Global Burden of Animal Diseases (GBADs)

- Costs, benefits and effectiveness of VBD and VBD-control programs

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- I am also grateful to people at The Roslin, University of Edinburgh who allow and encourage me to be part of these events
- And to my wife
- Of course thank you to Budimir and Marina for the invitation

Health (disease) and economics

- “Disease has affected economies both by demographic pressure that has changed supply and hence the price of labor and by its effect on the productivity of a particular region or social group. Disease’s intellectual and cultural effects have been far-reaching and profound; it has channelled (or blocked) individual creativity, and it may on occasion have set its stamp on the *optimism* or *pessimism* of an entire age”

From Hays, J.N. (1998) The Burden of Disease Epidemics and Human Response in Western History

Introduction – importance of people

- Threats from vector borne diseases are very real
- These threats change with time it is often thought to be due to climate change
- Yet at the heart of the issue are ***people***
- We create the linkages, modify environments and the weather

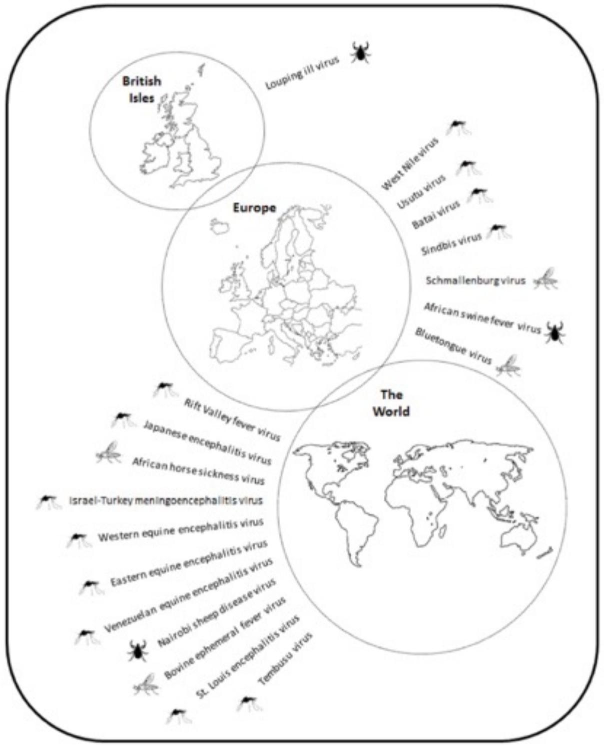
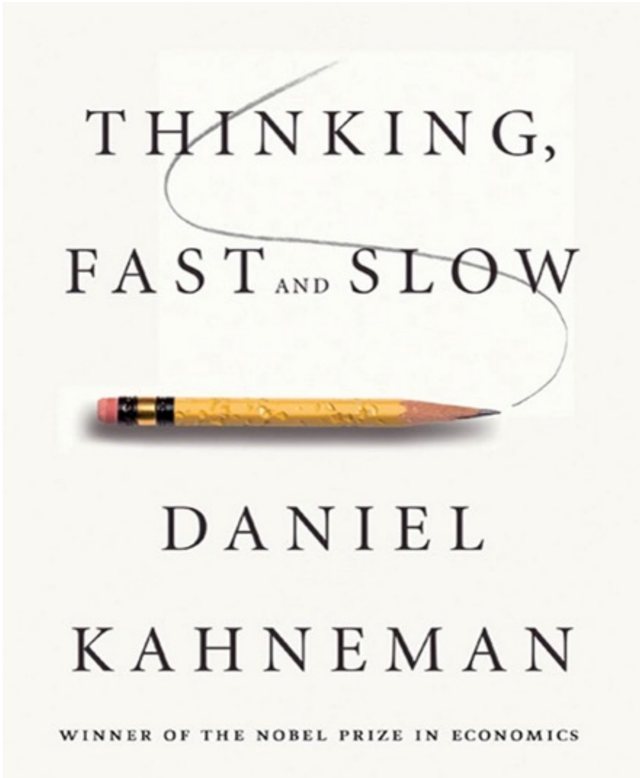


FIGURE 6 | Schematic showing the distribution of virus pathogens of animals in the British Isles, Europe and the World.

Folly et al 2020 https://doi.org/10.3389/fvets.2020.00020

Introduction – what drives people

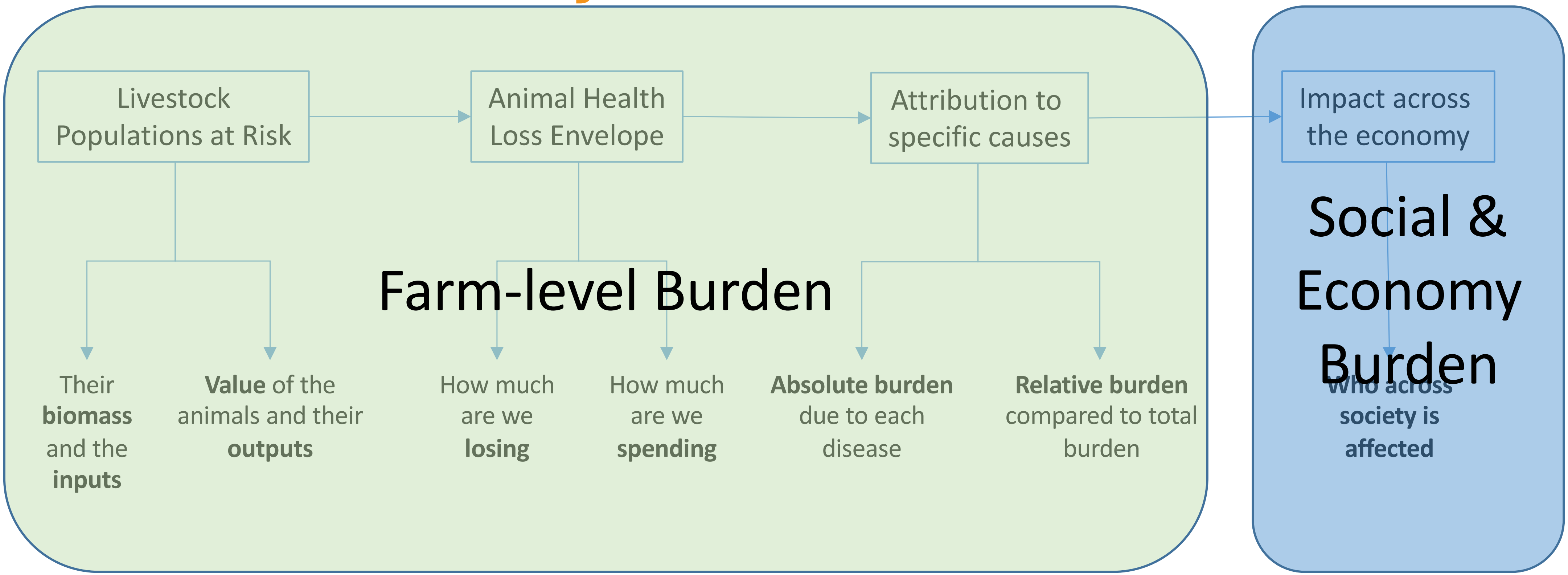
- Our behaviour in the face of decisions has been well studied
- We are drawn to heuristics (rule of thumb)
- More methodical approaches are often shunned
- This is particularly the case when we are under pressure



