ECONOMIC EVALUATION OF FMD MANAGEMENT OPTIONS

IMPLICATIONS FOR SCIENCE AND POLICY

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"The equation"
\[ C_{av} = (1-p) \times C_{\text{no outbreak}} + p \times C_{\text{outbreak}} \]

- \( C_{av} \) = average annual costs of FMD
- \( p \) = probability of an outbreak
- \( C_{\text{no outbreak}} \) = \( C \) annual surveillance
- \( C_{\text{outbreak}} \) = \( C \) direct + \( C \) control + \( C \) trade
Socio-economic effects of FMD and its control are determined by:

1. the probability of occurrence of an outbreak in one or more MS’s,

2. and the economic effects of
   a. the outbreak (the size and duration of the outbreak) and
   b. the control measures taken by Competent Authorities and

3. the reaction of stakeholders/public and trade partners.
The probability of occurrence of an outbreak in one or more MS’s
Source: WTO, international trade statistics (2012)
Current prices

Export of Agricultural products

- WORLD
- EU (25)
The world

Worldmapper.org
Meat exports

Worldmapper.org
Dairy exports

Worldmapper.org
Export to countries outside the EU

Export of Cheese from the Netherlands

Export value pig meat (2006)
Million€

<table>
<thead>
<tr>
<th></th>
<th>NL</th>
<th>DK</th>
<th>DE</th>
</tr>
</thead>
<tbody>
<tr>
<td>total</td>
<td>1767</td>
<td>3333</td>
<td>2458</td>
</tr>
<tr>
<td>intra EU</td>
<td>1543</td>
<td>2115</td>
<td>2200</td>
</tr>
<tr>
<td>extra EU</td>
<td>224</td>
<td>1218</td>
<td>257</td>
</tr>
<tr>
<td>fraction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>extra EU</td>
<td>13%</td>
<td>37%</td>
<td>10%</td>
</tr>
</tbody>
</table>

De Winter et al, LEI 2010
The economic effects of the outbreak and the control measures taken by Competent Authorities
Control of FMD in the EU

- Prophylactic vaccination in EU has been banned in the EU since 1992 (Directive 90/423/EEC)

- EU minimal measures:
  - culling of infected herds,
  - pre-emptive slaughter of contact herds,
  - establishment of control and surveillance zones

- Additional measures:
  - Ring culling and/or
  - Emergency vaccination
    - Delayed culling
    - Vaccination to live
2001 FMD outbreak in NL

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2001 FMD outbreak in NL

- 26 outbreaks were detected.
- All susceptible animals on approximately 1800 farms were vaccinated. All farms subsequently were depopulated.
- In total, approximately 260,000 animals were killed.

Economic effects of the outbreak

- **Direct costs:**
  - Compensation for depopulated animals
  - Depopulation (taxation, culling, transport & destruction, cleansing & disinfection)
  - Tracing
  - Screening
  - Vaccination
  - Additional surveillance in movement restriction zone

- **Indirect costs** *Business interruption*
  - Losses related to established movement restriction zones
  - Repopulation of the farm.
  - Losses from emergency vaccination
Economic effects of an outbreak

- **Direct costs:**
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  - Tracing
  - Screening
  - Vaccination
  - (Additional surveillance in movement restriction zone)

- **Indirect costs**
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  - Losses related to established movement restriction zones
  - Repopulation of the farm.
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Costs born by government (or PPP) & 60% by EU

Costs born by directly affected farmers
Consequential losses

- Export market losses
- Ripple effects.
  - upstream and downstream along the livestock value chain
- Spill-over effects.
  - During outbreaks e.g. tourism and other services
Export market losses

- The costs of animals and products, that because of an outbreak cannot be exported.
  - During the outbreak and after completion of screening until EU lifts export bans
  - After this period, this concerned the third countries market for live animals, meat, meat products, milk and milk products from infected countries/compartments for another 3 months without vaccination and for another 6 months with vaccination-to-live. (OIE terrestrial code article 8.5.8)
  - (Are markets after this period still available as before the outbreak?)
Costs of the 2001 FMD outbreak in NL

- Total for Dutch society: €900 million or 0.3% GNP
  - Direct costs: €90 million
e.g. enforcement costs, compensation of culled animals, screening etc.
  (had to be borne by the government)
  - Farmers (Indirect and export market losses): €320 million
  - Other parts of the livestock chain: €215 million
  - Tourism and recreation sector: €275 million

Source (CPB 2001 cited by Huirne et al., 2002)
Payments by the EU Emergency Fund (1997-2009)

- Total payments by Emergency fund in this period:
  - 1,109 million €
The reaction of stakeholders/public and trade partners
What has changed in the NL?

