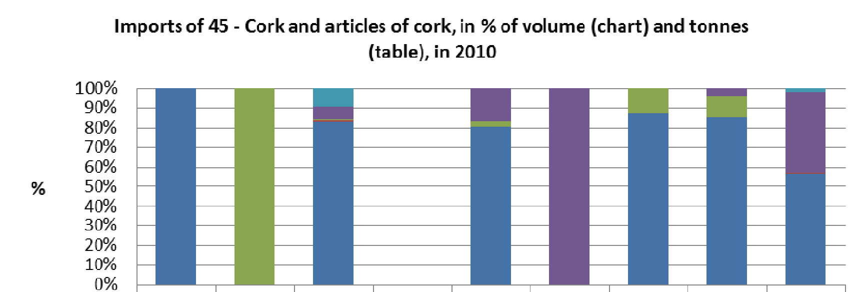
Figure 31: EU-27 imports of wood and articles of wood; wood charcoal, by mode of transport 2010

Most imports from faraway countries are transported by sea, although the largest share of imports (especially from Eastern and Central European countries) are imported by road or rail.

3.4.9 45 - CORK AND ARTICLES OF CORK

Chapter 45 contains products of cork, which is of plant origin. Most cork is dried after harvesting, but it may contain certain pests that are not killed by the drying process. Heading 4501 contains raw cork, which for all practicality is labelled 'fresh' in our analysis. All other headings contain debarked or processed cork. Most of these products are used in housing or the spirits industry or for other industrial purposes.

Switzerland, Morocco and China are among the largest suppliers of cork to the European market. The imports from the countries listed in the figure below are, with the noted exception of China, very small. Judging from the division of total extra-EU imports by mode of transport, the imports are mostly transported by sea and road.



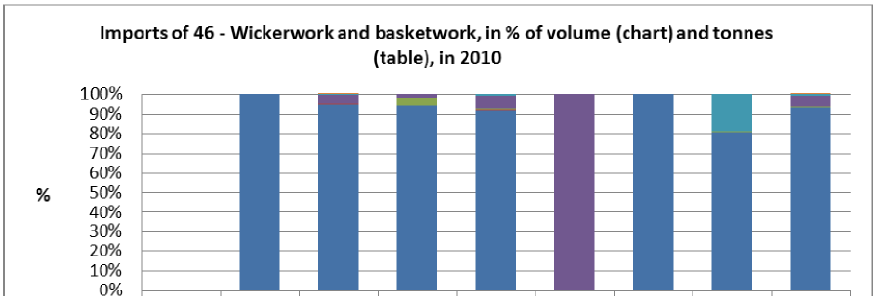
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	0
Unknown	0	0	422	0	0	0	0	0	428
Road	0	0	285	0	6	1	0	9	10272
Air	0	2	18	0	1	0	7	27	61
Rail	0	0	50	0	0	0	0	0	50
Sea	35	0	3706	0	29	0	47	208	14238

Note: The EU-27 does not import cork or articles of cork from Egypt.
Source: Eurostat.

Figure 32: EU-27 imports of cork and articles of cork, by mode of transport 2010

3.4.10 46 - Wickerwork and basketwork

The products in this chapter are mostly 'made directly to shape' from bamboo, rattan, vegetable plaiting material or non-vegetable plaiting material. Bottle envelopes made directly from straw are a separate product group. There is also a reference to products of loofah under heading 4602. The distinction between these different types of plaiting material may be relevant to risk assessment.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	8	0	0	0	0	0	10
Unknown	0	0	701	0	25	0	0	102	1113
Road	0	0	5524	1	238	7	0	1	9860
Air	0	0	228	2	24	0	0	3	366
Rail	0	0	325	0	16	0	0	0	495
Sea	0	30	128761	50	3490	0	585	433	167510

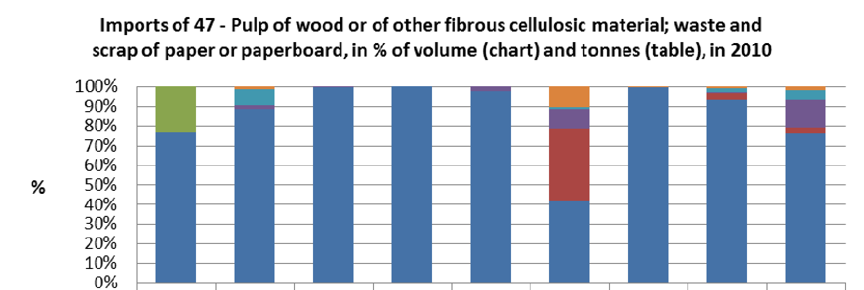
Note: The EU-27 does not import wickerwork or basketwork from Australia.
Source: Eurostat.

Figure 33: EU-27 imports of wickerwork and basketwork, by mode of transport 2010

3.4.11 47 - Pulp of wood or cellulosic material; waste of paper or paperboard

Products in this chapter are mainly identified using terms like 'mechanical wood pulp not chemically treated', 'chemical wood pulp', 'semi-chemical wood pulp', and 'unbleached', 'semi-bleached' or 'bleached'. The last two headings do not refer to wood pulp but to other fibrous cellulosic materials:

'4706 - Pulps of other fibrous cellulosic material (excl. wood)' and '4707 - Waste and scrap of paper or paperboard (excl. paper wool)'. The most common modes of transport for imports to the EU are depicted in Figure 34.



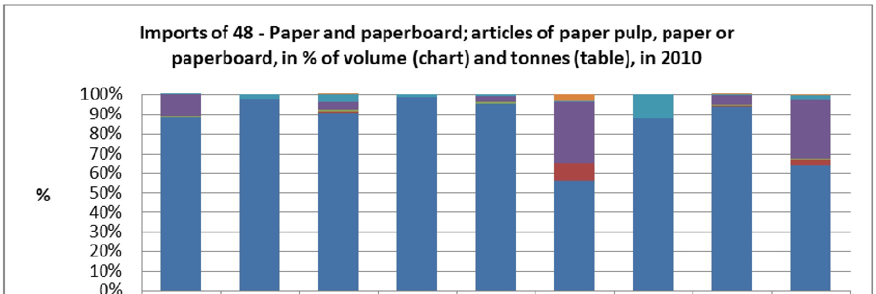
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	49648	0	0	0	36904	716	16502	179584
Unknown	0	290526	0	0	0	2396	0	36871	486495
Road	0	59131	35	0	24	34810	0	14621	1524944
Air	7	1196	31	0	0	0	0	590	4287
Rail	0	6915	1	0	0	128346	0	67244	282064
Sea	23	3139006	24635	77	1009	147896	149606	1886355	7982483

Source: Eurostat.

Figure 34: EU-27 imports of pulp of wood or of other fibrous cellulosic material; waste and scrap of paper or paperboard, by mode of transport 2010

3.4.12 48 - Paper and paperboard; articles of paper pulp, paper or paperboard

All products in this chapter are considered processed. The level of detail in this chapter is considerable. Many different kinds of paper and paper products are discerned. However, their relevance to pest risk analysis is limited.



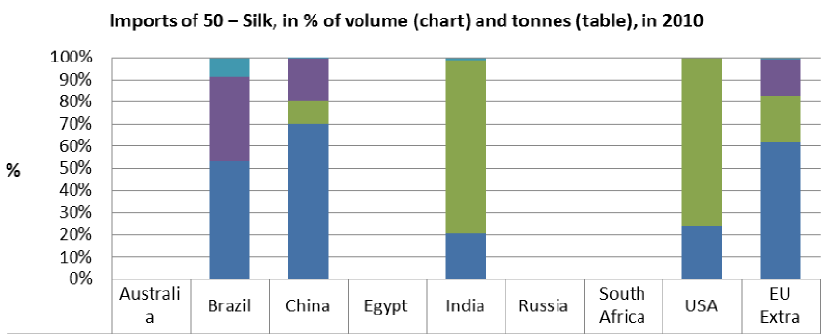
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	20	0	0	22134	0	116	22664
Unknown	58	8774	28033	670	492	5266	22228	3688	189477
Road	7836	879	27516	74	1131	222887	241	72583	2397720
Air	109	268	8065	42	478	32	95	10432	26720
Rail	0	0	5625	0	6	62539	8	1060	278234
Sea	64171	424868	677038	52094	44850	400188	162487	1410603	5134854

Source: Eurostat.

Figure 35: EU-27 imports of paper and paperboard; articles of paper pulp, paper or paperboard, by mode of transport 2010

3.4.13 50 - SILK

Bleached silk products are indicated by the term ‘bleached’ in the trade classification. Silk is of animal origin. The groups indicated as ‘raw’ can be considered fresh products, while the rest (e.g. silk yarn and woven fabrics) are considered processed products.



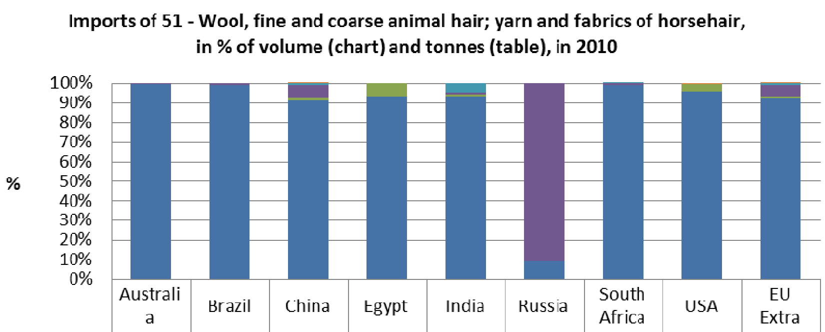
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	0
Unknown	0	15	5	0	11	0	0	0	31
Road	0	67	1162	0	7	0	0	0	1316
Air	0	0	645	0	911	0	0	16	1677
Rail	0	0	0	0	0	0	0	0	0
Sea	0	93	4281	0	242	0	0	5	4932

Note: The EU-27 does not import silk from Australia, Egypt, Russia or South Africa.
Source: Eurostat.

Figure 36: EU-27 imports of silk, by mode of transport 2010

3.4.14 51 - WOOL, FINE AND COARSE ANIMAL HAIR; YARN AND FABRICS OF HORSEHAIR

This chapter contains both uncarded and uncombed animal hair as well as carded wool and woven fabrics. Most of these products will go to the clothing industry. Uncarded and uncombed animal hair (‘neither carded nor combed’) is under headings 5101-5104. Wool and yarn is in headings 5105-5110, while woven fabrics are in headings 5111-5113.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	2	0	0	0	0	2	12
Unknown	0	0	304	0	376	0	12	0	2082
Road	39	26	2238	0	79	646	105	0	12861
Air	6	0	480	3	146	0	29	36	1479
Rail	0	0	2	0	0	0	0	0	27
Sea	29105	2550	31150	40	7756	65	16114	840	190569

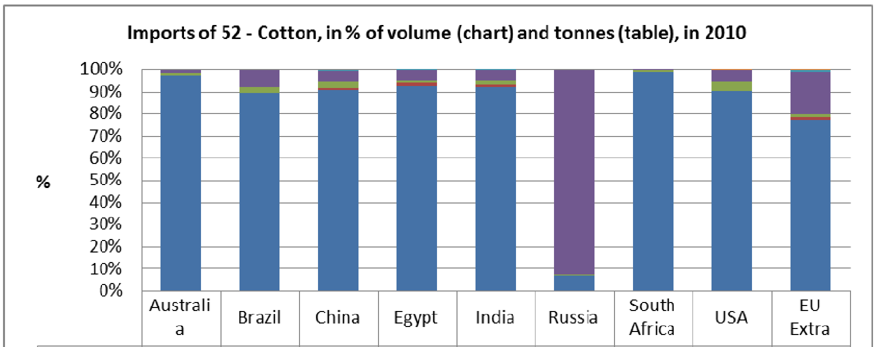
Source: Eurostat.

Figure 37: EU-27 imports of wool, fine and coarse animal hair; yarn and fabrics of horsehair, by mode of transport 2010

3.4.15 52 - Cotton

The chapter about cotton is subdivided into 12 headings, which roughly follow the same structure as that of wool in chapter 51: neither carded nor combed, waste, carded or combed, sewing thread, whether or not put up for retail sale, cotton yarn other than sewing thread, woven fabrics of cotton. The 4-digit (heading) level seems detailed enough for our purposes.

Nearly 80 per cent of the cotton imported from outside the EU is imported by sea, and less than 20 per cent is imported by road (see figure 38).



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	6	262
Unknown	0	0	414	14	598	0	0	6	7664
Road	4	461	4505	1470	6900	3518	1	676	175974
Air	4	151	2629	195	2665	11	4	593	13021
Rail	0	0	494	558	2137	2	0	0	10169
Sea	267	5230	82475	28377	144108	269	404	12275	712823

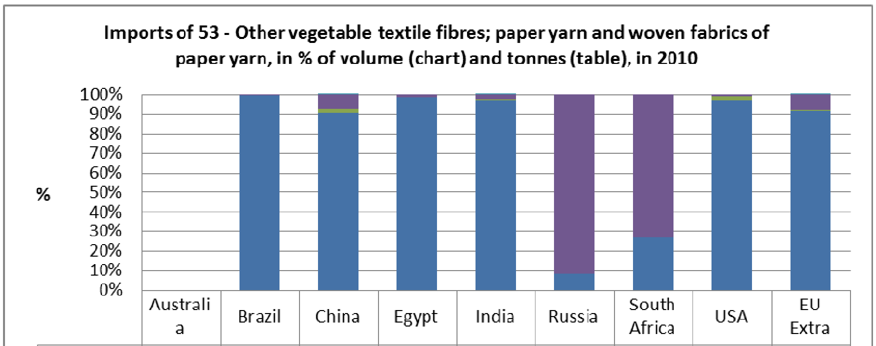
Source: Eurostat.

Figure 38: EU-27 imports of cotton, by mode of transport 2010

3.4.16 53 - Other vegetable textile fibres; paper yarn and woven fabrics of paper yarn

This chapter includes products like flax, hemp and jute, including raw or retted products, and yarn thereof. There is also heading ‘5305 - Coconut, abaca 'manila hemp or musa textilis', ramie and other vegetable textile fibres n.e.s., raw or processed, but not spun; tow and waste of such fibres, incl. yarn waste and garnetted stock’. Heading 5309 covers woven fabrics of the aforementioned products.

The products are largely imported by road from Russia and South Africa; the rest come by sea. But for other faraway countries, over 90 per cent of the products are transported by sea to the Europe. A very small share of the products are transported by either air or road.



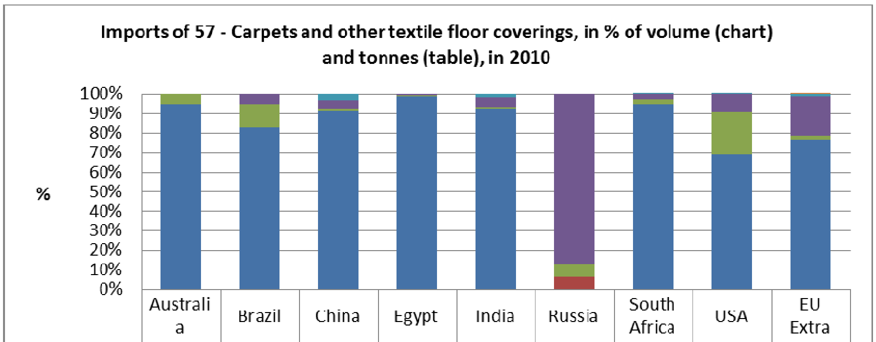
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	0
Unknown	0	0	12	0	37	0	0	0	70
Road	0	24	1522	63	1574	1488	51	10	19010
Air	0	1	346	5	193	2	0	20	679
Rail	0	0	9	4	177	0	0	0	440
Sea	0	4526	18280	5756	69839	136	19	1024	215163

Note: Australia does not export other vegetable textile fibres, paper yarn and woven fabrics to the EU-27.
Source: Eurostat.

Figure 39: EU-27 imports of other vegetable textile fibres; paper yarn and woven fabrics of paper yarn, by mode of transport 2010

3.4.17 57 - Carpets and other textile floor coverings

This chapter contains both carpets and textile floor coverings of natural and of synthetic materials, like nylon and polyamide. The first few subheadings refer to '5701 - Carpets of textile materials, knotted, whether or not made up' (which includes various carpets of wool or fine animal hair) and '5702 - Carpets and other textile floor coverings, woven, not tufted or flocked, whether or not made up, incl. kelem, schumacks, karamanie and similar hand-woven rugs'. Other headings include, for example, carpets and other floor coverings of felt. Some of the products in this chapter may include 'vegetable textile materials'.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	0	0	0	0	0	0	76
Unknown	0	0	2352	0	2269	0	1	2	5096
Road	0	2	3336	320	5118	13	29	553	68133
Air	13	5	576	163	2036	1	29	1229	6927
Rail	0	0	134	0	134	1	0	0	294
Sea	232	34	64194	42400	107152	0	1055	3999	264685

Source: Eurostat.

Figure 40: EU-27 imports of carpets and other textile floor coverings, by mode of transport 2010

3.4.18 58 - SPECIAL WOVEN FABRICS; TUFTED TEXTILE; LACE; TAPESTRIES; TRIMMINGS…

The chapter includes a wide variety of special fabrics, mostly imported for further processing in the clothing industry or related industries. Most of these are made from natural materials like cotton or wool, but some are described as being made from 'mad-made materials' or 'woven fabrics of metal thread'. For the purpose of our assessment, it suffices to state that these woven products are generally processed through yarning or dying, etc.

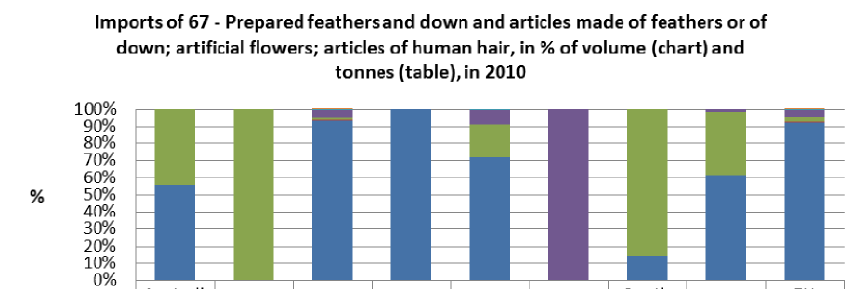
	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	4	0	0	0	0	0	26
Unknown	0	0	139	0	5	0	0	7	162
Road	0	2	1999	1	53	4	16	30	17727
Air	1	39	3003	22	753	0	4	189	5560
Rail	0	0	27	0	0	9	0	1	455
Sea	1	673	34668	58	2502	0	345	959	49568

Source: Eurostat.

Figure 41: EU-27 imports of special woven fabrics; tufted textile products; lace; tapestries; trimmings; embroidery, by mode of transport 2010

3.4.19 67 - PREPARED FEATHERS AND DOWN; ARTIFICIAL FLOWERS; ARTICLES OF HUMAN HAIR

In Chapter 67, products described as with 'feathers' are of animal origin. Some products may have animal skin: '6701 - Skins and other parts of birds with their feathers or down, feathers, parts of feathers, down and articles thereof (excl. goods of heading 0505, worked quills and scapes, footwear and headgear, articles of bedding and similar furnishing of […]'. The other headings in this chapter cover artificial flowers, and hair for making wigs, and wigs. The products are all processed in one way or another. Most of the products are intended for retail sale, although some may first pass through wholesale or be further processed.



	Australia	Brazil	China	Egypt	India	Russia	South Africa	USA	EU Extra
Other	0	0	20	0	0	0	0	0	24
Unknown	0	0	201	0	2	0	0	0	242
Road	0	0	2825	0	35	1	0	9	3003
Air	4	1	1019	0	83	0	12	181	1961
Rail	0	0	139	0	0	0	0	0	148
Sea	5	0	60818	14	311	0	2	307	67356

Source: Eurostat.

Figure 42: EU-27 imports of prepared feathers and down and articles made of feathers or of own; artificial flowers; articles of human hair, by mode of transport 2010

3.4.20 PART OF 84 - NUCLEAR REACTORS, BOILERS, MACHINERY AND MECHANICAL APPLIANCES

The last category of traded products that we assessed is agricultural, horticultural or forestry machinery. The headings included in the assessment were:

8432 - Agricultural, horticultural or forestry machinery for soil preparation or cultivation (excl. sprayers and dusters); lawn or sports-ground rollers

8433 - Harvesting or threshing machinery, including straw or fodder balers; grass or hay mowers; machines for cleaning, sorting or grading eggs, fruit or other agricultural produce (other than machines for cleaning, sorting or grading seed and grain)

8434 - Milking machines and dairy machinery (excl. refrigerating or heat treatment equipment, cream separators, clarifying centrifuges, filter presses and other filtering equipment)

8435 - Presses, crushers and similar machinery used in the manufacture of wine, cider, fruit juices or similar beverages (excl. machinery for the treatment of these beverages, incl. centrifuges, filter presses, other filtering equipment and domes

8436 - Agricultural, horticultural, forestry, poultry-keeping or bee-keeping machinery including germination plant fitted with mechanical or thermal equipment; poultry incubators and brooders

8437 - Machines for cleaning, sorting or grading seed, grain or dried leguminous vegetables; machinery used in the milling industry or for the working of cereals or dried leguminous vegetables (excl. farm-type machinery, heat treatment equipment)

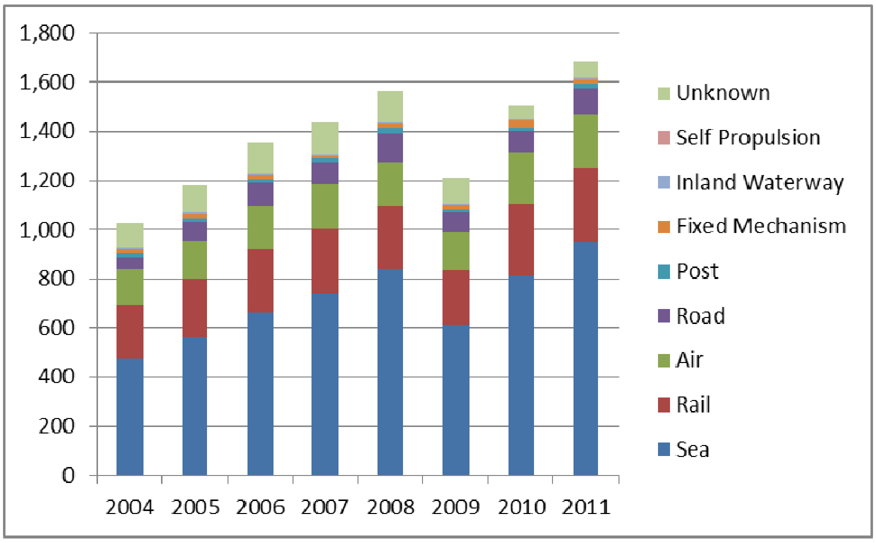
8438 - Machinery, not specified or included elsewhere in this chapter, for the industrial preparation or manufacture of food or drink (other than machinery for the extraction or preparation of animal or fixed vegetable fats or oils)

Although these products themselves may not pose any biological threat, they could carry pests to agricultural and horticultural regions. It is unknown whether such infestations actually occur. In the product descriptions there is no reference to the state of the product as being new or used. Although second-hand or used agricultural machines may pose a higher risk, they can not be identified as such. For the moment a 4-digit level of detail seems enough for our purposes.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

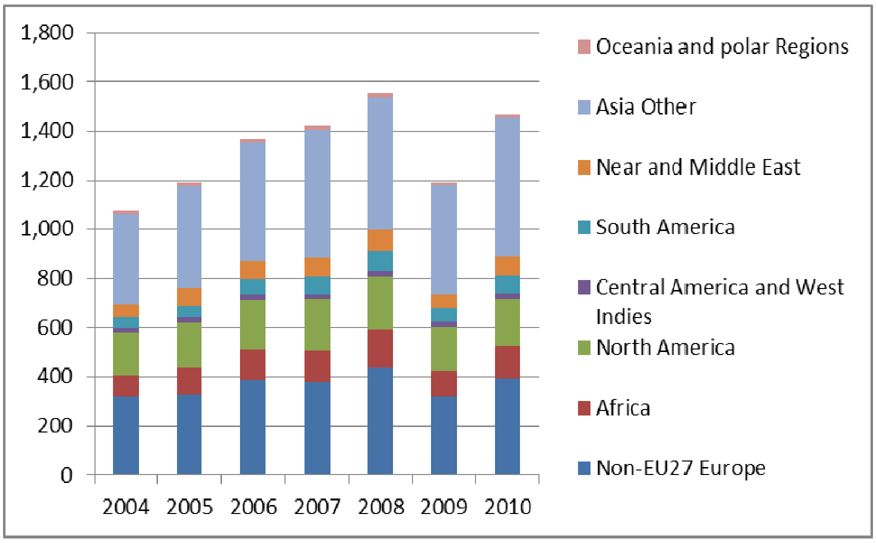
Imports from extra-EU countries are increasing. Since the enlargement of the EU in 2004, the value of EU-27 total imports of goods (including non-agricultural) increased from about 1.0 to 1.7 trillion euro in 2011 (see Figure 43). Most imports enter the EU by sea (56% in 2011). Sea transport is gradually increasing, while there is a moderate decline in the value of imports by rail. Air and road transport were relatively stable at 13 per cent and 6 per cent, respectively, between 2004 and 2011.



Source: Eurostat, EXTRA EU-27 trade since 2000 by mode of transport (HS2-HS4) (DS_043327).

Figure 43: EU-27 imports from third countries (Extra EU) by mode of transport, in billions of euros

The largest increase in extra-EU imports comes from Asia (excluding the Near and Middle East). The share in the money value of total imports increased from roughly 34 per cent of EU-27 countries' imports in 2004 to 38 per cent in 2010. On the whole, the market shares of the various partner regions/continents are relatively stable (with the notable exception of Asia), meaning that imports from all over the world are gradually increasing (see Figure 44).



Source: Eurostat Comext, aggregation and calculation by LEI.

Figure 44: EU-27 imports from third country regions (Extra EU) by partner region, in billions of euros

Based on the classification of traded products assessed above (Eurostat CN up to 8 digits) we can make the following general conclusions on the use of the CN classification:

1. For practical purposes, using a classification like CN - which is structured according to logical principles with regard to the origin of products and the degree of processing, and which corresponds logically to other internationally used product classifications (like WTO and UN HS-classification) - is an important attribute of any product-based trade assessment.
2. Of the available 96 chapters in the CN classification,1 we chose to include 41 fully and 3 partly in this assessment. Not all of these categories are relevant to the purpose of pest risk analysis. The most important ones in our view are the chapters concerning live animals and live plants (CN Chapters 01 and 06), and the ones that include products that contain soil or plant materials and that areused in agriculture and/or horticulture, or products that are other generally open-air applications. These latter chapters and headings include peat (2703) and wood (44). Such products may become a threat to the production base and the environment since they could introduce pests and pathogens and/or could be a risk themselves (invasive species). A second category of products that may pose a risk are seeds (other than those in Chapter 6). These may include seed potatoes, grass seeds, vegetable seeds and flower seeds.
3. The level of detail in the aforementioned three CN Chapters (and 1 subheading for peat, as mentioned above) differs considerably. With regards to live animals and live plants, details are generally not given. Especially for live plants there is hardly any distinction between the different varieties. For example, indoor pot plants are only discerned as having flowers or not. The reason for this seems that there is no economic need to make any further distinction, while the number of possible distinctions is almost endless. For a more in-depth risk analysis, this information is obviously needed. The CN classification and trade data-based emerging risk analysis is therefore limited in this respect and should be used as complementary to other analyses.
4. Products like meat (Chapter 2), dairy products (Chapter 4), and vegetables and fruit (Chapters 7 and 8) are mainly for retail sale and direct consumption, and as such generally pose a smaller risk of introducing pest/pathogens into the importing country and local hosts that come into contact with these pests/pathogens, when looking at the risks to local agricultural production or the local environment.

1 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2008:133:0001:0402:EN:PDF

5. For most of the other chapters, the level of detail seems sufficient for our current purpose of aiding the risk assessor in the analysis of newly emerging pests and the level of risk related to a certain flow of imports.
6. Adding detail to the categories of live plants and wood may add extra power of investigation. Sources of data on imports on a more disaggregated level may be found at national plant health authorities. It is, however, understood that there is currently no other more detailed product classification in use at national plant health inspection agencies than CN. From individual product descriptions, one may be able to construct more detailed data, but this process will be very time consuming. Combining rough data from the import statistics with expert judgement from people involved in the business may be a more efficient approach.
7. Some product groups contain both fresh and preserved products. Descriptions may say, for example, 'raw or roasted', 'whether or not cooked' or 'whether or not containing added sugar or other sweetening matter'. Some product categories can thus be classified as containing both fresh products and preserved products in different forms.

4.2 RECOMMENDATIONS

It is recommended:

- To use the CN classification as a basis for product classification in the decision tree. It is the most comprehensive and EU-wide used commodity classification. It has a logical structure based on the state of the product (fresh, processed, etc.). It corresponds to most other trade databases and therefore offers the possibility of combining the actual trade data with the risk assessor's work.
- Because the CN classification is at some points too aggregated for use in identifying hazards related to specific products, it is recommended to maintain flexibility on the part of the risk assessor. The classification of products and the identified risks based on the naming in the classification can serve as a starting point or reference.
- The CN classification is built up of chapters, headings and subheadings. The choice of the level of detail needed for analysis rests with the risk assessor. If the product is the starting point for the analysis, it is recommended to start at the most disaggregated level at 8-digits.
- For future extension of the risk assessment toolkit, it is recommended to explore the use of actual trade data in combination with notifications, product information and other data. Past trade information can serve as a means of both identifying priorities for risk assessment and calculating the potential damage from failure to contain risks. For trade analyses purposes, several tools have been developed that could serve as a source of inspiration for future risk assessment tools, including trade data (see e.g. http://www.trademap.org/light/SelectionMenu.aspx).

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APPENDIX 3: ANIMAL AND PEST/PATHOGEN CHARACTERISTICS AND INTRODUCTIONS; A SYSTEMATIC LITERATURE REVIEW

1 INTRODUCTION AND OBJECTIVES

The global trade in commodities has resulted in the introduction of plant and animal pathogens and pests (from now on referred to as pests/pathogens) in novel areas. There are abundant well-described examples of invading pest/pathogens in all sizes, ranging from tiny pathogens to mega-organisms. Famous examples include the introduction of the brown tree snake in Guam as a stowaway in military commodities, resulting in the elimination of the entire unique local avifauna (Wiles G.J, 2003); the introduction of the possum in New Zealand for the fur industry (Rose A.B, 1993); the introduction of Rift Valley fever in Egypt, Yemen and Saudi Arabia through the import of live animals, which resulted in the death of large quantities of livestock and the death of humans (Ahmad, 2000; Abdo-Salem et al., 2006; Abd el-Rahim et al., 1999); the introduction of Foot and Mouth disease in the United Kingdom through the import of swill, resulting in the culling of a huge number of livestock and in suicides among farmers (Samuel and Knowles, 2001; Mort M, 2005); and the unintended introduction of Japanese knotweed in various countries through seeds and as an ornamental plant . The impact of invasive species is not limited to livestock or human health. Some introductions lead to whole new ecosystems. The introduction of the North Pacific sea star, *Asterias amurensis*, in Victoria, Australia, is a prime example of such impact. Scallop dredgers reported the occasional by-catch of the North Pacific sea star between 1994 and 1998. Twelve years, later the population in Port Phillip Bay had increased to an estimated 120 million, exceeding the total biomass of all other fished species in the bay (Bax et al., 2003). These are just a few examples of the hundreds, if not thousands of introductions of alien species and pest/pathogens through international travel and trade. However, not all result in a severe impact and some even go unnoticed, such as the introduction of the muskrat in Ireland .

The risk of introducing exotic pests/pathogens is increasing due to the increased quantity of traded goods and an increase in the number of global trading partners. Other factors - such as climate change, increase in human and animal populations, and the demand for a greater variety of goods - also contribute to this increased risk of alien introduction. In response to this increased threat, technologies and methodologies for early detection and control of pest/pathogens have been improved considerably. This has enabled risk managers to intervene in trading processes known to be of high risk. For example, a surveillance system was set up in New Zealand for a pathway that was likely to result in the introduction of the Asian gypsy moth (Biosecurity New Zealand, 2009). This moth was known to be rife in a number of Russian ports in far eastern Russia. Information about the most likely place to find Asian gypsy moths or their eggs on sea containers has resulted in the interception of a number of Asian gypsy moth egg masses that would otherwise have entered New Zealand undetected (Biosecurity New Zealand, 2009).

Although successful, surveillance systems that are based only on visual inspection cannot prevent all introductions. What they can do is lower the propagule pressure, which has been shown to reduce the likelihood of establishment (Lockwood et al., 2005a) (R.E, 1997) (Veltman C.J, 1996) (Holle v. B, 2005) (PRISMA). However, the methodology development for risk analysis of alien pests/pathogens is mainly pest/pathogen focussed, without taking into consideration the specific interactions with the pest/pathogen, commodity or pathway, as for example with the Asian gypsy moth. The aim of this study was to systematically review the literature on pest/pathogen characteristics that affect the likelihood of commodity contamination, survival of the pest/pathogen during commodity processing and transport, and the likelihood of infecting a local host once introduced. Knowledge of pest/pathogen characteristics allows for the risk analysis and identification of high-risk commodities, rather than being pest/pathogen orientated, thus allowing the determination of a risk profile of a commodity or pathway. The focus of this literature review was on the characteristics of pests/pathogens that are dependent on the trade in commodities for introduction. Mega-organisms such as pigeons are not trade dependent and depend on a different set of characteristics for introduction, onward spread and establishment, such as being a capable flyer, and were thus not included in this review.