Introduction – a systematic approach

- Systematic approach to assessing the livestock sectors and animal health
  - What animals are at risk?
  - Which value chains are these animals linked to?
  - Does the disease impact human health – is this a zoonoses?
  - What are the financial liabilities and who will bear these costs?
    - Farmers
    - Companies
    - Government – national, EU
    - A combination

GBADs - Analytical structure to provide clarity on data and analysis

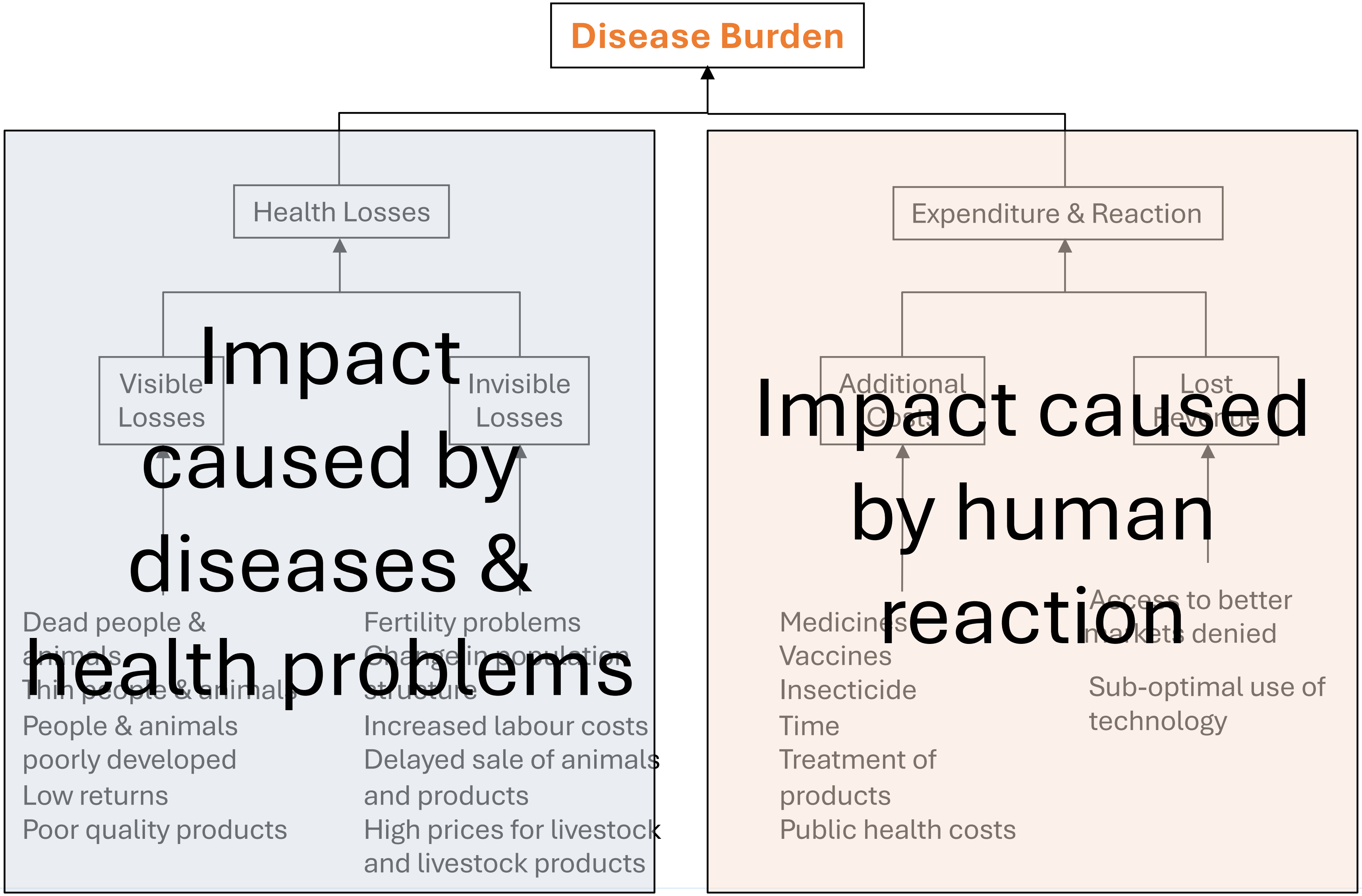


Rushton et al 2021

Introduction

- For an economic analysis of a vector borne disease we need a counterfactual scenario – a **baseline**
- Such baselines should be constructed from the knowledge of the current situation of the population at risk and current state of health – an estimation of the **burden of disease**
- A comparison then needs to be made between this baseline and the scenario with an intervention (the mitigation actions) – an estimation of the **difference between additional costs and benefits**

