

Determination of the acceptable risk of introduction of FMD virus in passenger luggage following the UK outbreak in 2001

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Within weeks of the February 2001 outbreak of foot-and-mouth disease in the UK, a number of measures were introduced at the border to reduce the risk of introduction of the disease into New Zealand. This paper examines the process that led to these decisions, and compares it to the decision-making process implied under the WTO framework. In particular, difficulties in determining the acceptable level of risk for low probability/high impact diseases are discussed.

Background

Foot-and-mouth disease (FMD) has long been endemic in most of Asia, Africa, the Middle East, and South America, but against that backdrop, the type-O PanAsia strain has been steadily spreading since 1990 from its presumed origin in northern India. Nevertheless, the UK epidemic that began on 20th February 2001 came as a shock to biosecurity agencies worldwide. Public and political anxiety concerning the risks to New Zealand agriculture rose quickly, and similar public reactions were seen in many other countries. Initial attempts by the Ministry of Agriculture and Forestry (MAF) to allay public concerns (Martin, 2001) were quickly dismissed by the media as 'complacency' (Anon, 2001a), and there were calls from a number of quarters to tighten border protection. Government rapidly concluded that further border measures were required, and on 12th March an extra \$4.6 million per year was allocated for airport biosecurity to raise the level of detection of 'risk goods' to as close to 100 percent as possible (MAF, 2001).

The SPS model of biosecurity decision-making

The Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) sets out basic rules for food safety and animal and plant health standards in international trade. The SPS agreement stipulates that SPS measures may be applied only to the extent necessary to protect human, animal or plant health, and that they should be based on sound scientific assessment of the risks using risk analysis methods recommended by the Office International des Epizooties (OIE) (WTO, 1998).

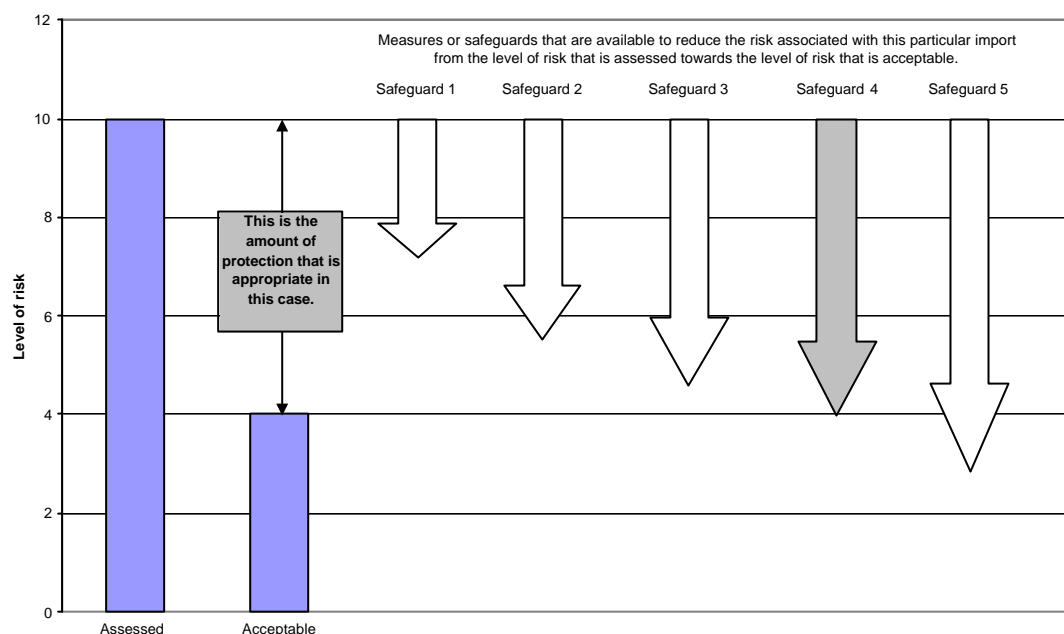
Underpinning the SPS agreement and the risk analysis methodology as set out by the OIE (OIE, 2000) is the implicit assumption that it is possible, through the application of scientific and economic analysis to:

- objectively measure the levels of risk associated with an import ;
- objectively evaluate a number of options for risk management in terms of how much each option would reduce that risk; and
- select and apply the measure or measures that delivered the correct (or appropriate) amount (or level) of protection (or risk reduction) in order to reduce the originally measured risk down to (but not below) a pre-determined acceptable level.

The outcome of such a purely rational and scientific process would achieve the SPS goal of transparent management of biosecurity risk without unnecessarily restricting trade.