2 METHODS

The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (PRISMA). The CVI and LEI developed a review protocol in order to ensure a high quality literature review. In this review, all studies in English, Dutch or German reporting on the relative importance of pest/pathogen characteristics determining the risk profile of a pest/pathogen-commodity pathway were included. A pathway was defined as any means that allows the entry or spread of a potential hazard, whether animate or inanimate ((MAF), 2006). Studies were excluded if pest/pathogen characteristics were not included in the risk analysis or were not linked to a commodity or pathway. The bibliographic databases searched were: CAB (database from Centre for Agricultural Bioscience International) (http://www.cabi.org/), Agricola (United States Department of Agriculture) (http://agricola.nal.usda.gov/), EconLit (the American Economic Association's electronic bibliography) (http://www.aeaweb.org) and Science Direct (http://www.info.sciverse.com/Home).

The search of the bibliographic databases was performed with the help of a librarian. Due to the non-existent keyword search such as Medical Subject Headings (MeSH) in PubMed, the list for search terms was extensive and included six categories (see table 1). References of selected studies were used for identification of further relevant studies (snowballing). In addition to a systematic review of databases, the websites of international organizations related to pest/pathogen introductions were searched for relevant grey literature. These organizations were: the European and Mediterranean Plant Protection Organization (EPPO) (http://www.eppo.org/), the European Food Safety Authority (EFSA) (http://www.efsa.europa.eu/), European Centre for Disease Prevention and Control (ECDC) (http://ecdc.europa.eu/), the US Department of Agriculture - Animal and Plant Health Inspection Service (USDA-AHPIS) (http://www.aphis.usda.gov/), the International Plant Protection Convention (IPPC) , the World Organisation for Animal Health (OIE) (http://www.oie.int/), World Health Organisation (WHO) (http://www.who.int/) and the Food and Agricultural Organisation (FAO) (http://www.fao.org/). Identified literature was imported into Endnote for referencing.

The papers identified were first selected on topic (animal or plant pests/pathogens), then screened on title and abstract only. A second screening was based on full-text. A standardized questionnaire was designed in Excel to collect and analyse data from studies selected for inclusion in the literature review. A pilot of the questionnaire was performed using four studies identified through a non-systematic search. Data were collected on the following six categories: (1) study (type of, aim of, author and publication), (2) commodity (type of, state of, use of, origins of, destination of), (3) transport (mode of, duration of, type of, circumstances of), (4) population most at risk, (5) pest/pathogen (type of, characteristics of), and (6) references of interest. The principal summary measure was the relative importance of pest/pathogen characteristics that affect the likelihood of commodity contamination, survival during processing and transport of commodity.

Table 1: Search terms used to identify relevant literature

Category	Search terms
Category 1: Pest/pathogen	Pest/pathogen or virus, viral or bacteria* or fungi or phytoplasma or protozoan or parasite*or prion* or pest* or insects, mites, nematodes or gastropods or vermin or weed* or insect* or vector or disease or micro-organism* or pest/pathogen or vector
Category 2: Epidemiology/ event	Alien or animal health or biosecurity or contamination or contaminated or dispersal or emerging or emergence or endemic or entry or epizootic or establishment or exotic or hazard or impact or infection or infestation or introduction or invasive or invasion or non-native or non-native or outbreak or plant health or quarantine or spread or threat or invasive or alien or invasive species
Category 3: Characteristics	Attribut* or characteristic* or propert* or risk factor* or characteristic*
Category 4: Commodities	Agricultural product* or biological product* or commodit* or animal* or pet or pets or livestock or wildlife or game or meat or hide* or bone or bones or fish or fishes or seafood or marine or freshwater or crustacean or mollusc or aquatic or plant or plants or wood or timber or packing material* or ornamental or flower* or cut flowers or nursery or nurseries or bulb* or tuber or tubers or seed or seeds or soil or vegetable* or nut or nuts or fruit or fruits or tea or coffee
Category 5: Trade	Export* or import* or third countr* or trade or international trade or trading or international transport* or international travel or shipment*
Category 6: Type of analysis	Risk analysis or risk assessment or meta-analysis or impact assessment or model or pest management or cost-benefit analysis or resource allocation or optimization or review or PRA or pest risk analysis or risk mapping.

3 RESULTS

3.1 LITERATURE SEARCH

Only the search terms in categories 1, 2, 3 and 4 were used. Use of the additional search terms related to trade (category 5) and type of analysis (category 6) resulted in the inclusion of a large number of papers reporting on studies on irrelevant topics, ranging from experiments in natural sciences to domestic issues. Thus, the literature search strategy was restricted to categories 1-4. This resulted in the identification of 1530 unique articles, of which 33 were identified by hand search on the websites of EPPO, EFSA, USDA-AHPHIS and OIE. The search history can be provided upon request.

3.2 STUDIES PEST/PATHOGEN CHARACTERISTICS

The literature search identified 199 papers reporting on animal pest/pathogens and 519 studies on plant pest/pathogen characteristics. In total 9 animal-related and 26 plant-related studies were included for qualitative analysis and synthesis, of which 16 were identified using the snowballing technique. The flow diagram for paper selection is shown in Figure 1. The main reasons for excluding the studies identified in the literature searches, both animal and plant, are listed in Table 2. All included papers were original research. No meta-analysis or systematic reviews were found. The characteristics of papers included are described in Table 3. Although some data were found on specific pest/pathogen characteristics - such as thermal death point, resistance to low or high pH values and other environmental stresses (MASS) - there were insufficient data to analyse whether a thermal death point of, for example, 80^0 C was a key characteristic of known pests/pathogens or just one of the many characteristics of pests/pathogens. The characteristics identified in this review that may be of importance for commodity-based introductions are listed in Table 4.

4 DISCUSSION

The pest/pathogen characteristics identified in this review are a result of a handful well-documented pest/pathogen introductions. The predictive value of these pest/pathogen characteristics for future risk assessments of the risk of pest/pathogen introduction in association with the import of commodities is debatable. Even when a pest/pathogen-commodity interaction is well described, the variability in production processes, characteristics for survival for each pest/pathogen, for each pathway, for each commodity, for each exit point, and the response of the pest/pathogens to this variability is variable, as the repertoire of a pest/pathogen characteristics may not be exhaustively studied or described (Lloret, 2005; Acosta, 2006; Burns, 2006; Muth, 2006; Thuiller W., 2006).

In addition to this lack of in-depth study of pest/pathogen characteristics repertoire, existing commodity import pathways undergo continuous change. For example, there has been an increase in the trade in mildly preserved foods. Such commodities undergo minimal processing steps, which require different pest/pathogen characteristics for commodity contamination than, for example, canned food (Havelaar et al., 2010). In addition to technological changes, other factors also play a role in pest/pathogen contamination of commodities. For example changes in commodity production was thought to play a leading role (Slingenbergh et al., 2004b). In fact, of 29 introductions investigated, only in 2 of those instances were pest/pathogen characteristics thought to play a leading role (Slingenbergh et al., 2004b). This suggests that likelihood of contamination of an imported commodity with pest/pathogenic agents is closely linked to the production process of that commodity, rather than the subsequent processing steps. This contributing effect of commodity production specifics as a main source for pest/pathogen introduction had been described before (Slingenbergh et al., 2004b). These factors add further complexity and limit the probability of identification of pest/pathogen characteristics that affect the likelihood of commodity contamination and pest/pathogen introduction (Murray, 2006) (Resh, 2005).

Even when the interactions between commodity production and processing specifics and pest/pathogen characteristics can be untangled, the problem that subspecies of pests/pathogens may have different characteristics affecting the likelihood of contamination of commodities and pest/pathogen introduction persists. For example, over two-thousand serotypes of salmonella have been identified (Schlundt et al., 2004b). As each animal harbours a vast number of microbial commensals and pest/pathogens, products made from animals are potentially exposed to trillions of microbe species, and possibly their subspecies (Brown, 2006a). The study of such microbial diversity is thought to be futile because it is beyond practical calculation (Brown, 2006a). Should a list of pest/pathogen characteristics become available in the future, they will have to be overlaid with climatological and seasonal influences.

In this study, no details on these variables were recorded because these are not considered pest/pathogen characteristics. In addition, some commodities (like tomatoes) are predominantly grown in greenhouses and transported to (heated) supermarkets. Thus, the effect of seasonal influences on pest/pathogen survival is limited to the commodity trade pathway specifics. What can be predicted is that pest/pathogens that are found on different hosts or commodities (so-called multi-host pest/pathogens) are more likely to be incremented in commodity contamination leading to incursion; this is also true for plant pest/pathogens. This effect is thought to be the result of the pest/pathogen circulating in higher numbers in a wider range of hosts and on commodities, and is thus more likely to come into contact with and survive on other commodities. Pest/pathogen characteristics resulting in an increased likelihood of commodity contamination described in this paper are likely to be a result of complex commodity-pest/pathogen interactions that are likely to alter over time. Pest/pathogen evolution is driven by biological, ecological, environmental and societal factors, such as those that put adaptive and selective pressure on microbes and hosts (Morse, 1995a) (Moxon et al., 1998) (Lederberg, 1992; Smolinski, 2003). Environmental stress factors such as high temperatures, commonly found in commodity production processes, have been linked to changes in pest/pathogen characteristics in both animal and plant species (Brown, 2006a) (Massot, 2008), (Root, 2003). The emergence of antibiotic-resistant bacteria as a result of the ubiquity of antimicrobials in the environment is another evolutionary lesson on microbial adaptation, as well as a demonstration of the power of natural selection and emergence of new characteristics (Morse, 1995a).

In addition, it is also not only the characteristics of the pest/pathogen that play a role in the introduction along commodity trade pathways: commodities that are introduced in larger numbers, or more frequently, are more likely to be associated with pest/pathogen introduction than commodities that are introduced in smaller numbers or less frequently. This is defined as introduction effort or propagule pressure (33). This is a composite measure of the number of individuals released into an environment, such as a region or, in the case of pest/pathogens, a commodity to which they are not native. Propagule pressure is an event-level characteristic that can differ for each introduced species, in contrast to location and species level characteristics, which are constant across repeated introductions (Cleaveland et al., 2001). The effect of propagule pressure has been observed in a wide range of organisms (Current and Garcia, 1991; Altekruse et al., 1999; Wheeler et al., 1999).

Since most harmless pests/pathogens or commensals are not analysed, determined or even detected, the resulting conclusions on key characteristics contain a significant level of bias and may not be applicable for an analysis of risks associated with novel commodity trade pathways (E.O., 2001). Thus, when a risk assessment of a commodity and the associated unintentional introduction of pest/pathogen species is performed, it is thought to be more productive to use existing parameters for risk assessment as described by EPPO 2007 (EPPO); (1) Strength of association between species and commodity; (2) volume of the commodity imported; (3) frequency of importation of commodity; (4) pest/pathogen survival rate and population growth during transport/storage of commodity; (5) suitability of environment for establishment of pest/pathogen in the importing region; (6) appropriateness of the time of year of importation for species establishment; (7) ease of species detection within or on commodities; (8) effectiveness of management measures, e.g. fumigation, inspection regime; (9) how widely the commodity is subsequently distributed in the importing region; and (10) likelihood of transfer from the commodity to a suitable host or habitat. In this review only steps 1 to 4 were considered. Steps 5 to 10 consider the risk of establishment and spread following introduction. Step 6 could also be of relevance for commodity contamination, though no link to seasonal (climatological) influences were detected in this review. This may be explained by the separation of commodity production and weather conditions. For example, the production of most fruits occurs wholly within greenhouses and animals harbour year round similar types and levels of pest/pathogens.
The use of mathematical modelling of pest/pathogen characteristics and commodity pathway specifics may further contribute to disentangling the relative importance of pest/pathogens characteristics from commodity and environmental influences, and increase our understanding of pests/pathogens and their behaviour (Hausner, 2003). However, despite advances in technology and our capacity to find more information and use information in different ways, the best predictor for commodity contamination remains the association between the commodity and its production origins and production specifics (Hulme, 2009). Thus, the introduction of pests/pathogens as contaminants of a commodity may be predicted from their association with specific host, host products and the living (or growing) environment of the host.

Finally, a systematic review was chosen for this study design. This proved to be of limited usefulness. In order to gain further insights into pest/pathogen characteristics that facilitate the introduction of a pest/pathogen through international trade, a review of all pest/pathogen risk assessments performed so far is recommended as a logical next step. Based on this review, a list of frequently assessed pests/pathogens can be made and these can be linked to their characteristics. Statistical analysis can then assist in the identification of key pest/pathogen characteristics.

5 CONCLUSION AND RECOMMENDATION

Pests/pathogens can be introduced through three broad mechanisms: importation of a commodity, arrival of a transport vector and/or natural spread from a neighbouring region. These three mechanisms result in six principal pathways: release, escape, contaminant, stowaway, corridor and unaided (Hulme P.E., 2008). The aim of this review was to identify pest/pathogen characteristics that facilitate the survival of a pest/pathogen along any of these pathways. The papers identified in this literature review predominantly reported on the general characteristics of a pest/pathogen without linking these to the likelihood of survival along any of these pathways. For example, the characteristics of *Eimera zuernii* were well described by Marquards (Marquardt, 1960), but not linked with a commodity or pathway. *Eimera zuernii* was thus not included in this review.

The effects of chemical and physical agents on the viability and infectivity of various pests/pathogens is also well described. For example by Santillana-Hayat et al. (2002), who describes this effect on *Encephalitozoon intestinalis*. Again, this was not in conjunction with a pathway or commodity. These are just two of many examples of such papers that lack a link with the likelihood of commodity contamination, introduction or spread. Thus, a list containing detailed description of characteristics that makes one pest/pathogen more or less likely to be introduced through the import of a commodity compared to another pest/pathogen could not be distilled. Neither could the relative importance of the characteristics found be assessed due to lack of information on the frequency and distribution of such characteristics in pest/pathogens found on commodities and found to be invasive, compared to pest/pathogens that have not been found on commodities or not found to be invasive. This problem has been described in the literature (Bremner, 2008). What can be deduced from the papers included in this review is that pest/pathogen characteristics are not specific to, for example, the likelihood of introduction or the likelihood of surviving in or on a commodity along a pathway; rather, certain characteristics appear to facilitate the successful completion of multiple steps along any introduction pathway.

Nonetheless, some more general conclusions on pest/pathogen characteristics could be made. A number of hurdles must be successfully negotiated and complex arrays of characteristics are needed for a pest/pathogen to be introduced through trade pathways (Brown, 2006a). There are seven accepted paradigms for the introduction of pest/pathogens and the infection of a local host: (1) exposure of commodity to pest/pathogen, (2) contamination of commodity with pest/pathogen, (3) spread of pest/pathogen from commodity to other commodities, (4) successful colonizing of commodity, (5) evasion/survival of pest/pathogen of commodity processing techniques, (6) shedding from commodity, and (7) finding and infecting a suitable host for replication once introduced (Brown, 2006a; Kliejunas et al., 2003b).

For this review, only steps 1 to 5 are considered relevant (introduction of pest/pathogen). A pest/pathogen is required to have an arsenal of characteristics that enable the successful completion of each step and, ultimately, the whole pathway. Nonetheless, two basic pest/pathogen characteristics categories were identified that may contribute to an increased likelihood of commodity contamination, survival of pest/pathogen on commodity and pest/pathogen introduction.

First, it matters where the pest/pathogen normally survives. Intracellular organisms (viruses) that are dependent on host cells to multiply and are unable to survive for long periods outside their host are unlikely candidates for introduction other than through the direct import of their hosts. Bacteria are much less host-specific than viruses, because there is no need for specificity of cellular machinery for reproduction and are thus more likely to be introduced along a commodity pathway. Prions in the nerve system are found only in animal products that contain nerve cells. Cross contamination and the contamination of commodities, other than host products, is therefore much less likely (Brown, 2006b). From this, it can be concluded that pest/pathogens that are commonly present at their host's body orifices or surfaces are the ones that most easily find their way to portals of entry in the recipient host or a commodity. The same is true for pest/pathogens that can survive in water, as water is abundant and commonly used in commodity production processes (Brown, 2006b). The exogenous stages of many waterborne parasites possess outer surfaces capable of withstanding a variety of physical and chemical treatments, making these pest/pathogens more risky for commodity contaminant and thus introduction along a commodity import pathway.

Second, the other characteristic identified relates to the capacity to withstand treatments designed to eliminate pest/pathogens on commodities, such as cooling, heating, or chemical or physical processing. This capacity results in a higher likelihood of survival of such processes, and ultimately in introduction through the import of a contaminated commodity. Still, it must be noted that the pest/pathogen characteristics identified for the successful contamination of and survival on a commodity leading to the introduction of a pest/pathogen are a result of a combination of commodity-pest/pathogen interactions.

Invasive alien plants require special attention. First of all, when plants or plant parts (seeds, cuttings, etc.) are traded, the commodity itself can turn into a pest. A well described example is *Eichhornia crassipes* (Brunel, 2009). Since many plants are intentionally introduced for ornamental or production purposes, human intervention supports rather than prevents the invasion of plant species. The main question with plants is not whether they can infest a commodity and thus be imported to other countries, but whether the imported plant can survive in the habitat of the importing country. The invasiveness of alien plants has been well studied and described in the literature and can be used for a risk analysis. In comparison, no studies were found reporting on plant viruses and only a few studies were identified reporting on plant fungi, plant bacteria and plant insects. The majority of papers on plants and their pest/pathogens report on forestry insects that threaten wood production and forests.

The recommendation is to include the following basic pest/pathogen characteristics in the decision support tree:
The location where the pest/pathogen survives on the commodity.
The capacity to withstand treatments designed to eliminate pests/pathogens on commodities.
However, since no information about the relative importance of these characteristics is available, prudence is called regarding the importance of these characteristics compared to characteristics derived from other sources and included in the decision support tree.

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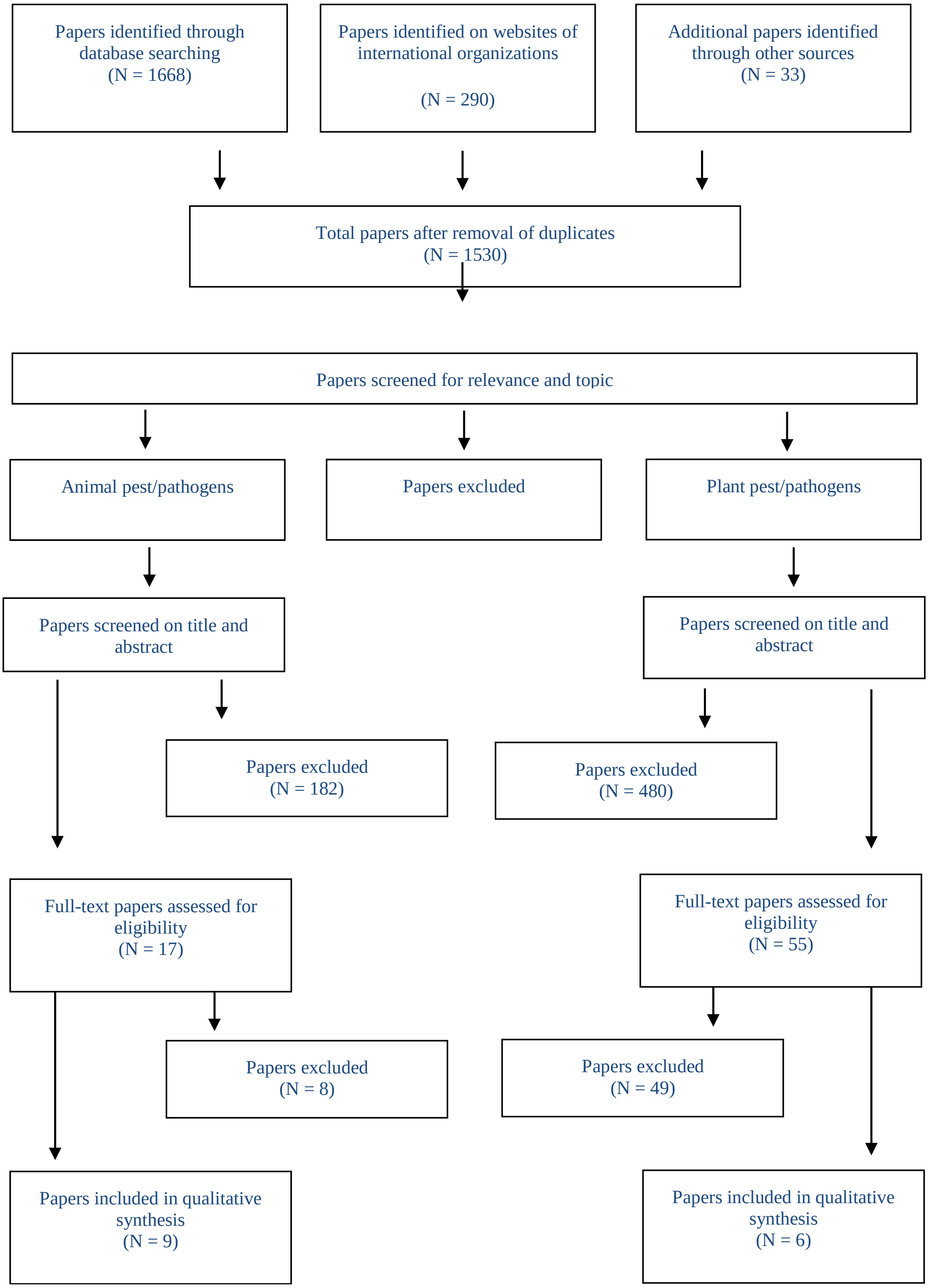
APPENDIX 3A: PAPER SELECTION FLOW DIAGRAM



APPENDIX 3B: MAIN REASONS FOR EXCLUSION

Animal	Plant
Risk analysis without description of pest/pathogen characteristics	Analysis of the risks of outbreak in certain regions - lack of international perspective
Risk analysis methodology development	
Control measures	Analysis of different measures aimed at the prevention of pest outbreaks
Policy development	
Surveillance and monitoring development	Evaluation of pest outbreaks, descriptive analysis of incidences
Not reporting on related commodities	
Emerging diseases without pathway and/or pest/pathogen characteristics	No description of pathway
Climate change and emerging/re-emerging diseases	Focus on climate change and pests, in particular invasive species
Politics of trade	Lack of trade relation
Trade quantity and patterns only	Descriptive analysis of trade agreements and other regulations dealing with invasive species
Test specifics	
Diseases transmission modelling	General description of model and database to analyse invasive species
Food-borne outbreaks	
Impact of policies and regulations and importance of	Conceptual framework for analysing invasive species, definition of invasiveness
Economic assessment of invasive species	
Ecological or financial impact	Economic analysis of the impact of pest outbreaks

APPENDIX 3C: KEY CHARACTERISTICS OF PAPERS INCLUDED IN THIS REVIEW

In this section the characteristics of papers included in this review are described. First a description is given of studies reporting on animal pest characteristics (Appendix 3c), followed by the studies reporting on plant pest characteristics (Appendix 3d).

Appendix 3c-I. Key characteristics of papers reporting on animal pest characteristics included in this review

First author	Title	Aim of paper	Main results	Comments
Gajadhar (Gajadhar and Allen, 2004)	Factors contributing to the public health and economic importance of waterborne zoonotic parasites.	To discuss the trend in global warming and climate change and potential for concurrent rise in waterborne disease outbreaks due to parasites.	The ability of many parasites to survive for long periods of time in the environment and resist many natural and artificial conditions make them some of the most difficult agents of waterborne zoonotic diseases to control. The characteristics and a zoonotic potential of these parasites require elucidation.	No relative comparison of pest/pathogen characteristics, but a description is given of some characteristics of water borne parasites.
Havelaar (Havelaar et al., 2010)	Future challenges to microbial food safety.	To discuss the challenges that microbes pose to food safety in the longer term and strategies and methodologies to counter these by combining recent developments in microbiology, epidemiology, mathematical modelling and expert knowledge.	Some changes may result in increased food safety risk while others result in a decreased risk. New tracking and tracing methods need to be developed and the behaviour of micro-organisms under environmentally stress conditions must be investigated. Models that predict microbial behaviour need to be developed and there is a need for better communication between all parties involved.	No relative comparison of pest/pathogen characteristics, but a description is given of some characteristics of food borne micro-organisms.
Schlundt (Schlundt et al., 2004a)	Emerging food-borne zoonoses.	A brief description of five of the most important emerging food-borne zoonotic pest/pathogens.	The authors emphasize the importance of science-based programmes for the continued reduction of pest/pathogens at relevant points of the 'farm-to-fork' food production chain.	No relative comparison of pest/pathogen characteristics, but a description is given of some characteristics of food-borne pest/pathogens.
Morse (Morse, 1995b)	Factors in the emergence of infectious diseases.	A discussion on the history of infectious diseases and the factors contributing to emergence.	Microbes are constantly evolving. On rare occasions this may lead to the new expression of disease. An important first step is to build an effective global early warning system.	No relative comparison of pest/pathogen characteristics, but a description is given of some characteristics and conditions needed for disease (re-) emergence.

Appendix 3c-II. Key characteristics of papers reporting on animal pest characteristics included in this review

First author	Title	Aim of paper	Main results	Comments
Skovgaard (Skovgaard, 2007a)	New trends in emerging pest/pathogens.	A description is given of the elements in the food chain that have resulted in the emergence of pest/pathogens.	The behaviour of microbes is unpredictable; they react to changes in their environment. Every link in the food chain contributes to the final result: an emerging pest/pathogen. It is for these reasons that it has been impossible or difficult for science to predict what is around the corner.	No relative comparison of pest/pathogen characteristics, but a description is given of some characteristics and conditions needed for food borne disease emergence/re-emergence.
Slingenberg (Slingenbergh et al., 2004a)	Ecological sources of zoonotic diseases	A description of the ecological sources of zoonotic diseases and the factors contributing to the emergence of disease.	The link between environmental change, new forms of disease and microbial adaptation is still in its infancy. Disease ecology shows that disease spread and the emergence of zoonotic and other veterinary public health concerns are largely the product of human activity.	An extensive review of factors contributing to the emergence of diseases. Pest/pathogen characteristics appear only to play a minor role in emergence.
Bremner (Bremner, 2008)	Species traits and ecological functioning in marine conservation and management.	To present traits analysis as a means for investigating functioning in marine ecosystems and discuss how it can be used in conservation and management.	Species' traits approach may make a significant contribution to the identification of species likely to become invasive or those particularly vulnerable to extinction and prediction of the effects of future disturbance such as climate change.	A useful overview of species' traits with the important note that environmental changes have been linked to changes in species' traits. Only when all characteristics of a species are available predictions can be made regarding its behaviour. Also, species traits and their relative importance will vary according to organism groups (micro-, meio- , macro- and mega-organisms).
Toy (Toy and Newfield, 2010)	The accidental introduction of invasive animals as hitchhikers through inanimate pathways: a New Zealand perspective.	A description of entry components of the introduction process of macroscopic organisms.	More data is needed and international cooperation is needed to develop new biosecurity treatments suitable for large-volume pathways.	Focus on hitchhiking macro-organisms, characteristics and pathways, from which some lessons may be transferable to micro-organisms.

Appendix 3c-III. Key characteristics of papers reporting on animal pest characteristics included in this review

First author	Title	Aim of paper	Main results	Comments
Lockwood (Lockwood et al., 2005b)	The role of propagule pressure in explaining species invasions.	To determine the role of propagule pressure in understanding the rate of geographical spread of non-native populations should lead to broader ecological and management insights into invasive species biology.	Elucidating the factors that determine introduction success involves disentangling the influence of characteristics of the species and environment, and the idiosyncrasies of specific introduction events. Propagule pressure is emerging as a single consistent correlate of establishment of success. However, being able to explain which species have already become biological invaders does not imply that we can predict which species will be the new invaders.	No description of essential characteristics. Findings though may also apply in predicting the likelihood of commodity contamination.

Appendix 3d-I. Key characteristics of papers reporting on plant pest/pathogen characteristics included in this review

First author	Title	Aim of paper	Main results	Comments
Colunga-Garcia (Colunga-Garcia et al., 2009)	Freight transport and the potential for invasions of exotic insects in urban and peri-urban forests of the United States	1) To approximate the final distribution of selected imports among Urban areas of the contiguous USA. 2) To characterize the final distribution of selected imports in terms of their spatial aggregation and dominant world region of origin and 3) To assess the effect of the final distribution on the level of risk to urban and peri-urban forests from EFI	Freight movement information is critical for proper risk assessment of EFI	The study is limited to forest insects and focussed on freight movement rather than on pest characteristics
White (White et al., 1992)	Pest risk assessment of the importation of *Pinus radiata* and Douglas-fir logs from New Zealand	Risk assessment to identify potential pests for the USA, estimate the probability of establishment and estimate the consequences	Seven pests were analysed: three with low risk, two with moderate risk and two with moderate to high risk	Study concerns 7 separate risk assessments
Anderson (Anderson et al., 2004)	Emerging infectious diseases of plants: pest/pathogen pollution, climate change and agro-technology drivers	Analysis of factors driving emergence of emerging infectious diseases and review of their impacts	Not easy to summarize	The study is a review

Appendix 3d-II. Key characteristics of papers reporting on plant pest characteristics included in this review

First author	Title	Aim of paper	Main results	Comments
McCullough (McCullough et al., 2006)	Interceptions of nonindigenous plant pests at US ports of entry and border crossings over a 17-year period	US interception data of non-indigenous plant pests and weeds have been analysed in order to investigate the relative importance of all potential pathways	The most important pathway is airports (73%), USA-Mexico land border crossings (13%) and marine ports (9%). Most pests (62%) were associated with baggage, 30% with cargo and 7% with plant propagative material. Insects are the most dominant pest category.	
Pysek and Richardson (Pyšek and Richardson, 2007)	Traits associated with invasiveness in alien plants: where do we stand?	Review studies aimed at identifying traits of plants enhancing invasiveness	An overview of all studied traits in comparative studies (both native-alien and alien-alien) and congeneric studies (comparing native and alien plants within the same at a fine taxonomic scale) and whether they contribute to invasiveness	Paper is a review.
Kliejunas et al (Kliejunas et al., 2003b)	Pest risk assessment of the importation into the USA of unprocessed logs and chips of eighteen eucalypt species from Australia	To conduct a pathway risk analysis	A number of pests and pest/pathogens have been given a risk score based on individual risk assessments.	Paper makes use of a risk assessment scheme composed on the basis of seven elements described in a report by Orr et al. (1993) (generic non-indigenous pest risk assessment process) and rating criteria developed by a USDA-APHIS and Forest Service team of risk analysts

Appendix 3e: Plant and animal pest/pathogen characteristics. In this section are the pest/pathogen characteristics identified in the included literature. First a description is given of animal related pest/pathogen characteristics (Table 3e), followed by the studies reporting on plant related pest/pathogen characteristics (Table 3f)

Appendix 3e-I. Animal pest/pathogen characteristics

Paper	Characteristic	Effect	Examples	Notes
Gajadhar (Gajadhar and Allen, 2004)	Life stages that include resistant stages such as oocysts and spores.	Highly resistant to external environmental challenges, including many physical and chemical disinfection methods such as heating and freezing.	Oocysts: Amoebae (*Balantidium, Giardia*) Spores: *Blastocytosis*, Oocysts: *Toxoplasma gondii, Isospora*, *Cyclospora and Cryptosporidium*. Eggs: *Nematodes, trematodes and cystodos*.	These outer 'shells' do not protect against extreme temperatures, desiccation, low relative humidity, freeze-thaw cycles or irradiation from either natural or artificial sources. The formation of spores, eggs and other exoskeletal stages is not a direct virulence trait but it does contribute to survival in the animal chain as well as transfer to the human food chain (Hayes K.R., 2008).
Havelaar (Havelaar et al., 2010)	Spore forming and activation of genes responsible for repair following exposure to different external stress factors.	Resistant to temperatures up to and well above those of classic sterilization (121^{o} C)	Shiga toxin-producing E. Coli and its survival on fresh products, meat and in unpasteurized juices following treatment with preservatives and oxidizing agents. (Erickson and Doyle 2007). Resistance of spores from B. Cereus to acid. This also facilitates the 'settlement' and toxin production of the organism in the intestine (Wijnands L.M., 2006) (Stenfors Arneseri L.P, 2008).	Spores express specific stress response genes during germination, some of which are likely responsible for repair of thermal damage (Setlow, 2006) . Similar systems for stress adaptation may also exist for food preservatives such as sorbic acid (Ter Beek A., 2008) (Mollapour M., 2008).
Schlundt (Schlundt et al., 2004a)	Thermophilic and high infection pressure (propagule pressure).	Resistant to high temperatures during food processing.	Campylobacter - The leading cause of zoonotic enteric infections in most developed and developing countries (59 + 70)	Burden of disease caused by Campylobacter is not only due to its capacity to survive high temperatures. Also the high infection pressure in animal populations such as poultry and pigs play a significant role.

