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Quantitative economic impact assessment of invasive plant pests: What does it require and when is it worth the effort?

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ABSTRACT

According to the International Plant Protection Convention and the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary measures, any measure against the introduction and spread of new pests must be justified by a science-based pest risk analysis. Economic impact assessments are usually carried out using a qualitative approach, based on classifying the size of impact into five categories, from "minimal" to "massive". Whilst the qualitative approach may be adequate in many instances, it lacks transparency and demonstrable objectivity. A quantitative approach for economic impact assessment may improve transparency and strengthen the justification for measures, if taken, but requires additional work, and it requires specific data and models. This paper, first, compares the strengths and weaknesses of qualitative and quantitative approaches. Second, it clarifies the data and models needed to conduct a quantitative economic impact assessment to support a decision on the pest quarantine status or justify management measures. Third, it identifies the criteria for choosing the appropriate level of complexity, regarding the resolution, economic technique and time frame of the quantitative approach. The greater transparency and objectivity of the quantitative vis-a-vis qualitative economic impact assessment may enhance plant health policy and decision making at national and international regulatory bodies. However, uncertainties that are inherent to this approach may weaken this position. Hence, PRAs require a mixture of quantitative and qualitative approaches for assessing impacts and the exact balance of the two has to be case-specific.

1. Introduction

As defined by the International Plant Protection Convention (IPPC) and the World Trade Organization Agreement on the Application of Sanitary and Phytosanitary measures (WTO-SPS), any measure aimed at preventing the introduction and spread of new pests must be justified by a science-based pest risk analysis (PRA) to ensure that imposed measures are used only as plant health protection instruments and not as unjustified barriers to trade (FAO, 1995). Technical, scientific and economic evidence are evaluated in a PRA to determine whether an organism needs to be categorized as quarantine pest and, if so, how it should be managed.

In practice, the economic impact assessments within most PRAs are based on a qualitative approach, i.e. expert judgments on likely economic consequences, and not on an explicit quantification of costs (Sansford, 2002; EPPO, 2011). Expert judgments have low costs and make efficient use of qualitative expert knowledge, but may suffer from important drawbacks such as a lack of transparency and repeatability (Sansford, 2002). To guard against this, plant protection agencies generally apply structured decision support schemes as outlined in the International Standards on Phytosanitary Measures (ISPM) No. 11 (FAO, 2004; EPPO, 2011). These schemes consist of a logical sequence of questions or options to capture the experts' opinion. For each question or option, the expert provides his/her answer by selecting a score within some predefined ordinal risk classification scheme. Such a scheme describes economic consequences in broad qualitative terms, without strict guidelines defining time frame, class offsets, etc. Economic impacts are assessed by questions or options considering the expected yield or quality losses, the potential impact on international trade and expected control costs (EPPO, 2011; ACIA-CFIA, 2008;

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USDA, 2012; Biosecurity Australia, 2007). Although this approach is helpful for classifying pest impacts, the status of the assessment has weak quantitative support. It has therefore some shortcomings in justifying measures, which may turn out to be weaknesses in case of a trade dispute.

There is a growing awareness that quantitative economic impact assessments are essential to provide a better transparency and objectivity of the quarantine regulation (Sansford, 2002). Conducting a quantitative economic impact assessment with the aim of supporting a decision on pest quarantine status or management measures requires subject specific information in terms of data and models. ISPM no. 11 gives general guidelines on the impacts that have to be taken into account (i.e. direct and indirect impacts) and analytical techniques which are suitable for a quantitative economic impact assessment (i.e. partial budgeting, partial equilibrium modelling and computable general equilibrium modelling). However, risk analysts are usually not trained as economists, and they need guidance with respect to the required data and economic modelling technique to conduct a proper quantitative economic impact assessment. Furthermore, guidance is needed to assess whether the required extra data collection and human resources are worth the effort because usage of more comprehensive techniques may introduce more uncertainty in the results than is justified by the extra insights they may provide (Vose, 2001; Sansford, 2002). ISPM No. 11 states that "*Pest risk assessment needs to be only as complex as is technically justified by the circumstances*" (FAO, 2004) but does not provide any further guidance in selecting the appropriate complexity level of the assessment. This paper aims to make a contribution towards filling this gap with respect to the impact assessment part of the pest risk analysis.

The objectives of the paper are: first, to compare the strengths and weaknesses of a qualitative and quantitative approach for assessing economic pest impacts. Second, to clarify the data and models needed to conduct a quantitative economic impact assessment in support of a decision on pest quarantine status or management measures. Third, to provide criteria that can be used to select the appropriate level of complexity in the economic impact assessment part of a PRA.