- No more images of large scale culling of animals
- Society is closely monitoring what is happening
- No welfare slaughter with destruction but welfare slaughter with animals and products made available for consumption
- Vaccination to live strategy
Approach

Policy makers

Epidemiological modelling

Economic evaluation

Health Economics: Getting Value for Money
Methodology (1) Definition of investigated policy options / Control strategies:

The following strategies were evaluated:

1. EU basic strategy: EU minimal measures
2. EU basic strategy + Culling in 1 km around infected farms
3. EU basic strategy + Vaccination with radius of 2 or 5 km around infected farms (culling 1st week)
Farm densities 2006

- **Cattle**: 37,000 farms, 3.7 mln animals
- **Sheep**: 18,000 farms, 1.5 mln animals
- **Pigs**: 9,000 farms, 11 mln animals

Legend:
- 4 farms/km²
- 3 farms/km²
- 2 farms/km²
- 1 farm/km²
- 0 farms/km²
Methodology (2) Epidemiological modelling

- **Within-herd module**
  - For each species:
    - Transmission rate
    - Infectious period
    - Clinical symptoms
    - Vaccination effect
    - Detection limit
  - Literature on cattle, sheep, pigs:
    - Transmission experiments
    - Vaccination experiments
  - I&R database (cattle, sheep)
  - GD database (pigs)
  - Data FMD outbreak 2001

- **Between-herd module**
  - Infection pressure over time
  - Detection time
  - Infection time
  - Vaccination time (preemptive)
  - Culling time
  - Transmission kernel
  - Locations
  - Farm types

- **Course of hypothetical epidemic**

- **Control strategy**

- **Backer et al, 2008, EU FMD conference**

**Graph**

- # infectious farms (50%)
- Time (days)
- 1 km culling
- 2 km vaccination
- 5 km vaccination
- EU basic

**Legend**

- DPLA
Methodology (3) Economic assessment
When vaccination-to-live strategy is applied

- Products of vaccinated animals produced *during* the outbreak: no difference with other animals in control and surveillance zones

- Products of vaccinated animals still present *after* the end of the outbreak until declared officially free:
  - Logistic processing and sub-optimal value
  - Market acceptance: products restricted to Dutch market
Estimated Average value loss due to lower revenues and logistic processing of vaccinated animals (in € per vaccinated animal).

<table>
<thead>
<tr>
<th>Category</th>
<th>Value loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy cows</td>
<td>450 €/ animal</td>
</tr>
<tr>
<td>Young stock</td>
<td>5 €/ animal</td>
</tr>
<tr>
<td>Veal calves</td>
<td>550 €/ animal</td>
</tr>
<tr>
<td>Other cattle</td>
<td>26 €/ animal</td>
</tr>
<tr>
<td>Sows</td>
<td>260 €/ animal</td>
</tr>
<tr>
<td>Fattening pigs</td>
<td>50 €/ animal</td>
</tr>
<tr>
<td>Sheep</td>
<td>34 €/ animal</td>
</tr>
</tbody>
</table>
## FMD SPLA (< 2 farms/km²) area Friesland:

<table>
<thead>
<tr>
<th></th>
<th>NUMBER OF CULLED FARMS</th>
<th>LAST WEEK OF DETECTION</th>
<th>TOTAL COSTS INCL COSTS OF OPERATION (in M€)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50% 5% 95%</td>
<td>50% 5% 95%</td>
<td>50% 5% 95%</td>
</tr>
<tr>
<td>EU</td>
<td>7 2 46</td>
<td>3 1 12</td>
<td>58 48 102</td>
</tr>
<tr>
<td>cul1</td>
<td>56 2 295</td>
<td>3 1 8</td>
<td>62 48 109</td>
</tr>
<tr>
<td>vac2</td>
<td>30 2 117</td>
<td>3 1 8</td>
<td>61 48 108</td>
</tr>
<tr>
<td>vac5</td>
<td>30 2 113</td>
<td>3 1 6</td>
<td>65 48 122</td>
</tr>
</tbody>
</table>
FMD PDLA (>4 farms/km²): Gelderse vallei

