The Economics of Animal Health: Direct and Indirect Costs of Animal Disease Outbreaks

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Introduction

> The 83rd General Session raised the need for more information on “The Economics of Animal Health”

> The concerns about this area reflect recent periods with major animal disease outbreaks

> They also reflect increasing pressure on public budgets and the need to justify expenditure in key economic areas

• Including the economic activities associated with animals and therefore animal health
Introduction

- In academic terms the use of economics in animal health is relatively recent.
- Much of the early work was based on the use of cost-benefit analysis methods of past and future disease control programmes.
- Some economists have argued that this was less an economic approach, more about financial analysis to justify decisions already taken.
Introduction

- It also raises the question of how economics is currently being used and how data are being collected to allow the best use of economics.
- We are all aware of the PVS data collection process.
- And some will be aware of the work that has been done to initiate an assessment of the impact of diseases and the usefulness of resources in an animal health context.
Introduction

> The paper will present how data are being collected across the world on the economic impact of major animal diseases
> In addition it will look at how these data are being used
> It will raise questions about the weaknesses in data collection, capture and analysis
> And whether economics is being used well
Materials and Methods
What is economics?

- A strict definition of economics would be the *study of the use of scare resources with competing demands*.
- The starting point when using an economic approach would be to develop an **understanding of the allocation of resources** in the system of interest, in order to:
  - Describe current allocation of resources
  - Determine if the allocation is **optimal**
  - Assess if the **reallocation** will lead to a situation closer to optimality
What is economics?

> Within this analytical framework there needs to be a recognition that at the time of any assessment:

• There is a given **set of technologies**
  - There may well be better technologies available that are yet to be discovered
  - Discovery is influenced by **government policy** and powerful companies

• There is a given **set of prices**
  - These prices could be set by the market – supply and demand
  - However they are likely to be influenced by **government policy** and/or sheer power by dominant buyers and/or sellers of goods
The institutional environment

- Additional aspects form the **institutional environment**
- They include the **rules** laid down by society for any process, be it consumption or production
- And include the **enforcement** of these rules
- This powerful **combination** of rules and enforcement **influence** the measure of **optimality** that is held so dear in economics
Health Impact

Health Losses

Visible Losses
- Dead people & animals
- Thin people & animals
- People & animals poorly developed
- Low returns
- Poor quality products

Invisible Losses
- Fertility problems
- Change in population structure
- Increased labour costs
- Delayed sale of animals and products
- High prices for livestock and livestock products

Expenditure & Reaction

Additional Costs
- Medicines
- Vaccines
- Insecticide
- Time
- Treatment of products
- Public health costs

Lost Revenue
- Access to better markets denied
- Sub-optimal use of technology

Modified from Rushton et al, 1999; Rushton, 2009
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Impact caused by diseases & health problems

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Impact caused by human reaction

Impact caused by diseases & health problems
The Framework – *fixed cost investment*

- The impact of an animal disease has to be placed in a context of the veterinary service
- Previous investments in education, research and infrastructure – management and physical – will dictate how we react to disease risk and disease presence
- These fixed cost investments need to be considered
The questionnaire

- The questionnaire covered areas related to the framework:
  - Veterinary services – fixed costs
  - Costs of control of disease outbreaks since 2000.
  - Production losses caused by the transboundary diseases that were endemic in countries.
  - Wider impacts of disease on trade and the general economy.

- Final section asked who carried out the analysis and how it was used
Data collection and storage

- The questionnaire was sent out to all 180 member states with a response required early in 2016.
- The forms were returned by 116 countries in the specified time.
- Data were entered into a specifically designed Access database.
Data analysis

- Extraction of data and descriptive analysis were carried out and related to the key themes of the framework
  - Fixed investments in animal health
  - Losses in production due to specific diseases
  - Costs of reaction in terms of surveillance, prevention and control measures
  - Costs of reaction in terms of trade

- All monetary amounts were converted to US$
Results
Countries that completed the questionnaire

116 countries (65%) returned the completed questionnaire in time to be included in the main analysis.
Further countries supplied forms later
Proportion of the global livestock population by species

Three quarters (15 out of 20) of the top twenty countries with bovines replied to the survey, 13 out of 20 of the top small ruminant and poultry countries and 18 out of 20 of the top swine population countries.
Survey coverage

- There was a relatively low response of returns from SE Asia, parts of East and West Africa and a major country in the Middle East.
- This affected the level of coverage for poultry, small ruminants and bovines.
- However, the survey has both a good geographical reach and also a good coverage of the major livestock species.
Veterinary services

> All countries provided data on veterinary service personnel

> There was a total of 722,105 veterinarians, 328,572 veterinary assistants and 407,785 other support staff reported.