Appendix 3e-II. Animal pest/pathogen characteristics

Paper	Characteristic	Effect	Examples	Notes
Schlundt (Schlundt et al., 2004a)	Acid resistance and resistance to low minimum water activity.	Able to survive certain food processing steps.	E. Coli 0157:H7 can grow in acidic foods, down to a pH of 4.4 as well as in foods with a minimum water activity of 0.95.	No data are available to determine the relative importance of each or the combination of these characteristics. This example is also mentioned by Skovgaard (Skovgaard, 2007b). E. Coli O157:H7 possesses at least three acid-resistant systems that account for its well-known ability to tolerate acid environments (Li et al., 1998).
Morse (Morse, 1995b)	Genetic mutation speed	New strain resulting in emerging disease	*Haemophilus influenzae* is an emerging disease, probably due to new strain. No description of acquired characteristic compared to other strains.	Despite data on characteristic responsible for emergence, this is still missing. This paper reports on 23 emerging diseases. In only one case (*Haemophilus Influenzae*) can the emergence be related to pest/ pathogen characteristics. In all other 22 cases the reasons for emergence are all external factors such as environmental changes and changes in food processing techniques.
Morse (Morse, 1995b)	Long duration of infectivity	Emerging/re-emerging disease	Anthrax spores are known to remain infectious for years (Peiso et al., 2011).	Long duration of infectivity can be compared to high propagule pressure, which is known to be a leading cause of pest/pathogen incursion and successful establishment.

Appendix 3e-III. Animal pest/pathogen characteristics

Paper	Characteristic	Effect	Examples	Notes
Skovgaard (Skovgaard, 2007a)	Ability to multiply at temperatures close to 0^{o} C	Ability to flourish despite the development of the chilling chain both in retail handling of food and in households.	*Yersinia enterocolitica* came about in the mid-1960s and flourished in importance in the following decades. It is called 'the bacterium that came from the cold'.	This shows that characteristics to survive temperature extremes go both ways: ability to survive hot and cold temperatures and to replicate.
Slingenberg (Slingenberg et al., 2004a)	K/R selection strategies. K strategy stands for long generation time and low numbers of offspring, while R strategy stands for short generation time and high numbers of offspring. This can be seen as a pest/pathogen characteristic as it is genetically determined.	Organisms living in risky environments produce as many offspring as possible to maximize chance of survival. This reproduction strategy is also beneficial in both dispersing to (pathway) and surviving in new habitats.	A well-described example is the introduction of organisms such as mussels and crabs to novel areas due to transport of juveniles in ballast water of bulk ships. Most parasites such as the tape-worm also have this characteristic.	Emerging pest/pathogens are acknowledged to follow approximately the same pattern (Cleaveland et al., 2001), i.e. most successful emerging pest/pathogens are those with high offspring rates and with short generation time and for which minor changes in the genome may change pest/pathogen characteristics.
Slingenberg (Slingenberg et al., 2004a)	Host immune system evasive or suppressive.	Pest/pathogens causing lifelong immunity reduce the duration of their relationship with a suitable host and thus the propagule pressure on an animate/ inanimate commodity.	*Mycobacterium avium spp. paratuberculosis* (MAP) does not cause immunity and the organism has been shown to some extent to survive the pasteurization of milk (Grant I.R., 2005). In contrast, infection with *Poxviridae chordopoxvirinae* results in lifelong immunity. Thus, there is a risk of commodity contamination only during the viraemic stage. This reduces the propagule pressure for commodities derived from cows.	Also for pest/pathogens that induce lifelong immunity, some animals become lifelong shedders and 'super spreaders'. Examples of this phenomenon are BVDV and FIP (Smirnova N.P., 2008).

Appendix 3e-IV. Animal pest/pathogen characteristics

Paper	Characteristic	Effect	Examples	Notes
Bremner (Bremner, 2008)	High fecundity, fast growth, early maturity, wide food spectrum and high genetic variability (Berezina N.A., 2007).	These factors contribute to the ability to spread quickly once introduced. High fecundity also increases the likelihood of commodity contamination. Wide food spectrum and high genetic variability increases likelihood of survival along the introduction pathway.	Rats and cockroaches are prime examples of commodity contamination. There have been documented incursions since the time of Colombo.	These mainly apply to macro-organisms, less so on micro-organisms.
Slingenberg (Slingenbergh et al., 2004a)	Reproductive strategy: (K/R) strategy, host range, mode of transmission, vector distribution, virulence and infective period.	K/R strategy and infective period; see above. Wide host range increases probability of contamination of a range of commodities and thus surviving along at least one pathway. Mode of transmission makes commodity contamination more or less likely. The effect of virulence is two-tiered: high virulence generally results in a higher virus shedding thus more likelihood of environmental or commodity contamination, and high virulence is characterized by a lower ID-50 dose.	Campylobacter spp. has a large host range (e.g. poultry, pigs, and humans), can also survive in the environment and has a low ID-50 dose. Thus, commodity contamination is likely if derived from host sources. In addition, it can survive and multiply in relatively high temperatures. In comparison, coliform bacteria have relatively high ID-50 values. Thus, cleanliness of swimming water is measured not by the presence or absence but by the number of coliform bacteria.	A summary of innate biology characteristics of pest/pathogens without further argumentation.

Appendix 3e-V. Animal pest/pathogen characteristics

Paper	Characteristic	Effect	Examples	Notes
Toy (Toy and Newfield, 2010)	Life stage with dormancy, hibernation, or aestivation.	Allows for survival during extended periods when conditions for survival and replication are suboptimal.	E.g. eggs of the *Aedes* flood water mosquito which can stay dormant for years until conditions have sufficiently improved. Anthrax spores are known for their long survival time in burial pits.	Dormant stages have implications for e.g. food stuffs that can be kept for prolonged periods of time.
Lockwood (Lockwood et al., 2005b)	Degree of contamination	Small populations are more likely than larger ones to become extinct. In other words, processing of commodities is more likely to eliminate limited contamination but may not be effective in case of widespread contamination	Poultry products heavily contaminated with Campylobacter spp. are more likely to result in cross-contamination with fresh produce.	This is strongly linked with the virulence of pest/ pathogens.
Lockwood (Lockwood et al., 2005b)	Spatial effect of contamination, e.g. seasonal living habits	Incursion and onward spread is more likely through constant source of contamination. The constant incursion rate is more likely to result in onward spread when conditions are right.	Pest/pathogenic avian influenza is a seasonal hazard. Commodity contamination with AI is less likely in autumn.	Seasonal surveillance may improve cost-effectiveness of commodity surveillance.

Appendix 3f: Pest plant characteristics - persistence pest/Pest/pathogenic plants

Paper	Characteristic	Effect	Examples	Notes
Pysek and Richardson (Pyšek and Richardson, 2007)	Seed dormancy, seed bank longevity and size	Seed dormancy and long-term seed banks allow species to extend germination over time and to wait for preferred conditions.	No examples provided	Most other results of this study explain invasiveness (including establishment and spread) rather than entry.
Colunga-Garcia(Colunga-Garcia et al., 2009), White (White et al., 1992), McCullough et al. (McCullough et al., 2006), & Kliejunas et al. (Kliejunas et al., 2003a)	Wood boring	Insects that hide in bark, cambium or wood are persistent against measures such as monitoring and control. They cannot be easily find and are difficult to control	*Agrilus Planipennis*, New Zealand drywood termite, other bark beetles	Wood boring is a characteristic that enables the insect to hide in wood.
Kliejunas et al. (Kliejunas et al., 2003a)	Small size	Difficult to detect, surviving processing	*Xyleborus ambrosia* beetles, *Pityophtorus ssp*.	
Kliejunas et al. (Kliejunas et al., 2003a)	Cryptic nature	Difficult to detect	*Anoplophora glabripennis*	
Kliejunas et al. (Kliejunas et al., 2003a)	Polyphagous	Can be associated with commodities of different origin.	*Thrips hawaiiensis*	
Kliejunas et al. (Kliejunas et al., 2003a)	Infecting multiple plant parts: seeds, seedlings, all vegetative and generative parts	Multiple pathways for introduction	*Gibberella circinata*	Kliejunas et al. (2003) indicates this as random distribution in host material.
Anderson (Anderson et al., 2004)	Vector dependency (negative characteristic)	Contact with local hosts in country of destination depends on the presence of a competent vector and is thus less likely. This is especially important for viruses.	*Citrus tristeza* virus	Study does not focus on pest/ pathogen characteristics

APPENDIX 4: PEST RISK ASSESSMENT SCHEMES AND STANDARDS: A COMPARISON OF DIFFERENT GUIDELINES

1 INTRODUCTION AND OBJECTIVES

A pest or pathogen is a biological hazard if it is able to enter a pathway at some point, survive subsequent stages in the pathway, spread into the environment after entry into the EU, and cause damage in the environment where it is released. The likelihood that a pest/pathogen enters a country depends on the interaction between the organism and the pathway. In this project, the pathway is limited to commodities. Therefore, the likelihood of entry of a pest/pathogen by a certain pathway is determined by the characteristics of the commodity, the pathogen/pest, and the pathway of the commodity. Characteristics of commodities are the subject of Appendix 2. In this appendix, we focus on pests and pathogens.

Various types of information sources can be used (e.g. Internet sources, peer reviewed papers, books). A systematic review of scientific literature to identify pest and pathogen characteristics based on empirical evidence was carried out; the results are reported in Appendix 3. However, only a limited number of studies of relevance were identified, and all of them examined only a small number of characteristics. Therefore, additional sources were necessary .

The objective of this study was to review existing guidelines for pest risk assessment (both organism- and pathway-initiated; plant and animal health) for pest/pathogen characteristics that should be considered when assessing the likelihood of entry. The review resulted in a list of risk factors that experts have generally agreed upon. The results were used, together with the results of the systematic literature review, for the development of a decision support tree to determine the risk profile of commodities.

2 METHODS

Pest risk assessments (PRA) are carried out by countries and organizations to judge whether exotic pests and pathogens threaten the health of domestic plants and animals. These PRAs follow the structure of pathways from exporting country to importing country. Most PRA schemes are developed by modifying existing PRA schemes. For this study, the FAO (Food and Agricultural Organisation of the United Nations) standards (FAO, 2004) were used as the basic scheme to start with. The FAO standards were analysed for aspects that can increase or decrease the risk of introducing a pest/pathogen (risk factors in plant and animal health). These aspects were all characteristics of the pathway, commodity, country or pest/pathogen. The other PRA guidelines or schemes were compared to the FAO standards. When a PRA scheme contains an aspect that is absent from the FAO standards, it was added to the extensive scheme. This led to the creation of an extensive PRA scheme that contains elements of various other schemes.

As in all the PRA schemes compared, the chronological series from the situation in the exporting country to the aspects for establishment was followed. PRA schemes start with the possibility of the infestation of a commodity with pests/pathogens in the exporting country and follow the complete pathway, including spread in the importing country. In this project it was agreed not to incorporate spread and impact, but to stop the analysis after the entry of the pest/pathogen into the importing country. In this review, PRA schemes were analysed without the exclusion of establishment and spread. The following PRA schemes were compared to the FAO standards (FAO, 2004):
Biosecurity Australia (Biosecurity Australia, 2001).
US Department of Agriculture Animal and Plant Health Inspection Service, Plant Protection and Quarantine Permits and Risk Assessment (USDA, 2000).

Biosecurity New Zealand (Biosecurity New Zealand, 2006).
European and Mediterranean Plant Protection Organisation (EPPO, 2011).
DEFRA (DEFRA, 2009)
World Organisation for Animal Health (OIE) (OIE, 2004).

3 RESULTS

The results of the comparison of the seven PRA schemes (five from the plant health domain and two from the animal health domain) resulted in Appendix 4a. Table 1 shows the complete pathway, including the spread and establishment of the pest/pathogen. Approximately 60 characteristics that can enhance the chance of introduction of a pest/pathogen by importing a commodity, were identified for the phases ‘initiation of a possible pest/pathogen’ and ‘possibility of entry of a pest/pathogen’. Some characteristics overlapped a little.

Pathway-related characteristics/risk factors:
- Change in international trade
- New pathway is identified
- Pre-select relevant pathways
- Association of pest/pathogen with pathway: routes of infection
- Association of pest/pathogen with pathway: route of exposure (oral, respiratory, percutaneous)
- Volume and frequency of movement along the pathway
- Seasonal timing
- Quantity of commodity to be imported
- Speed and conditions of transport and duration of lifecycle of the pest/pathogen in relation to time in transport and storage
- Quarantine
- The intensity of sampling and inspection regimes
- Identification of potential risk by scientific research

Commodity-related:
- International trade in new plants/animals- New commodity or commodity from new point of origin
- Import of new species for selection and scientific purposes
- Detected pest/pathogen in imported consignment
- Ease of contamination of the commodity
- Relevant processes and production methods of the commodity- Commercial procedures applied to consignments in country of origin, transport or storage, e.g. refrigeration (circumstances)

Country-related (importing and/or exporting country):
- Infestation of pest/pathogen in PRA area has been found
- Reported pest/pathogen outside an origin area
- A pest/pathogen is repeatedly intercepted
- Silent spread of disease within country of origin
- Review of policy: insights have been changed for any reason
- Proposal by other country
- A dispute about phytosanitary measures
- National policy decision
- Initiation by other country or international organization
- A new treatment system or process impacts on an earlier decision
- Contact between livestock and wildlife
- Prevalence of the pest/disease/pathogen in the source area

- Official country disease status
- Exporting country's pest and disease management systems
- Evaluation of the exporting country's veterinary service, surveillance, eradication and control programmes and zoning systems
- Animal demographics in exporting country
- Farming and husbandry practices in exporting country
- Pest/pathogen management, cultural and commercial procedures at place of origin
- Existence of hazard-free areas and areas of low prevalence in the exporting country
- Vaccination in country of origin
- Prevalence of pest/pathogen likely to be associated with consignment
- Animal movements within country, e.g. movements to and from markets, seasonal movements of livestock to and from grazing land.

Pest/pathogen-related:
- Infectivity, virulence and stability of the pest/pathogen
- Identification of pest/pathogen: invasion elsewhere
- Identification of pest/pathogen: damage reported elsewhere
- Observed and reported frequently in int. trade elsewhere
- Organism has been identified as a vector for other pests/pathogens
- Occurrence in life-stage that could be associated with commodities, containers or conveyances
- Effect of processing
- Speed and conditions of transport and duration of lifecycle of the pest/pathogen in relation to time in transport and storage
- Vulnerability of the life-stages of the pest/pathogen during transport and storage
- Likelihood of multiplication during transport
- Pest/pathogen surviving existing pest management procedures: ease of detection
- Pest/pathogen surviving existing pest management procedures: detection/testing at the border?
- The impact of vaccination, testing, treatment and quarantine
- Location of the pest/pathogen on the commodity (e.g. surface or not)
- Symptoms of expression
- Distinction of symptoms
- Distinguishing from similar organisms
- Risks from by-products and waste
- Predilection sites of the hazard

4 DISCUSSION

Reviewing guidelines for pest risk assessments turned out to be useful for finding pest/pathogen characteristics, and also commodity, country and pathway related characteristics (risk factors), for assessing the likelihood of entry, establishment and spread of pests/pathogens. The review resulted in a long list of characteristics. This is not surprising. PRA schemes are developed to include and assess all aspects affecting the likelihood of entry, establishment and spread of certain pests or pathogens. Aspects are mainly based on expert knowledge about previous introductions of pests/pathogens and assumptions of possible routes of introduction.

The general agreement on those aspects is enhanced by the fact that most PRA schemes have not been developed independently from each other. Some of the pest/pathogen characteristics were also found in the systematic review of scientific literature (Appendix 3), although they are sometimes described using other words, partly based on empirical evidence. For example, the characteristics 'reproductive strategy' and 'genetic adaptability' mentioned in the PRA guidelines describe the same as 'gene activation', 'genetic mutation speed' and 'high genetic variability' do in the systematic review. Ideally, PRA schemes are tested empirically to identify the significance and impact of each aspect addressed in the scheme simultaneously. However, this is practically impossible, because it requires a large number of performed PRAs for which there are sufficient empirical data. This is not the case, because PRA schemes are applied to justify measures. If these measures are successfully applied, no data will be generated to test the scheme, which is most often the case. Therefore, expertise will remain the main source for identifying relevant pest and pathogen characteristics.

The list of characteristics covers a complete pathway, from initiation of possible pests/pathogens to spread after establishment. In the project it was agreed to follow pathways until the pest/pathogen enters the country, but to exclude spread after establishment. This means that the list is longer than needed for the project, but it can also be used for other risk assessment purposes. Entry of a pest/ pathogen into a country means that the pest has survived several barriers. Moving alongside the pathway is an obstacle race. This was of importance for the following phase in the project, namely the selection of characteristics for incorporation in the decision tree. We should, however, realise that the pathway approach of the PRA schemes is more or less chronological. The structure of a decision tree might be very different, depending on the most discriminatory characteristics.

5 CONCLUSION AND RECOMMENDATION

Reviewing guidelines for pest risk assessments turned out to be useful for finding pest/pathogen characteristics, and also commodity, country and pathway related characteristics (risk factors), for assessing the likelihood of entry, establishment and spread of pests/pathogens. The review resulted in a long list of characteristics. When developing the decision tree, all characteristics on the list were evaluated for their usefulness in the decision tree. Not all characteristics were included in the decision tree. This depended on the discriminatory power of each characteristic.

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APPENDIX 4A: INVENTORY OF PRA SCHEMES FOR THE INTRODUCTION, SPREAD AND ESTABLISHMENT OF PEST/PATHOGENS IN THE IMPORTING COUNTRY AFTER IMPORTING A COMMODITY

Phase	Activities	Risk factors	Additional origin
Initiation of possible pests/pathogens	Identification of pathway	Change in international trade	
		International trade in new plants/animals	
		New pathway is identified	
		Infectivity, virulence and stability of the pest/pathogen	OIE
		New commodity or commodity from new point of origin	Australia
		Import of new species for selection and scientific purposes	Australia
	Identification of pest/pathogen	Infestation of pest/ pathogen in PRA area has been found Detected pest/pathogen in imported consignment	
		Identification of potential risk by scientific research	
		Invasion elsewhere	
		Damage reported elsewhere	
		Observed and reported frequently in inter-national trade elsewhere	
		Organism has been identified as a vector for other pests/ pathogens	
		Reported pest/pathogen outside an origin area	Australia
		A pest/pathogen is repeatedly intercepted	Australia
		Silent spread of disease within country of origin	DEFRA
	Review of policy	Insights have been changed for any reason	
		Proposal by other country	
		A dispute about phytosanitary measures	
		National policy decision	Australia
		Initiation by other country or international organization	Australia
		A new treatment system or process impacts on an earlier decision	Australia
Identification of pathways	Consider potential relevant pathways	Preselect relevant pathways	
	Association of pest/pathogen with pathway		
		Routes of infection	OIE
		Route of exposure (oral, respiratory, percutaneous)	OIE

Phase	Activities	Risk factors	Additional origin
Probability of entry of a pest/pathogen		Contact between livestock and wildlife	DEFRA
	Probability of being associated with the pathway at origin	Prevalence of the pest/ disease/pathogen in the source area	
		Official country disease status	OIE
		Exporting country's pest and disease management systems	New Zealand
		Evaluation of the exporting country's veterinary service, surveillance, eradication and control programmes and zoning systems	OIE
		Animal demographics in exporting country	OIE
		Farming and husbandry practices exporting country	OIE
		Occurrence in life-stage that *could* be associated with commodities, containers or conveyances	
		Ease of contamination of the commodity	OIE
		Volume and frequency of movement along the pathway	
		Seasonal timing	
		Pest/pathogen management, cultural and commercial procedures at place of origin	
		Relevant processes and production methods of the commodity	OIE
		Existence of hazard-free areas and areas of low prevalence in the exporting country	New Zealand
		Quantity of commodity to be imported	Australia
		Ease of contamination	Australia
		Effect of processing	Australia
		Vaccination in country of origin	Australia
	Probability of survival during transport or storage	Speed and conditions of transport and duration of lifecycle of the pest/ pathogen in relation to time in transport and storage	
		Vulnerability of the life-stages of the pest/ pathogen during transport and storage	
		Likelihood of multiplication during transport	EPPO
		Prevalence of pest/ pathogen likely to be associated with consignment	
		Commercial procedures applied to consignments in country of origin, transport or storage, e.g. refrigeration (circumstances)	

Phase	Activities	Risk factors	Additional origin
	Pest/pathogen surviving existing pest management procedures	Ease of detection	EPPO
		Detection/testing at the border? Yes/no	DEFRA
		Impact of vaccination, testing, treatment and quarantine	OIE
		Quarantine	Australia
		Location of the pest/ pathogen on the commodity (e.g. surface or not)	EPPO
		Symptoms of expression	EPPO
		Distinction of symptoms	EPPO
		The intensity of sampling and inspection regimes	EPPO
		Distinguishing from similar organisms	EPPO
		Risks from by-products and waste	EPPO
		Predilection sites of the hazard	OIE
	Spread by animal movement	Animal movements within country, e.g. movements to and from markets, seasonal movements of livestock to and from grazing land	DEFRA
Establishment	Availability, quantity and distribution of hosts in the PRA area	Needed host for lifecycle	
		Presently widely distributed (abundant)	EPPO
		Hosts occur within sufficient geographic proximity to allow pest/pathogen to complete its lifecycle	
		Susceptibility to the hazard of animals from which the commodity is derived	OIE
		Presence of 'other' vector in PRA area	
		Susceptibility of animals likely to be exposed to the hazard (species, age, sex)	OIE
		Presence of alternative host plants	
		Presence of vector in PRA area when needed for dispersal	Australia
	Environmental suitability in the PRA area	Environmental suitability in the PRA area	
	Similarity climatic conditions compared to land of origin	Suitable climatic conditions for spread	EPPO
	Similarity of other abiotic factors compared to land of origin	Suitable other abiotic conditions for spread	EPPO/Australia
		Geographical and environmental characteristics, such as rainfall, soil and temperature	New Zealand/ OIE

Phase	Activities	Risk factors	Additional origin
	Pest in relation to protected cultivation	Pest recorded in protected cultivation	EPPO
	Relation to possible competing existing species		EPPO
	Cultural practices and control measures, e.g. crop rotation	Cultural practices and control measures, e.g. crop rotation	
	Other characteristics of pests/pathogens	Reproductive strategy	
		Genetic adaptability (resistance)	
		Potential movements of commodities	
		Susceptibility of the environment	New Zealand
Spread after establishment	Suitability of natural environment for natural spread of a pest/ pathogen	Suitability of natural environment for natural spread of a pest/ pathogen	
	Presence of natural barriers	Presence of natural barriers	Australia
		Unintended use of commodity	New Zealand
		Methods of slurry disposal	DEFRA
	Potential vectors	Potential vectors	
	Potential natural enemies	Potential natural enemies	
		Presence of natural barriers	Australia
	Cultural practices and control measures	Establishment in relation to cultivation, e.g. soil cultivation and crop rotation	EPPO
		Potential of management practices to prevent establishment	EPPO
		Survival of eradication programmes	EPPO
		Waste disposal from by-products and waste	New Zealand
		Methods of slurry disposal	DEFRA
		Illegal waste food feeding	DEFRA
	Other characteristics	Reproduction characteristics in relation to establishment	EPPO
		Adaptability of pest/ pathogen to circum-stances in PRA area	EPPO
		Potential of relative small population to establish	EPPO
		Introductions in other areas in the past	EPPO
		Human and animal demographics	OIE
		Farming and husbandry practices	OIE
		Customs and cultural practices	OIE
		Spread by human assistance	EPPO
		Movements of farm staff or vets between premises	DEFRA

Phase: Part of the risk pathway.
Activities: Description of group of risk factors, which are described separately in the column 'risk factors'.
Risk factors: Characteristics of pathway, commodity, country or pest/pathogen that can enhance the chance of initiation, introduction, spread or establishment of a pest/pathogen.
Additional origin: The PRA scheme/guidelines reference, from which this risk factor is derived. If this column is empty, this risk factor was from the FAO standards.

APPENDIX 5: REVIEW OF HAZARD IDENTIFICATION PROTOCOLS

1 INTRODUCTION

1.1 BACKGROUND

Such factors as increased worldwide trade and climate change have contributed to an increase in risks posed by exotic plant and animal pathogens/pests. Since trade is a major pathway for the introduction of exotic plant and animal pathogens/pests, there is an increasing need for a protocol to determine the risk profile of new pathways. This is the context in which the European Food Safety Authority (EFSA) issued the call for proposals to develop a 'Commodity-based hazard identification protocol for emerging diseases in plants and animals'.

In response to the EFSA call, the current project 'CHIP: Commodity based Hazard Identification Protocol for emerging diseases in plants and animals' is developing a commodity-based hazard identification process suitable for biological hazards in plants and animals, and to develop a robust decision tree that can be applied in a timescale suitable for emerging risks. The project consists of four work packages with different objectives and approaches.

The first work package (WP1) concerned the development of a biological hazard identification protocol for imported commodities. The results of WP1 include a pathway model, a harmonized list of commodities, a harmonized classification of biological hazards, a risk-based classification of commodities, and a decision support tree that can be used by risk assessors to judge the level of risk of a certain commodity of being infested with a plant or animal pathogen/pest and to get recommendations on which pathogen/past category should be sought in the inspection of the commodity.

In total, six tasks were defined in WP1 with corresponding deliverables. One of these tasks (Task 1.5) was a review of hazard identification protocols in policy areas such as human health and food safety. This document reports the review process and the results of this task.

1.2 OBJECTIVE

The objective of this review was to identify best practices for developing a hazard identification protocol in order to prevent pitfalls in the development of a decision support tree for the CHIP project. The review was focused on data-based hazard identification protocols in comparable policy areas such as food safety and human health. Attention was also paid to the embedding of the protocols in the context in which they were developed.

1.3 APPROACH

To define the aim and scope of the review, the first step was to formulate the review questions and inclusion criteria for the protocols. A literature search was then carried out to collect hazard identification protocols and supplementary materials in comparable policy areas. Based on the inclusion criteria, the most relevant protocols were then selected and summarized for in-depth assessment. The final step of the review was to synthesize the findings from the reviewed protocols and derive recommendations.

1.4 READING GUIDE

Chapter 2 presents the review questions and the inclusion criteria. An account is then given of the search strategy and results. Chapter 3 presents an analysis of the selected protocols in conjunction with the review questions and discusses the implications. Based on the findings presented in Chapter 3, key recommendations for the development of the decision tree are made in Chapter 4.

2 REVIEW PROCESS

2.1 GENERAL CONSIDERATIONS

The review process was carried out as a desk study focusing on hazard identification protocols in three comparable policy areas concerning commodity import: human health, food safety, and biosecurity. To structure the review process, the review questions were divided into general questions and specific questions: the former concerned the general features of hazard identification protocols that determine the context of the decision support tree, while the latter were related to the decision support tree itself, and particularly to how the decision support tree addresses the features of the commodity and the features of the harmful agents.

When selecting the protocols to be reviewed, attention was paid to the similarity of the hazards considered in those protocols to those considered in the CHIP project, and the availability of information concerning the development of the protocols. The review presents a descriptive account of the included protocols.

2.2 REVIEW QUESTIONS

The review questions were specified around key elements of best practices for developing hazard identification protocol. Best practices were defined as generally accepted, standardized techniques, methods or processes that have been proven over time to accomplish given tasks.

The general review questions were:
RG1. Which principles and standards are used?
RG2. Which data-based methodologies are used?
RG3. How are the protocols evaluated?
RG4. Which institutes apply the protocol?
RG5. What success and failure factors are reported?

The specific questions were:
RS1. Which principles and criteria are used for the methodology used in the protocol?
RS2. What are the outputs of the decision support trees?
RS3. How are the outputs used in supporting relevant risk-management decisions?
RS4. How do the decision support trees make use of the commodity data and hazard information?
RS5. How are the features of commodities considered in the decision support tree?
RS6. How are the potential hazards associated with the commodities?

2.3 SEARCH STRATEGY

The search for relevant protocols was carried out through Google and the websites of plant/animal health authorities and institutes. All possible combinations of the following search terms were used with Google:
hazard identification
protocol or guidelines
commodity.
The websites of the following authorities were consulted for guidelines and protocols:
1. FVO: Food and Veterinary Office
2. EPPO: European and Mediterranean Plant Protection Organization
3. OIE: International Organization of Animal Health

4. FAO: Food and Agriculture Organization
5. WHO: World Health Organization
6. WTO: World Trade Organization

2.4 INCLUSION CRITERIA

Following inclusion criteria were used to select the protocols to be reviewed:
1. The protocol is used for the identification of hazards for human health or food safety.
2. The protocol concerns commodity import.

2.5 SEARCH RESULTS

Although many protocols and guidelines were found with the search term 'hazard identification', only a few were directly aimed at hazard identification for the purpose of commodity import control. Considering the objective of the review, the search scope was then broadened to protocols or guidelines for import risk analysis concerning food safety, public health or biosecurity. Based on the inclusion criteria, 10 documents (named protocols, standards, guidelines or frameworks) were selected for further review. Table 1 presents an overview of the key features of these documents.

Table 1: Protocol, guidelines or frameworks for hazard identification concerning commodity import

No	Title	Country	Year	Authority
1	Import Risk Analysis Handbook 2007 (update 2009)	Australia	'09	Australian Government Department of Agriculture, Fisheries and Forestry (DAFF), Biosecurity Australia
2	Animal Health and Production Risk Analysis Framework	Canada	'01	Animal Health & Production Divisionand Animal, Plant and Food Risk Analysis Network (APFRAN), Science Division, Canadian Food Inspection Agency (CFIA)
3	Guidelines for the management of invasive alien plants or potentially invasive alien plants which are intended for import or have been intentionally imported	EPPO region	'06	European and Mediterranean Plant Protection Organization (EPPO)
4	Guidelines on Pest Risk Analysis	EPPO region	'09	European and Mediterranean Plant Protection Organization (EPPO)
5	Categorization of commodities according to their pest risk. ISPM No. 32. International Standards for Phytosanitary Measures	International	'09	International Plant Protection Convention
6	Devising import health measures for animal commodities	International	'07	World Organization for Animal Health
7	Risk Analysis procedures, version 1	New Zealand	'06	Ministry of Agriculture and Forestry, Biosecurity New Zealand
8	Risk identification and assessment of non-native freshwater fishes: concepts and perspectives on protocols for the UK	UK	'05	Centre for Environment, Fisheries & Agriculture Science (CEFAS)
9	Hazard Analysis and Critical Control Point Principles and Application Guidelines	USA	'97	National Advisory Committee on Microbiological Criteria for Foods

No	Title	Country	Year	Authority
10	Guidelines for the importation of certain wooden and bamboo commodities to NAPPO member countries. RSPM 38. NAPPO Regional Standards for Phytosanitary Measures (RSPM)	North America	’09	North American Plant Protection Organization (NAPPO) Executive Committee

In addition to the protocol documents, relevant risk analysis reports and scientific literature were also retrieved to obtain information on and insights into the application of these protocols. The literature list is presented in ‘References’.

3 MAIN FINDINGS

3.1 GENERAL OBSERVATIONS

Protocols are programme- and topic-specific documents that provide direction or criteria on how inspection agencies must operationalize specific requirement(s) identified within relevant regulations and standards. They are an important mechanism by which greater standardization is achieved in the implementation of the concerned programmes (OPHS, 2008). In the case of hazard identification, the protocols reviewed provided guidelines or directions on how import inspection agencies must identify biological hazards relevant for import risk analysis according to international and national sanitary and phytosanitary regulations and standards.

A hazard is generally defined as a biological, chemical or physical agent in, or a condition of, a commodity with the potential to cause an adverse health effect (see e.g. CAC, 1999; CAC, 2005). Hazard identification means the process of identifying the pathogenic agents that could potentially be introduced in the commodity considered for importation. Although hazard identification is an important issue in its own right, it is more often placed in the broader context of risk analysis as a preliminary step towards further risk analysis and intervention measures.

As stated in the International Animal Health Code (OIE, 2000), hazard identification is an essential step that must be conducted before the risk assessment. The whole risk analysis process consists of four interrelated steps. These steps clarify the stages of the risk assessment, describing them in terms of the events necessary for the identified potential risk(s) to occur, and facilitate the understanding and evaluation of the outputs. The product is the risk assessment report that is used in risk communication and risk management. The relationship between hazard identification, risk assessment and risk management is schematically illustrated in Figure 1.

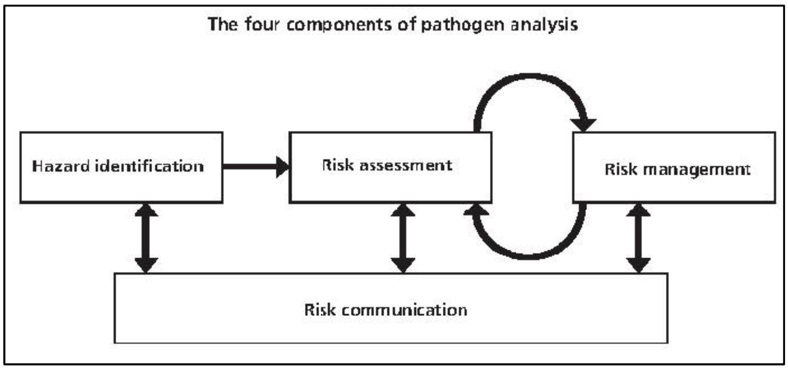

Figure 1: The four components of pathogen risk analysis (Arthur et al., 2009)

As a common feature, all protocols or guidelines reviewed make a clear distinction between hazard identification and risk assessment. More specifically, hazard identification is considered a categorization step, identifying biological agents *dichotomously* as potential hazards or not. A disease agent is only a hazard for that commodity if the agent can infect or contaminate the commodity, can survive any treatment and transportation, and potentially be exposed to a susceptible host (primary or secondary), resulting in adverse consequences.