Establishing the baseline – the burden of animal diseases

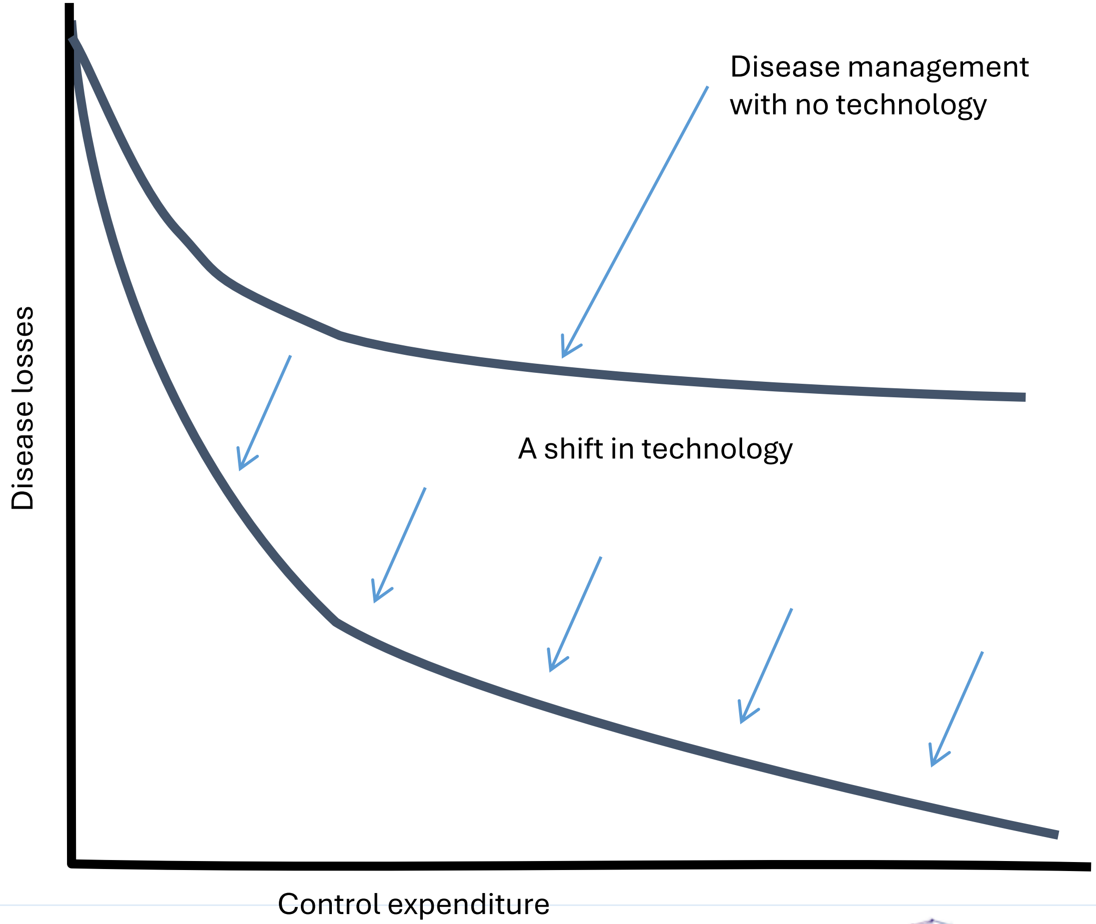


https://animalhealthmetrics.org

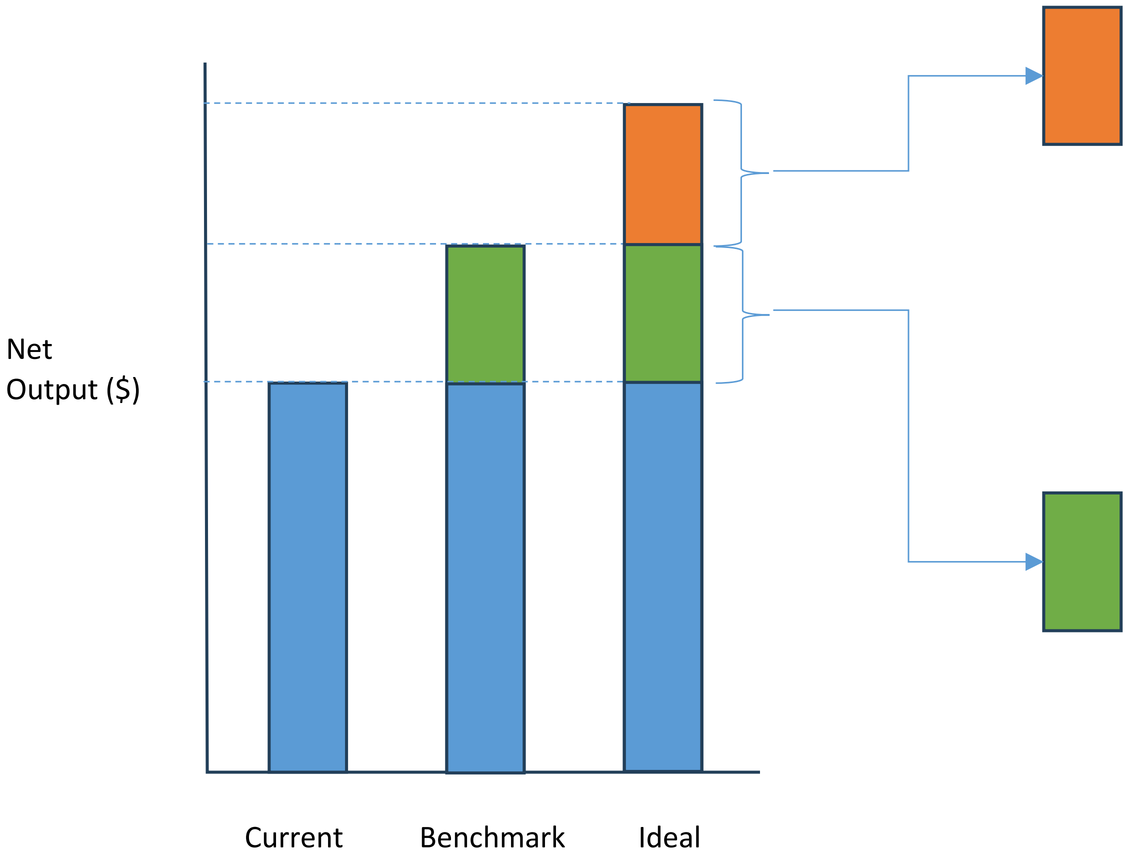
Modified from Rushton et al, 1999; Rushton, 2009

Change in technology

- Disease mitigation technologies are not static
- New vaccines, diagnostics alter the relationships between disease losses and animal health expenditure
- In the long run we need to assess the value of animal heath investments



GBADs gap analysis (AHLE)



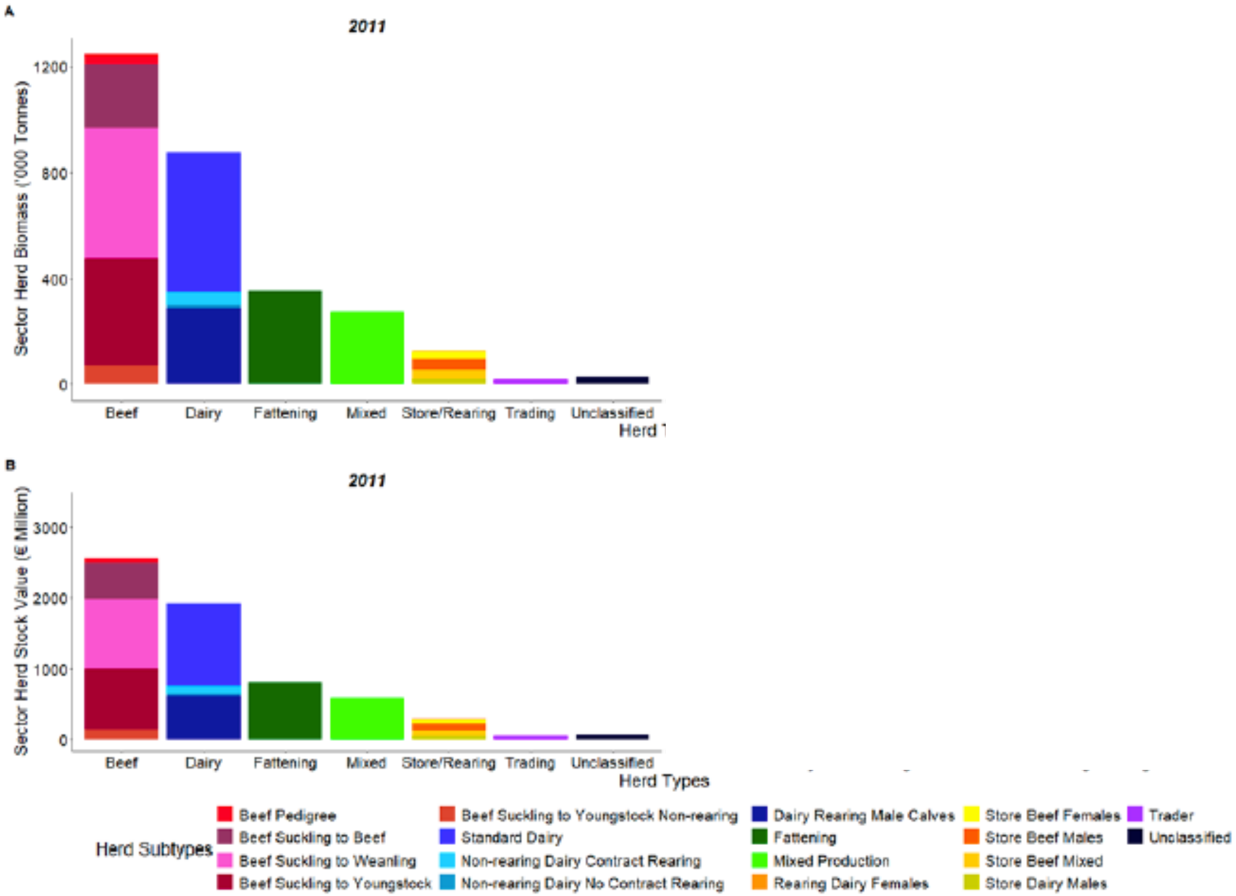
Nature of the gap	Reason for the gap	Policy correction
Not Attainable	Technologies absent Delivery methods & management absent	Research & Development
Attainable	Access to technologies Poor allocation of inputs and services	Coordination Education, extension Information provision