> Overall from the member states who replied there are 2,369 LSU per veterinarian and 1,628 LSU per veterinarian and veterinary assistant.
The ideal staff ratio is difficult to define

Further analysis is required that includes: the value of animals; the role of companion and sporting animal medicine; and the salary levels of staff.
Veterinary service expenditure

> Only 50 of the countries who returned the questionnaire provided specific data on the costs of the veterinary service

> Of these countries a total of US$ 4 billion was estimated to be spent annually

> US$ 3.1 billion came from public sector budgets and US$ 0.5 billion from private sector funds
Expenditure per livestock unit ranged from US$ 0.06 to US$ 934.32 LSU/year

The average was US$ 6.80 per LSU/year

A quarter of the countries who reported expenditure spent less than a US$ 1 per LSU/year and half of the countries less that US$ 4.00 per LSU/year
Specific disease control programmes

- A majority of the countries (105 out of 117) reported having specific disease control programmes.
- Three quarters of the programmes were for just seventeen diseases
- Food borne and zoonotic diseases are frequently reported programmes, yet there is an absence of programmes to control campylobacter
A quarter had more than 7 specific disease programmes and nearly three quarters five or more programmes. One country reported 29 specific disease programmes and three countries only one.
Countries reported a total of 682 specific disease programmes, approximately half had programmes for brucellosis, avian influenza and FMD. 24 countries reported a PPR programme despite this being a problem in approximately 80 countries.
Average annual cost of disease control programmes by type of disease

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number of programmes that reported expenditure</th>
<th>Average annual cost per programme (million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMD</td>
<td>28</td>
<td>35.9</td>
</tr>
<tr>
<td>Bovine Tb</td>
<td>24</td>
<td>20.9</td>
</tr>
<tr>
<td>Varroa</td>
<td>2</td>
<td>6.0</td>
</tr>
<tr>
<td>Sea Lice</td>
<td>1</td>
<td>3.2</td>
</tr>
<tr>
<td>RVF</td>
<td>2</td>
<td>3.2</td>
</tr>
<tr>
<td>Other</td>
<td>37</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Approximately half of the disease control programmes recorded (379 of 682) had data on the annual expenditure
Costs of programmes for diseases that are endemic, sporadic or not present

- **Endemic** – US$95 million per year
  - Major costs endemic bovine tuberculosis (US$ 49.6 million) followed by varroa (US$ 6 million) and ASF (US$ 4.3 million)

- **Sporadic** US$ 35 million per year
  - Bovine tuberculosis (US$ 5.3 million), Aujeszky (US$ 3.1 million), TSE (US$ 2.9 million) and ASF (US$ 2.2 million).

- **For countries free** – US$99 million per year
  - FMD (US$ 81.9 million) was the major cost.
Production losses

> Nearly two thirds of the countries reported having one or more endemic transboundary disease

No data provided were useful to estimate production losses of these diseases

- PPR (28),
- Newcastle disease (19),
- ASF (15),
- CBPP (15),
- brucellosis (14)
- lumpy skin disease (11)
Disease outbreaks
There were 358 reported disease outbreaks since 2000. A quarter of these were due to avian influenza. Two thirds were caused by just five diseases: AI, FMD, CSF, Newcastle disease and ASF.
Costs of disease outbreaks

- Of the 358 outbreaks reported only 128 had information on the costs of the outbreaks which totalled US$ 12.1 billion since 2000.
- Two thirds of these costs were attributed to five TSE outbreaks alone and a further 20% of the costs were caused by 33 outbreaks of avian influenza.
Proportion of outbreak costs reported by disease since 2000 (total costs were US$ 12.1 billion).