The main findings with respect to the review questions are given below.

3.2 GENERAL REVIEW QUESTIONS

3.2.1 RG1: WHICH PRINCIPLES AND STANDARDS ARE USED?

International standards and conventions such as listed in EFSA (2009) are generally observed in developing protocols for import risk analysis. More specifically, the principles employed by the reviewed protocols reflect those principles and guidelines stipulated in following international principles, standards and agreements concerning food safety, phytosanitary measures and animal health:

1. WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS agreement)
2. ISPM 1 (1993) Principles of plant quarantine as related to international trade. Rome, IPPC, FAO
3. ISPM 2 (1995) Guidelines for pest risk analysis. Rome, IPPC, FAO
4. ISPM 5 (1999) Glossary of phytosanitary terms. Rome, IPPC, FAO
5. ISPM 7 (1997) Export certification system. Rome, IPPC, FAO
6. ISPM 8 (1998) Determination of pest status in an area. Rome, IPPC, FAO
7. ISPM 12 (2001) Guidelines for phytosanitary certificates. Rome, IPPC, FAO
8. ISPM 13 (2001) Guidelines for the notification of non-compliance and emergency action, Rome, IPPC, FAO

9. ISPM 15 (2009) Regulation of wood packaging material in international trade. Rome, IPPC, FAO
10. ISPM 25 (2006) Consignments in transit. Rome, IPPC, FAO
11. ISPM 32 (2009) Categorization of Commodities According to their Pest Risk, Rome, IPPC
12. EPPO (1999) EPPO Standards PM 1/2(8) EPPO A1 and A2 lists of quarantine pests. In: EPPO Standards PM1 General phytosanitary measures, pp. 5-17. OEPP/EPPO, Paris
13. OIE (2000) Guidelines for risk analysis, in International Animal Health Code. Chapter 1.3.2
14. OIE (2004) Handbook on Import Risk Analysis for Animals and Animal Products. Volume 1a. Introduction and qualitative risk analysis. p. 57

For instance, the key principles behind the framework of Biosecurity New Zealand concerning hazard identification are:

Effective: That each risk analysis accurately measures the risks to the extent necessary and identifies mitigation options that achieve a level of appropriate protection for the importing country.

Efficient: The risk analysis programme avoids duplication and unnecessary use of resources, meets agreed timeframes and focuses on the areas of greatest priority.

Transparent: That the reasoning and evidence behind the decisions recommended by the risk analysis, and areas of uncertainty and their possible consequences to those recommendations, are clearly documented and made available to stakeholders.

Consistent: That all risk analyses completed following the protocol achieve the same high level of performance and provide recommendations that deliver the appropriate level of protection for the importing country using a common process and methodology.

Precautionary: That the risk analyst incorporates a level of precaution in the import risk analyses to account for uncertainty; for instance, when making a professional judgement on whether available information is sufficient and when making assumptions. Where there is insufficient information, provisional measures may be recommended recognizing the obligation to seek additional information.

Science based: The risk analysis should be based on the best available information that is in accordance with current scientific thinking. The risk analysis process and the determination of the appropriate level of protection should not be compromised by pressures of trade or protection.

Compliant: That the risks analysis process and methodology meet the needs of and complies with the domestic legislation of the importing country and international obligations.

3.2.2 RG2: Which data-based methodologies are used?

None of the protocols reviewed made use of formal hazard identification techniques such as HAZOP and fault-tree analysis or other techniques such as reviewed by Glossop et al. (2000). In general, the methodology described in the protocols follows the guidelines in Section 1.3 of the Terrestrial Animal Health Code (OIE, 2007), whereby the first step in the risk analysis is hazard identification, and the risk analysis process provided by the International Plant Protection Convention (IPPC). In particular, the International Standards for Phytosanitary Measures (ISPM) Nos. 2, 11, and 21 together provide a risk analysis process on which to base the consideration of the risks to plant health from pests or diseases imported on plants and plant materials, and regulated articles, including inanimate objects.

A umber of protocols were built upon a decision support scheme or checklist using generic classifications of the commodity or the potential pathogens (e.g., the EPPO decision scheme). The decision support scheme consists of a series of ‘yes/no’ questions concerning the commodity, its conditions, its intended use, and import control measures. For example, for the hazard identification of non-native freshwater fishes, one potential means of assessing invasiveness is the Pheloung et al. (1999) Weed Risk Assessment (WRA), which is a semi-quantitative scoring system (with quantitative elements) for screening plants not present in Australia and New Zealand. The WRA spread sheet consists of a series of questions (responses: yes/no/don’t know) that are selected on the basis of expert evaluation of published literature on the species under evaluation. Each question is scored, generally on a scale of -1 to +1, to produce a total numerical score that is positively correlated with ‘weediness’.

The WRA was adapted to create the Fish Invasiveness Screening Kit (FISK) for the UK (Copp et al., 2005).

3.2.3 RG3: How are the protocols evaluated?

The protocols were all subject to official and peer reviews and regularly updated with feedback and information. The protocols were considered a living document, and as such it was expected that improvements will be made to the protocols as and when required. For the risk analysis procedures of Biosecurity New Zealand, a full review of the procedures would be undertaken once they have been implemented and sufficient experience has been gained in their use. Any significant changes to the procedures would be discussed with key stakeholders.

Peer review is also an important part of the review process. APFRAN selects the participants for peer review according to the risk assessment. The peer review participants may include experts from the CFIA centres of expertise, CFIA field epidemiologists, risk analysts, economists and biostatisticians. The comments received from the participants are incorporated into a revised risk assessment document. The consultative process may be curtailed due to trade-related time constraints.

3.2.4 RG4: Which institutes apply the protocol?

Table 2 shows the agencies that apply the protocols reviewed.

Table 2: Institutes/agencies that apply the protocols

No	Title	Institutes/Agencies
1	Import Risk Analysis Handbook 2007 (updated 2009)	Biosecurity Australian (pre-border) The Australian Quarantine and Inspection Service (AQIS) (at the border)
2	Animal Health and Production Risk Analysis Framework	Animal Health & Production Division and Animal, Plant and Food Risk Analysis Network (APFRAN),
3	Guidelines for the management of invasive alien plants or potentially invasive alien plants which are intended for import or have been intentionally imported	EPPO import inspection authorities
4	Guidelines on Pest Risk Analysis	EPPO import inspection authorities
5	Categorization of commodities according to their pest risk. ISPM No. 32. International Standards for Phytosanitary Measures	Inspection agencies
6	Devising import health measures for animal commodities	Inspection agencies
7	Risk Analysis procedures, v. 1	MAF Biosecurity New Zealand
8	Risk identification and assessment of non-native freshwater fishes: concepts and perspectives on protocols for the UK	Centre for Environment, Fisheries & Aquaculture Science (CEFAS)
9	Hazard Analysis and Critical Control Point Principles and Application Guidelines	HACCP team of each food/feed company
10	Guidelines for the importation of certain wooden and bamboo commodities to NAPPO member countries. RSPM 38. NAPPO Regional Standards for Phytosanitary Measures (RSPM)	NAPPO import Inspection Agencies

3.2.5 RG5: WHAT SUCCESS AND FAILURE FACTORS ARE REPORTED?

Based on the introductory texts and background documents, success factors in developing a hazard identification protocol include the practice that the protocols were developed by a multidisciplinary group with members from the industry, academia and government, including consultation with and oversight from the food regulation authorities and inspection agencies. Another success factor is the science-based approach to ensure the reliability and transparency of the outcome, which is evidenced by the large amount of scientific literature frequently cited in the protocols. An important point of attention in the review and updates of the protocols was the scientific scrutiny and the overall transparency of the hazard identification and the whole quarantine import risk analysis process.

Although possible pitfalls were seldom mentioned in the protocols and applications, the authors of a number of applications and scientific articles pointed out possible limitations and challenges for hazard identification:

1. Confusion between hazard identification and risk assessment.
2. Incomplete or unreliable information on the combination of harmful organisms and commodity pathway.

The first pitfall can be avoided by clearly defining the objective and outcomes of the protocol. The second pitfall concerns the limitations on the information that is available for developing a preliminary list of harmful organisms or diseases. These limitations include (Ormsby, 2007):

The information must be considered at least reasonably reliable and therefore be sourced from the scientific literature rather than the popular media or other such sources.

Many organisms and diseases associated with a commodity will not have been identified in any scientific (or other) sources of information. This will vary depending on how well the commodity in question has been studied, which itself is most often a reflection of the commodity’s economic importance to a region or country.

Many organisms have yet to be discovered or identified and as such may not be reported. Crous and Groenewald (2005) estimated that only 7% of the fungal species thought to exist are known to science.

Organisms or diseases that are considered insignificant on the commodity in question may be under-reported, even though they may be significant for other commodities.

3.3 SPECIFIC REVIEW QUESTIONS

3.3.1 RS1: WHICH PRINCIPLES AND CRITERIA ARE USED FOR THE METHODOLOGY USED IN THE PROTOCOL?

Besides general principles and criteria that are relevant for developing a reliable methodology, the hazard identification protocol of the Canadian Food Inspection Agency (CFIA, 2001) has the following criteria for identifying hazard for imported animals and animal products:

- The hazard identification must be in accordance with the Sanitary Phytosanitary (SPS) Agreement of the World Trade Organization (WTO).
- The biological agents are exotic to the importing country (including foreign strains, serovars, serotypes, species, or subspecies) or represent biological agents of diseases for which national control and eradication programmes are in place and that could potentially produce adverse consequences associated with the importation of a commodity.
- The potential hazards identified would be those appropriate to the species being imported, or from which the commodity is derived, and that are present in the exporting country in that species or other susceptible species.
- A disease agent is a hazard for that commodity only if the agent can infect or contaminate the commodity, can survive any treatment and transportation, and potentially be exposed to a susceptible host (primary or secondary), resulting in adverse consequences.

- The OIE list of diseases represents the principal list of diseases (biological agents) for conducting hazard identification for the importation of animals and animal products.
- The hazard list may include those vector-borne diseases for which there is no known competent vector in the importing country. The potential adverse consequences would result from and be limited to disease in the imported animals themselves.
- With respect to animal products, the disease agents must be able to survive any processing methods, the time interval between harvesting/processing and importation, and then be exposed to a susceptible host. This combination of processing, mode of transmission, and exposure to target host or hosts greatly reduces the list of hazards associated with animal product importation.
- The hazards identified for feather, meat, blood and bone meals reflect the likelihood of recontamination of these products with raw material following rendering at temperatures that may be more than sufficient to inactivate many animal pathogens. Recontamination is considered an important source of pathogens in processed foods (Reij and Den Aantrekker, 2004)
- Exposure of a susceptible host to a hazard in an imported product would occur through the oral route. The deliberate feeding of product in swill or as uncooked scraps to swine, or as scraps either deliberately fed to or foraged by dogs, results in these two species being the major target hosts exposed to hazards. The use of imported feather, meat, bone and blood meal as a dietary supplement (as a mineral lick or as part of a compounded feed) or in fertilizer exposes additional target hosts.
- The evaluation of the veterinary services, surveillance programmes and zoning and regionalization systems may be important inputs for hazard identification with respect to the presence of a biological agent infecting an animal population in the exporting country.
- Animals and animal products being imported into internationally recognized zones in the importing country that are free of specific diseases (biological agents) would necessitate that these disease agents be considered hazards.

3.3.2 RS2: What are the outputs of the decision support trees?

The decision support tree or decision support scheme typically consists of a sequence of questions to assist in determining whether a commodity is a hazard. Outputs of the decision support tree are the answers to these questions for the commodity under consideration. The final output of the decision tree is a dichotomous outcome, that is, whether or not a certain commodity contains a hazard (see Figure 2).

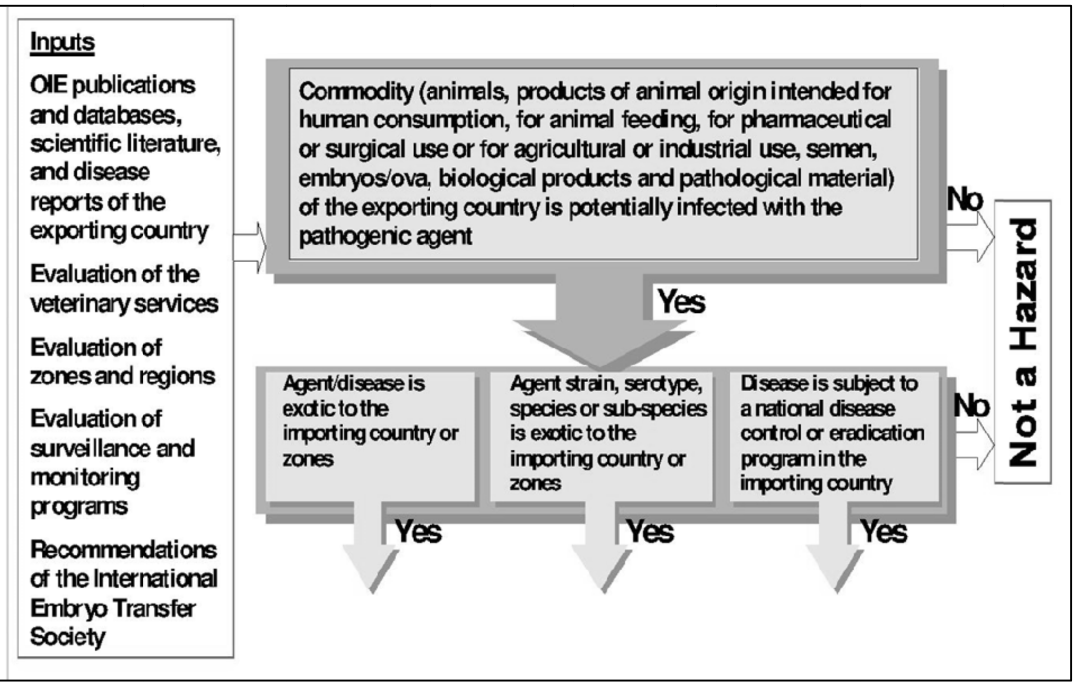

Figure 2: Input and output of the hazard identification protocol (CFIA, 2007)

3.3.3 RS3: HOW ARE THE OUTPUTS USED IN SUPPORTING RELEVANT RISK-MANAGEMENT DECISIONS?

Outputs of the decision support scheme are important to decide whether further characterization of the hazard and risk assessment is necessary. Figure 3 provides an overview of the relationship between hazard identification and risk management.

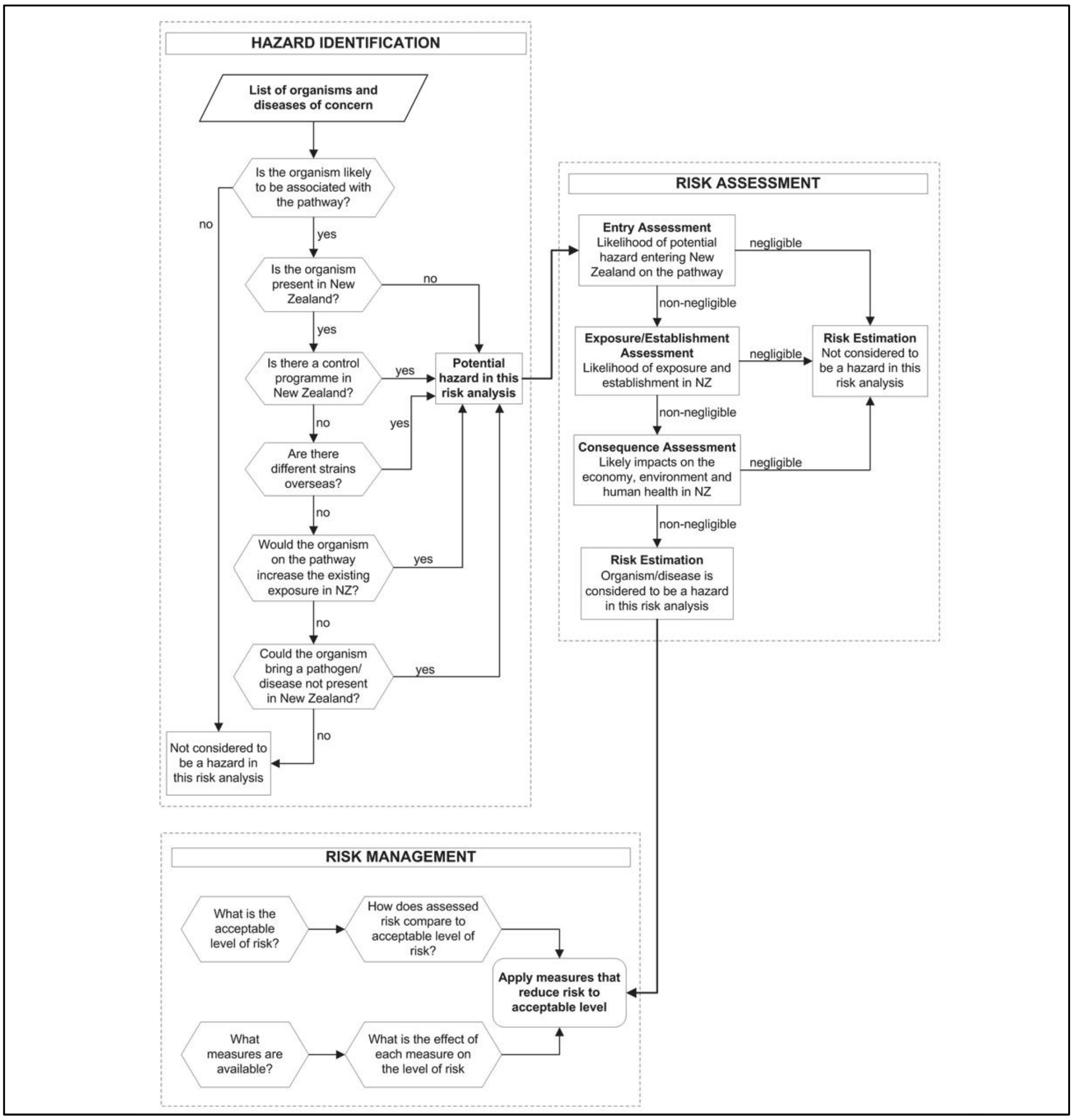

Figure 3: Diagrammatic representation of the risk analysis process

3.3.4 *RS4: How do the decision support trees make use of the commodity data and hazard information?*

Several sources of information are routinely referenced when developing hazard lists for most plant-based commodities. The organization CAB International (2011) provides a web-based compendium of crop pests and diseases that can be used to compile hazard information on any plant host included in the supporting database. The website ‘Plant Viruses Online’ (Brunt et al., 1996) provides a web-based interface into a database containing information on viruses including host association. The ‘Fungal databases’ (Farr et al., 2007) is provided online by the United States Department of Agriculture, and contains extensive information on fugal and host associations (Ellis and Ellis, 1997).

Information about pathogens that cause animal diseases or are derived from animal and animal products is also provided by the World Animal Health Information System and the World Animal Health Information Database (WAHIS & WAHID). The WAHIS and WAHID, a scientific network, is hosted by the animal health information department of the OIE. The system and the database contain the OIE list of diseases and reports of notifications. The objectives of the network is to achieve transparency of the animal disease situation worldwide (Berlingieri, 2011).

The hazard identification process involves identifying the pathogenic agents that could potentially produce adverse consequences associated with the importation of a commodity. The first step is to identify as many organisms and diseases as reasonably possible that could potentially be associated with the commodity pathway in question. One factor in favour of organism or disease identification is that any significant organisms or diseases on the commodity in question are more likely to have been reported.

Some information was used to exclude commodities from being considered potential hazards. For example, in the risk analysis report of MAF Biosecurity New Zealand, exclusion criteria for the classification as diseases/organisms not being potential hazards in the egg power risk analysis include:

- Disease agents that are known to be present in New Zealand are not potential hazards.
- Disease agents that have not been demonstrated as being transmitted in the commodity are not potential hazards.
- Disease agents that will be inactivated by the processing conditions defined for the commodity are not potential hazards.

3.3.5 RS5: How are the features of commodities considered in the decision support tree?

Although not directly stated, the features of the commodity are used for ‘commodity profiling’ and ‘commodity categorization’ according to pest risk (see e.g., Anonymous, 2007). Features that are of relevance are:

- Whether the commodity is processed or not and, if so, the effect of the method and degree of processing to which a commodity has been subjected.
- The intended use and consequent potential as a pathway for the introduction of regulated pests. Some intended uses of commodities (e.g. planting) result in a much higher probability of introducing pests than others (e.g. processing). More information is contained in ISPM No.11: Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms, 2004, section 2.2.1.5.
- Whether the commodity has previously been imported into the country.
- Whether the commodity comes from a new area or new country of origin.

According to ISPM 32, national plant protection organizations (NPPOs) may categorize a commodity into four categories by taking into account whether it has been processed, the method and degree of processing, and where appropriate the intended use:

Category 1. Commodities have been processed to the point where they do not remain capable of being infested with quarantine pests. Hence, no phytosanitary measures should be required and such a commodity should not be deemed to require phytosanitary certification with respect to pests that may have been present in the commodity before the process.

Category 2. Commodities have been processed but remain capable of being infested with some quarantine pests. The intended use may be, for example, consumption or further processing. The NPPO of the importing country may determine that a pest risk analysis (PRA) is necessary.

Category 3. Commodities have not been processed and the intended use is for a purpose other than propagation, for example, consumption or processing. A PRA is necessary to identify the pest risks related to this pathway. Examples of commodities in this category include some fresh fruits and vegetables for consumption and cut flowers.

Category 4. Commodities have not been processed and the intended use is planting. A PRA is necessary to identify the pest risks related to this pathway.

Examples of commodities in category 4 include propagative material (e.g. cuttings, seeds, seed potatoes, plants in vitro, micro-propagative plant material and other plants to be planted). Because commodities in this category are not processed and their intended use is for propagation or planting, their potential to introduce or spread regulated pests is higher than that for other intended uses.

Examples of processes and the resultant commodities that can meet the criteria for category 2 are provided in the standard. Although commodities in category 2 have been processed, the processing method may not completely eliminate all quarantine pests. If it is determined that the method and degree of processing do not eliminate the pest risk of quarantine pests, consideration should be given to the intended use of the commodity in order to evaluate the probability of establishment and spread of the quarantine pests. In this case, a PRA may be needed to determine this. An illustration of the categorization is given in Figure 4.

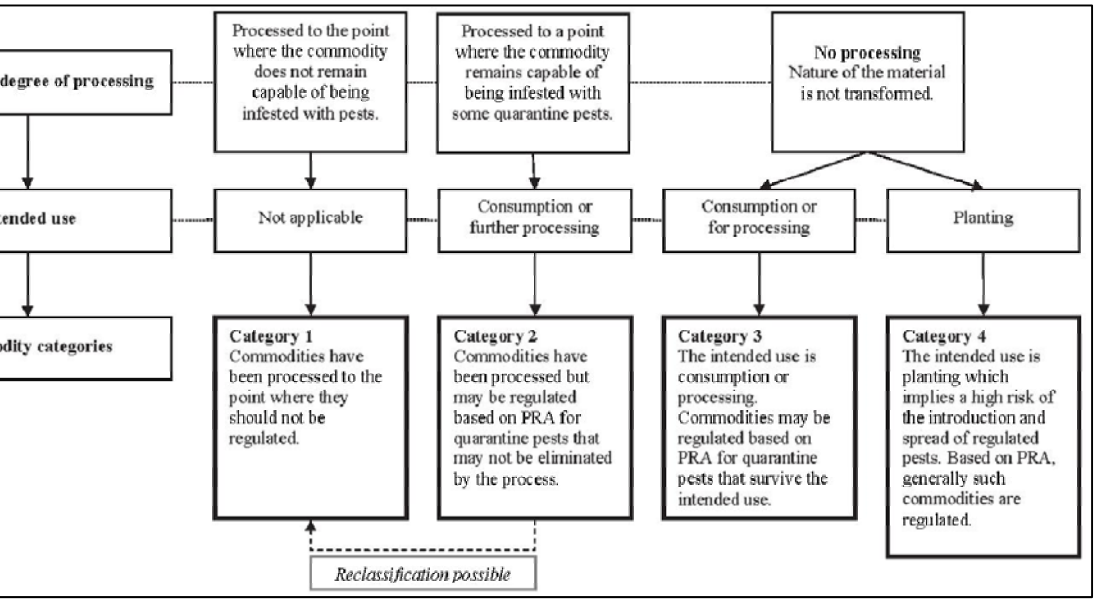

Figure 4: Flow chart illustrating categorization of commodities according to their pest risks

3.3.6 RS6: How are the potential hazards associated with the commodities?

As illustrated by the CFIA protocol, the hazard identification process for commodities begins with the collation of a list of organisms that might be associated with the commodity under consideration in the manufacture of this commodity (the preliminary hazard list). The diseases/agents of interest are those that could be transmitted in or on the commodity under consideration and could infect domestic animals or plants. An example of the preliminary hazard list of imported egg powders for New Zealand was compiled from Diseases of Poultry, 11th Edition, 2003 (MAF Biosecurity New Zealand, 2008).

The potential hazards identified would be those appropriate to the species being imported, or from which the commodity is derived, and that may be present in the exporting country. It is necessary to identify whether each potential hazard is already present in the importing country, and whether it is a notifiable disease or is subject to control or eradication in that country and to ensure that import measures are not more trade restrictive than those applied within the country.

Although not intended for guiding import risk analysis, the Fish and Fishery Products Hazards and Controls Guidance (USDA, 2011) contains examples of how potential hazards are associated with the commodity (fish and fishery products) as meant for developing a HACCP plan. The guidance provides information on how to identify species-related hazards and potential process-related hazards. In particular, the guidance contains lists of potential hazards that are associated with specific species of vertebrates and invertebrates, and a list of potential hazards that are associated with specific finished fishery products, as a result of the finished production form, the package type, and the method of distribution and storage.

4 Conclusion and recommendation

4.1 Conclusions

Although hazard identification is an important issue in its own right, it is more often placed in the broader context of quarantine risk analysis as a preliminary step towards further risk analysis and intervention measures. To ensure that the protocol correctly specifies the expected outcome, it is important to define the hazard precisely and make clear the distinction between hazard identification and risk assessment.

Existing hazard identification protocols typically concentrate on the assessment of individual pathogens or individual commodities. To develop a generic commodity-based hazard identification protocol, it is necessary to associate any commodity with potential pathogens and the pathways. This requires a categorizing step for both commodities and potentially harmful organisms and an identifying step to establish the association between the category of commodity and the category of hazards.

4.2 Recommendations

Based on the review, some recommendations can be made with respect to the development of the hazard identification protocol in general and the decision support tree to be developed in Task 1.6 in particular:

With regard to the protocol in general:

- The objectives of the hazard identification protocol should be defined according to the principles and criteria of relevant regulations and standards.

- The protocol should be reviewed by a multidisciplinary group comprising representatives from the industry, academia and inspection agencies.
- The protocol should be regularly updated with new information on commodity pathways and pathogens.

With regard to the decision support tree in particular:

- The structure of the decision support tree should be in accordance with the official categorization of the commodities and the pathogens.
- The full range of hazard types should be considered and the outputs of the hazard identification process fully documented.
- The decision support tree should be illustrated with typical commodities, pathogens and pathways. The principles of the decision support tree should be well documented and explained.
- The underlying logic and relationships of the decision support tree should be supported by scientific evidence and take into account uncertainties.

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APPENDIX 6: MANUAL FOR CHIP DECISION SUPPORT TREE, VERSION 10

1 INTRODUCTION

EFSA requested the development of a protocol to determine the risk profile of commodities as a computerized decision tree in Excel. This program guides risk analysts in their decision to inspect commodities to identify or monitor existing and new hazards.

The decision tree has the following characteristics:

It is generic: it can be applied to all commodities of plant and animal origin.

The decision tree has a modular structure to facilitate both quick and in-depth assessments.

The program in Excel can be applied freely by stakeholders, together with the documentation in which the decision tree is described (this manual) and the results are justified (report).

The decision tree can be used for the rapid screening of commodities in the EU. It considers the pathway starting from the country of origin to entry into the EU.

The characteristics with the most discriminating power are the highest in the decision tree.

Three levels of likelihood are distinguished: high, moderate and low

> *In the following, when we use the term 'risk' we mean likelihood ('low', 'moderate' or 'high').*

> *For detailed background information and justification, please refer to the report: Bremmer and Swanenburg, 2012, 'CHIP: Biological hazard identification protocol; D1.6 Outline of the decision tree', EFSA.*

Cases

The decision tree is illustrated with screenshots from two cases:

1. Litchi from Madagascar arriving at Rotterdam Harbour
2. Sausage casings from Algeria imported by Spain

> *In the decision tree the user should only enter text, click radio buttons and click on other buttons. Never adapt the sheets. Only in the generic pathway model (section 4) the user is allowed to insert additional rows.*

2. STRUCTURE OF THE MODEL

The decision tree guides the user through the questions that will eventually result in an indication of the potential impact of the pathogens/pests. The figure below shows the flow chart of the decision tree.

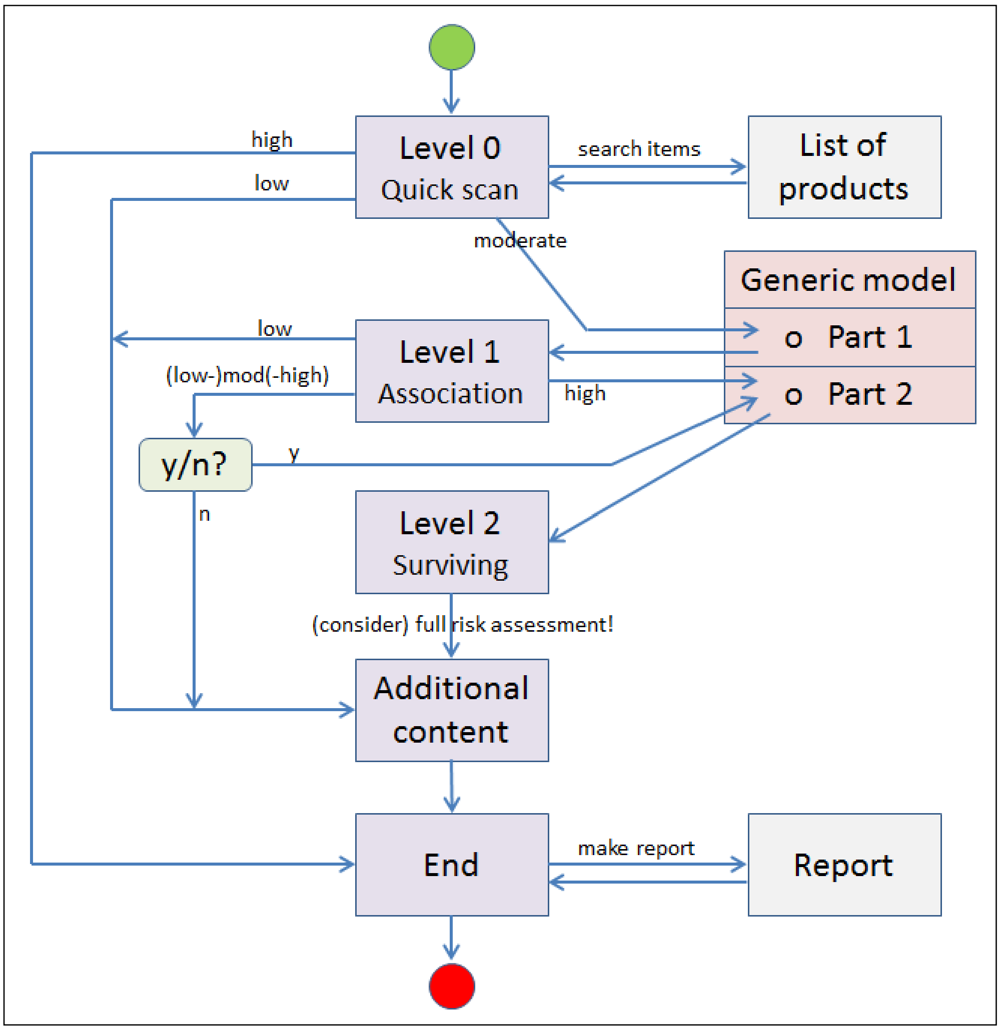


Figure 1: General structure of the model in the form of a flow chart

The program starts (i.e. green circle) with level 0. In this level, a quick scan of the risk is performed. On the basis of the state of the product and the intended use, the likelihood of entry of pests/pathogens will be assessed. Level 0 concludes with one of three likelihoods: high, moderate or low. Each outcome leads to a different recommendation, that is, 'moderate' will lead to the [Generic model] sheet. After 'Part 1' of this sheet is completed, the model guides the user to Level 1: questions about the likelihood that potential pests/pathogens are associated with the commodity. If the outcome of this level is 'low to moderate', 'moderate' or 'moderate to high', the user is asked (i.e. 'yes/no?') whether the analysis should be continued. If the answer is 'no', Level 2 is skipped and the program proceeds with the [Additional content] sheet and finally the [End] sheet. The user is requested to make a report of the outcome or to stop (i.e. red circle).