2. Qualitative economic impact assessment

In Europe the EPPO PRA scheme is used to perform a qualitative impact assessment of the pest risk (EPPO, 2011). It provides a decision support scheme based on ISPM 11 developed by the International Plant Protection Convention. An adapted EPPO scheme is used by the European Food Safety Authority EFSA (EFSA, 2010; EFSA, 2012). Similar schemes are used in other parts of the world. For instance, in Canada (ACIA-CFIA, 2008), the USA (USDA, 2012), Australia (Biosecurity Australia, 2007) and New Zealand (Biosecurity New Zealand, 2006).

The EPPO scheme consists of a logical sequence of questions addressing all elements of ISPM 11. The scheme is designed as a binary decision tree to quickly eliminate organisms that do not qualify as potential quarantine pests. The PRA section dealing with the economic impact assessment consists of 6 questions. The first two questions concern the size of the expected impact with and without control measures. The third question addresses the efficacy of the existing control measures (excluding the phytosanitary measures). The fourth question addresses the expected increase in production costs (including control costs), and the last two questions deal with the expected change in consumer demand and the expected losses in the export market. In the EPPO scheme, impacts are assessed on a five-point ordinal scale (minimal, minor, moderate, major or massive) based on the evidence and expert's experience. These qualitative impact assessments are justified by explanatory text. Due to the difficulty of creating generic rating guidance for the ordinal scale, clarifying notes are attached to the questions. These notes explain how the risk analyst can select the proper score with regard to the magnitude of the impact. The notes, for instance, provide examples which the risk analyst can use as a reference when making his assessment.

For example, in 2004, a PRA was conducted on *Tomato chlorosis virus* (ToCV). In the economic impact assessment section, it was concluded that it predicted significant damage (i.e. high impact) in tomato fields and glasshouses and that the severity of the symptoms and damage would vary according to the cultivar. Furthermore, the experts expected that ToCV would increase the price of tomatoes in the case of substantial losses causing potential changes in producer supply and subsequently consumer demand. Regarding potential trade, they concluded that the extent to which this would affect export markets is highly uncertain (EPPO, 2014a).

Since 2006, the first year of EPPO conducting PRAs following the EPPO decision support scheme, seventeen PRAs were conducted for insects and mites, two for nematodes, two for fungi, two for bacteria, one for a virus and six for invasive plants. Four PRAs are currently under development. A list of the finalized PRAs conducted by EPPO can be found on their website (EPPO, 2014b). In Europe, PRAs are also conducted by the Plant Health Panel of the European Food Safety Authority (Jeger et al., 2012). These assessments are carried out according to a conceptual framework that is broadly similar to the scheme used by EPPO (EFSA, 2010). An overview of risk assessments completed by EFSA is given at http://www.efsa.europa.eu/en/topics/topic/planthealth.htm.

The qualitative schemes used in other parts of the world (mentioned above) are similar to the EPPO and EFSA schemes. In general, all these schemes are targeting all types of plant pests except for the Australian and New Zealand schemes. The generic Biosecurity Australia and Biosecurity New Zealand schemes are generally not used for invasive plants because these countries have developed specific risk assessment schemes for these.

3. Quantitative economic impact assessment

Generally, a quantitative economic impact assessment integrates information on the assets at risk, the pest spread, the potential direct damage, and the subsequent economic consequences to producers, consumers, and international trade. Data on pest introduction, establishment and spread are, therefore, indispensable for an accurate quantitative estimation. In most pest risk assessments, introduction, establishment and spread assessments are conducted qualitatively, requiring a quantitative estimation of these risk elements for the impact assessments. Recent developments in the quantitative assessments of climate suitability,

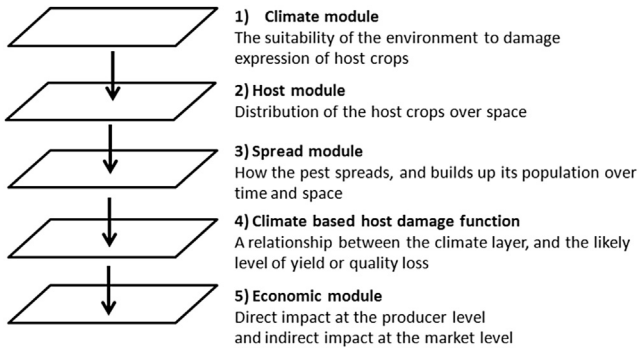

Fig. 1. Bio-economic framework to assess the economic impacts using a quantitative approach.