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<tbody>
<tr>
<td></td>
<td>50%        5%         95%</td>
<td>50%        5%         95%</td>
<td>50%    5%         95%</td>
</tr>
<tr>
<td>cul1</td>
<td>971        206        3217</td>
<td>9          4          15</td>
<td>236     94        615</td>
</tr>
<tr>
<td>vac2</td>
<td>260        70         707</td>
<td>10         5          17</td>
<td>227     99        526</td>
</tr>
<tr>
<td>vac5</td>
<td>230        68         571</td>
<td>6          4          11</td>
<td>228     106       504</td>
</tr>
</tbody>
</table>
Distribution of costs (median DPLA)

Culling 1 km
- Culling + disinfection infected farms: 30%
- Repopulation infected farms: 7%
- Transport prohibition non-infected farms: 4%
- Empty housing infected farms: 5%
- Market & export loss: 14%
- D destructed feed + milk infected farms: 2%
- Value loss vaccinated animals: 0%

Vaccination 2 km
- Repopulation infected farms: 2%
- Transport prohibition on-infected farms: 6%
- Empty housing infected farms: 2%
- Logistic slaughtering vaccinated animals: 1%
- Value loss vaccinated animals: 38%
- Market & export loss: 23%
- Empty housing non-infected farms in infected compartments: 6%
- Logistic slaughtering vaccinated animals: 1%
- Culled animals infected farms: 16%
- D destructed feed + milk infected farms: 1%
Distribution of costs

Culling 1 km
- Culling + disinfection infected farms: 30%
- Culled animals infected farms: 34%
- Repopulation infected farms: 7%
- Transport prohibition non-infected farms: 4%
- Empty housing infected farms: 5%
- Market & export loss: 14%

Vaccination 2 km
- Vaccinating: 1%
- Culling + disinfection infected farms: 9%
- Culled animals infected farms: 11%
- Transport prohibition non-infected farms: 6%
- Empty housing infected farms: 2%
- Logistic slaughtering vaccinated animals: 0%
- Value loss vaccinated animals in NL: 38%
- Empty housing non-infected farms in infected compartments: 6%
- Destructed feed + milk infected farms: 1%
Implications for policy and research

1. Reduce the probability of occurrence of an outbreak in one or more MS’s,
   1. → preventive measures
   2. → public Private Partnerships
Share responsibility and costs between public and private sector (the PPP)

- All farmers pay a levy to the compensation scheme.
- Sharing responsibility between government and stakeholders has to be established before decisions on cost sharing can be defined.
  - Provides incentives for farmers to stimulate behavioural changes.
  - Should impose biosecurity standards/quality assurance.
  - Determining an appropriate base for cost sharing is a highly complex matter (no “one size fits all” solution).
  - Should adequately consider national and regional differences.
  - Should be based on a EU set of basic requirements (and preferably recognized by the EU).
  - Example is Dutch Animal Health Fund
Animal health fund

- Covenant of the Ministry of LNV with the Commodity Boards Cattle, Pigs, Poultry, Sheep and Goats
- Covenant for financing outbreaks of animal disease
  - Covers payments of the costs of outbreaks of contagious animal diseases designated by the Dutch government.
  - The expenses for legal control of contagious animal diseases.
  - Maximal contribution of different livestock sectors in 5 year period
Implications for policy and research (2)

- Research indicates that vaccination-to-live is alternative for large scale culling
- Support with epi- and eco-models to continuous update during an outbreak
- Harmonisation of regulation vaccination-to-live with culling or vaccination as delayed culling
- Challenge is to put experiences from the past into perspective of the 21st century
Conclusion

- Economic evaluation of different FMD management options:
  - should to be based on universal principles,
  - need to be tailored to local circumstances in discussion with stakeholders,
  - is likely to result in different solutions for different countries e.g. due to difference in livestock population density, trade patterns or acceptance of product originating from vaccinated animals, and
  - should be supported by epidemiological and economic models.
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