This theoretical relationship is shown for a hypothetical example in Figure 1.

Figure 1. The relationship between assessed risk, acceptable risk, and the appropriate level of protection.



In this example our assessed level of risk is clearly higher than the acceptable risk. It is apparent also that we have at our disposal five different measures to choose from in managing the risk, and it is further assumed that we know in advance how much risk reduction can be achieved by each of the available measures. Measures 1 to 3 are unable to reduce the risk down to the acceptable level, and Measure 5 would reduce it too far, which would be unnecessarily trade restrictive. Clearly, Measure 4 would reduce the risk from the assessed level to the acceptable level, and therefore it would deliver the level of protection that is appropriate. Thus, although the SPS agreement notes that the terms 'acceptable level of risk' and 'appropriate level of protection' are commonly used interchangeably, they may not be exactly the same concepts.

However, as already alluded to above, there are many assumptions involved in this model, and although many countries are grappling with these issues, none have yet managed to specify the acceptable level of risk in precise quantitative terms as envisaged under the WTO framework.

Among the issues arising is how risk should be expressed. A number of articles of the SPS Agreement suggest that risk should preferably be expressed quantitatively, and this preference has been clearly articulated by the SPS Committee (WTO, 2000). Further, both the SPS Agreement and the OIE Guidelines for Risk Analysis (OIE, 2000) suggest that risk is a function of likelihood and consequence, and this relationship (in the absence of safeguards) has been presented by Caporale et al (1999, p 730) as follows,:

$$Risk = f(likelihood, consequence)$$

Further, article 5.3 of the SPS Agreement implies that the consequences of an adverse event should be measurable in economic terms. Therefore, if risk is a product of likelihood and consequence, then when likelihood is expressed as a probability and consequence is expressed in dollar terms, then it follows that risk itself (and acceptable risk, and the appropriate level of protection) should also be expressed in dollar terms.

However, the apparent faith in quantification that was implicitly expressed by SPS Members at the time of signing the agreement, and since reaffirmed by the SPS Committee, does not appear to be based on any realistic appraisal of what quantification can be expected to deliver, and it remains to be seen whether this model is applicable in practice.

Application of the SPS model : FMD risk in international air passenger luggage

One of the most important routes of international spread of FMD virus is illegally imported meat from viraemic animals which is subsequently fed to pigs. This risk has long been recognised, and for many countries whose economies are heavily reliant on the exports of animals and animal products, the exclusion of FMD virus has always been a primary focus of the state veterinary service (Pharo, 2002).

In an 'ideal world' the risk of introduction of FMD virus in passenger luggage could be assessed, and the acceptable level of FMD risk would be known. But how much border protection would be appropriate to reduce the risk of FMD incursions? Again in an 'ideal world', if the acceptable risk were expressed in dollar terms as implied by the SPS model, then it would make sense to increase protective measures at the border for FMD until the marginal benefits of protection from FMD were equal to the marginal costs of the imposing the measures.

A number of important practical issues arise in the application of this approach.

Assessing the current FMD risk at the border

The biosecurity objective at airports is to prevent the illegal importation of 'risk goods' including animal products with passengers and their belongings. However, it is recognised that no measures can never be completely effective, and that regardless of the stringency of measures in place, there will be some level of risk goods that evade detection. This level of risk goods is referred to as 'slippage'.

Slippage can be estimated for any particular border measure by comparing the achieved detection rate of risk goods against the true carriage rate. At airports this has been achieved by considering full baggage search as a 'gold standard'. Although it could be argued that slippage could be reduced to almost zero by the application of full baggage search to all passengers, this would not be possible for a number of reasons. In particular, the Convention on International Civil Aviation, to which New Zealand is a signatory, states that passengers should be cleared from international airports within 45 minutes of arrival, and the cost of a system that would allow that with full baggage search would be extreme, in view of the number of passengers involved - in the year 2000, approximately 3.5 million passengers and crew arrived in New Zealand by air, and passenger numbers have been doubling every 7 years (Whyte, 2001).

To establish the sensitivity of border measures, the full baggage search would be applied over a short period on a sample of passengers that have already been passed by the measure being assessed. By applying this form of validation, it was estimated that the sensitivity of MAF procedures in place at airports prior to the initial introduction of x-ray machines was approximately 55%. That is, existing measures were detecting only about 55% of risk goods in passenger luggage. The remaining 45% was the slippage. On this basis, it has been estimated that the daily slippage of meat and meat products prior to 1997 was about 25 kg per day (Whyte, personal communication).