Not shown in this figure are the possibilities to go back to the previous sheet, for example to revise answers.

The overview in Figure 1 can be useful to consult regularly when using the program for the first time.

3. GUIDANCE THROUGH THE QUESTIONS

Getting started

Open the Excel program and an empty template will appear. The session can start.

> *If you want to start with an empty template after you have already filled in a few (or all) questions, use the **(Re)start** button (Figure 2, comment 1.).*
>
> *But be careful: all answers to the questions and all comments will be lost!*

In the following, the reference in the figure is abbreviated: F2c1 means Figure 2, comment 1.

Follow the green questions

The user is guided by following the question with the green background (F2c2); this is the current question to be answered. This first question, and also many other questions, is answered by clicking a radio button (F2c3). The answer to the question is made visible by a small black dot in the radio button (F3c1).

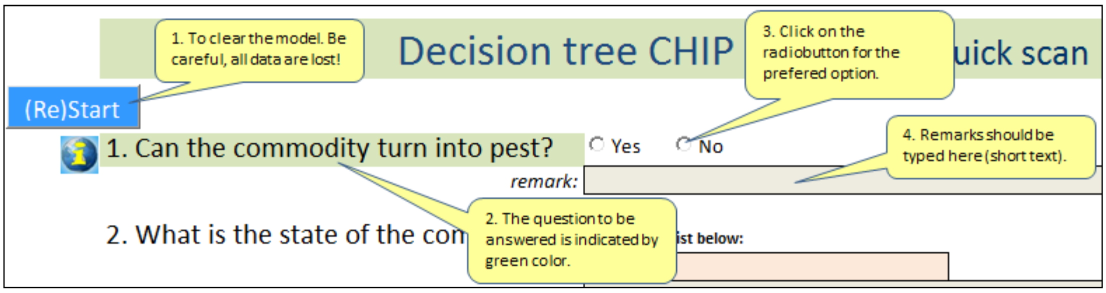


Figure 2: Guide through answering questions

If necessary you can add a remark (F2c4). Do not exceed the available space.

After answering the first question, the next question to be answered is given a green background (F3c2). Make sure that all questions on the top right-hand side are answered, including the radio button for destination (F3c3).

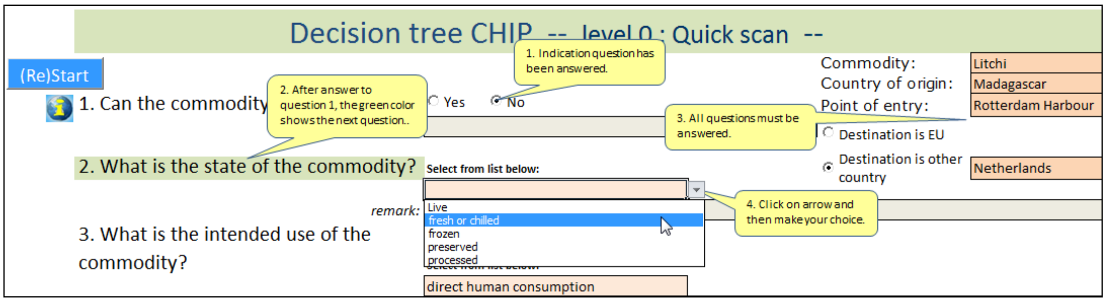


Figure 3: Selecting from a list (Litchi case)

> *If you have doubts about the level of likelihood, choose the highest one. For example, choose 'moderate' if you cannot decide between 'moderate' and 'low', and 'high' if you cannot choose between 'moderate' and 'high'.*

<u>Selecting from a list</u>

Not all questions are answered by clicking radio buttons. Some questions make use of a predefined list, for example question 2 (F3c4).

> ⚠ *Caution: do not type in the text in the questions with 'Select from list below' (e.g. the second question). Always use the list box!*

If you click on the coloured field below the text 'Select from list below:', a small arrow appears next to the field. Click on that arrow and a list appears (F3c4). Then go to the desired option and click on the text.

<u>List of products</u>

The program has a database of products with characteristics that can be used. Select the characteristics: the state of the commodity (for question 2) and the intended use (for question 3). Searching for the commodity in the list can be made easier by entering some text next to 'Extra search name' (Figure 4).

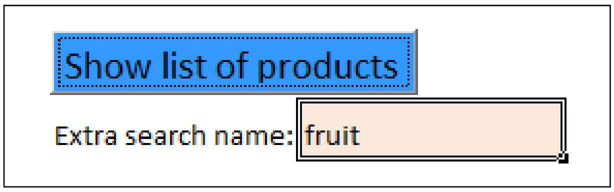


Figure 4: Retrieving the list of products from a database

After you have clicked on the 'Show list of products' button, you will be asked if this is of animal or plant origin. Then a query is made from the database, the relevant products are collected and presented in the list of products (Figure 5). Note the criteria of the selection on top of this list. In this example the list consists of 40 products (40 hits).

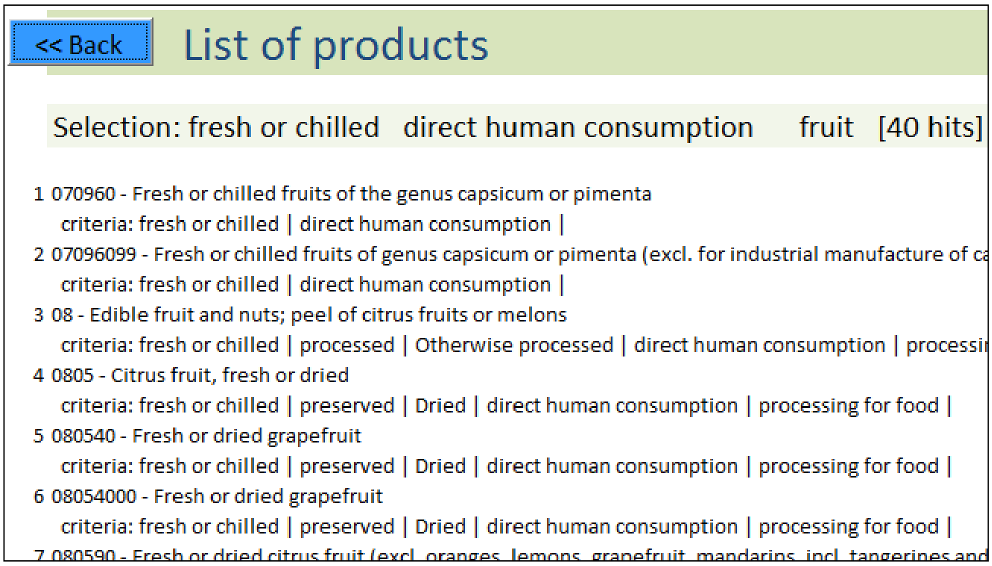


Figure 5: List of products from the database (40 hits with the selection criteria on top)

<u>'<<Back' button</u>

The program has several '<<Back' buttons to return to the previous screen (see Figure 5, top left). In this example, you go back to Level 0. Some '<<Back' buttons go back to the previous sheet to change answers, comments, etc. The '<<Back' buttons on the sheets 'Additional contents' and 'End' will go directly to the start (i.e. Level 0).

> ⚠ *Always use buttons to go to the sheets. These buttons have the desired functionality. Never click on the sheet tabs on the Excel sheet (these are at the bottom of the sheet).*

<u>At the end of a level</u>

When all questions of a level have been answered, you will be requested by the green guidance to 'Click on Continue button ->' (F6c2). Note the result of this level, for example 'Moderate' (F6c1). To proceed, click the '>> Continue' button. If in Level 0 not all inputs are given, a remark appears (F6c3). You should first provide all necessary answers.

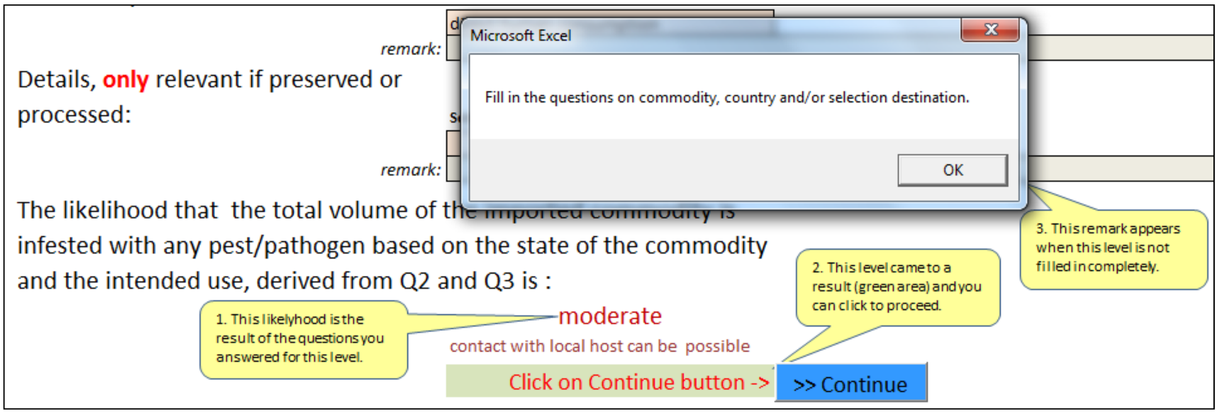


Figure 6: Result of a level and continuation

<u>Messages</u>

After all answers are given and the '>> Continue' button is pressed, another message appears. Such messages give information that is used for guidance. An example is given in Figure 7. In this example, the user will be guided to the Generic Pathway Model and is requested to fill in Part 1 of the scheme.

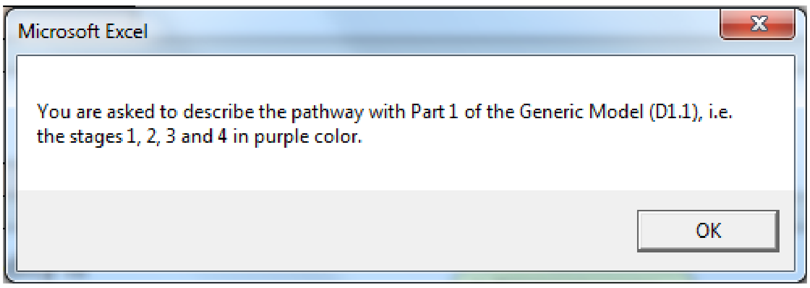


Figure 7: An example of a message: guidance on which parts of the pathway model have to be
filled in

> *During the use of the program it is highly recommended to **save** several times. At the first saving, give the Excel file an **appropriate name**.*

4. GENERIC PATHWAY MODEL

Figure 1 shows that a ‘moderate’ outcome from Level 0 and a ‘high’ and ‘moderate’ (optional) outcome from Level 1 will guide the user to the generic pathway model. This model serves as a tool for the risk assessor to structure and store relevant information about conditions affecting the likelihood of pest/pathogen association and survival. The use of the pathway model is not obligatory.

For more information on the generic pathway model, see ‘APPENDIX 1: MODELLING A PATHWAY’ .

The scheme contains information from the sheet of Level 0 (see Figure 8). The information must not be overwritten; see the remarks ‘to be filled in at Level 0’.

Scheme generic pathways for animals, plants and animal/plant products		
Commodity:	Litchi	to be filled in at Level0
Country of origin:	Madagascar	to be filled in at Level0
Point of entry:	Rotterdam Harbour	to be filled in at Level0

Figure 8: Pathway information on the generic pathway model

Below the pathway information from Figure 8, there is a window that contains information on how to use the scheme (F9c1). It is requested to read this information carefully, especially the first time.

The scheme is split into two parts (Part 1 and Part 2). The program will tell the user which part has to be filled in (see Figure 7).

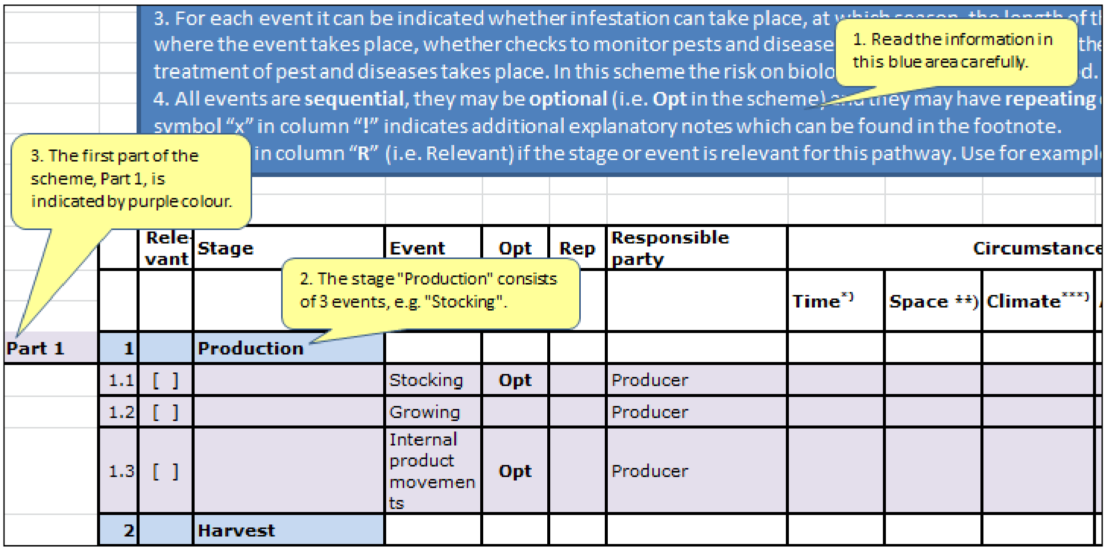


Figure 9: Generic Pathway Model

The scheme consists of several stages (F8c2) of Part 1 (in purple, F8c3) or Part 2. Stages are further divided into events. For the commodity, for each relevant stage and events, responsible parties, physical circumstances, and control points including checks and treatments can be filled in. If required, the user can extend the width of the rows or columns, or insert rows if there are more processing steps.

All stages are described in table 1 and all events are described in table 2, which also explains the circumstances and control points.

Table 1: Description of stages

Stage	Occurs	Description
Production	Always	The production of the commodity itself or - in the case of a processed product - the production of the ingredient of the commodity (e.g. the production of pigs for the salami commodity). Import of production material for this stage is not considered. The user determines the start of the pathway (e.g. start with planting of trees, or with the multiplication process or with the growing of trees).
Harvesting	Always	This stage concerns all activities between the end of the production and the moment the commodity is collected. These activities take place at the same farm.
Collect from farm	Opt/Rep	This stage is not relevant if successive stages take place on/from the farm (processing or international transport). The collection activity may be repetitive. For example, collecting of peppers: first at villages, then at cities and finally at distribution points before intercontinental transport. Mixing may take place at each collection point, which may lead to risk of infection with pest/pathogen.
Processing	Opt/Rep	Producing commodity from raw material. If the commodity has to be processed, there may be repetitive cycles of events. For example, milk factory followed by cheese factory, or slaughter followed by cutting followed by salami producer. Destruction, handling of by-products and waste is also industry processing (one of the cycles), but these products are considered only when they are treated as pathway commodity. It is possible that processing can take place at the same firm as production (e.g. on-farm cheese production).
International transport	Always	The commodity is always transported from the exporting country to the importing country. It arrives at a port, airport or other point of entry depending on the means of transport.
Distribution	Opt	Distribution is relevant when the arrival at the importing company is not the last stage. The destination of the commodity is considered irrelevant to the pathway; it may be very complex because of the wide variety or incomplete information. The destination can be a farm (e.g. seed commodity), trader, industry, storage or retail (shops).

Table 2: Description of events

	Event	Occurs	Description
1			
1.1	Stocking	Opt	The stocking of young animals, plant material or seed at the farm. It is assumed that these come from other farms in the same country; import is not considered. Stocking is not relevant (optional) in closed farms (e.g. produce own seed or piglets).
1.2	Growing		The growth phase of the animal or plant that serves as the basic material for the production of the commodity till it can be collected or harvested. For example, the growing of piglets until they are old enough for slaughter, or the growing of tomato plants until the tomatoes can be harvested. Fill in treatments/measures that are applied here and are effective in making the commodity free from pest/pathogens.
1.3	Internal product movements	Opt	If commodities have to be moved during or at the end of the production cycle. For example, pot plants to an adjacent glasshouse or animals to another stable of the same farm.

	Event	Occurs	Description
2			
2.1	Collection activity	Rep	The product is collected on the farm. This can be harvesting on arable farms, the picking of flowers, fruit or vegetables on horticulture farms, or milking on dairy farms. The event may be repetitive, for example milking or shearing of sheep.
2.2	After 'harvest' treatment	Opt	After the product is collected or harvested, treatment of the product might be necessary. List the treatments if more than one is needed. Examples of treatments are cooling, injections/ vaccinations, washing.
2.3	Packaging	Opt	If relevant, all non-treatment activities of the collected product that are necessary before the product can be stored or transported (e.g. wrapping).
2.4	Storage at farm	Opt	If the product has to be stored before it leaves the farm, describe the kind of storage. If the product has to wait only shortly, this event may be omitted. It is up to the user to decide whether and when it is called storage. The longer the time period, the more attention should be paid to storage conditions (e.g. cooling).
3			
3.1	Transport		The product is transported from the farm to a storage place.
3.2	Merging (adding/mixing)	Opt/ Rep	Before storage, the product may be merged with products from other farms. The other products can be added (without mixing) or mixing can take place (e.g. milk collection from farms).
3.3	Storage		The product is stored before it goes to the next stage.
4			
4.1	Transport to industry	Opt	It is possible that processing takes place on the same farm as production, for example on-farm cheese production. In that case, transport is not required.
4.2	Critical Processing	Opt/ Rep	This event is not relevant if processing consists only of packaging. If relevant, one or more critical processes can take place.
4.3	Packaging	Opt	The product may be packed after zero, one or more critical processing cycles. This is optional.
4.4	Storage at industry		It is assumed that the product has to be stored before being transported from the industry or farm where it has been processed.
5			
5.1	Transport to harbour, airport, …	Opt	If the commodity is not transported directly from the farm or industry to the importing country, then it is transported to a location (e.g. near the airport) where it can await transport.
5.2	Storage	Opt	Storage is optional. Here, the product is waiting at the harbour or airport till international transport (from outside EU) can take place. The storage facility can be a conditioned cell. It is assumed that merging does not take place at this location.
5.3	Transport to importing country		The commodity leaves the exporting country and crosses the border where it arrives at the point of entry.
	POINT OF ENTRY		
5.4	Domestic transp. (customs/insp.)		The commodity is always transported (directly or indirectly) from the point of entry to the importing company. Handling of customs or inspection can take place just before transport or at a later moment in the stage.
5.5	Storage (e.g. customs)	Opt	The commodity is stored if it is not going directly to the importing company.
5.6	Transport (lorry)	Opt	If stored, the commodity is transported to the importing company.
5.7	Arrival at importing company		If not already done, handling of customs or inspection can take place here. Although not specified as separate event, the commodity can be stored at this location.

	Event	Occurs	Description
6			
6.1	Transport (lorry)	Opt	If the importing company is not the final destination, it will be transported to that location.
6.2	Merging (adding/mixing)	Opt	Merging may take place. Lots that have no problems can be contaminated with pests/ pathogens.
6.3	Splitting (divergence)	Opt	Splitting may take place, pests/pathogens can be distributed to a range of firms.
6.4	Destination or distribution to consumer or retail		After the commodity arrives at the importing company, it can arrive directly or indirectly (transport, merging, splitting) at the destination where it may be distributed. See description of this stage.

Table 3: Description of circumstances and control points

Circumstance	Description
Time	Time period of the event (season, duration)
Space	Geographic location, open/closed (e.g. glasshouse), scattered, area, etc.
Climate	Temperature, humidity, annual climate pattern, etc.
Additives	Insecticides, animal medicines, etc.
Other	Any information about the event that might have an influence on pests/pathogens on/in the commodity.
Control point	
Checks	Official inspection of commodity at border or other tests/controls that check that a commodity is free of certain pathogens/pests. The user should ask him-/herself: is the commodity subject to pest/pathogen regulations aimed at monitoring commodities for the presence of pests and pathogens, such as inspections and quarantine?
Treatment	This is not a CCP (critical control point) that is used in HACCP. It is a treatment of the commodity that might have an effect on pests/pathogens on/in the commodity. For example, the use of insecticides, vaccination.

Two examples are provided to show how the generic pathway model can be used: litchis and sausage casings. As shown, not all cells are filled in. This is the consequence of a lack of relevant information.

	Relevant	Stage	Event	Opt	Rep	Responsible party	Circumstances					Control point		!	Description stage / event
							Time *)	Space **)	Climate ***)	Additives	Other	Checks ****)	Treat-ment		
1		**Production**													
1.1	[ ]		Stocking	**Opt**		Producer	0	open	see growing					**x**	Plants are propagated by air-layering. The plants are productive after three years. So
1.2	[ ]		Growing			Producer	year round	open	sub-tropical, not to humid. Average max. 30OC				applying pesticides		Litchies grow on trees, which are pruned at about 3m high
1.3	[ ]		Internal product movements	**Opt**		Producer								**x**	No
2		**Harvest**													
2.1	[ ]		Collection activity		**Rep**	Producer	september	open						**x**	**Fruits are transported to packing house**
2.2	[ ]		After "harvest" treatment	**Opt**		Producer	september	packing house					Sulphitation (CO2)	**x**	shorting grading; sulphitation takes place direct after the harvest to prevent browning
2.3	[ ]		Packaging	**Opt**		Producer	september	open						**x**	Palletisation; insects have access to fruits
2.4	[ ]		Storage at firm	**Opt**		Producer								**x**	
3		**Collect from farm**		**Opt**	**Rep**									**x**	
3.1	[ ]		Transport			Exporter/trader	sept - jan								transport in refrigerated containers
3.2	[ ]		Merging (adding/mixing)	**Opt**	**Rep**	Exporter/trader									no
3.3	[ ]		Storage			Exporter/trader	sept - jan	closed	2OC						transport in refrigerated containers
4		**Processing**		**Opt**	**Rep**									**x**	Most litchees are used for fresh production; part of the lychees are processed for juice, icecream. Since fresh litchees are assumed to be the most risky intended use, this analysis is limited to fresh products
4.1	[ ]		Transport to industry	**Opt**		Proc.Plant /Trade									
4.2	[ ]		Critical Processing	**Opt**	**Rep**	Processing plant									
4.3	[ ]		Packaging	**Opt**											
4.4	[ ]		Storage at industry			Processing plant									
5		**Int. transport**													
5.1	[ ]		Transport to harbour, airport,...	**Opt**		Exporter/trader	sept - jan	closed	2OC				no		mainly harbour, partly airport, uncertain whether phytosanitary checks take place
5.2	[ ]		Storage	**Opt**										**x**	
5.3	[ ]		Transport to importing country			Exporter/trader	okt - march	closed	2OC						
			POINT OF ENTRY												
5.4	[ ]		Domestic transp.(customs /insp.)			Importer	okt - march	closed	2OC						
5.5	[ ]		Storage (e.a. customs)	**Opt**		Importer	okt - march	closed	2OC						
5.6	[ ]		Transport (Lorry)	**Opt**		Importer	okt - march	closed	2OC						
5.7	[ ]		Arrival Importing company			Imp. company	okt - march	closed	2OC					**x**	
6		**Distribution**		**Opt**										**x**	
6.1	[ ]		Transport (Lorry)	**Opt**		Distributor	okt - march	closed	2OC						
6.2	[ ]		Merging (adding/mixing)	**Opt**		Distributor									
6.3	[ ]		Splitting (divergence)	**Opt**		Distributor									
6.4	[ ]		Destination or distribution to consumer or retail			Distributor	okt - march	closed	2OC						

Figure 10: Generic Pathway model, filled in for Litchi

	Rele-vant	Stage	Event	Opt	Rep	Responsible party	Circumstances					Control point		!	Description stage / event
							Time *)	Space **)	Climate ***)	Additives	Other	Checks ****)	Treat-ment		
1		Production													
1.1	[ ]		Stocking	Opt		Producer								x	
1.2	[ ]		Growing			Producer	Years	grassland	Warm						Growing of sheep/lambs
1.3	[ ]		Internal product movements	Opt		Producer								x	
2		Harvest													
2.1	[ ]		Collection activity		Rep	Producer								x	
2.2	[ ]		After “harvest” treatment	Opt		Producer								x	
2.3	[ ]		Packaging	Opt		Producer								x	
2.4	[ ]		Storage at firm	Opt		Producer								x	
3		Collect from farm		Opt	Rep									x	
3.1	[ ]		Transport			Exporter/trader	2-24 hours	Truck	Warm						Transport to slaughterhouse
3.2	[ ]		Merging (adding/mixing)	Opt	Rep	Exporter/trader									Mixing with other sheep that are collected from different farms
3.3	[ ]		Storage			Exporter/trader									
4		Processing		Opt	Rep									x	
4.1 a	[ ]		Transport to industry	Opt		Proc.Plant /Trade									Transport to slaughterhouse
4.2 a	[ ]		Critical Processing	Opt	Rep	Processing plant									Slaughter process, from living animal to carcass; Intestines that will be used for casings are separated from the total package of guts, stomach, etc.
4.3 a	[ ]		Packaging	Opt											
4.4 a	[ ]		Storage at industry			Processing plant									Storage of intestines before transport
4.1 .b			Transport to industry												Transport to casings factory
4.2 .b			Critical Processing							Salt					Casings production
4.3 .b			Packaging												Packaging of casings
4.4 .b			Storage at industry												Storage before transport
5		Int. transport													
5.1	[ ]		Transport to harbour, airport,...	Opt		Exporter/trader									Transport to harbour
5.2	[ ]		Storage	Opt										x	Storage before loading on boat
5.3	[ ]		Transport to importing country			Exporter/trader									Boat transport
			POINT OF ENTRY									Border check			
5.4	[ ]		Domestic transp.(customs /insp.)			Importer									
5.5	[ ]		Storage (e.a. customs)	Opt		Importer									Storage at customs
5.6	[ ]		Transport (Lorry)	Opt		Importer									Transport to sausage factory
5.7	[ ]		Arrival Importing company			Imp. company								x	Arrival at suasage factory
6		Distribution		Opt										x	
6.1	[ ]		Transport (Lorry)	Opt		Distributor									
6.2	[ ]		Merging (adding/mixing)	Opt		Distributor									
6.3	[ ]		Splitting (divergence)	Opt		Distributor									
6.4	[ ]		Destination or distribution to consumer or retail			Distributor									

Figure 11: Generic Pathway model, filled in for Sausage casings

5. GOING THROUGH THE LEVELS

The user is guided through the program. There are seven routes (Figure 1). The route that consists of all levels is:

*Start->**Level0**->List of products->Level0->Pathway Part1->**Level1**->Pathway Part2->**Level2**->Add.cont.->End->Report->End->Stop*

In Levels 1 and 2, the user is guided in the same way as in Level 0 (see section 3: ‘Going through the questions’). At the bottom of both levels, intermediate results about the risk of species categories are presented. Figure 12 is an example of this, from Level 1 of the Litchi case.

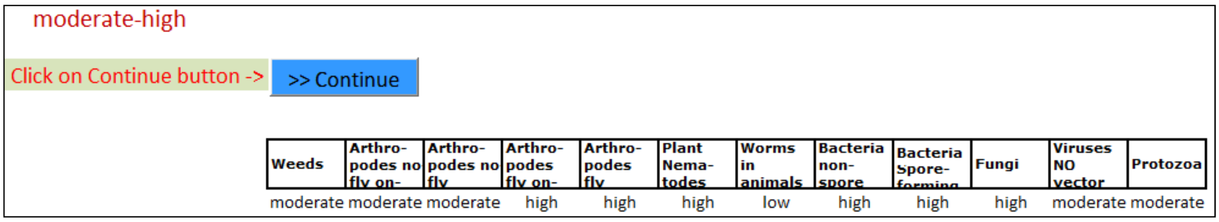


Figure 12: Result of Level 1 of the Litchi case

The overall risk of Level 1 of this case is 'moderate to high'. The model derives this risk from the individual pest/pathogen categories risk. This is not just an average or the maximum, but based on following rules:

Overall risk	Rule to infer overall risk
low	all risks of pest/pathogen categories are 'low'
low-moderate	one or two are 'moderate' and none is 'high'
moderate	more than two are 'moderate' and none is 'high'
moderate-high	the average is less than 2.5 (where 'low'=1, 'moderate'=2, 'high'=3)
high	average is 2.5 or more

Based on the species risks, it can easily be calculated that the average is 2.42 ('low'=1, etc.). The rules in the table make it clear that the overall risk of Level 1 of the Litchi case is 'moderate to high'.

Different cases may lead to different results. For example, the sausage casing case has an overall risk of 'low to moderate' after Level 1. There are two pest/pathogen categories that have the score 'moderate' and the rest have 'low'; according to the rules in the table (second rule), this classification is correct.

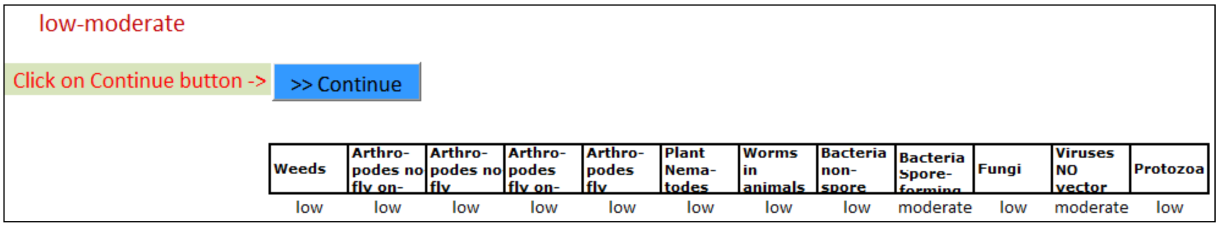


Figure 11: Result of Level 1 of the Sausage Casing case

Level 2 is visited after Part 2 of the generic pathway model, and this level is comparable to Level 1. Question 8a ('8a. Is there a climate match between the country of origin and the EU?') is not relevant when the destination is EU. In that case, this question is coloured grey.

When the overall risk is not 'low', the user is advised by a message to conduct full risk assessments for all organisms that have not previously been subject to assessment and have a high likelihood of infesting local hosts or coming into contact with local hosts. The program proceeds with the 'Additional Content' sheet.

