Economic evaluations of the FMD epizootic for agriculture and trade

Franka Tomassen, Monique Mourits & Ruud Huirne
Wageningen University, The Netherlands

Successful economic eradication of an FMD epidemic mainly depends on the selected control strategy and on the time interval between diagnosis and implementation of the control strategy. Selecting an inadequate strategy may cause large additional economic losses. Delayed implementation of control measures may cause extensive spread of the disease. This means that it is very important for animal health authorities to make the right decision immediately after the first diagnosis. Usually there is no time to gather additional data to support decision making. Therefore, it is absolutely essential to have an overall analytic structure for these kinds of situations beforehand.

We developed a tool, that can serve as an analytical framework for economic analysis, to support decision making on control strategies during the early stage of an epidemic. This tool comprises a decision tree using all information available in the first three days after the declaration of an outbreak. The information concerns mainly the livestock and herd density in the outbreak region, the possibility of airborne spread and an estimation of the period between first infection and first detection.

The objective of the decision tree is to calculate the economically optimal control strategy for each situation. Economically optimal means that direct costs and export losses are minimised. A calculation has been made for the Netherlands.

The starting point of the tree is an epidemiological model. This model uses contact patterns of different farm types to simulate the spread of the disease. The effect of four control strategies on FMD dynamics have been modelled. Based on the current EU legislation and analyses of recent epidemics, the following control strategies are considered in this study:
(1) stamping-out of infected herds (85/511/EEC) and culling of high-risk contact herds (SO);
(2) SO extended with ring culling of all susceptible animals within a radius of 1 km of an infected herd (RC1);
(3) SO extended with ring vaccination of all susceptible animals within a radius of 1 km of an infected herd (VC1);
(4) SO extended with ring vaccination of all susceptible animals within a radius of 3 km (VC3).

All four strategies include movement control. The last three strategies also took into account the possibility of airborne spread outside implemented rings. Susceptible animals outside a ring but downwind of a virus plume were culled or vaccinated respectively. Vaccinated animals were culled as quickly as possible to keep the necessary period for regaining the status of FMD-free country without

vaccination as short as possible. Here, culling and destruction capacities were the restricting factors.

An economic model converted outbreak and control effects of farming and processing operations into estimates of direct costs and consequential export and trade losses. The extent of the consequential export and trade losses depends on the duration and size of the epidemic and the reactions of importing countries during and after the epidemic. These reactions are distracted from international trade restrictions during recent epidemics.

The calculations show that animal density within the outbreak region is an important determinant in deciding on the optimal control strategy. There is a considerable regional variation in the size of impacts. The results also indicate that the export losses are much higher than the direct costs.

Ring vaccination is the economically optimal strategy for densely populated livestock areas because this strategy reduces the number of infected herds and the duration of the epidemic compared to the other strategies. Ring culling is the economically optimal strategy for sparsely populated livestock areas. For livestock areas that are neither very densely populated nor very sparsely populated, the optimal strategy depends on the period between first infection and first detection and the presence of airborne spread.

The duration of an epidemic is one of the most important parameters, which determined the economic impact of an epidemic. In densely populated livestock areas the culling and rendering capacity is the limiting factor, causing delays in culling and extension of the epidemic. Therefore, ring vaccination is the optimal strategy in these areas because it reduces the number of infected farms and likewise the duration of the epidemic. These results can be used as yardsticks for deciding on control measures during possible FMD epidemics in the future.

Statements for discussion
- Power of ring vaccination in densely populated livestock areas is usually underestimated

- Huge impact of trade restrictions on economic losses, and therefore on economic optimal strategies, is not always recognised.

- Importance of regionalisation principle for reduction of trade losses.