The FMD risk posed by 25 kg per day slippage of meat and meat products is very difficult to assess. The relevant factors to consider are contained in the 'release assessment' and 'exposure assessment' steps of the OIE guidelines for risk assessment (see Murray, 2002 for details). While it is well recognised that FMD virus is likely to be present in meat from animals that were viraemic at the time of slaughter, the duration of survival of the virus in such meat depends on a number of factors (see Pharo, 2002). Moreover, the small quantities of meat that are carried by individual passengers mean that the 25 kg may have originated from a number of different countries, each with different FMD statuses. Concerning exposure, for contaminated meat to result in an outbreak of FMD in New Zealand, it would have to be fed to pigs without being cooked. Considering the type of meat and meat products that are carried by passengers (generally processed or cooked meat for personal consumption), the likelihood that it would either contain FMD virus or would be disposed of in garbage which would find its way into pigs is probably remote.

At this point it may be noted that the border situation in New Zealand is very different to some other countries that have experienced outbreaks of FMD in recent years. For example, in 1999 the Taiwanese authorities seized around 1000 tonnes of meat products smuggled from China, and it has been estimated that this amount may represent as little as 10% of the total amount smuggled (Croddy, 2001). In the UK there appear to be few controls in place to control meat in passenger luggage, even though about 67 million passengers arrive at UK airports per year (Pharo, 2002). In a one-off survey carried out over an 8 month period in 2000, fourteen flights from Africa were searched by UK customs officials, and 5½ tonnes of meat and fish were found in passenger luggage. These amounts are said to be eclipsed by the organised smuggling of bush meats and apparently deliberate mis-declaration of cargo shipments (Anonymous, 2001b).

Given the remote likelihood of exposure it is difficult to objectively determine the risk that 25 kg of meat slippage poses. In quantitative risk analyses the likelihood of there being one or more outbreaks is usually calculated on the basis of a most likely hypothesised exposure scenario, and the result of such a calculation is usually expressed as a probability per import year (Murray, 2002). In this case, it could be expressed as the probability per tonne of illegal imports per year.

How well such a calculation corresponds to reality, however, is often a matter of conjecture. Not only are there potentially issues related to the design of the scenario tree, there is usually very limited information available on which to base estimates of probabilities on each branch. Indeed, such 'estimates' may be in reality little more than guesses, made by more or less informed individuals or groups.

Assessing the effect of risk management measures

Nevertheless, assuming that the probability of one or more outbreaks can be calculated, the risk reduction effect of applying a measure at the border would be the change in that probability with the measure in place - in other words the 'probability saved'.

Thus, if risk is the product of likelihood and consequence, then the benefits of that measure would be calculated as the product of the probability saved and the cost of an outbreak. The cost of applying measures can be calculated relatively easily, and the net benefits would be the difference between the two. As indicated earlier, it would make sense to increase measures at the border until the net benefits were zero.

However, there are also major difficulties associated with calculating the likely cost of an outbreak and therefore the benefits of avoiding an outbreak.

This is primarily because the cost of any individual outbreak will depend on a number of factors; such as the number of properties involved, the production and mortality losses and the losses due to closure of domestic or international markets. These losses will vary with the virulence of the particular strain of the agent, production systems and livestock population density in the area of introduction, weather, season etc. Thus, while conceptually there could be a broad spectrum of economic impacts, consequence assessment remains a relatively undeveloped step in the OIE risk analysis process (see, for example, Murray, 2002).

For these reasons, economic impact assessment often assumes a worst case economic effect, usually based on economic models of varying complexity requiring various amounts of data and relying on various assumptions.

Notwithstanding these difficulties, as has already been alluded to above, for countries whose economies are heavily reliant on exports of animals and animal products, the major losses that would arise from the introduction of certain disease agents would be those resulting from the loss of export markets, and FMD is the most extreme example of such diseases. In the case of New Zealand, a single outbreak of FMD on a solitary property would result in immediate suspension of exports valued at about \$10 billion per annum (Fox, 2001). Even if the disease were eradicated immediately without any spread to other properties (very unlikely, given the highly contagious nature of the disease), there would be considerable difficulties and delays associated with regaining access to lost international markets.

Assessment summary

Are we likely to attain the 'brave new world' of transparent and consistent decision making based on quantitative scientific analysis of the risks according to the WTO framework? This seems unlikely, at least in the short term. Applying quantitative analysis to biosecurity decision-making as implied in the SPS agreement involves many difficulties. Given the extent of these difficulties discussed above, it is perhaps understandable that biosecurity risk analyses are rarely quantitative.

What was the basis for the decision to increase border measures against FMD?