Avoidable and unavoidable losses

- Total burden (AHLE) can be divided between **avoidable** and **unavoidable** losses
- Avoidable losses indicate technical and allocation issues within the system – **Policy making on information and coordination**
  - **Spending the wrong amount, on the wrong things**
  - **Unequal access across the population**
- Unavoidable losses indicate lack of technical options for producers – **Policy making for R&D**
  - **The interventions needed don't exist, or are not accessible to the population**

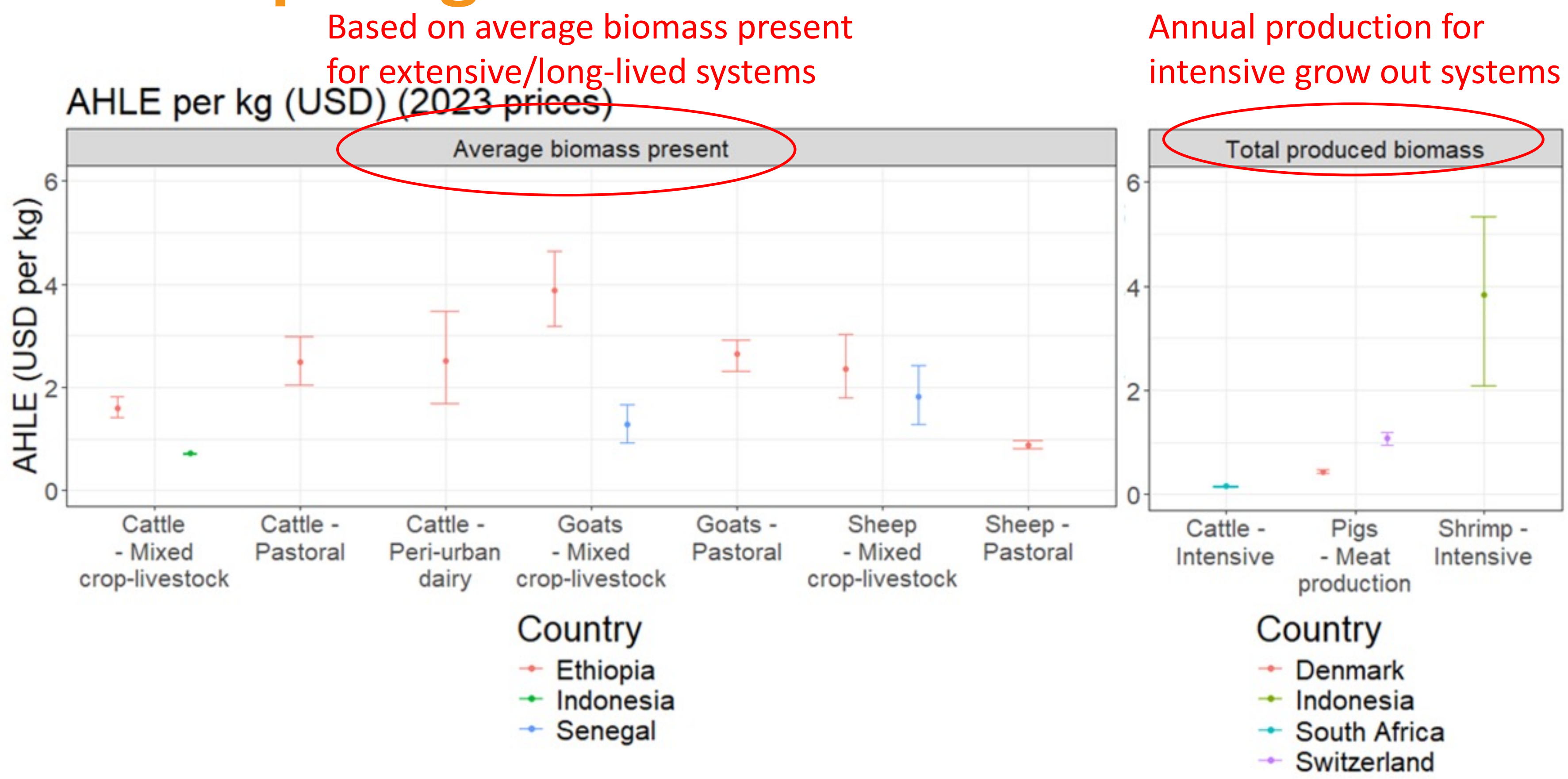
The population at risk – their biomass and value

- Irish cattle between 2011 and 2021 have shifted from beef to dairy
    - Genetics and systems have changed
- And there has been an increase in value from €6 to 8 billion
    - Liability has changed