One TSE outbreak was estimated to cost US$ 6.95 billion signifying over half of all the reported costs of outbreaks reported since 2000.
Average duration and monthly costs of disease outbreaks by disease

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number of outbreaks</th>
<th>Average duration (months)</th>
<th>Cost per month (million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabies</td>
<td>2</td>
<td>6</td>
<td>37.5</td>
</tr>
</tbody>
</table>

Longest duration of an outbreak was TSE
The most expensive with regards cost per month were rabies and equine influenza

<table>
<thead>
<tr>
<th>Disease</th>
<th>Number of outbreaks</th>
<th>Average duration (months)</th>
<th>Cost per month (million US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMD</td>
<td>21</td>
<td>10.9</td>
<td>2.1</td>
</tr>
<tr>
<td>Blue tongue virus</td>
<td>10</td>
<td>36.7</td>
<td>1.7</td>
</tr>
<tr>
<td>Q fever</td>
<td>1</td>
<td>36</td>
<td>1.1</td>
</tr>
<tr>
<td>Swine Vesicular Disease</td>
<td>1</td>
<td>24</td>
<td>1</td>
</tr>
</tbody>
</table>
Trade Impacts
Proportion of outbreaks that were reported to affect trade by disease
Trade losses reported during the outbreaks of specific diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Reports</th>
<th>Average duration (months)</th>
<th>Loss reported (US$)</th>
<th></th>
<th></th>
<th></th>
<th>Average per month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
<td>Total</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schmallenberg Virus</td>
<td>2</td>
<td>40</td>
<td>2,328</td>
<td>462,050</td>
<td>232,189</td>
<td></td>
<td>5,805</td>
</tr>
<tr>
<td>TSE</td>
<td>5</td>
<td>69.3</td>
<td>723,100</td>
<td>665,252,000</td>
<td>157,209,171</td>
<td></td>
<td>2,267,440</td>
</tr>
</tbody>
</table>
Trade losses reported during the outbreaks of specific diseases

<table>
<thead>
<tr>
<th>Country</th>
<th>Disease</th>
<th>Other goods affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>AI</td>
<td>Rendered poultry meals, pet food</td>
</tr>
<tr>
<td>Botswana, Peru, United Kingdom</td>
<td>FMD</td>
<td>Hides and skins; Fishmeal:</td>
</tr>
<tr>
<td>Germany, Italy, Sweden</td>
<td>Blue tongue virus</td>
<td>Genetics</td>
</tr>
<tr>
<td>Kuwait</td>
<td>Glanders</td>
<td>Live horses</td>
</tr>
<tr>
<td>Lesotho</td>
<td>Anthrax</td>
<td>Wool and mohair</td>
</tr>
<tr>
<td>South Africa</td>
<td>African horse sickness</td>
<td>Live horses</td>
</tr>
<tr>
<td>South Africa</td>
<td>Rift Valley Fever</td>
<td>Wool</td>
</tr>
</tbody>
</table>
Comments on the impact on trade due to transboundary disease in neighbouring or trading partner countries

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Country</th>
<th>Overall impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EI</td>
<td>Mauritius, New Caledonia, Fiji, Maldives</td>
<td>Negatively affected live animal imports</td>
</tr>
<tr>
<td>Theileria</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Half of the respondents said they had problems with their trade due to neighbouring or trading partners having transboundary diseases. Most impacts were negative, but some were positive.

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Country</th>
<th>Overall impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVF</td>
<td>Mauritius</td>
<td></td>
</tr>
<tr>
<td>AI</td>
<td>Australia; Bhutan; New Caledonia, Norway</td>
<td>Short and medium term positive impacts on exports of products and genetics</td>
</tr>
<tr>
<td>ASF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ND</td>
<td>Norway, New Caledonia, Norway</td>
<td></td>
</tr>
<tr>
<td>PRRS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Wider economy impacts

- About a half of the countries reported impacts on the wider economy due to disease.

**Only 16 analyses were reported**

- Only six countries reported the type of analysis.
- Half of the analyses were for avian influenza, two for FMD and two for TSE.
- Analyses of avian influenza outbreaks.

- Other countries did not specify the methods used.
Much of the economic analysis was carried out inhouse and used inhouse for decision making.
Discussion and conclusions
Summary of the data collected

- Countries could report on the number of vets, yet not all had data on costs of the veterinary services.
- Data on the economic impacts of disease are sparse.
- There was no information available on production losses.
- There is a concentration of information on costs of control and trade impacts in some countries.
- The information available is inadequate to develop a picture of overall investment in animal health.
An improved application of economics to animal health

An economic approach

- Understand the context
- Adding value through searching for optimality
  - Why it is weak
- Reallocate resources

An animal health approach

- A disease becomes important
- Adding value through advocacy
  - An economic justification is made
- Disease programme begins
The challenge

- The pragmatic approach to animal health in many cases has worked

So is there a need for a shift in how we do business?