⚠ *Different answers to questions will not always result in a change of the risk of individual species or overall risk.*

Level	Question	Answer categories	Source of information	Example of answers based on sausage casings and litchi cases	Remarks	Continuation
0	1. Can the commodity turn into pest?	Yes, no	Expertise. For plants, a weed risk assessment scheme can be applied (Australia 2008)	Sausage casings: No Litchi: No. Litchi is a tropical fruit, and will not grow in Europe	This can only be the case for living animals and plants that have never before been imported into the EU	If 'Yes', conduct full risk assessment for this plant or animal (not part of the decision tree); afterwards go to q2. If 'No', go directly to q2.
0	2. What is the state of the commodity?	Alive, fresh or chilled, frozen, preserved (with subcategories), processed (with subcategories)	Commodity database in decision tree	Sausage casings: Preserved (salted, in brine) Litchi: Fresh or chilled		Go to q3
0	3a. What is the intended use of the commodity?	Propagation multiplication/ production, ornamental use, agricultural input, feed, direct human consumption, processing for food, processing otherwise	Commodity database in decision tree	Sausage casings: Processing for food Litchi: Direct human consumption		Go to q4
0	3b. Details, only relevant if preserved or processed	A predefined list is given	Commodity database in decision tree	Sausage casings: Preserved (salted, in brine) Litchi: Not relevant		Go to q4
0	Conclusion level 0: What is the likelihood that the total volume of the imported commodity is infested with any pest/ pathogen based on the state of the commodity and the intended use?	High: It is likely that infestation of local hosts will take place. Moderate: Infestation of local hosts is possible Low: The likelihood of infestation is negligible	Table 3.1 of report	Sausage casings: The likelihood is low → it is recommended to stop the analysis Litchi: The likelihood is moderate → it is recommended to continue the analysis by filling in the pathway model and Level 1	In the decision tree, answering this question will be automated. Consider all relevant pest/pathogen categories	If likelihood level is high, collect list of potential pests/pathogens associated with the commodity, conduct full risk assessment for all organisms that have not previously been subject to assessment (not part of the decision tree). If likelihood level is moderate, describe pathway, part 1

Level	Question	Answer categories	Source of information	Example of answers based on sausage casings and litchi cases	Remarks	Continuation
						(Appendix 1) and go to q4. If likelihood level is low, go to q10
1	4a. Is unpolluted water (tap water, rainwater, deep groundwater) used for production of the commodity?	Yes, No	Expertise, desk research	Sausage casings: No, use of possibly polluted surface water Litchi: No, production takes place outside. The water is therefore polluted.	The infestation can take place at different stages in the process before transport and storage	Go to 4b
1	4b. Is the commodity produced in a building (for example stable, glasshouse, etc.) with air filter system for incoming air or nets over the windows to keep arthropods out?	Yes, No	Expertise, desk research, standards and legislation in country of origin	Sausage casings: No, sheep are kept in open fields Litchi: No		Go to 4c
1	4c. Does the commodity come into contact with the outside environment (wildlife, unsterilized soil, grass, seawater etc.)?	Yes, No	Expertise, desk research	Sausage casings: Yes Litchi: Yes, litchi trees are grown in orchards and are therefore not protected from contact with the outside environment.		Go to 5
1	5. What kind of measures are applied to control pests and pathogens?	To make the commodity pest/ pathogen free To prevent damage to the commodity No measures	Expertise, desk research, EU inspection reports: http://ec.europa.eu/food/fvo/index_en.cfm?reptoshow=3	Sausage casings: Measures to prevent damage to commodity, for example vaccinations Litchi: Measures to prevent damage to the fruits. This implies that measures are not intended to make the commodity pest/pathogen free, but to	Measures to make the commodity pest/ pathogen free imply e.g. tissue culture. Measures to prevent damage to the commodity are regular crop protection and use of medicines for animals.	Go to 6

Level	Question	Answer categories	Source of information	Example of answers based on sausage casings and litchi cases	Remarks	Continuation
				prevent financial losses caused by pests/pathogens.		
1	6. Is the commodity subject to pest/pathogen regulations aimed at monitoring commodities for the presence of pests and pathogens, such as inspections and quarantine?	Yes, No	Expertise, desk research, EU inspection reports: http://ec.europa.eu/food/fvo/index_en.cfm?reptoshow=3	Sausage casings: No Litchi: No. In the past some experiments have been executed, but are not being continued.		Go to 7
1	7. Is packaging effective to prevent infestation?	Yes, No	Expertise, desk research	Sausage casings: Yes, sausage casings are hermetically packed Litchi: No. The fruits are stored in open boxes, which are accessible to pests and pathogens from outside.	Consult the pathway model: infestation can also take place after the application of measures! Effective packaging prevents pests/pathogens for coming into contact with the commodity. The commodity should be hermetically isolated by totally closed containers or individually packed in plastic, sealed pallet boxes, etc. In the case of package in open pallet boxes, paper boxes, etc., pests and pathogens still have access to the commodity.	Go to q7
1	What is the likelihood of survival of any pest/pathogen during production and trade process despite	High: It is likely Moderate: It is possible Low: The likelihood is negligible	Question 2, Table 3.5 of report	Sausage casings: Low to moderate: for most pathogens it is low, for spore-forming bacteria and viruses it is moderate		

Level	Question	Answer categories	Source of information	Example of answers based on sausage casings and litchi cases	Remarks	Continuation
	commercial measures affecting the state of the commodity?			Litchi: High. The fruits are not subject to commercial procedures affecting the survival of pests and pathogens.		
1	Conclusion: What is the likelihood of survival of any pest/pathogen on the commodity	High: It is likely Moderate: It is possible Low: the likelihood is negligible	Apply table 3.7 of report (matrix based on minimum rule)	Sausage casings: The likelihood of survival of any pest/pathogen on the commodity is low to moderate. In this case it can be decided to stop the analysis Litchi: The likelihood of survival of any pest/pathogen on the commodity, given the answers on q5, q6, q7 and the question regarding the commercial measures (derived from the answer on question 2) is moderate to high, which implies that it is highly recommended to proceed with the analysis in level 2.		If likelihood level is high, describe pathway, part 2 (appendix 1), go to q8a. If likelihood level is moderate, consider describing pathway, part 2 (appendix 1) and continue with q8a; otherwise go to q10. If likelihood level is low, go to q10
2	8a. Is there a climate match between the country of origin and the country of destination?	Yes, No	Expertise, desk research	Sausage casings: Yes Litchi: No, the tropical climate of Madagascar differs from the Dutch climate	Question only relevant if country of destination is not EU. Consider minimum, maximum, average temperature and average rainfall, dry/wet seasons	Go to q8b
2	8b. Is there a seasonal match between the	Yes, No	Google maps	Sausage casings: Yes Litchi: No, Madagascar is	Assess whether country of origin is below the	Go to q9

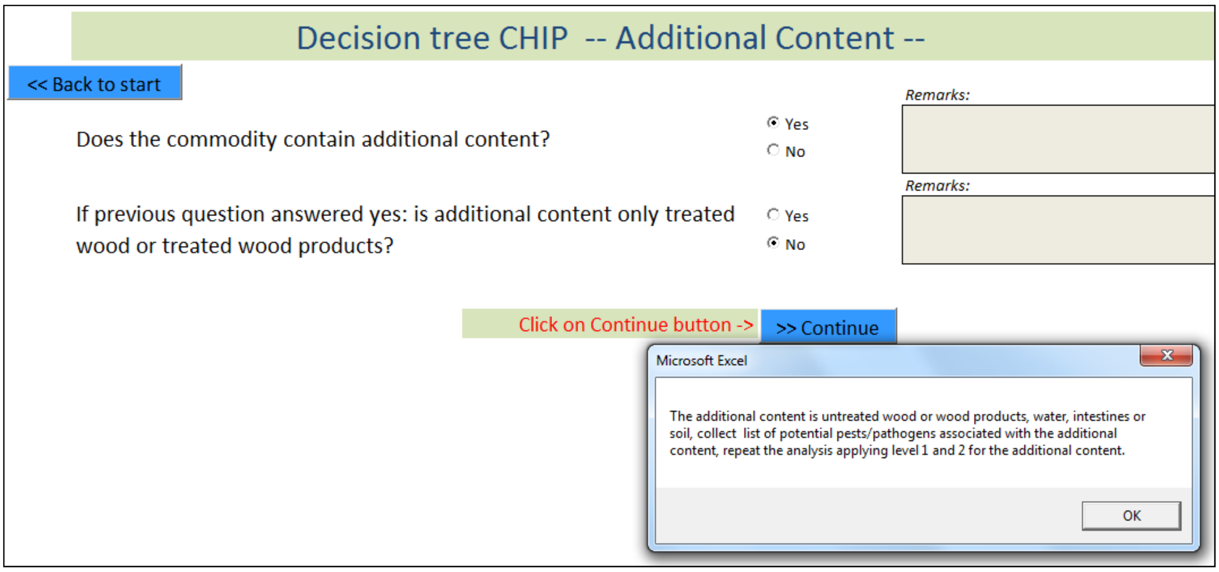
Level	Question	Answer categories	Source of information	Example of answers based on sausage casings and litchi cases	Remarks	Continuation
	country of origin and the country of destination?			on the other side of the equator.	equator	
2	9. Is the commodity placed in quarantine after entry and/or subject to inspection?	Yes, no	Expertise, desk research, EU inspection reports: http://ec.europa.eu/food/fvo/index_en.cfm?reptoshow=3, and websites: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:021:0001:0029:EN:PDF http://ec.europa.eu/food/animal/bips/news_en.htm website of local inspection agency	Sausage casings: Yes. No quarantine measures are applied, but there are border inspection upon entry into the EU Litchi: No, litchis are not subject to inspections		Go to q10
2	What is the likelihood of pest/pathogen categories infesting local hosts by independent movement of the pest/pathogen?	High: It is likely Moderate: It is possible Low: The likelihood is negligible	Question 7	Sausage casings: Low, because the commodity is hermetically packed, which prevents pests from moving away from the commodity Litchi: Varies from low to high. Especially flying arthropods are considered to have a high likelihood	It is assumed that effective packaging prevents pests/pathogens from moving out.	
2	What is the likelihood of infestation of local hosts by the commodity?	Propagation/multiplication/production, agricultural input, feed: high (it is likely); ornamental use: moderate (it is possible); direct human consumption, processing	Question 3	Sausage casings: Low, because the commodity will be processed for food Litchi: Low, because the commodities are consumed.		

Level	Question	Answer categories	Source of information	Example of answers based on sausage casings and litchi cases	Remarks	Continuation
		for food, processing otherwise: low (the likelihood is negligible)				
2	What is the likelihood of infestation of local hosts by waste?	Propagation/multiplication/production, agricultural input, feed: high (it is likely); ornamental use, direct human consumption: moderate (it is possible); processing for food, processing otherwise: low (the likelihood is negligible)	Question 3	Sausage casings: Low, because waste of the commodity will not end up in the environment of agricultural production Litchi: Moderate, because the waste (peels of litchis, seeds) can end up in the environment		
2	Conclusion level 2	High: It is likely Moderate: It is possible Low: The likelihood is negligible	Apply table 3.7 (matrix based on minimum rule) and 3.8 of report (matrix based on maximum rule) at pest/pathogen category level	Sausage casings: The final risk is low, which is the consequence of a low likelihood that pests/pathogens will survive the processing, and the commodity and pests will not come in contact with the environment or agricultural production Litchi: The results of level 2 is moderate, because the fruit is consumed directly, but there still is a risk that peels and seeds can end up in the environment.		Conduct full risk assessments for all organisms that have not previously been subject to assessment and have a high likelihood of infesting local hosts (not part of the decision tree). Consider conducting full risk assessments for all organisms that have not previously been subject to assessment and have a moderate likelihood (not part of the decision tree).
0	10a. Does the commodity contain additional content?	Yes, no	Expertise	Sausage casings: No Litchi: No	Additional content implies wood or wood products, water, intestines	If no, stop the analysis; if yes, go to q 10b.

Level	Question	Answer categories	Source of information	Example of answers based on sausage casings and litchi cases	Remarks	Continuation
					or soil	
0	10b. If previous question answered 'Yes': is additional content only treated wood or treated wood products?	Yes, no	Expertise	Sausage casings: Not relevant Litchi: Not relevant		If yes, stop the analysis; if no, conduct full risk assessments for organisms potentially associated with the additional content

6. ADDITIONAL CONTENT SHEET

If the commodity contains additional content (answer to first question 'Yes') and this is not treated (answer to second question 'No'), a message appears (see Figure 12).



1. **Figure 12**: Appearance of a message on the 'Additional Content' sheet

Only then, the following message appears on the 'End' sheet:

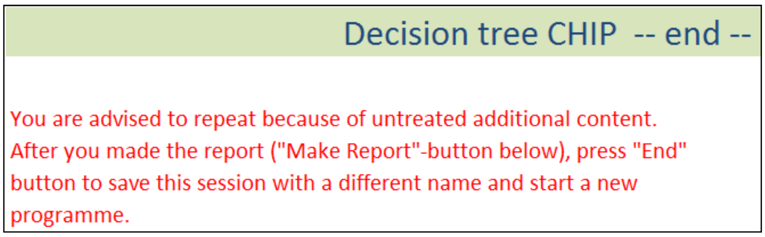


Figure 13: This red coloured text on the 'End' sheet appears only after the message shown in Figure 12

When you have finished the sheet 'Additional Content', you may go back to the start (F14c1) and check all the answers you have given. You may also modify answers or start a new session (F2c1).

⚠ *Changing an answer may lead to a different route through the program. There is a risk that answers to irrelevant questions effect the result. Instead of modifying, it is highly recommended to delete all answers and start a new session (F2c1).*

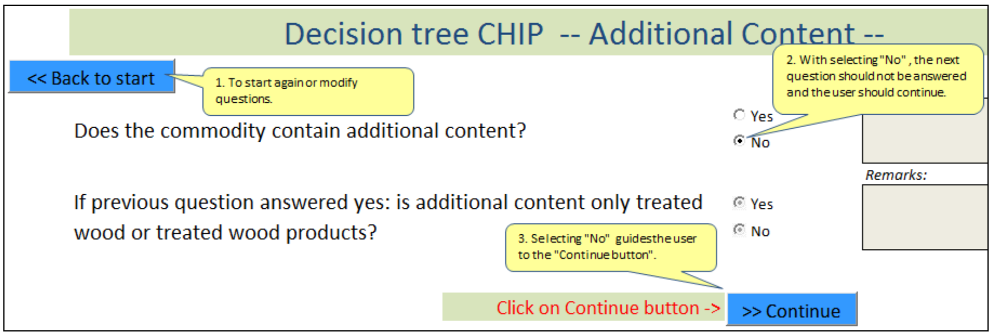


Figure 14: The 'Additional Content' sheet

7. THE END SHEET AND THE REPORT

As can be seen from Figure 1, the sheet following 'Additional content' is always the 'End' sheet. From this sheet there are three possible routes:

1. Go to the start to review your answers or to start a new session (F2c1).
2. Make a report (a detailed overview of the answers and results).
3. Stop the session ('End' button).

> ⚠ *If you stop the program, the Excel file will close. Make sure you save your work!*

> *It is highly recommended to press the 'Make Report' button before exiting program.*

After pressing the 'Make Report' button, a detailed sheet of results appears. Scroll down to see all the results. Figure 15 shows part of the report from the Sausage Casing case. Answers to the questions are shown in italics.

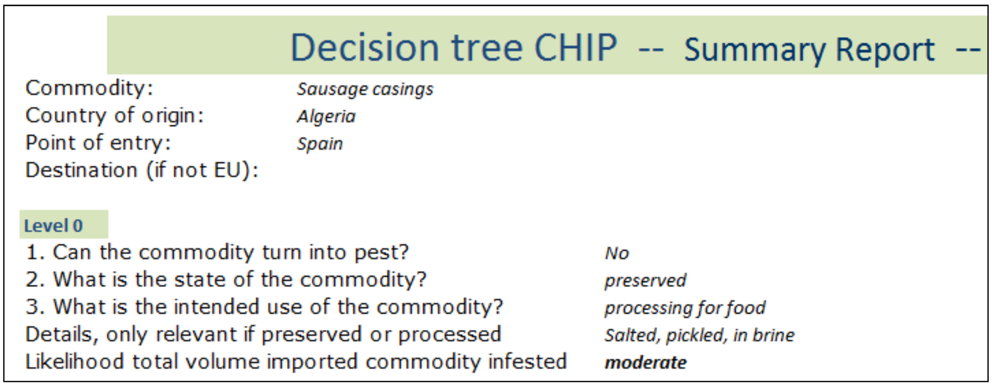
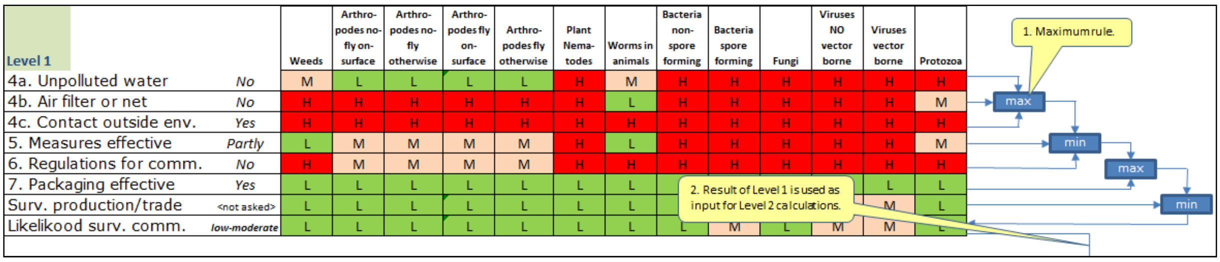


Figure 15: Answers to questions in Level 0 (part of the 'Report' sheet)

Results of all questions and summarizations are indicated by colours and symbols:
H (red background) indicates 'high' risk
M (pink background) indicates 'moderate' risk
L (green background) indicates 'low' risk



Level 1		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
4a. Unpolluted water	*No*	M	L	L	L	L	H	M	H	H	H	H	H	H
4b. Air filter or net	*No*	H	H	H	H	H	H	L	H	H	H	H	H	M
4c. Contact outside env.	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
5. Measures effective	*Partly*	L	M	M	M	M	H	L	H	H	H	H	H	M
6. Regulations for comm.	*No*	H	M	M	M	M	H	H	H	H	H	H	H	H
7. Packaging effective	*Yes*	L	L	L	L	L	L	L	[illegible]	[illegible]	[illegible]	[illegible]	L	L
Surv. production/trade	<not asked>	L	L	L	L	L	L	L	[illegible]	[illegible]	[illegible]	[illegible]	M	L
Likelikood surv. comm.	*low-moderate*	L	L	L	L	L	L	L	L	M	L	M	M	L

Figure 16: Part of the report from the Sausage Casing case; calculation rules on the right side

The report shows how to combine risks in order to summarize and come to conclusions per level and at an overall level. There are two summarizing rules applied:
max: the maximum of the risks (e.g. F16c1)
min: the minimum of the risks

Deduction by means of these rules is illustrated for the Sausage Casing case with 'Protozoa' (Figure 16). For Level 1, this is done in the following steps:

1. 4a=H , 4b=M , 4c=H –max→ H
2. Step1=H , 5=M , 6=H –min→ M
3. Step2=M , 7=L –max→ M
4. Step3=M , Surv.=L –min→ L = result Level 1 for 'Protozoa' is 'Low'

The result of Level 1 is used as input for the deduction of Level 2 (illustrated by a down arrow, F16c2).

The 'Report' sheet also contains all the remarks made by the user.

8. TROUBLESHOOTING

<u>Risk category different from expected</u>
If one of the outcomes is different from expected (e.g. 'high' instead of 'moderate'), consult the tables in the report describing the decision tree or inspect the Report sheet after you have finished the session. The 'anomaly' may be explained by the min/max rules.

<u>Buttons not reacting</u>

> ⚠ *If the buttons don't work (no reaction when clicked), please ensure that macros are enabled. Otherwise, ask your organization's Excel expert to change the macro security options.*

<u>When a button is clicked</u>
The Decision Tree Model is a model in Excel that uses Visual Basic for Applications (VBA). Especially VBA might cause errors that are not apparent. Figure 17 shows an example.

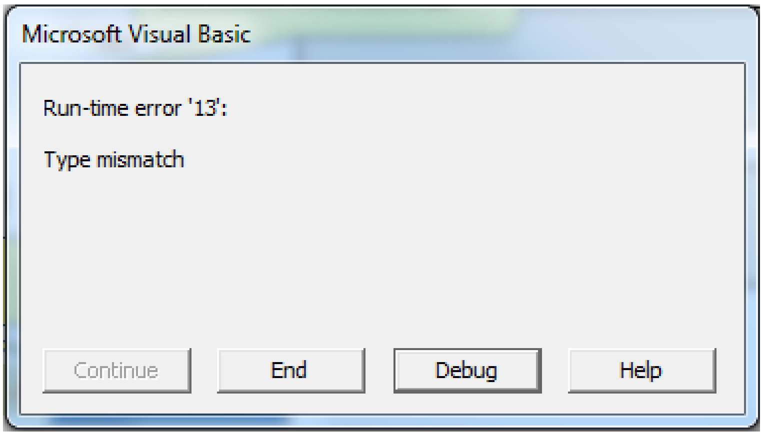


Figure 17: Error from VBA

> ***For this error and all errors below**: If you cannot figure out what went wrong or are unable to make a correction, exit the program without saving and start again with the last saved version or start with an empty program. It is important that you save regularly.*

<u>Conclusion not shown (properly)</u>

After all questions have been answered on a level sheet and there is no conclusion or there appears a text '#DIV/0!' (or some other text except a risk category), there has presumable been a mistake in answering a question or an Excel cell has been accidentally deleted.

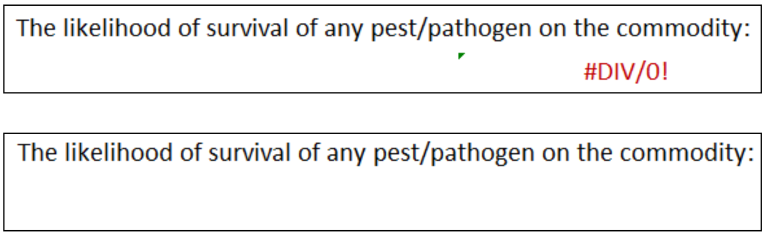


Figure 18: Error showing result of the level

<u>Report does not show all the results</u>

Make sure that you only use the buttons while using the program. Perhaps you have clicked the 'Report' sheet tab. If so, go back to the 'End' sheet and continue by clicking on the 'Make report' button.

APPENDIX 7: CASE STUDIES

1 INTRODUCTION AND OBJECTIVE

The first version of the decision support tree was tested with case studies, in order to see whether the model is technically correct and to demonstrate its application.

2 METHODOLOGY

Six commodities were chosen for case studies. The following criteria were applied to select the case studies:
Both animal and plant products (equally distributed).
Variation in type of product: live, processed, etc.
Variation in assumed likelihood level.

The case studies were conducted by the team members. The information was collected on the basis of the expertise of the team members, and from papers and documents available on the web. The whole analysis per case study was executed in about one day, in order to test whether the decision support tree can be applied within a suitable time scale.

Even if the decision support tree recommended stopping the analysis after the application of level 0 or level 1, the analysis was continued at the next level, for demonstration purposes and to check the internal consistency between level 0 and levels 1 and 2.

The decision tree was adjusted on the basis of the results of the case studies.

3 RESULTS

The following case studies were carried out: Pacific oyster imported from China, frozen poultry from Thailand, sausage casings from Algeria, litchis from Madagascar, tomato seed from Mexico and trees from Canada.

The case studies resulted in a number of adjustments to the first version of the decision tree, which comprised four levels. Level 2 contained questions about storage and transport conditions. However, it turned out that those aspects had very limited discriminatory power and did not add to the final conclusion. This is because storage and transport conditions are intended to keep the quality of the commodity at a high level, but do not usually involve additional treatments that affect pest and pathogen survival.

Furthermore, it turned out that the question about production under protected conditions needed to be accentuated, in order to assess the likelihood of pest and pathogen association with the commodity during production. This resulted in three routes of association being included in level 1, question 4: by water, by air or by physical contact with the outside environment. The question regarding whether measures are applied that are effective in making the commodity pest and pathogen free with the answers ‘yes’ and ‘no’, has been changed into a question that asks what measures are applied. This enables the risk assessor to distinguish between measures that make the commodity totally free and those that only prevent damage to the commodity.

The case studies were repeated with the final version of the decision support tree. The case studies are reported in Appendix 7a.

A comparison of the results of level 0 with the final results is presented in table 1. It should be noted that level 0 has three potential scores – high, medium and low – and that levels 1 and 2 have two additional potential scores, namely moderate to high, and low to moderate. In three cases, the final result is exactly the same as the result of level 0, and in three cases slightly different.

Table 1: Comparison of results of level 0 and level 2

Commodity	Result level 0	Result level 2 (final result)
Pacific oyster	Moderate	Moderate to high
Frozen poultry	Moderate	Moderate
Sausage casings	Low	Low
Litchi	Moderate	Moderate
Tomato seed	High	Moderate to high
Trees	High	Moderate to high

Given that those categories do not exist in level 0, the results show consistency between level 0 and levels 1 and 2.

4 DISCUSSION AND RECOMMENDATIONS

The case studies turned out to be a useful instrument to test whether the decision support tree functions properly. It also helped to test the discriminating power of the individual questions. The case studies could not be applied to assess the reliability of the results, because there is no independent source of empirical data that can serve for validation of the results. Most databases containing data on interceptions of contaminated commodities (such as EUROPHYT and TRACES) contain data only on the intercepted commodities, and not on the whole production volume. Furthermore, interceptions take place as a consequence of monitoring, which is focussed on commodities with a high perceived likelihood level of contamination or infestation.

The presentation of the results of case studies to experts with knowledge of the organism in question may cause doubt about the validity of the results. This is because these experts know the biological hazards associated with the commodity. An example is infestation of sausage casings with foot and mouth disease. It must be kept in mind that the decision support tree is intended to prioritize commodities. Therefore, this does not imply that the infestation of commodities with a low likelihood with pests and pathogens is impossible.

It is recommended to assess the logic of the results when completing an analysis with the decision support tree. For example, in the case of the Pacific oyster, the final risk level is moderate to high, but if we look closer at this result, it is clear that the high risk is for arthropods. However, arthropods do not play a role as pests/pathogens in oysters, and it is not likely that oysters carry arthropods with them during importation. The decision tree is a generic tool and does not contain sufficient detail to prevent these types of inconsistencies. Therefore, the user of the decision tree should always have some basic knowledge of the commodity in order to interpret the results of the decision tree.

APPENDIX 7A

CASE STUDY: PACIFIC OYSTER, IMPORTED FROM CHINA INTO THE EU

Background

Global Pacific oyster production increased from about 150 tonnes in 1950 to 750 tonnes in 1980. By 2003, global production had increased to 4.38 million tonnes. China produced 84% of the global production. Japan, France and the Republic of Korea produced 261,000, 238,000 and 115,000 tonnes, respectively. The two other major producers are the United States (43,000 tonnes) and Taiwan (23,000 tonnes).

Numerous techniques are used in the production of Pacific oysters. These techniques depend on factors such as the seed supply resources, the environmental conditions in the region and the market product, that is, whether the oysters are sold in a half shell or shelled for meat extraction. Production can either be entirely sea-based or rely on hatcheries for seed supply.

Broodstock produces larvae
Larvae are grown in sea-based or land-based nurseries. Growing almost completely sea-based takes 18–30 months to develop to the market size of 70–100 g live weight (including shell).

According to the website of the Nederlandse Voedsel en Warenautoriteit (Netherlands Food and Consumer Product Safety Authority), the import of living aquaculture animals from China is forbidden, as it is from the USA, Greenland, Korea, etc. This means that testing at the border is not prescribed. The case study is therefore completely virtual.

Decision tree

Level 0

Commodity: Pacific oyster
Country of origin: China
Point of entry: Rotterdam Harbour

Question 1: Can the commodity turn into a pest?
Answer: Yes
Explanation: This has already happened in many locations all over the world
Answer of the decision tree: Conduct full risk assessment

Question 2: What is the state of the commodity?
Answer: Live, in water

Question 3: What is the intended use of the commodity?
Answer: Direct human consumption

Conclusion of level 0

The likelihood that the total volume of the imported commodity being infested with any pest/pathogen based on the state of the commodity and the intended use is: moderate (If the oysters were to be used for multiplication/production, the likelihood would be high, and a full risk assessment should be started).

Level 1

Question 4a. Is unpolluted water (tap water, rainwater, filtered water) used for production?
Answer: No (use of polluted water, i.e. seawater)

Question 4b. Is the commodity produced in a building (stable, glasshouse, etc.) with an air filter system for incoming air or nets over the windows to keep arthropods out?
Answer: No (produced in the sea)

Question 4c. Does the commodity come into contact with the outside environment (wildlife, unsterilized soil, grass, etc.)?
Answer: Yes (not possible to prevent contact with the outside environment)

Question 5: What kind of measures are applied to control pests/pathogens?
Answer: None (because we could not find any information about possible measures in oyster production)

Question 6: Is the commodity subject to pest/pathogen regulations aimed at monitoring commodities for the presence of pests and pathogens ?
Answer: No (because we aimed for the highest possible likelihood of introduction (worst case scenario), and we were uncertain about regulations during production)

Question 7: Is packaging effective to prevent contact with new pests/pathogens?
Answer: No (the oysters are not in a package during transport, but in big water containers)

Question 8 (not asked in decision tree, but answer based on 'state of the commodity'): What is the likelihood of survival of any pest/pathogen during the production and trade process despite commercial measures affecting the state of the commodity?
Answer: High

Conclusion of level 1

The likelihood of survival of any pest/pathogen in/on the commodity: high
This means that we could stop using the decision tree and conduct a full risk assessment, but because this is a case study we continue with level 2.

Level 2

Is the decision tree used for import of commodities in EU in general? (filled in in level 0)
Answer: Yes (therefore question 8a does not need to be answered)

(Question 8a: Is there a climate match between the country of origin and the EU?
Answer: Yes (in some southern countries)

Question 8b. Is there a seasonal match between the country of origin and the EU?
Answer: Yes (in summer)

Question 9: Is the commodity placed in quarantine after entry and/or inspected for the presence of pests/pathogens?
Answer: Yes (Pacific oysters are not placed in quarantine, but there is border inspection upon entry to the EU, although this does not cover all possible pests/pathogens)
(is high for likelihood of entry/infestation local host)

Questions not asked in decision tree, but answers are based on earlier given information (question 3):

- What is the likelihood of pest/pathogen categories coming into contact with a local host by independent movement of the pest/pathogen?
  Answer (based on table 3.6 and the fact that the commodity is not packaged): high (for two pest/pathogen categories; for the others it is medium to low)
- What is the likelihood of the commodity itself coming into contact with a local host (depends on the intended use of the commodity)?
  Answer: follows automatically from decision tree: low (direct human consumption)
- What is the likelihood of the commodity's waste coming into contact with a local host?
  Answer: moderate (direct human consumption)

Conclusion level 2 (maximum of all organism groups): moderate to high

In this case it is advised to conduct a full risk assessment to find out which pests/pathogens can possibly survive in/on the commodity and can come into contact with a local host.

Additional content

Does the commodity contain additional content?
Answer: Yes (seawater)

Conclusion: repeat the decision tree for the seawater as commodity

Conclusion

Level 0 results in a moderate likelihood. Level 1 results in a high likelihood that any pest/pathogen can survive on the commodity, whereas level 2 results in a moderate to high likelihood that pests/pathogens can come into contact with a local host.

It can be seen in the report that the high likelihood at the end of level 2 is because of arthropods. In the case of oysters, arthropods do not play a role as pests/pathogens, so for the 'important' pest/pathogen categories the final result is a moderate likelihood.

Note: The decision tree was filled in without much knowledge of the production/import pathway of the pacific oyster. However, it turned out that even without much knowledge, it is possible to answer most of the questions.

The commodity has an additional content, namely seawater. Some questions are not so easy to answer for water.

Summary report

The summary report is presented in Table 1. It shows the results for all pest/pathogen categories per question and for the total, and also shows the decision rules (minimum and maximum rules).

References

http://en.wikipedia.org/wiki/Pacific_oyster

http://en.wikipedia.org/wiki/oyster_farming

http://www.waddenacademie.knaw.nl/fileadmin/inhoud/pdf/06-wadweten/Proefschriften/Proefschrift_Karin_Troost.pdf

Table 1: Summary report for Pacific oyster

Decision tree CHIP -- Summary Report --

<< Back

Commodity: *Pacific Oyster*
Country of origin: *China*
Point of entry: *Rotterdam*
Destination (if not EU):

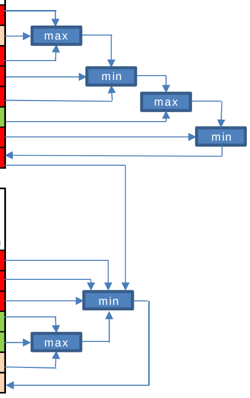
Level 0

1. Can the commodity turn into pest? *Yes*
2. What is the state of the commodity? *Live*
3. What is the intended use of the commodity? *direct human consumption*

Details, only relevant if preserved or processed *0*
Likelihood total volume imported commodity infested ***moderate***

Level 1		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
4a. Unpolluted water	*No*	M	L	L	L	L	H	M	H	H	H	H	H	H
4b. Air filter or net	*No*	H	H	H	H	H	H	L	H	H	H	H	H	M
4c. Contact outside env.	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
5. Measures effective	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
6. Regulations for comm.	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
7. Packaging effective	*No*	M	L	L	H	H	L	L	M	M	M	M	M	L
Surv. production/trade	<not asked>	H	H	H	H	H	H	H	H	H	H	H	H	H
Likelikood surv. comm.	*high*	H	H	H	H	H	H	H	H	H	H	H	H	H

Level 2		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
8a. Climate match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
8b. Seasonal match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
9. Quarantine/inspection	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
Infecting hosts org.	<not asked>	M	L	L	H	H	L	L	M	M	M	M	M	L
Infecting hosts comm.	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Infestation by waste	<not asked>	M	M	M	M	M	M	M	M	M	M	M	M	M
Final Risk	*moderate-high*	M	M	M	H	H	M	M	M	M	M	M	M	M



Additional Content

Commodity contains additional content *Yes*
Additional content treated wood / prod. *No*

Remarks

CASE STUDY: POULTRY FROM THAILAND, IMPORTED INTO THE NETHERLANDS

Background

Poultry production in Thailand can be classified into three primary systems: large-scale industrial production, semi-industrial production and smallholder backyard farming. Industrial production normally consists of vertically integrated companies that control every stage of production from breeding hens to marketing processed chicken. Backyard farming chicken products are not exported.

Thailand has one of the most advanced broiler production sectors, with levels of efficiency and overall performance equal or exceeding that of most other countries.

In 1998, EU certification of having met the standards had been issued to 22 poultry dressing plants and 29 meat processing plants in Thailand (certification includes HACCP, ISO 2000 and Good Agricultural Practices). Farms that export broilers have to comply with the Farm Standards Regulation.

Thailand is the world's fourth largest exporter of poultry products. Since the export restrictions in the wake of the HPAI outbreaks, there has been a shift to value added processed products. The primary importers of Thai poultry products are the EU and Japan. In fact, 35% of the European Union's chicken import quota is taken up by Thai companies (USDA, 2007).

In this case study, we took frozen poultry (broiler) cuts as an example. Although the import of chicken meat from Thailand is banned at the moment (see below), it was decided to carry out this case study, because it is just an example to show if the decision tree works well.