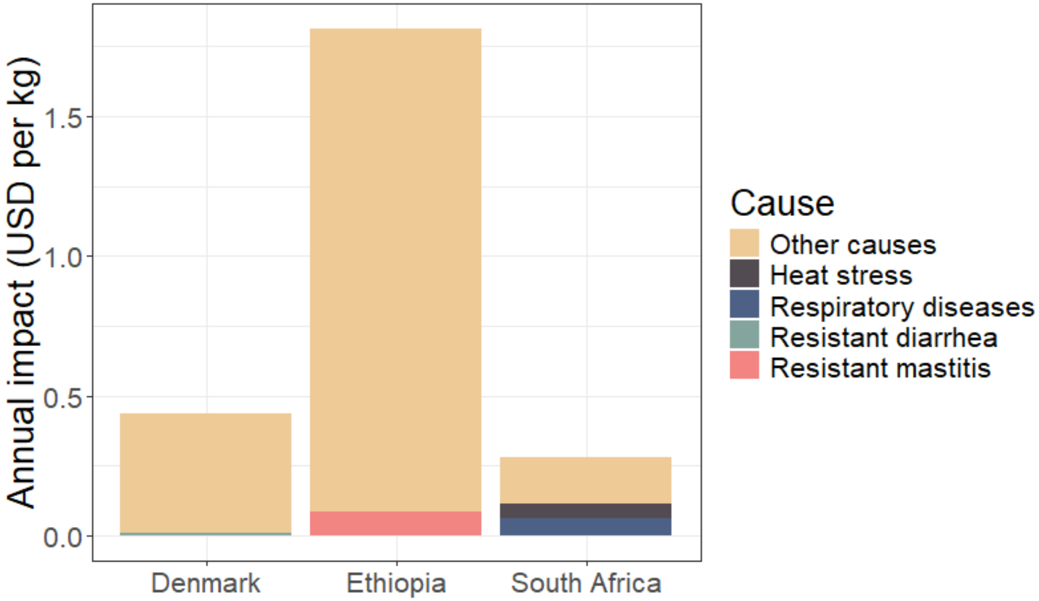
Murray et al., 2025, pre-print, http://dx.doi.org/10.2139/ssrn.4902603

The AHLE per kg of biomass



Overview of the Global Burden of Animal Diseases Program: Methodology and Applications, Meyer et al. 2025 (in preparation)

Attributing to cause



Denmark: impact of post-weaning diarrhoea resistant to antimicrobials on the pork sector

Ethiopia: Impact of antibiotic-resistant mastitis on the cattle sector

South Africa: impact of heat stress and bovine respiratory disease complex on beef cattle in feedlots

Impacts of animal health on the economy

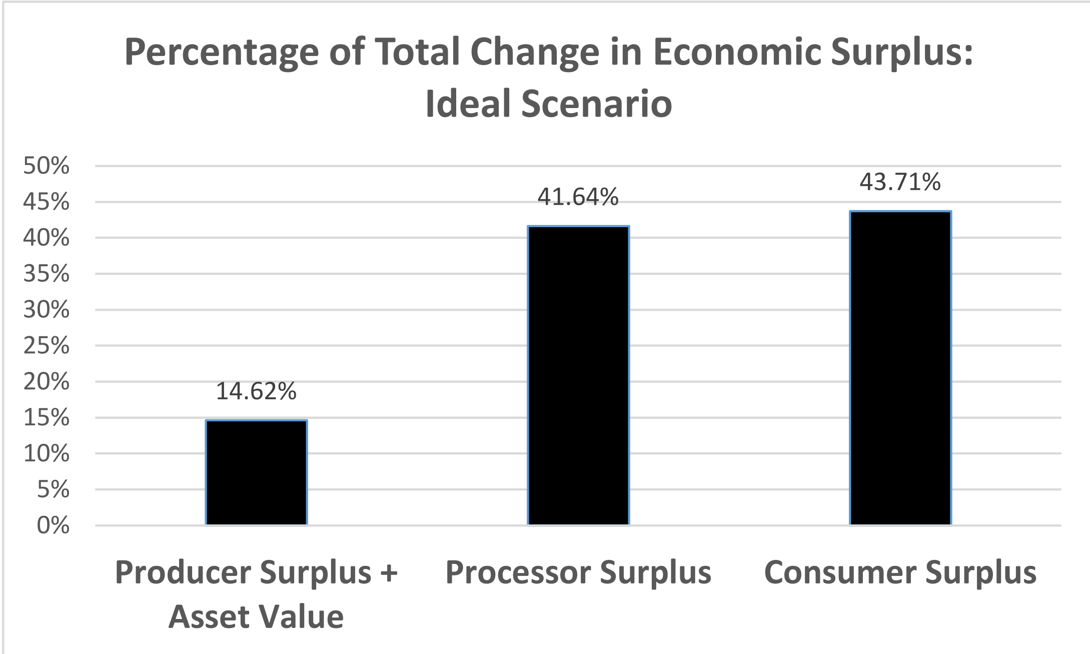
https://animalhealthmetrics.org

Courtesy of Tom Marsh, Golam Shakil, Dustin Pendell

GBADs Animal health metrics for sustainable food systems

Animal health impacts consumers

- Animal health burdens affect consumers and value chain actors more than producers
- A shift in animal health burdens will generate benefits across society and in particular urban consumers



Courtesy of Tom Marsh, Golam Shakil, Dustin Pendell

Importance of burden estimations

- Good burden estimations provide **support** for **advocacy** for disease management
- A series of burden of assessments will indicate **resource allocation between diseases**
- Detailed burden estimations **indicate where resources** are being **used** to manage **a disease**
- They allow indications of **misallocation** of **resource** and where resource use can be **improved**

The case of Blue Tongue

Blue Tongue Impacts – what is available at farm level?
- Morbidity and Mortality

- In the Netherlands the mortality risk ratios indicated **increased mortality** associated with BTV-8 (Santman-Berends et al, 2010)
- However, Elbers et al (2008) concluded that **morbidity and mortality** in outbreak cattle herds and sheep flocks **was very limited**. However, almost 50% of the clinically sick sheep died in outbreak sheep herds.
- Italy reported 18% morbidity in sheep and goats and between 3 and 5% mortality in 2001-3 (Calistri, 2004)

Blue Tongue Impacts – what is available at farm level?
- Milk Loss in cattle

- 3% of annual production over a 2 to 6 month period (Nusinovici et al 2013)
- Greater than 1 kg per cow during the initial infection (Madoasse et al, 2014)

Blue Tongue Impacts – what is available at farm level?
- Fertility Loss in Cattle