During the 3 weeks following the outbreak of FMD in the UK, there was no formal MAF evaluation of the risk of FMD in passenger luggage. Nor was there time to carry out even a

rudimentary benefit-cost analysis before Cabinet reached the decision to increase the x-ray capacity to enable 100% inspection of passenger baggage.

Although this decision was justified by Cabinet on the basis that "the number of recent high-profile incursions" indicated that New Zealand's biosecurity systems were "under pressure" (Cabinet, 2001), it is not clear how that conclusion was reached, and in fact a subsequent analysis suggests that, on the contrary, the situation was as follows:

- the number of incursions has not risen substantially in recent years
- of the so-called 'high-profile incursions', only fruit fly can be strongly linked to air passengers
- as a result of the installation of the first 7 x-ray machines following the 1997 fruit-fly incursion, the risk of meat and meat products slippage was reduced from about 25 kg per day in 1996 to less than 5 kg per day in 2000 (Whyte, personal communication), which means that the risk in February 2001 was less than 20% of the risk that had been present in 1996.

In one of the policy documents of the New Zealand Labour Party released in the run up to the 1999 general election, it was pledged that, if elected, "Labour will aim for border inspection standards that achieve interception rates as close to 100% as possible of all at-risk pathways including visitors, vessels, aircraft, containers, goods and produce, and mail" (New Zealand Labour Party, 1999). In the light of such a pledge, it appears reasonable to conclude that government saw this situation as an opportunity to fulfil a campaign promise. Officials that had pushed unsuccessfully for this outcome for many years, based on their perception of the fruit-fly risk, would presumably have not been opposed to seizing on the FMD outbreak as an opportunity to achieve what they had long believed was in the national interest. It is also possible that decision-makers had their own perceptions of how the FMD risk had changed since the outbreak in the UK, or perhaps this reflects a change in acceptable risk as a result of a change in government. Finally it could be simply that that politicians felt that they had to be seen to be acting in the face of rising public anxiety.

Whatever the decision-making process was in this instance, conspicuously lacking was either an objective analysis of the additional risk that was presented at New Zealand's international airports as a result of the outbreak of FMD in the UK, or an objective evaluation the level of security already achieved at the border by existing biosecurity measures.

Conclusion

What does this say about decision-making and the acceptable level of risk in general? The answers are more likely to be found in the political and social sciences rather than in veterinary science.

Of particular importance is the public perception of risks and the role of rationality in political decision-making. It is abundantly clear that the public perception of the biosecurity risks facing New Zealand has changed markedly over the past 5 years, as the 'distinctive biodiversity' of this country has come to be seen as increasingly under threat from the risks posed by a wide range of exotic organisms and pests (PCE, 2000). Relatively little has been published on the perception of biosecurity risks, and the bulk of the literature on risk perception is related to environmental risks, particularly in the context of various forms of pollution and predominantly from the US perspective. However, the 'subjective and value-laden' nature of risk perception is increasingly recognised, so that views of individuals about a

particular risk will depend on many factors including worldview, gender, education, and socio-economic level. Moreover, these differences are just as likely to be seen within scientific professions as between professionals and 'laymen', particularly when scientists are working at the limits of their expertise (Slovic, 1999). Risks are more likely to be considered unacceptable if they are imposed, memorable, imaginable, or have potentially catastrophic consequences, regardless of their probability of occurrence (Slovic et al, 2000).

The role of the media has become increasingly important in influencing public perceptions of risks in the past 5 years. Sandman (1994) has noted that most of the media coverage of risk stories is not really about risk; rather, it is about blame, fear, and anger. Thus, in Sandman's view the focus of the media is on 'outrage', not 'hazard'. This fits well with the New Zealand media coverage of FMD in the UK: the fear was related to the damage that FMD would cause to New Zealand, the blame was directed towards MAF for being cavalier and complacent, and the anger was directed at politicians for allowing the country to be exposed to such a risk by having border measures in place that were perceived to be inadequate.

Since it appears that 'scientific experts' and the public frequently see risk in fundamentally different terms, the question arises, who should make decisions for society on what constitutes an acceptable risk? Clearly the 'traditional' view of risk assessment as a purely scientific enterprise is not sustainable, and serious attention to participation and process issues is likely to become increasingly important (Slovic, 1999).

Finally, what can be concluded about the acceptable level of risk of FMD to New Zealand? It appears that the only acceptable outcome for this country is "no incursions of FMD". Thus, even a single incursion would be seen as a failure, and it may mean that for some diseases the only acceptable risk is one that is as close to zero as can be practically achieved.

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