> *www.dailymail.co.uk* ***2 January 2012***
>
> ***EU bans Thai chicken amid flu scare***
>
> *Europe has banned imports of chicken meat from Thailand as a precaution against the spread of bird flu from Asia. The move follows confirmation from the Thai authorities that two boys had tested positive for the virus, reversing days of vehement denials that the country was facing a crisis. At least five people in Vietnam have already died as a result of bird flu – or avian influenza - since mid-December when the latest outbreak first emerged in Korea. A Thai man is thought to have become the latest fatality when health officials in the country said today they suspected he died of the disease. The ban today was proposed by EU food safety Commissioner David Byrne, who said: 'We cannot take any risks with public health or animal health.'*
> *Thailand is the only Asian country from which the EU imports poultry – 128,000 tonnes last year. The UK imported 36,649 tonnes of poultry meat from the country last year – up from 23,634 tonnes in 2002. The majority is used in the catering sector and for processed food. Supermarkets Tesco and Safeway confirmed it used some Thai chicken in its ready-made meals. Fast food chains Kentucky Fried Chicken and McDonald's said they had suspended use of the small amount of chicken they had previously sourced from Thailand.*
> *The EU ban, which will be reviewed on February 2, has been taken despite the low risk of the disease spreading in poultry meat. There have been no known cases of avian flu transmitting to humans through contaminated meat. However, Ben Bradshaw, animal health minister at the UK's Department for Environment, Food and Rural Affairs, said: 'I am keen to ensure we do everything possible to prevent the disease being introduced into UK poultry flocks via imports of poultry meat. Although we have assessed the risk of importing the virus in meat or meat products as low, we cannot take any chances.' Avian influenza rarely passes from birds. The first documented infection of humans occurred in Hong Kong in 1997 when the H5N1 strain caused severe respiratory disease in 18 humans, six of whom died.*

Decision tree

Level 0

Commodity: Frozen poultry
Country of origin: Thailand
Point of entry: Rotterdam Harbour (destination is the EU)

Question 1: Can the commodity turn into a pest?
Answer: No

Question 2: What is the state of the commodity?
Answer: Frozen

Question 3: What is the intended use of the commodity?
Answer: Human consumption

Conclusion of level 0

The likelihood that the total volume of the imported commodity being infested with any pest/pathogen based on the state of the commodity and the intended use is (based on table 3.1 in report): **moderate**

In the case of a moderate likelihood it can be decided to stop with the decision tree, but in this case we proceed with level 1. When you click to continue, you are asked to fill in the pathway model, level 1.

Level 1

Question 4a: Is unpolluted water (tap water, rainwater, filtered water) used for production?
Answer: Yes (the chickens are kept indoors and are provided with controlled water)

Question 4b. Is the commodity produced in a building (for example stable/glasshouse, etc.) with an air filter system for incoming air or nets over the windows to keep arthropods out?
Answer: No (the chickens are reared in a poultry house, but the air will not be filtered)

Question 4c. Does the commodity come into contact with the outside environment (wildlife, unsterilized soil, grass, etc.)?
Answer: No (the chickens are reared in a poultry house isolated from the outside environment)

Question 5: What kind of measures are applied to control pests/pathogens?
Answer: Measures to prevent damage to the commodity (some vaccinations, controlled feed, etc.)

Question 6: Is the commodity subject to pest/pathogen regulations aimed at monitoring commodities for the presence of pests and pathogens ?
Answer: No (we not know the answer, so chose to answer ‘No’)

Question 7: Is packaging effective to prevent contact with new pests/pathogens?
Answer: Yes (frozen chickens are packed together in small plastic containers, which are isolated from the environment to keep them frozen)

Question 2 (not asked in decision tree, but answer based on 'state of the commodity' question): What is the likelihood of survival of any pest/pathogen during production and trade process despite commercial measures affecting the state of the commodity?
Answer (table 3.5): High

Conclusion of level 1

The likelihood of survival of any pest/pathogen on the commodity is moderate to high

Level 2

Is the decision tree used for imports into the EU in general? (filled in in level 0)
Answer: Yes (then question 8a does not need to be answered)
(Question 8a: Is there a climate match between the country of origin and the EU?
Answer: Yes (in some southern countries)

Question 8b. Is there a seasonal match between the country of origin and the EU?
Answer: Yes (in summer)

Question 9: Is the commodity placed in quarantine and/or inspected after entry?
Answer: Yes (no quarantine but there is border inspection upon entry into the EU)

Questions not asked in decision tree, but answers based on information given earlier (question 3):
- What is the likelihood of pest/pathogen categories coming into contact with a local host by independent movement of the pest/pathogen?
  Answer (based on table 3.6, and the fact that the commodity is packaged): Low
- What is the likelihood of the commodity itself coming into contact with a local host (depends on the intended use of the commodity)?
  Answer: Low (follows automatically from decision tree (direct human consumption))
- What is the likelihood of the commodity's waste coming into contact with a local host?
  Answer: Moderate (direct human consumption)

Conclusion of level 2

Final risk (maximum of all organism groups): **Moderate**

Additional content

Does the commodity contain additional content?
Answer: No

Conclusion

The conclusion is that there is a moderate likelihood that frozen poultry is contaminated with pests/pathogens that can come into contact with local hosts.

Summary report

The summary report is presented in Table 2. It shows the results for all pest/pathogen categories per question and for the total, and also shows the decision rules (minimum and maximum rules). The table shows that the likelihood is moderate for arthropods not living on the surface of commodities, nematodes (not relevant for poultry), bacteria, fungi and viruses. This is a result of the combination of the frozen state of the commodity, inspection at the border of the importing country and the possibility that waste comes into contact with local hosts.

References

http://www.fao.org/ag/againfo/programmes/en/pplpi/docarc/rep-0809_thaipoultrychain.pdf

http://www.fao.org/ag/againfo/resources/en/publications/sector_reports/lsr_THA.pdf\

Table 2: Summary report for frozen poultry

Decision tree CHIP -- Summary Report --

<< Back

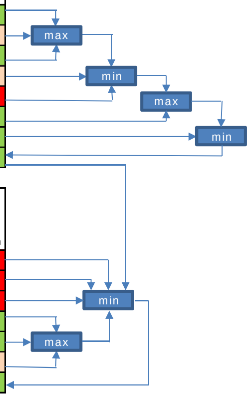
Commodity:	*Frozen poultry*
Country of origin:	*Thailand*
Point of entry:	*Rotterdam Harbour*
Destination (if not EU):	

Level 0

1. Can the commodity turn into pest?	*No*
2. What is the state of the commodity?	*frozen*
3. What is the intended use of the commodity?	*direct human consumption*
Details, only relevant if preserved or processed	*0*
Likelihood total volume imported commodity infested	***moderate***

Level 1		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
4a. Unpolluted water	*Yes*	L	L	L	L	L	L	L	L	L	L	L	L	L
4b. Air filter or net	*No*	H	H	H	H	H	H	L	H	H	H	H	H	M
4c. Contact outside env.	*No*	L	L	L	L	L	L	L	L	L	L	L	L	L
5. Measures effective	*Partly*	L	M	M	M	M	H	L	H	H	H	H	H	M
6. Regulations for comm.	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
7. Packaging effective	*Yes*	L	L	L	L	L	L	L	L	L	L	L	L	L
Surv. production/trade	<not asked>	H	H	H	H	H	H	L	M	H	H	M	M	L
Likelikood surv. comm.	***moderate-high***	L	M	M	M	M	H	L	M	H	H	M	M	L

Level 2		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
8a. Climate match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
8b. Seasonal match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
9. Quarantine/inspection	*Yes*	H	L	H	L	H	H	H	M	H	M	H	H	H
Infecting hosts org.	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Infecting hosts comm.	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Infestation by waste	<not asked>	M	M	M	M	M	M	M	M	M	M	M	M	M
Final Risk	***moderate***	L	L	M	L	M	M	L	M	M	M	M	M	L



Additional Content

Commodity contains additional content	*No*
Additional content treated wood / prod.	

Remarks

CASE STUDY: NATURAL SAUSAGE CASINGS FROM ALGERIA IMPORTED INTO THE EU (SPAIN)

Background

Natural sausage casings used in sausage production are derived from the intestinal tract or bladders of farm animals (pigs, sheep, goats, cattle and horses). They have been scraped and cleaned, and been treated with salt (NaCl) or dried after cleaning.

For this case it was chosen to take sausage casings originating from the intestines of sheep. The most common treatment for natural sausage casings involves the use of (NaCl) or brine (saturated salt solution).

Treated and untreated casings fall under CN code 0504 00 00 (‘Guts, bladders and stomachs of animals (other than fish), whole and pieces thereof, fresh, chilled, frozen, salted, in brine, dried or smoked’). When casings are produced from sheep, only the small intestines are used, particularly the duodenum and jejunum, and sometimes also the ileum. Natural casings originating from pigs or small ruminants, consist of the tunica submucosa, after the cleaning process is finished. Intestinal mucosa, Peyer’s patches and the outer layers are removed completely.

Production of natural casings (in brief)
Slaughter
Intestines removed from attached organs (liver, spleen, etc.)
Intestines pulled from the mesentery
SRM removed
Manure stripped out

Result: ‘untreated intestines’ or ‘green runners’
Untreated intestines transported to cleaning operation in chilled water or frozen
Sheep casings are fermented for 1–7 days to facilitate the removal of the various layers
Mucosa and musculary and serosa layers removed
Casings cooled off in cold water bath or cold salt brine tank
Salted by hand or machine
Put in bundles or nets and stored in closed casks
Transported to sorting operations
Rinsed in water and desalted to facilitate sorting
Filled with water, calibre measured, graded, classified
Repacked as bundles in dry salt or saturated brine
Transported to distribution centre or sausage producer

Country of origin

Algeria was chosen as country of origin just as an example.
In 2011, the following notifiable animal diseases were found in Algeria (source: WAHID):
American foul brood of honey bees (not relevant to sheep)
Bluetongue
Bovine tuberculosis
Brucellosis (*B. abortus and B. melitensis*)
Echinococcosis/hydatidosis
Leishmaniosis
Peste des petits ruminants

Rabies
Sheep pox and goat pox
Varroosis of honey bees (not relevant to sheep)

Decision tree

Level 0

Commodity: Sausage casings
Country of origin: Algeria
Point of entry: Spain (destination is the EU)

Question 1. Can the commodity turn into a pest?
Answer: No

Question 2. What is the state of the commodity?
Answer: Preserved (salted, in brine)
Question 3. What is the intended use of the commodity?
Answer: Processing for food

Conclusion of level 0

The likelihood that the total volume of the imported commodity being infested with any pest/pathogen based on the state of the commodity and the intended use is: Low
(based on table 3.1 in report)

In the case of a low likelihood, it is recommended to stop the analysis with the decision tree, but in this case we continue with level 1.

Level 1

Question 4a. Is unpolluted water (tap water, rainwater, filtered water) used for production?
Answer: No (use of possibly polluted surface water)
Result from table 3.3: High for survival

Question 4b. Is the commodity produced in a building (stable, glasshouse, etc.) with an air filter system for incoming air or nets over the windows to keep arthropods out?
Answer: No (sheep are kept in open fields)
Result from table 3.3: High for survival

Question 4c. Does the commodity come into contact with the outside environment (wildlife, unsterilized soil, grass, etc.)?
Answer: Yes
Result from table 3.3: High for survival

Result of question 4 with maximum rule (table 3.8): High (not for each category of pest/pathogens; see decision tree in Excel)

Question 5: What kind of measures are applied to control pest/pathogens?
Answer: Measures to prevent damage to commodity, for example vaccinations (in table 3.4: High for survival)

Question 6: Is the commodity subject to pest/pathogen regulations in order to check the presence of pests and pathogens ?
Answer: No (no information could be found concerning whether Algeria prescribes special regulations for the production of sausage casings)

Question 7: Is packaging effective to prevent infestation during transport and storage?
Answer: Yes (is low for survival)

Question 8 (not asked in decision tree, but answer based on 'state of the commodity'): What is the likelihood of survival of any pest/pathogen during production and trade process despite commercial measures affecting the state of the commodity?
Answer (table 3.5): Low to moderate (for most pathogens it is low, for spore-forming bacteria and viruses it is moderate)

Result of level 1

The likelihood of survival of any pest/pathogen on the commodity: **low to moderate**

In this case it can be decided to stop; however, for case study reasons, we also conducted level 2 of the decision tree.

Level 2

Is the decision tree used for imports into the EU in general?
Answer: Yes (then question 8a does not need to be answered)
(Question 8a: Is there a climate match between the country of origin and the EU?
Answer: Yes (in some southern countries) (is High for survival, table 3.6))

Question 8b. Is there a seasonal match between the country of origin and the EU?
Answer: Yes (in summer) (is High for survival, table 3.6)

Question 9: Is the commodity placed in quarantine and/or inspected after entry?
Answer: No quarantine, but there is border inspection upon entry to the EU
(is High for likelihood of entry/infestation of local host)

Questions not asked in decision tree, but answers based on information given earlier:

- What is the likelihood of pest/pathogen categories coming into contact with a local host by independent movement of the pest/pathogen?
  Answer (based on table 3.6, and the fact that the commodity is packaged): Low
- What is the likelihood of the commodity itself coming into contact with a local host (depends on the intended use of the commodity)?
  Answer: Low (follows automatically from decision tree (processing for food))
- What is the likelihood of the commodity's waste coming into contact with a local host?
  Answer: Low (processing for food)

Conclusion level 2

Final risk (maximum of all organism groups): Low.

Additional content

Question: Does the commodity contain additional content?
Answer: No

Conclusion

The conclusion is that the risk that sausage casings serve as a means to introduce exotic pests and pathogens is low. The reason is that because of the way sausage casings are preserved (salted, pickled, in brine), most pest/pathogen categories cannot survive. The intended use (human consumption) means that the surviving pest/pathogen categories (spore-forming bacteria and viruses) do not come into contact with local hosts.

Summary report

The summary report is presented in Table 3. It shows the results for all pest/pathogen categories per question and for the total, and also shows the decision rules (minimum and maximum rules).

References

Community guide to good practice for hygiene and the application of the HACCP principles in the production of natural sausage casings. Edited by J. J. Wijnker. ENSCA 2011 http://ec.europa.eu/food/food/biosafety/hygienelegislation/guidelines_good_practice_haccp_en.pdf

Aspects of quality assurance in processing natural sausage casings. J.J. Wijnker. PhD thesis Utrecht University, 2009. http://igitur-archive.library.uu.nl/dissertations/2009-0108-201005/wijnker-11.pdf

Importation of Sausage Casings into Australia. Import Risk Analysis. Australian Quarantine and Inspection Service, 1999. http://www.daff.gov.au/__data/assets/pdf_file/0019/14842/00-005b.pdf

Table 3: Summary report for sausage casings

Decision tree CHIP -- Summary Report --

<< Back

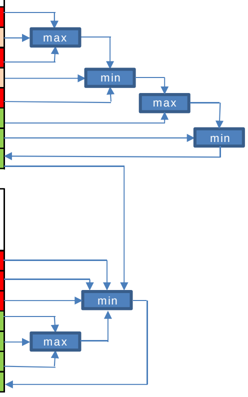
Commodity:	*Sausage casings*
Country of origin:	*Algeria*
Point of entry:	*Spain*
Destination (if not EU):	

Level 0

1. Can the commodity turn into pest?	*No*
2. What is the state of the commodity?	*preserved*
3. What is the intended use of the commodity?	*processing for food*
Details, only relevant if preserved or processed	*Salted, pickled, in brine*
Likelihood total volume imported commodity infested	***low***

Level 1		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
4a. Unpolluted water	*No*	M	L	L	L	L	H	M	H	H	H	H	H	H
4b. Air filter or net	*No*	H	H	H	H	H	H	L	H	H	H	H	H	M
4c. Contact outside env.	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
5. Measures effective	*Partly*	L	M	M	M	M	H	L	H	H	H	H	H	M
6. Regulations for comm.	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
7. Packaging effective	*Yes*	L	L	L	L	L	L	L	L	L	L	L	L	L
Surv. production/trade	<not asked>	L	L	L	L	L	L	L	L	M	L	M	M	L
Likelikood surv. comm.	*low-moderate*	L	L	L	L	L	L	L	L	M	L	M	M	L

Level 2		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
8a. Climate match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
8b. Seasonal match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
9. Quarantine/inspection	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
Infecting hosts org.	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Infecting hosts comm.	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Infestation by waste	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Final Risk	*low*	L	L	L	L	L	L	L	L	L	L	L	L	L



Additional Content

Commodity contains additional content	*No*
Additional content treated wood / prod.	

Remarks

CASE STUDY: LITCHIS IMPORTED INTO THE EU FROM MADAGASCAR

Background

Litchi chinensis originally comes from China. Litchis are cultivated in several countries (Madagascar, Israel, Thailand, etc.). Madagascar was chosen because this is the main exporting country to the EU. The fruits are predominantly used for fresh consumption, but also for processing for juice, ice cream, etc. The case study is limited to fresh consumption because this is assumed to be the most risky pathway.

The fruits are grown on trees that can reach a height of about 25 m. Most production takes place by small-scale producers. The ideal climate for production is an average maximum temperature of 30^{o}C, and not too humid.

The main pests and diseases are arthropods, mainly insects, which are controlled by pesticides. The products are sold to exporters by brokers. Shortly after harvest, the products are sulphitated in order to protect the fruits from browning. The products are shipped to the EU in containers that are cooled to 2^{o}C.

Although some exporters are EUREP GAP certified, and some experiments with phytosanitary control have been carried out in order to meet EU quality and food safety standards, there are no systematic checks before the litchis are shipped to the EU. Upon entering the EU, litchis do not have to be inspected.

Decision tree

Level 0

Question 1: Can the commodity turn into a pest?
Answer: No (litchi is a tropical fruit and will not grow in Europe)

Question 2: What is the state of the commodity?
Answer: Fresh or chilled

Question 3: What is the intended use of the commodity?
Answer: Direct human consumption

Conclusion level 0

The likelihood that the total volume of the imported commodity being infested with any pest/pathogen based on the state of the commodity and the intended use is moderate: contact with any pathogen/pest is possible.

Level 1

Question 4a: Is unpolluted water (tap water, rainwater, filtered water) used for production?
Answer: No (production takes place outside; the water is therefore polluted)

Question 4b: Is the commodity produced in a building (stable, glasshouse, etc.) with an air filter system for incoming air or nets over the windows to keep arthropods out?
Answer: No

Question 4c: Does the commodity come into contact with the outside environment (wildlife, unsterilized soil, grass, etc.)?
Answer: Yes (litchi trees are grown in orchards and are therefore not protected from contact with the outside environment)

Question 5: What kind of measures are applied to control pests and pathogens?
Answer: Measures to prevent damage to the fruits. This implies that measures are not intended to make the commodity pest/pathogen free, but to prevent financial losses caused by pests/pathogens.

Question 6: Is the commodity subject to pest/pathogen regulations aimed at monitoring commodities for the presence of pests and pathogens such as inspections and quarantine?
Answer: No (some experiments have been carried out, but are not continuing)

Question 7: Is packaging effective to prevent infestation?
Answer: No (the fruits are stored in open boxes, which are accessible to pests and pathogens from outside)

Question: What is the likelihood of survival of any pest/pathogen during production and trade process despite commercial measures affecting the state of the commodity?
Answer: High (the fruits are not subject to commercial procedures affecting the survival of pests and pathogens)

Conclusion level 1

The likelihood of survival of any pest/pathogen on the commodity, given the answers to q5, q6, q7 and the question regarding the commercial measures (derived from the answer to question 2) is moderate to high, which implies that it is highly recommended to proceed with the level 2 analysis.

Level 2

Question 8a: Is there a climate match between the country of origin and the EU?
Answer: No (the tropical climate of Madagascar differs from the climate in the Netherlands)

Question 8b: Is there a seasonal match between the country of origin and the country of destination?
Answer: No (Madagascar is on the other side of the equator)

Question 9: Is the commodity placed in quarantine after entry and/or subject to inspection?
Answer: No

Question: What is the likelihood of pest/pathogen categories infesting local hosts by independent movement of the pest/pathogen?
Answer: Varies from low to high (especially flying arthropods are considered to have a high likelihood)

Question: What is the likelihood of infestation of local hosts by the commodity?
Answer: Low (because the commodities are consumed)

Question: What is the likelihood of infestation of local hosts by waste?
Answer: Moderate (the waste – peels , seeds – can end up in the environment)

Conclusion level 2

The result of level 2 is moderate, because the fruit is consumed directly, but there is still a risk that peels and seeds can end up in the environment.

Additional content

Question: Does the commodity contain additional content?
Answer: No

Conclusion

The analysis of level 0 indicated that the risk is moderate. Therefore it was recommended to continue the analysis with level 1. The result of level 1 is moderate to high, because it is rather likely that the litchi can be infested and that measures are insufficient to make the fruit pest and pathogen free. The result of level 2 is moderate, because the fruit is consumed directly, but there is still a risk that peels and seeds can end up in the environment. Because the commodity does not contain additional content, the final conclusion is that there is a moderate likelihood that litchis introduce pests and pathogens.

Summary report

The summary report is presented in table 4. Ii shows the answers to each question together with the scores for each pest/pathogen category. The conclusion for each level can be checked by application of the decision rules as indicated after the scores. This indicates that the conclusion of a moderate likelihood applies to most pest/pathogen categories, except for weeds and worms in animals (which is, of course, not relevant to litchis).

References

Litchi from Madagascar (http://aloalo-kft.com/ENG/litchis_en.pdf)

USAID/ Madagascar (2009) Madagascar and market expansion (BAMEX) August 2004 – August 2008, Final Report (http://pdf.usaid.gov/pdf_docs/PDACL928.pdf)

Bignebat, Celine and Isabelle Vagneron (2010) Private certification in the Madagascar lychee export chain: business-driven or donor-driven dynamics? (Very first draft). FP7-funded project 'NTM-Impact'.

Christina Didier (sa) The Lychee, PowerPoint presentation. (http://www.unece.org/fileadmin/DAM/trade/agr/meetings/capacity-building/2006_mojmirovce-SK/TheLychee.pdf)

Table 4: Summary report for litchis

Decision tree CHIP -- Summary Report --

<< Back

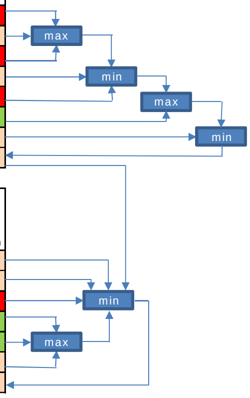
Commodity:	*Litchi*
Country of origin:	*Madagascar*
Point of entry:	*Rotterdam harbour*
Destination (if not EU):	Netherlands

Level 0

1. Can the commodity turn into pest?	*No*
2. What is the state of the commodity?	*fresh or chilled*
3. What is the intended use of the commodity?	*direct human consumption*
Details, only relevant if preserved or processed	*0*
Likelihood total volume imported commodity infested	***moderate***

Level 1		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
4a. Unpolluted water	*No*	M	L	L	L	L	H	M	H	H	H	H	H	H
4b. Air filter or net	*No*	H	H	H	H	H	H	L	H	H	H	H	H	M
4c. Contact outside env.	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
5. Measures effective	*Partly*	L	M	M	M	M	H	L	H	H	H	H	H	M
6. Regulations for comm.	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
7. Packaging effective	*No*	M	L	L	H	H	L	L	M	M	M	M	M	L
Surv. production/trade	<not asked>	H	H	H	H	H	H	M	H	H	H	M	M	M
Likelikood surv. comm.	***moderate-high***	M	M	M	H	H	H	L	H	H	H	M	M	M

Level 2		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
8a. Climate match	*(No)*	L	M	M	M	M	M	H	M	H	M	H	M	M
8b. Seasonal match	*No*	H	M	M	M	M	H	H	H	H	M	H	M	M
9. Quarantine/inspection	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
Infecting hosts org.	<not asked>	M	L	L	H	H	L	L	M	M	M	M	M	L
Infecting hosts comm.	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Infestation by waste	<not asked>	M	M	M	M	M	M	M	M	M	M	M	M	M
Final Risk	***moderate***	L	M	M	M	M	M	L	M	M	M	M	M	M



Additional Content

Commodity contains additional content	*No*
Additional content treated wood / prod.	

Remarks

3. What is the intended use of the commodity? Lithis are also used for juice and ice cream, but only to a limited extent

CASE STUDY: IMPORT OF TOMATO SEED FROM MEXICO TO THE NETHERLANDS

Background

Tomato seed is imported into the Netherlands (and thus into the EU) for the production of young tomato plants in order to produce tomatoes. The table below presents the imports into EU. The production of tomato seeds takes place in greenhouses. It depends on the place where the tomato seeds are produced. Two tomato seed producers in Mexico participate in the Good Seed and Plant Practices (GSPP), which is an international, transparent business chain system to prevent tomato seed and plant lots from being infected with *Clavibacter michiganensis subsp. michiganensis (Cmm)*. Participants in this system commit themselves to strict hygienic measures. In this case study, it is assumed that not all tomato seeds are produced according to the GSPP guidelines.

Decision tree

Level 0

Question 1: Can the commodity turn into a pest?
Answer: No (tomatoes are already grown in the EU)

Question 2: What is the state of the commodity?
Answer: Alive

Question 3: What is the intended use of the commodity?
Answer: Propagation, multiplication, production

Conclusion

The likelihood that the imported commodity being infested with any pest/pathogen based on the state of the commodity and the intended use is high.

In general, seeds are live products and intended as plants for planting, in this case tomato plants. This implies that the likelihood of infestation with any pathogen/pest is high. According to the decision tree, answering any other question is superfluous. The recommendation is to execute full risk assessments for all pests and pathogens by which the seeds can be contaminated, and that have not previously been subject to risk assessment.

For testing purpose, application of the decision tree is continued in order to detect whether the application of level 1 and 2 will result in the same conclusion.

Level 1

Question 4a: Is unpolluted water (tap water, rainwater, filtered water) used for production?
Answer: No (although the production takes place inside, no special measures are taken to use unpolluted water)

Question 4b: Is the commodity produced in a building (stable, glasshouse, etc.) with an air filter system for incoming air or nets over the windows to keep arthropods out?
Answer: No

Question 4c: Does the commodity come into contact with the outside environment (wildlife, unsterilized soil, grass, etc.)?
Answer: Yes (the greenhouses are not totally isolated from the environment)

Question 5: What kind of measures is applied to control pests and pathogens?
Answer: Measures to prevent damage to the tomato plants. This implies that measures are not intended to make the commodity pest/pathogen free, but to prevent financial losses caused by pests/pathogens.

Question 6: Is the commodity subject to pest/pathogen regulations aimed at monitoring commodities for the presence of pests and pathogens such as inspections and quarantine?
Answer: No (this is unknown, so we chose 'No')

Question 7: Is packaging effective to prevent infestation?
Answer: Yes (the tomato seeds are transported in sealed bags)

Question: What is the likelihood of survival of any pest/pathogen during production and trade process despite commercial measures affecting the state of the commodity?
Answer: High (although the seeds are dried, infection with pathogens cannot be excluded)

Conclusion

The likelihood of survival of any pest/pathogen in/on the commodity, given the answers to q5, q6, q7 and the question regarding the commercial measures (derived from the answer to question 2), is moderate to high, which implies that it is highly recommended to proceed with the level 2 analysis.

Level 2

Question 8a: Is there a climate match between the country of origin and the EU?
Answer: It is not necessary to answer this question, because in the case of the EU, the answer is always 'Yes'

Question 8b: Is there a seasonal match between the country of origin and the EU?
Answer: No

Question 9: Is the commodity placed in quarantine after entry and/or subject to inspection?
Answer: Yes (tomato seeds must be inspected)

Question: What is the likelihood of pest/pathogen categories infesting local hosts by independent movement of the pest/pathogen?
Answer: Low (the seeds are packaged in sealed bags, so no pests or pathogens can escape)

Question: What is the likelihood of infestation of local hosts by the commodity?
Answer (based on the answer to question 3): High (the seeds are used for production purposes)

Question: What is the likelihood of infestation of local hosts by waste?
Answer (based on the answer to question 3): High (however, it must be noted that the use of tomato seeds does not result in waste)

Conclusion level 2: The result of level 2 is moderate to high, which implies that individual organism-based risk analyses are recommended.

Additional content

Question: Does the commodity contain additional content?
Answer: No

Conclusion

The analysis of level 0 indicated that the risk is moderate. Therefore it was recommended to continue the analysis with level 1. The result of level 1 is moderate to high, because it is rather likely that tomato seed can be infested and that measures are insufficient to make the seeds pest and pathogen free. The result of level 2 is also moderate to high, because the seeds are used for the production of tomatoes, and are therefore starting point of the production process.

Summary report

The summary report is presented in table 5. It shows the answers to each question together with the scores for each pest/pathogen category. The conclusion for each level can be checked by application of the decision rules as indicated after the scores. The report shows that the likelihood of infestation varies over the pest/pathogen categories. Especially nematodes, spore-forming bacteria and viruses have a high likelihood. Comparison with the conclusion of level 1 indicates that inspections and/or quarantine reduces the likelihood of arthropods on the surface, non-spore forming bacteria and fungi.

References

http://www.gspp.eu/

Table 5: Summary report for tomato seed

Decision tree CHIP -- Summary Report --

<< Back

Commodity:	*Tomato seed*
Country of origin:	*Mexico*
Point of entry:	*Schiphol Airport*
Destination (if not EU):	

Level 0

1. Can the commodity turn into pest?	*No*
2. What is the state of the commodity?	*Live*
3. What is the intended use of the commodity?	*propagation/multiplication/production*
Details, only relevant if preserved or processed	*0*
Likelihood total volume imported commodity infested	***high***

Level 1		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
4a. Unpolluted water	*No*	M	L	L	L	L	H	M	H	H	H	H	H	H
4b. Air filter or net	*No*	H	H	H	H	H	H	L	H	H	H	H	H	M
4c. Contact outside env.	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
5. Measures effective	*Partly*	L	M	M	M	M	H	L	H	H	H	H	H	M
6. Regulations for comm.	*No*	H	H	H	H	H	H	H	H	H	H	H	H	H
7. Packaging effective	*Yes*	L	L	L	L	L	L	L	L	L	L	L	L	L
Surv. production/trade	<not asked>	H	H	H	H	H	H	H	H	H	H	H	H	H
Likelikood surv. comm.	***moderate-high***	L	M	M	M	M	H	L	H	H	H	H	H	M

Level 2		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
8a. Climate match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
8b. Seasonal match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
9. Quarantine/inspection	*Yes*	H	L	H	L	H	H	H	M	H	M	H	H	H
Infecting hosts org.	<not asked>	L	L	L	L	L	L	L	L	L	L	L	L	L
Infecting hosts comm.	<not asked>	H	H	H	H	H	H	H	H	H	H	H	H	H
Infestation by waste	<not asked>	H	H	H	H	H	H	H	H	H	H	H	H	H
Final Risk	***moderate-high***	L	L	M	L	M	H	L	M	H	M	H	H	M

Additional Content

Commodity contains additional content	*No*
Additional content treated wood / prod.	

Case study: Import of trees from Canada into the EU

Background

The category 'trees' comprises different species and thus host plants for different pests and pathogens. Most host plants are also grown in the EU. The imported trees are used for ornamental purposes in gardens and the living environment.

Decision tree

Level 0

Question 1: Can the commodity turn into a pest?
Answer: Yes, depending on the species introduced. Therefore it is recommended to conduct a full risk assessment for any species that is introduced into Europe for the first time.

Question 2: What is the state of the commodity?
Answer: Alive

Question 3: What is the intended use of the commodity?
Answer: Ornamental use

Conclusion level 0

The likelihood that the total volume of the imported commodity being infested with any pest/pathogen based on the state of the commodity and the intended use is high. Therefore, it is recommended to conduct a full risk analysis for all known associated pathogens and pest that have not previously been subject to risk analysis.

For testing purpose we continued the analysis with level 1 and 2.

Level 1

Question 4a: Is unpolluted water (tap water, rainwater, filtered water) used for production?
Answer: No (production takes place outside; the water is therefore polluted)
Question 4b: Is the commodity produced in a building (stable, glasshouse, etc.) with an air filter system for incoming air or nets over the windows to keep arthropods out?
Answer: No

Question 4c: Does the commodity come into contact with the outside environment (wildlife, unsterilized soil, grass, etc.)?
Answer: Yes (the trees are not protected against contact with outside environment)

Question 5: What kind of measures are applied to control pests and pathogens?
Answer: Measures to prevent damage to the trees. This implies that measures are intended to prevent financial losses caused by pests/pathogens. The consequence is that low levels of infestation still can exist.

Question 6: Is the commodity subject to pest/pathogen regulations aimed at monitoring commodities for the presence of pests and pathogens such as inspections and quarantine?
Answer: Yes (nursery stock production in Canada is subject to regulations imposed by the CFIA to keep nursery stock free from quarantine organisms)

Question 7: Is packaging effective to prevent infestation?
Answer: No (the trees are stored in pallet boxes that are accessible to pests and pathogens)

Question: What is the likelihood of survival of any pest/pathogen during production and trade process despite commercial measures affecting the state of the commodity?
Answer: High (the trees are not subject to commercial procedures affecting the survival of pests and pathogens)

Conclusion

The likelihood of survival of any pest/pathogen on the commodity, given the answers to q5, q6, q7 and the question regarding the commercial measures (derived from the answer to question 2), is moderate to high, which implies that it is highly recommended to proceed with the level 2 analysis.

Level 2

Question 8a: Is there a climate match between the country of origin and the EU?
Answer: Yes

Question 8b. Is there a seasonal match between the country of origin and the EU?
Answer: Yes
Question 9: Is the commodity placed in quarantine after entry and/or subject to inspection?
Answer: Yes (all trees imported into the EU must be inspected)

Question: What is the likelihood of pest/pathogen categories infesting local hosts by independent movement of the pest/pathogen?
Answer: Depends on the pest/pathogen category. The likelihood is high for organisms that have the ability of independent movement, such as flying arthropods.