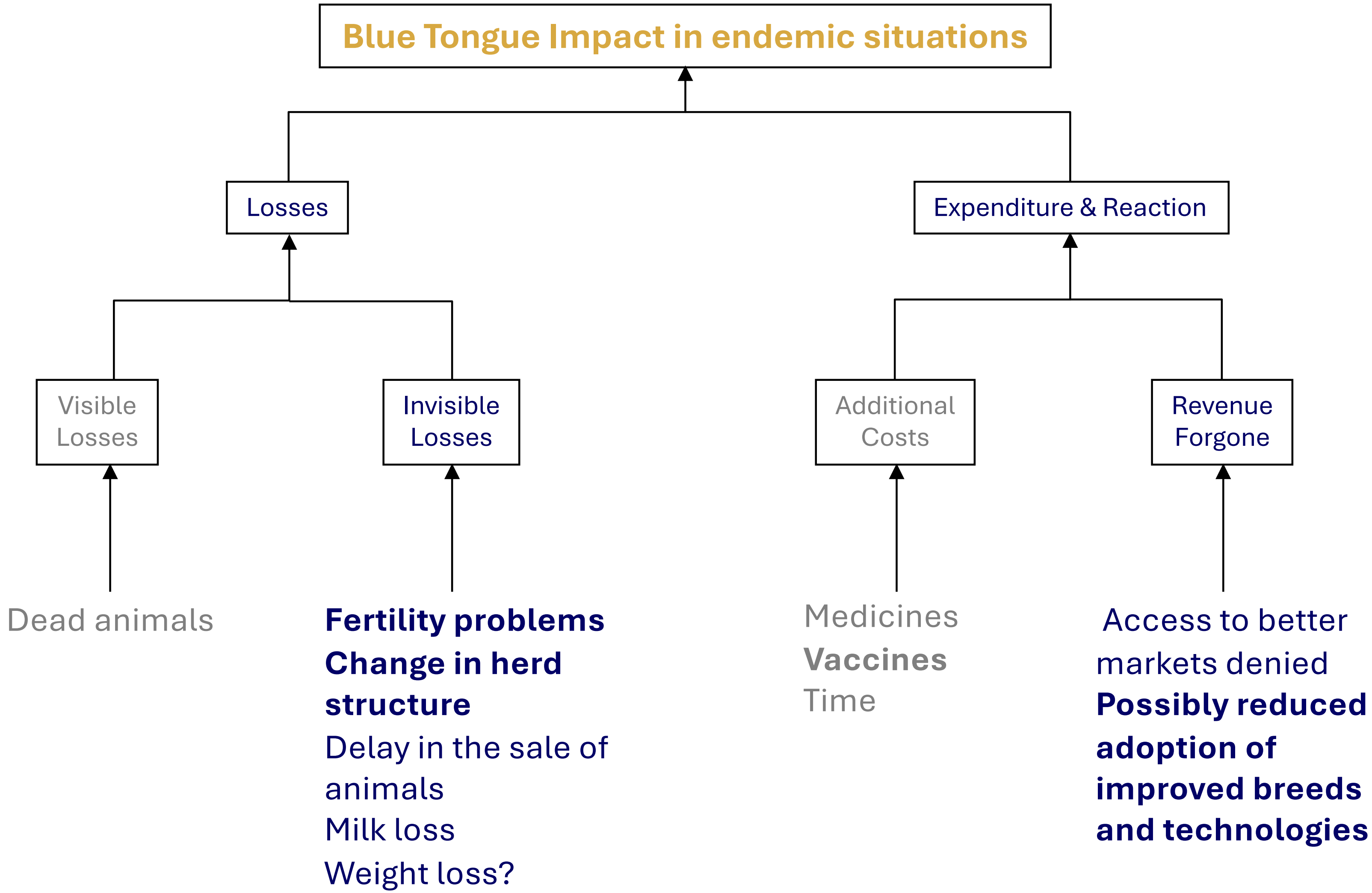
- Abortions, late embryonic death, and short gestations were increased with BTV presence (Marceau et al, 2014)
- Reported odd ratios of **abortion** 5.2 in BTV cases in cattle (Zanella et al 2012).
- In the Netherlands Santman-Berends et al (2010) reported that infected cows were **5 times** more likely to **return for insemination** within 56 days after first insemination. These cows needed **1.7 times more inseminations** for an assumed pregnancy, and needed **2.5 times more days** between first and last insemination compared to the period prior to seroconversion and compared to cows not infected by BTV-8 in 2008.

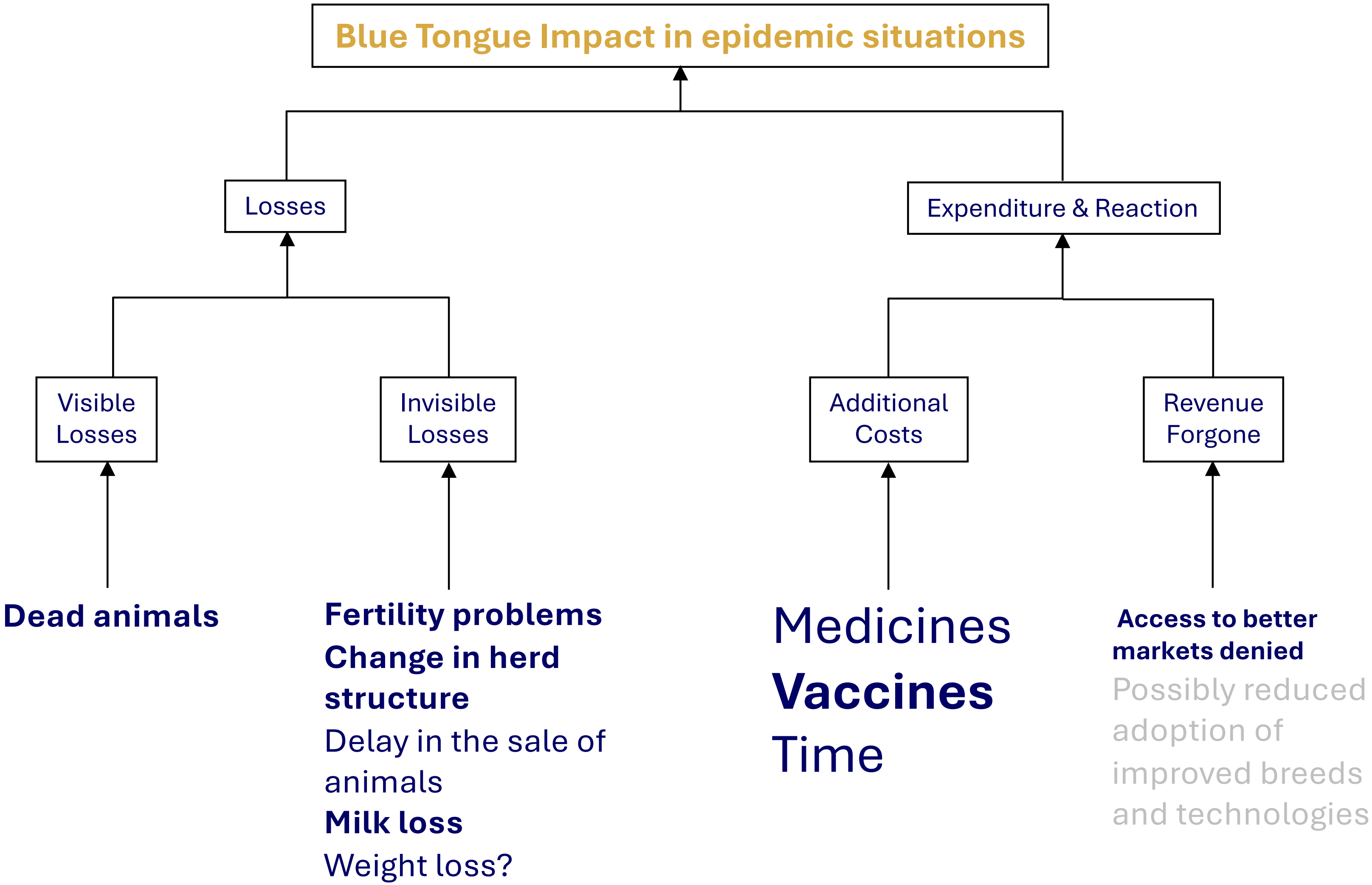
Blue Tongue Impacts
– what is available at national or regional level?