- Plus animal health status of populations under the control of people has improved markedly
A way forward

Animal health inputs are supplied in a context of the changing role of animals in society.

There is a need for data capture and analysis systems that allow prioritzation on the education, research and policy challenges.
Health Impact

Animal health & welfare burden
- Bio-economy models
  - Production Parameters
    - Species & Species
      - Population
  - Disease

Costs of surveillance, control & prevention plus impacts on markets
- Bio-economy models
  - Programmes
  - Core
    - Markets
  - Chronic Distortions
  - Shocks
  - Private Spend
  - Public Spend
At a micro-level

- **Inputs (costs)** - Animal health system costs that affect animal health status and burden (losses)
- **Outputs (benefits)** – The avoided animal health and welfare burden (losses) can be used as a basis for **outcome measures**
- For specific animal health programmes it would be possible to develop a **library of cost-effectiveness measures and cost benefit analyses**
  - A potential production surface to examine optimality?
At a sector level

- Animal health & welfare burden (losses) by country and by region will highlight the level of problems in the animal population.
- Linking these to overall costs of animal health systems should help to identify where resource use is ineffective and inefficient.
- Assessment of the effectiveness of the overall animal health system should be possible.
Key messages

- At best we are being reactive and at worst drifting with what is seen as a given

Animal health decision making could be improved by better use of economics to meet the current challenges and confront the future ones

- Sounds like an ideal world, but human health are working towards it
Reflections on educational needs, research needs and policy challenges
Understanding and meeting the education challenges in the health system

Much of the animal health education at present is following the money – small animal clinician work

Veterinarians need awareness of economics and social science skills to understand and influence change

And this cadre also need to be able to identify poor allocations of resource and communicate these to people with power to change the allocation
Understanding and meeting the research challenges in the health system

- Research is needed on metrics for animal health and welfare burdens, the capture and analysis of

Economists and social scientists are needed to support and engage in this research

the specific programmes will facilitate the identification of weaknesses in the system that need to be addressed by research
Understanding and meeting the policy challenges in the health system

A systematic process of collecting, capturing and analysing animal health and welfare burdens will allow prioritising and addressing these issues.

**Policy** could become a **mix of demand driven responses**, and where market failure exists, **supply led responses** to address poor resource allocation.

Policy needs to become more evidence based.
Recommendations
Recommendation
– Veterinary education

- Veterinary education at undergraduate, postgraduate and continuing professional development should include the use of economics in animal health and welfare

- The economic materials should be focused on very practical and applied use, and the understanding the underlying economic concepts of resource allocation
Recommendation
– Global Burden of Animal Disease

- A pilot project is established to initiate global burden of animal disease estimates
- Such a project should determine the diseases to be included – transboundary and endemic - and needs to include the production losses, control costs and trade impacts of these diseases
- Data collection, capture and analysis methods would need to be established
- A full project would mirror the global burden of human disease
Recommendation
- Costs of national veterinary services

> A pilot project is established to collect and summarise data on the costs of national veterinary services

> Where possible this should include investments of governments, NGOs and private sector in animal health education, research and key infrastructure

> A full project would mirror the human health accounting system, that was initially published by OECD in 2000 and updated in 2011, and be guided by the OIE PVS system
A new society

- International Society for Economics and Social Science of Animal Health
- We will hold a first meeting for a day before SVEPM in Inverness in March 2017
- We will be inviting papers and posters to cut across the animal health, economics and social sciences
- We want to create a bridge
Further information

➢ For more information on NEAT please look at
  • www.neat-network.eu

➢ For information on NEOH please look at
  • http://neoh.onehealthglobal.net

➢ For information on the work we are involved in with agriculture and health please look at
  • http://www.lcirah.ac.uk/home

➢ For courses offered at RVC please look at
  • http://www.rvc.ac.uk/Postgraduate/Distance/Index.cfm
  • http://www.atp-ilhp.org