Question: What is the likelihood of infestation of local hosts by the commodity?
Answer: High (the trees are directly used as plants for planting in nursery stock, and come into direct contact with local hosts)

Question: What is the likelihood of infestation of local hosts by waste?
Answer: High (the likelihood is high that any waste coming from the imported trees will end up at the nurseries, and come into direct contact with local hosts)

Conclusion level 2

The result of level 2 is moderate to high, which implies that individual organism based risk analyses are recommended.

Additional content

Question: Does the commodity contain additional content?
Answer: Yes (soil and wood)

Question: If the answer to the previous question was ‘yes’: Is the additional content only treated wood or treated wood products?
Answer: No

Conclusion: It is recommended to conduct full risk assessments for soil pathogens and pests that have not previously been subject to risk assessments in the EU.

Conclusion

The analysis of level 0 indicated that the risk is high. It was therefore recommended to conduct full risk assessments for soil pathogens and pests that have not previously been subject to risk assessments in the EU. The same applies to the trees themselves. If the species have not previously been imported, it is recommended to conduct a risk assessment for the species itself.
Although not necessary, we continued the analysis with level 1 and 2 for demonstration purposes. The result of level 1 is moderate to high, because it is expected that although measures are applied, the likelihood that trees are infested is still high, because packaging is not effective against re-infestation, especially with flying arthropods. The results of level 2 is also moderate to high.

Summary report

The summary report is presented in table 6. It gives the answers to each question together with the scores for each pest/pathogen category. The conclusion for each level can be checked by application of the decision rules as indicated after the scores. The report shows that the likelihood of infestation varies over the pest/pathogen categories. Especially the likelihood that flying arthropods not living on the surface will come into contact with local hosts is high. A comparison of the results of level 1 and 2 shows that the likelihood that flying arthropods living on the surface come into contact with local hosts is reduced due to inspections at the border in the country of destination.

Table 6: Summary report for trees

Decision tree CHIP -- Summary Report --

<< Back

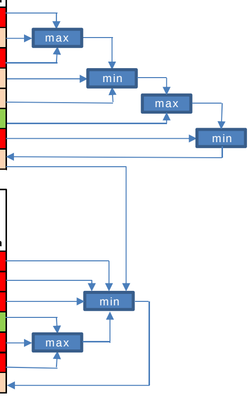
Commodity:	*Trees*
Country of origin:	*Canada*
Point of entry:	*Rotterdam harbour*
Destination (if not EU):	

Level 0

1. Can the commodity turn into pest?	*Yes*
2. What is the state of the commodity?	*Live*
3. What is the intended use of the commodity?	*propagation/multiplication/production*
Details, only relevant if preserved or processed	*0*
Likelihood total volume imported commodity infested	***high***

Level 1		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
4a. Unpolluted water	*No*	M	L	L	L	L	H	M	H	H	H	H	H	H
4b. Air filter or net	*No*	H	H	H	H	H	H	L	H	H	H	H	H	M
4c. Contact outside env.	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
5. Measures effective	*Partly*	L	M	M	M	M	H	L	H	H	H	H	H	M
6. Regulations for comm.	*Yes*	L	L	M	L	M	M	L	M	M	M	M	M	M
7. Packaging effective	*No*	M	L	L	H	H	L	L	M	M	M	M	M	L
Surv. production/trade	<not asked>	H	H	H	H	H	H	H	H	H	H	H	H	H
Likelikood surv. comm.	***moderate-high***	M	L	M	H	H	M	L	M	M	M	M	M	M

Level 2		Weeds	Arthro-podes no-fly on-surface	Arthro-podes no-fly otherwise	Arthro-podes fly on-surface	Arthro-podes fly otherwise	Plant Nema-todes	Worms in animals	Bacteria non-spore forming	Bacteria spore forming	Fungi	Viruses NO vector borne	Viruses vector borne	Protozoa
8a. Climate match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
8b. Seasonal match	*Yes*	H	H	H	H	H	H	H	H	H	H	H	H	H
9. Quarantine/inspection	*Yes*	H	L	H	L	H	H	H	M	H	M	H	H	H
Infecting hosts org.	<not asked>	M	L	L	H	H	L	L	M	M	M	M	M	L
Infecting hosts comm.	<not asked>	H	H	H	H	H	H	H	H	H	H	H	H	H
Infestation by waste	<not asked>	H	H	H	H	H	H	H	H	H	H	H	H	H
Final Risk	***moderate-high***	M	L	M	L	H	M	L	M	M	M	M	M	M



Additional Content

Commodity contains additional content	*Yes*
Additional content treated wood / prod.	*No*

Remarks

1. Can the commodity turn into pest? Depends whether the species are imported in the EU for the first time

9. Quarantine/inspection All living plants have to be inspected after arrival in the EU

APPENDIX 8: MINUTES OF CHIP EXPERT MEETINGS

Minutes of EFSA project expert meeting (CHIP)

19 October 2011, Schiphol, Amsterdam

Present:
Trond Rafoss (TR), Norway
Evangelia Sossidou (ES), Greece
Louise Kelly (LK), VLA, Great Britain
Richard Baker (RB), FERA, Great Britain
Jan Schans (JS), nVWA, the Netherlands
Maarten Hoek (MH), CVI, CHIP project team member
Manon Swanenburg (MS), CVI, CHIP project team member
Marie Luise Rau (MR), LEI, CHIP project team member
Johan Bremmer (JB), LEI, CHIP project leader
By teleconference: Jane Richardson (JR), EFSA

Absent:
Hella Kehlenbeck, Germany

General

The objective of the expert meeting was to present and discuss:
- the draft results of CHIP tasks intended for use in the decision tree,
- the concept decision tree, and
- the case studies that will be conducted to test and demonstrate the decision tree.

If necessary, experts would be consulted during the execution of the project. This document summarizes all remarks made during the meeting. On the basis of these remarks, suggestions were made to adjust the reports, decision tree and case studies.

The following generic remarks were made

- Add a glossary to the final report, using terms correctly and consistently throughout the project report. Where necessary, use different terms for plants and animals. Use EPPO and EFSA terms rather than other definitions or developing own definitions. Pay attention to:
    - entry, establishment, impact (not spread as in animal health)
    - primary and secondary production
    - farm practice, production system, production types
    - risk and likelihood; provide rating guidance
    - work undertaken by EFSA to compare definitions from the plant health and the animal health side
    - FAO glossary
- More and better up-date and concerted efforts, communication with other projects by EFSA
- Use ‘pest/pathogen’ in all documents
- Consider use of drop-down lists in tables to be completed

Task 1.1 Modelling a pathway

The pathway model received support from the experts as well as from Jane. The following remarks were made:

- Explain the pathway and different steps, elements, better, give examples – what is meant by processing? E.g. processing also includes slaughter or a different step in the pathway.
- Exporting country, transport, import country: define clearly where our pathway starts and where it ends.
- Provide the possibility to add information to the pathway.
- Information on country needs to be elaborated. Look at geography, distance, climate zone, and most importantly whether country regulates; the exporting country regulates but also the importing country regulates – both aspects may be important and reduce the risk of entry. In particular good agricultural practice guidelines/procedures in exporting country could be very important.
- Elaborate a number of examples to inform risk analysts how to complete a pathway analysis and at which level of detail.
- It was unclear how to complete tables; need to provide decent fool-proof guidance
- Make clear who needs to complete the tables. Answer: the risk assessor.
- Stress for each table why it has to be completed: define objective.
- Difference between primary and secondary production – glossary!
- Control point – what to fill in? Define, use example.
- Do we need to add intervention points in the table?
- Should quantity and frequency also be included in the pathway? No. This is part of the trigger to conduct an analysis.
- Farm practice/production systems, farm types (e.g. organic production, pasture-based, free-range, etc.). How to take account of this? Capture this in glossary.
- Do not use ‘agriculture’ as it does not include horticulture etc.

Task 1.2 Review of EU and MS regulations on the definition of commodities

- Criteria ‘alive’ and ‘fresh or chilled’: these two product characteristics may fit animal products but for plant products it is difficult. For plants, there is no difference between live products and fresh or chilled products. Reconsider and explain in the report.
- The criterion ‘preserved’ may need to include something like natural (not preserved, fresh). Where to put ‘chilled’ in this case? ‘Fresh and chilled’ as a part of ‘natural’? Reconsider and explain in the report.
- Additional criteria. Treatment: treated and untreated products have different risk levels and this information should be part of the decision tree. Answer: This is not a product characteristic that can be identified using trade data classification. Treatment is part of the pathway but cannot be used as a product characteristic.
- Distinguish a product group for machinery, industry product or something like this; e.g. animal, plant and industrial products?
- Where does fertilizer fit in as a product? Answer: it is a chemical.
- Where does soil, growing medium and peat fit in? Answer: will be investigated.
- Are pets included in the characteristics (intended use)? Answer: it is not possible to identify in the database whether ‘animals’ [are → includes?] pet animals.

- Add a section about the decision to use CN classification in the report; elaborate and also use the EFSA report on different classification and more detailed information. This would clarify how the decision tree should be used.
- Possible to include information about illegal products? Answer: useful information, since illegal products entering the EU may pose a lot of risks but this is beyond of the scope of the project. However, interesting to have a look at the classification used in a UK report.
- EUROSTAT has serious shortcomings; make clear and explore consequences. (inaccurate data).
- TRACES: EPPO is working on a new CN template – can we have a draft? Need to refer to this doc in any event. Richard will send it to Johan.
- There is also an EFSA report on EUROSTAT; need to refer to this and perhaps use a bit of it. This report has been used.
- Don't use 'introduction': use 'movement along a pathway' and 'entry' (when crossing the border).
- A danger is that too much will fall within the high risk category. There won't be enough time to perform a risk analysis for all commodities classified as high risk, rendering the tool useless. WHAT TO DO? VALID POINT – great tool without a workable outcome is useless. Need to think about this very hard.
- Jane suggested 4 categories for selecting crème de la crème (very high risk, high risk, moderate risk, low risk). For very high risk products the decision tree may not be needed, but this would proceed immediately to a full risk assessment.
- Focus on third countries – EU.
- Explain what is to be done if one commodity has multiple risks? Or why this is mostly the case and what to do about it.
- Consider waste of commodities imported. Stress in pathway that risk assessor needs to consider by-products and the risks they pose. (Good example: oranges for marmalade, low risk, discarding of peels, higher risk? YES if swill feeding….)

- Review tables for unnecessary level of detail. Delete if possible; keep it simple.

Task 1.3 Systematic reviews of known trade risks and associated commodities

Systematic literature review:

- The result of the systematic review is not surprising, limited information deducted, shows the lack of studies but also the usefulness of systematic review for the question looked at. Add section on the usefulness of the systematic review method for the question about pathogen/pest traits, pathways and entry. Mention limitations of the review; the question looked at in the systematic review is too broad, not specific to a certain pathogen/pest or pathway, and this makes it difficult to find literature.
- X is critical about systematic reviews as a method of obtaining information for general questions about risks/hazards. He doubts whether the systematic review is the right method. He suggests another method, but this cannot be applied since the systematic review is agreed in the project proposal.
- Do reviewed studies also look at specific information on geography characteristics, climate zones and seasonality (time of entry) and how this influences entry, establishment and spread of pathogens/pests? This info about geography, climate zones and seasonality (time of entry) is important and should be considered in terms of a characteristics. Add this information to the systematic review.

- In the analysis the link between the commodity and the pathogen is unclear. Help risk assessors through the process more smoothly.
- Literature review goes too far. Stop at border!

- Review of risk assessment:
- FAO standards rather than FAO scheme. Difference between standard and scheme: standard refers to what should be included in a risk assessment for example, and scheme is more practical in terms of giving recommendations or setting requirements concerning how to do assessments.
- Jan will send some interesting docs for review – action: Maarten Hoek.

Task 1.6 Outline of the decision tree

- Explain the content of risk: likelihood or possibility.
- Risk level: obstacle race; for now use lowest risk along a pathway. E.g. high – high – low – high results into: low.
- Sequencing of the questions asked, the order of the levels – which aspect to consider first: commodity or pathogen? Explain the levels better: what do they include and how the decision is made: yes or no question? Where to get the information to make the yes or no decision, what question and information is part of the project?
- Is trade volume used in the decision tree (trade signal)? Frequency of trade, geography, distance … used in the decision tree? Should be used in the project; if not, at least mentioned why it is not used. Answer: The signal would be a change in the volume of trade or exporting country. Characteristics such as distance from EU, and food/feed safety procedure/regulations that are in place should be considered in the decision tree.
- What do you mean with ‘likely’? Do you mean ‘possible’? Needs to be explained.
- Is it ‘a’ pest or ‘any’ pest? Answer: It should be ‘any’ pest or ‘hazard’ in this stage of the decision tree.
- All participants agree that the questions in the outline of the structure should be described more clearly. It should be noted that the questions in slide 5 (outline) are not the questions in the decision tree.
- What to do if the risk level is moderate? Answer: this is up to the risk assessor to decide (depending on the budget etc.).
- What to do with the waste? For example: if you import fruits for producing jam, the risk is low, but the waste of this process can have a high risk. Answer: in this case the risk is therefore moderate. But if you just import the jam, the risk is low.
- Is it possible that the same pathogen can have a low and a high risk, for example depending on the climate of the importing country? Answer: this is possible. This will be asked later on in the decision tree.
- If you throw out a commodity in an early stage, perhaps in a later stage the pathogen can start growing. Would you overlook this?
- Answer: this depends on the order of questions in the decision tree. But as we only go until entry, we do not include growth in a later stage of the pathway.
- Are 3 levels of risk is enough? Would 4 or 5 be more convenient?
- It is agreed by all that living products intended for growing have the highest risk. Should we have a fourth risk level for this category? It is possible to define these commodities

before you start the decision tree, and to always screen those commodities with a complete risk assessment.

- It is recommended to add ‘uncertainty’ to the level of risk.
- The project team asks the input from the experts for the tables as presented in the presentation and the report. The experts are asked to send their comments and additional information by mail to Johan Bremmer or to Manon Swanenburg. It is suggested to put all invertebrates together.
- What are principles for summarizing likelihoods? If the principle is multiplication, than the result cannot exceed the minimum score. E.g. low x high = low and not moderate.
- At what point do we know which pests/pathogens can be on the commodity? Answer: a list should be made after the first step in the decision tree. The experts are of the opinion that in that case, the analysis of the second stage implies a full pest risk assessment (for which guidelines are already well documented). This project should have a different approach. It is recommended first to address aspects like climate etc., so that you don’t have to collect a list of possible pests/pathogens.
- It is suggested to look at ‘a pest/pathogen’ (not yet defined; keep the pest abstract through the pathway) and go through the pathway stages and see how the pest/ pathogen can react. MS thinks this is a good idea. Throughout the pathway categories of pathogens that can no longer survive will be sorted out. Surviving pest/pathogens that are likely to enter the country of destination are recommended for a full risk assessment, which is beyond the scope of the project.
- An alien organism does not need to be a pest in its place of origin.
- It is suggested to use easily accessible information, like geographical information, climate, distance, season. The draft report of the EFSA meeting on ‘emerging risks in plant health’ can be helpful.

The following conclusions were made

The decision tree needs to be at three levels instead of two (this was also discussed with EFSA on 17 October). First level: commodity traits, second level: pathway traits, third level: species traits. In the tree, pests/pathogens will be looked at at an abstract level, no pathogen details. No detailed PRA must be done. The tree should just give a rough indication of the risk level of a pathway.

The last discussion points regard:

- Where to stop the pathway (see the jam example): what to do with the waste problem? An example is animal manure. It is concluded that the waste risk should be addressed somewhere in the decision tree.
- Whether animal welfare should be included. It has been proven that welfare is one of the factors that affect health (and also public health). Answer: this is true, but reduced animal welfare is an impact which is not considered in the scope of this project and should therefore not be included in the decision tree.
- Whether welfare/production systems (like organic farming) should be included in the pathway description and the decision tree. It is suggested to include this in ‘regulated pathway yes/no’.
- Does the project result need to be a real decision tree or can it also be a ‘ decision support scheme’? Jane answers that this would also be helpful.

WP3 case studies

- The project team has some doubt about the suggested commodities/pathways. Suggestion for animal products are ‘sausage casing’ and animal by-products for animal feed. Are they imported from outside Europe? X remarks that the suggested pathways are all within Europe. Poultry from Thailand would be an idea (instead of salami). The Pacific oyster is already established in Europe. Can this be used, then, for a case study? Johan thinks this is not a problem. Finally it is concluded that for all the suggested pathways we should look retrospectively. It is concluded to do for animal: Pacific oyster, poultry from Thailand and a raw-milk cheese.

  An alternative suggestion for plant products is ‘wood chips’ from Canada (imported into Norway). For plant products, goji berries were suggested by EFSA, but Johan discovered these are native to Europe. The suggestion is to replace them with lychee.

  It was planned to look at the number of notifications to compare the result of the case studies with ‘real numbers’. X says that using interception data is difficult, because you don’t know how many samples have been taken, how many were negative and how efficient the testing method is. It is difficult to judge if results are accurate.
- The main objective of the case studies should be to see whether the decision tree works well from a user’s perspective. It is difficult to test if it is really generic, because the case studies are limited. X suggests comparing the raw-milk cheese pathway with an imaginary pathway in which no testing, detection, etc. is done. X asks for the definition of the levels of risk. Johan answers that the project team will explain the levels of risk (levels of likelihood) in a user guide.

  X asks if the case studies will be conducted in the Netherlands. Answer: yes. She thinks that if you really want to validate the results you should do each case study more than once (by different persons). X offers to contribute to the case studies. X says that many people are working on risk assessment and pathway analysis. Perhaps result of this project can be used by them. It would be good to know which projects are working on this subject.
- Suggestion for validation of the decision tree:
  - Let others use the model to perform an risk analysis on the same product – same outcome?
  - Look at already reported goods, then get someone who is unaware of the work done to do a risk analysis – same outcome? If not, why not?

Concluding remarks

The experts are thanked for their presence and very helpful comments.
Next expert meeting mid-January (RB suggest 16 January, because of an EFSA meeting of the plant health panel in Parma on 18–19 January).

CHIP EXPERT MEETING ON 16 JANUARY 2012, SCHIPHOL, AMSTERDAM

Present:
Trond Rafoss, Norway
vangelia Sossidou, Greece
Louise Kelly, VLA, Great Britain
Richard Baker, FERA, Great Britain
Hella Kehlenbeck, Germany
Jan Schans, nVWA, the Netherlands
Manon Swanenburg, CVI, CHIP project team member
Michiel van Galen, LEI, CHIP project team member
Johan Bremmer, LEI, CHIP project leader
Jane Richardson, EFSA

Outline of the adjusted decision tree

The decision tree was amended on the basis of the last expert meeting and comments from EFSA.
In the current version, there are 3 levels of risk: low, moderate, high.
Uncertainty as such is not explicitly incorporated in the decision tree. However, if uncertainty exists about conditions or parameters, it is advised to choose the highest relevant risk option.

X:

- Pay attention to the terminology about entry and infestation. And about establishment and reproduction. Infestation of local host is better termed 'contact with local host'. LK says that in animals we would normally say 'exposure of a local host'. TR also thinks that we now go too deep into the establishment stage.
- With 3 levels of risk there may be too many cases in the high risk category. Is there enough discrimination? JR seconds this worry. JB recognizes this comment and explains that the potential lack of discrimination results from the logic followed in the decision tree, in which all levels are linked. The discrimination in level 0 fades away in level 1. This level contains more details because a distinction is made between pest/pathogen categories. The summary is made on the basis of the maximum rule, which implies that exceptions may dominate the outcome. This is a main discussion point for this meeting.
- Uncertainty: how is it measured or what does it mean?
- Difference between 'live' and 'fresh or chilled' is not always clear for plant products. This is acknowledged by the project team. Here we use the terminology of the CN database. Live plants generally are those with roots on them or that are used for propagation. Live vegetables are not a category. Products meant for consumption as such are generally called 'fresh or chilled'. From a biological hazard point of view, the distinction is not always very strict. Seeds from a tomato e.g. may very well be alive and spur reproduction of the plant. The same problem applies to wood products. This will be somewhat further addressed in the report. However, in the decision tree, the distinction between 'alive' and 'fresh or chilled' has no consequences.

X asks if colour additives are incorporated, or other additives that are fed to animals to create functional foods. The additives can contain pathogens. Answer from the project team: in the CN database these additives are generally not included (described or distinguished). MS says that additives need to be filled in in the pathway description when working with the decision tree. So, it is not a direct question in the decision tree, but you have to keep it in mind when applying the decision tree.

X: Make a recommendation for an additional literature review on the effects of preservation, preparation and processing.

X: Include a comment in the Decision Tree report that it is partly based on the CN classification, and explain its shortcomings.

X: Look at literature on food technology for definitions of processing, preserving, etc.

X: There are many links between CN classification and EC regulation. E.g. seed potato import from Brazil to Belgium arose as a possible threat from the analysis of trade data. Regulation may, however, already prohibit such imports: errors in the database can be detected by looking at the regulations. Add as a recommendation.

X: (on sheet Task 1.3 Systematic review) Systematic review is very time consuming, but also the questions were not very well defined by EFSA (in-depth research for table 3.4 would have been more useful). Better questions may improve the review effectiveness dramatically. Process of selecting the articles in systematic review is very important, in order to justify the choices made. Add a discussion on the use of systematic review to the report.

Outline of the decision tree

X: Leave out the word ‘agricultural’.

X: Dried products may still pose a risk. Perhaps it is better to let the option of proceeding to level 2 open, if additional information is available.

X: A conservative approach would be to classify preserved products as moderate risk.

X: Combine categories (with respect to preservation and processing) that have the same risk (live and fresh/chilled). What does the term ‘industrial’ mean in level 0 ‘State of product’? It means products without an organic origin. Add explanations to the report. MvG replies that the categories mentioned are the official classifications used in the CN database.

X: At level 0: Question 4: ‘What is … the total volume ..?’ This is confusing: change to ‘total trade’. There has been discussion about ‘total consignment/shipment’. But here it means total trade (as in all consignments entering the country).

X: Increase in trade can be a risk as well. Can the volume be a trigger to apply the model? X: it is difficult in the decision tree to include an increase in volume as a risk itself. Of course an increase in volume will increase the level of risk. The decision tree is being developed to distinguish commodities with a high risk profile from commodities with a low risk profile, irrespective the traded volume. Therefore, the triggers from trade are signals to apply the decision tree only.

X: ‘Crop protection’ and ‘protected crops’. This may be confusing terminology. Perhaps better to use ‘open’ and ‘closed’ instead of ‘protected’ and ‘unprotected’.

X: Protection (greenhouses, stables) (question 5) may not be a good indicator of containing hazards. Access to soil, water and air can still exist. Soil sterilization methods may decrease risks. X seconds this observation, and recommends splitting the questions to address these aspects separately.

X: Are differences in legislation between countries part of the decision tree? The question 6a and 6b are yes/no only.

X: First two questions (9a, 9b): may not be very important or discriminating for transport phase, only apply to infestation or survival (establishment), and are not important for entry. X adds that climate can be important for reaching the local host.

X: Why is length of transport important (9c)? X: it's about the likelihood of multiplication during transport.

X: Would it be useful to have a more detailed table about transport conditions?

JB: The state of the product is assumed to be the same as the transport conditions.

X: The length of transport and the conditions of transport determine the survival of pests/pathogens: 10 days of cooling perhaps kills a pest, whereas one day of cooling does not.

Make sure that numbering (numbers and letters) are consistently and uniquely used throughout the reports and decision tree.

X: Discriminatory power of level 2 is important. Can we end up with a low risk (stopping the assessment) after level 2? If not, level 2 can be skipped.

X: Let the user write down which trade flows are concerned and why that is new, or which other cases may be comparable. And whether the trade/commodity is already regulated. And why an analysis may be necessary. Add empty text boxes to the decision tree.

X: Is inspection at the border the same as quarantine? This also includes other measures, which are in the regulations of the country of destination. The question will be adjusted.

Decision tree (demonstration) and tables 3.3, 3.4 and 3.5

Question 6b: general marketing directives, quarantine requirements. It is not completely clear what is meant: does this apply to the country of origin only? How does GlobalGAP fit in here? JB: it is about any measure applied to detect pests and pathogens.

X: The distinction of risks per pest/pathogen category is very useful. Further work may be done on chemicals, threats to human health, and links between commodities, pathways and risks. Add recommendations for future research.

X: The risks of biological hazards from animals that are not usually associated with the commodity (like mice and rats) is not part of the decision tree. Make a comment on that in the report. It cannot be a part of the decision tree.

Question 9c:

X: Transport and storage are two separate things. Make separate questions about the duration. Can these separate questions be combined through statistical analysis? Project team: not as it is now. Two questions that only ask for total length longer than lifecycle cannot be added up to make one indicator.

Reformulate the question in such a way that the element of pest survival becomes explicit. The project team will look into this and come up with a solution that addresses the comment from the expert.

X:

Question 12: 'local hosts'. Does that refer only to the commodity in question (e.g. litchi)? Answer from the project team: not necessarily, but in this project we have no further information on potential pests or hosts.

The number of ports of entry is also important. Compare a trade flow that always comes through one of the major ports of Europe with one that is spread over dozens of ports of entry.

Add functionality on printing a report with a summary of the answers, risks and also the logic behind the risk level.

Cases

Users can add their own products instead of only looking at CN product classification.

A trade signal is generally too broad. Other signals are more important. The project team acknowledges this observation. The triggers (from trade or any other source) are not a part of the decision tree itself.

X: Litchi is considered to have a low risk, because there is hardly any litchi production in the EU. Is that also considered in the decision tree? Project team will look at that.

X: After step 0 one can only attain moderate or high risk. There should be more discriminatory power in steps 1, 2, 3.

Products for direct consumption: low risk
Infestation history
Type of pests associated with the product
Importance/size of production in EU.

One possible way may be to (again) add a 'very high' risk category. No decision has been made on this. Project team will look into it.

In the decision tree there are some issues in step 0 that may be different for plants and animal products. E.g. cut flowers have many notifications but the risks are generally considered low as they are used for consumption. Perhaps add some extra explanation about 'live' / 'fresh or chilled' / 'frozen' to make the differences between animal and plant products clear.

Table 3.3: Add examples to the report, and guidance for the questions. How about products that are not strictly produced but gathered outside (like some mushrooms)?

Discussion follows about the protective effect of stables, glass houses, etc. Some think it lowers risk (less/no contact with wildlife, vectors, etc.), while others think it does not make a difference.

X: Exposure to air, water or soil is more important than protected conditions itself. Project team proposes to make a distinction between several production conditions, to make the decision tree at this point more discriminatory: access to a) groundwater, b) surface water, c) wildlife, d) soil, e) air, etc.

Viruses may use vectors such as arthropods. Is this interconnectedness included in the decision tree? Yes.

It is concluded that some of the questions and risk categorizations in the tables are very debatable. Nevertheless, the experts welcome the work done and realize that the trade-off between simplicity and general application of use may be hard to combine with the complexity of the issues in real life. The project team will reassess the logic behind the questions and the categorization and send an amended version of the tables to the experts before 2 Feb. The experts are asked to comment before 15 Feb.

X: Stress in the report that the logic behind the decision tree is based on evidence found so far, but that future improvement may be necessary after further study.

Table 3.4: X: Leave question marks as they are; instead of changing to 'high'.

Last round of comments

X: Infestation of local hosts might need more attention. Don't go into establishment. Also, the intensity of the infestation may mean a higher chance of detection.

X: Combination of plant and animal products has always been a very difficult task. The study is important as it stresses some of the shortcomings of the general approach and future work to be done (for now remember that it is a methodology project, so the tables do not need to be complete). In general, X is very pleased with the team's efforts and accomplishments. With respect to the criteria: they should all be targeted at reducing the risks (table 3.3). Criteria that are not discriminatory with respect to risk are unnecessary in the decision tree.

X: The decision tree should of course be as simple as possible, but it is important to make it specific enough to be useful to risk assessors. Validation of the decision tree is also very important. In the future we should learn from validation and improve.

X: Pay special attention to the connection to the real world. Make the tree visible (e.g. in report). Case studies are relevant for validation. It might also be a good idea to 'put the matrix upside down'.

X: It is a good basis. Although it is a very generalized decision tree, the way of thinking is good. It may be more related to TRACES, EUROPHYT, RASFF.

Publication of the results will be possible through the EFSA website.

GLOSSARY

- **Aestivation**: a state of animal dormancy characterized by inactivity and a lowered metabolic rate
- **Alien**: unknown, or non-native
- **Characteristic**: physical property or attribute
- **Climate change**: change in the statistical distribution of weather patterns over long periods
- **Commensals:** organism partaking in a commensal relationship (mutual benefit)
- **Commodity**: a type of plant, plant product, animal or animal product being moved for trade or other purpose
- **Contamination**: the presence of a pest or other regulated articles not being an infestation
- **Control**: measures to prevent onward spread of contamination / disease
- **Cost-effectiveness**: a form of economic analysis that compares the relative costs and outcomes (effects) of two or more courses of action
- **Dormancy**: is a period in an organism's life cycle when growth, development, and (in animals) physical activity are temporarily stopped.
- **Emerging diseases**: An emerging disease is one that has appeared in a population for the first time, or that may have existed previously but is rapidly increasing in incidence or geographic range.
- **Entry**: movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled
- **Establishment**: perpetuation, for the foreseeable future of a pest within an area after entry
- **Exoskeleton**: the external skeleton that supports and protects an animal's body
- **Exotic**: not native
- **Export**: international trade whereby goods produced in one country are shipped to another country for future sale or trade
- **Fecundity**: the ability to reproduce
- **Generation time**: the time needed to complete one generation
- **Genetic mutation**: changes in a genomic sequence
- **Hazard**: is a situation that poses a level of threat to life, health, property, or environment
- **Hibernation**: a state of inactivity and metabolic depression in animals, characterized by lower body temperature, slower breathing, and lower metabolic rate
- **High genetic variability**: a measure of the tendency of individual genotypes in a population to vary from one another
- **Hitchhikers**: a means of transportation
- **ID-50 dose**: a measure known as the median infective dose
- **Impact**: the extent of the effect of an initiating cause
- **Import**: the act of bringing goods into a country
- **Incursion**: an isolated population of a pest recently detected in an area, not known to be established, but expected to survive for the immediate future
- **Infection**: the colonization of a host organism by parasite species
- **Infectious diseases**: communicable diseases, contagious diseases or transmissible diseases
- **Infectivity**: the ability of a pest/pathogen to establish an infection
- **Infestation**: presence in a commodity of a living pest
- **Inoculum pressure**: The number of infective units (propagules) in a given volume or area.
- **Introduction**: a species established by humans outside its natural range
- **Invasiveness**: the ability of a pest/pathogen to invade new environments, and have an adverse effect on the habitats and bioregions they invade
- **Macroscopic organisms**: size which is measurable and observable by the naked eye
- **Meta-analysis**: combines the results of several studies that address a set of related research hypotheses

- **Microbe**: a microscopic organism that comprises either a single cell (unicellular), cell clusters, or no cell at all (acellular).
- **Minimum water activity**: the vapour pressure of a liquid
- **Monitoring**: to make sure no further contamination is occurring
- **Non-native**: alien or exotic
- **Oocysts**: A thick-walled structure in which sporozoan zygotes develop and that serves to transfer them to new hosts
- **Outbreak**: the occurrence of cases of disease in excess of what would normally be expected in a defined community, geographical area or season
- **Pathogen**: a microbe or microorganism such as a virus, bacteria, fungi, phytoplasma, protozoan, parasite, prion, insects, mites, nematodes, gastropods, vermin, weed, vector, or other micro-organism that causes disease in its animal or plant host
- **pathway**: Any means that allows the entry or spread of a pest
- **Persistent**: remaining attached beyond the usual time
- **Pest**: Any species, strain of biotype of plant, animal or pathogenic agent injurious to plants, plant products, animals or animal products
- **Polyphagia**: constant hunger
- **Processing**: set of methods and techniques used to transform raw ingredients into food
- **Propagule pressure**: a composite measure of the number of individuals of a species released into a region to which they are not native. It incorporates estimates of the absolute number of individuals involved in any one release event (propagule size) and the number of discrete release events (propagule number).
- **Property**: trait or characteristic
- **Quarantine:** Official confinement of regulated articles for observation and research or for further inspection, testing and/or treatment
- **Risk analysis**: A process undertaken to deal with matters which pose a potential danger, managed according to certain standard procedures that involves: Hazard Identification, Risk Assessment, Risk Management, Risk Communication.
- **Risk assessment**: The process of evaluating the risk resulting from a hazard
- **Risk factor**: a variable associated with an increased risk
- **Spores**: a reproductive structure that is adapted for dispersal and surviving for extended periods of time in unfavourable conditions
- Surveillance: the monitoring of an identified hazard
- **Thermal death point**: a concept used to determine how long it takes to kill a specific bacteria at a specific temperature
- **Thermophile**: the ability to live and grow in extremely hot environments that would kill most other microorganisms
- **Third country**: a country that is not a member of the (European) Union
- **Vector**: vehicle used for transfer and transport
- **Virulence**: the degree of pest/pathogenicity within a group or species of parasites as indicated by case fatality rates and/or the ability of the organism to invade the tissues of the host