- In India – outbreaks in native breed sheep kept in smallholder systems in the south with vaccination programme (Prasad et al, 2009)
- In **Australia and East Asia – bluetongue outbreaks are rarely reported** and, involve few animals and usually affecting imported European breeds of sheep. Several countries have not even recognized the presence of BTV (Daniels et al, 2009)
- In 2007, a BTV-8 outbreak in **France** was estimated to cost **US$1.4 billion**. Losses were largely due to the inability to trade cattle, a very substantial industry in France, on the international market

Blue Tongue Impacts
– what is available at national or regional level?

- In the **Netherlands** the net costs of the BTV8 epidemic were estimated to be **€32.4 million 2006 and €164–175 million in 2007**. Majority of the impact was due to control measures in 2006 and production losses in 2007 (Velhuis et al 2010)
- In the Americas it is reported that BTV causes losses due to clinical disease and more importantly impact through loss of trade (Wilson et al, 2009). In the USA these losses and the associated testing of cattle for BTV status have been estimated at **US$130 million annually**


Blue Tongue Impact in endemic situations
Losses
Expenditure & Reaction
Visible Losses
Invisible Losses
Additional Costs
Revenue Forgone
Dead animals
Fertility problems
Change in herd structure
Delay in the sale of animals
Milk loss
Weight loss?
Medicines
Vaccines
Time
Access to better markets denied
Possibly reduced adoption of improved breeds and technologies



Blue Tongue Impact in epidemic situations
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Blue Tongue Impact – What is missing?

- **Little information** on the impacts in **endemically stable situations**
- **Very little information** on the **costs** of surveillance, control and prevention
- Limited information on the costs of our reactions in terms of trade
- No information on the limits the disease causes in endemic settings with regards adoption of improved breeds and production systems – **gap for small ruminants**

Assessing the effectiveness of control - Blue Tongue Control

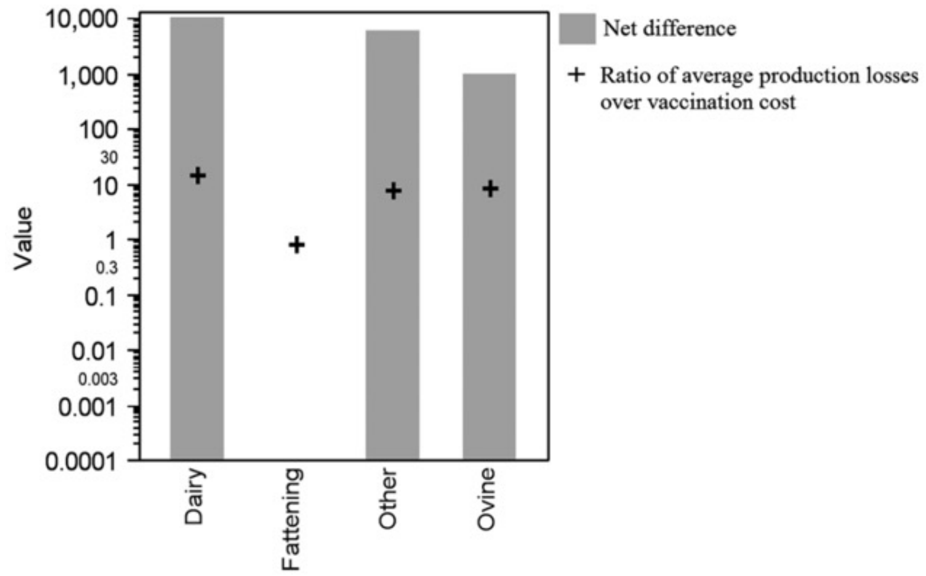
Blue Tongue – Scotland

- The cost of a BTV 8 outbreak in Scotland was estimated to be £100m per annum - £30m in production losses and £70m in expenditure and reactions).
- Prevention costs of surveillance and other activities aimed were estimated to be £141m over 5 years with £2.3 million for vaccination of cattle and sheep
- The findings indicated that prevention costs to reduce to risk of BTV 8 incursion were fully justified.

Scottish Government no date

Blue Tongue – Belgium (Cargnel et al, 2018)

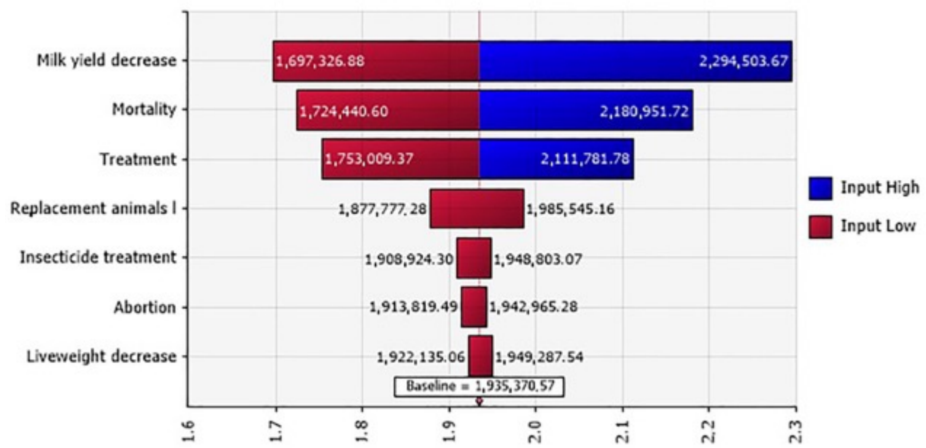
- A study of the 2008 outbreak in Belgium showed clear impact of the vaccination policies
- Yet the benefits of vaccination are not equal
- Sheep farmers did not vaccinate as quickly as cattle farmers



DOI: 10.1111/tbed.13034

Blue Tongue (BTV-4) – Tunisia (Ben Salem et al 2024)

- Economic impact of the BTV-4 outbreak in Tunisia,
- Milk yield decrease, mortality, and veterinary treatment were key contributors to the total economic impact.
- Preventive measures and early detection indicators contribute to informed decision-making and effective strategies for safeguarding livestock and farmers



https://animalhealthmetrics.org

doi: 10.3389/fvets.2024.1310202

Reflections

Information on value chains and markets

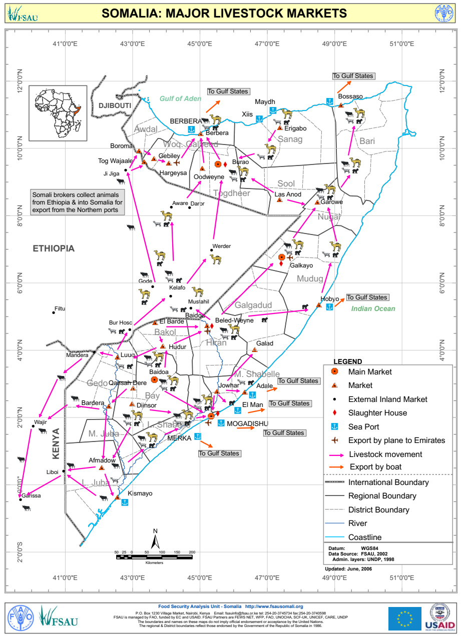
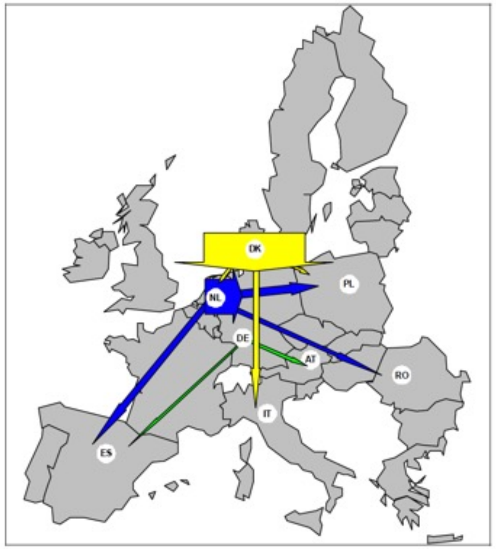


Figure 6: Net exchanges of young pigs

Scheme of the intra-EU exchanges (2008)

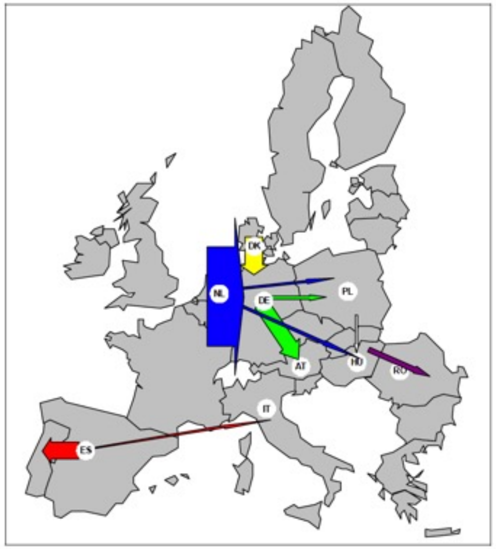


Source: Eurostat (comext)

Arrow width is proportional to the volume of intra-EU foreign trade surplus (in tons).
The 10 main surpluses on pigs weighing less than 50 kg account for 89% of the overall balances

Figure 7: Net exchanges of pigs for slaughtering

Scheme of the intra-EU exchanges (2008)



Source: Eurostat (comext)

Arrow width is proportional to the volume of intra-EU foreign trade surplus (in tons).
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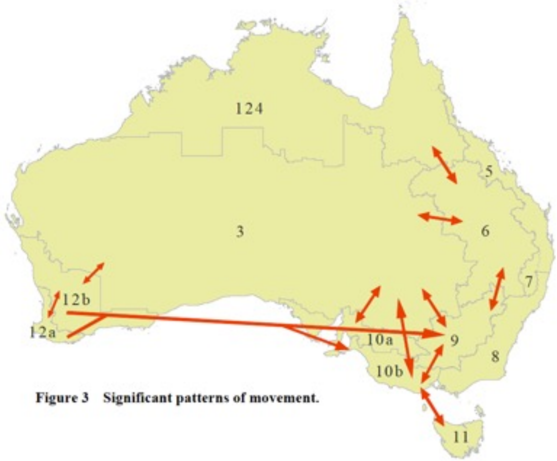
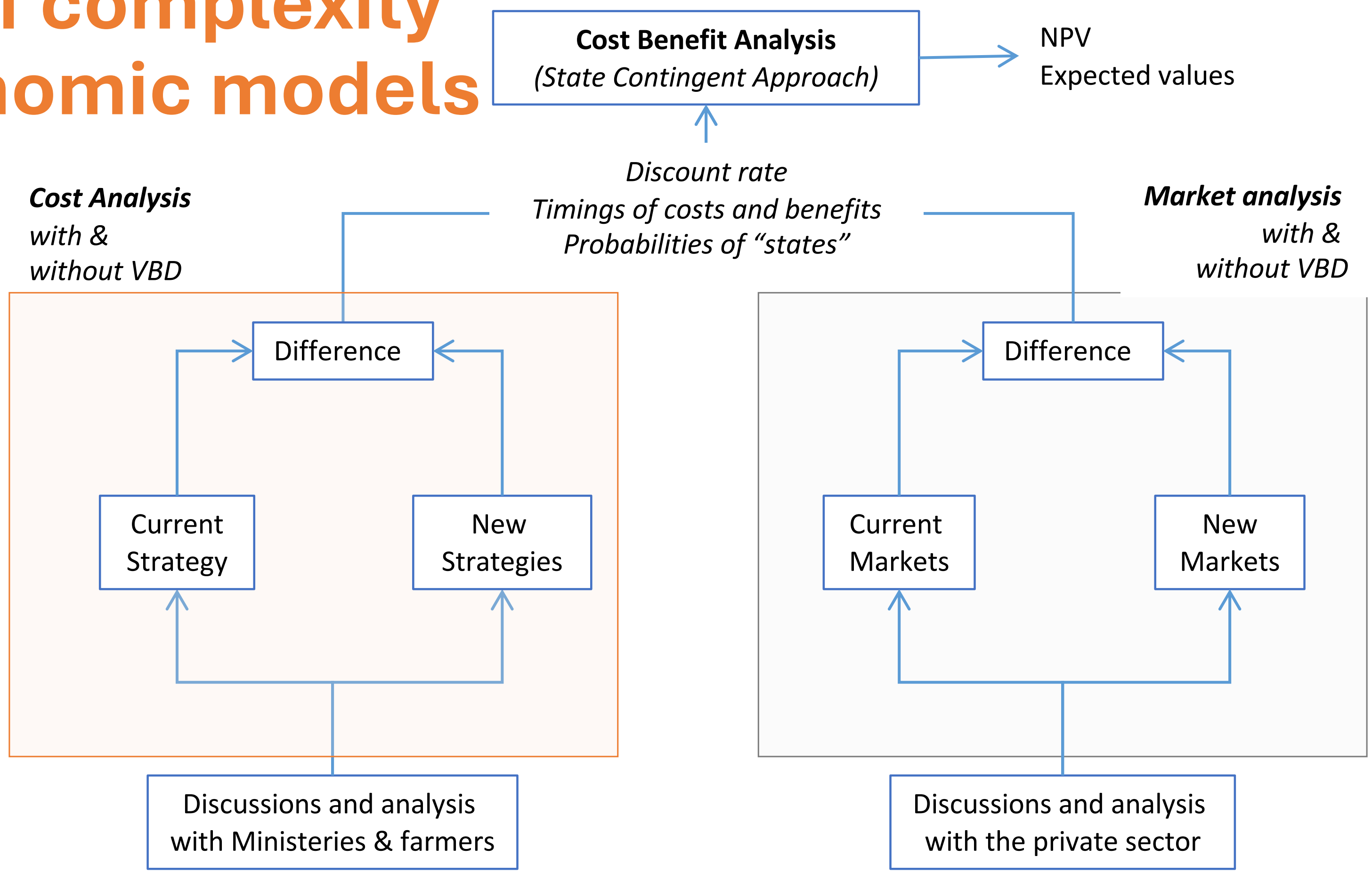
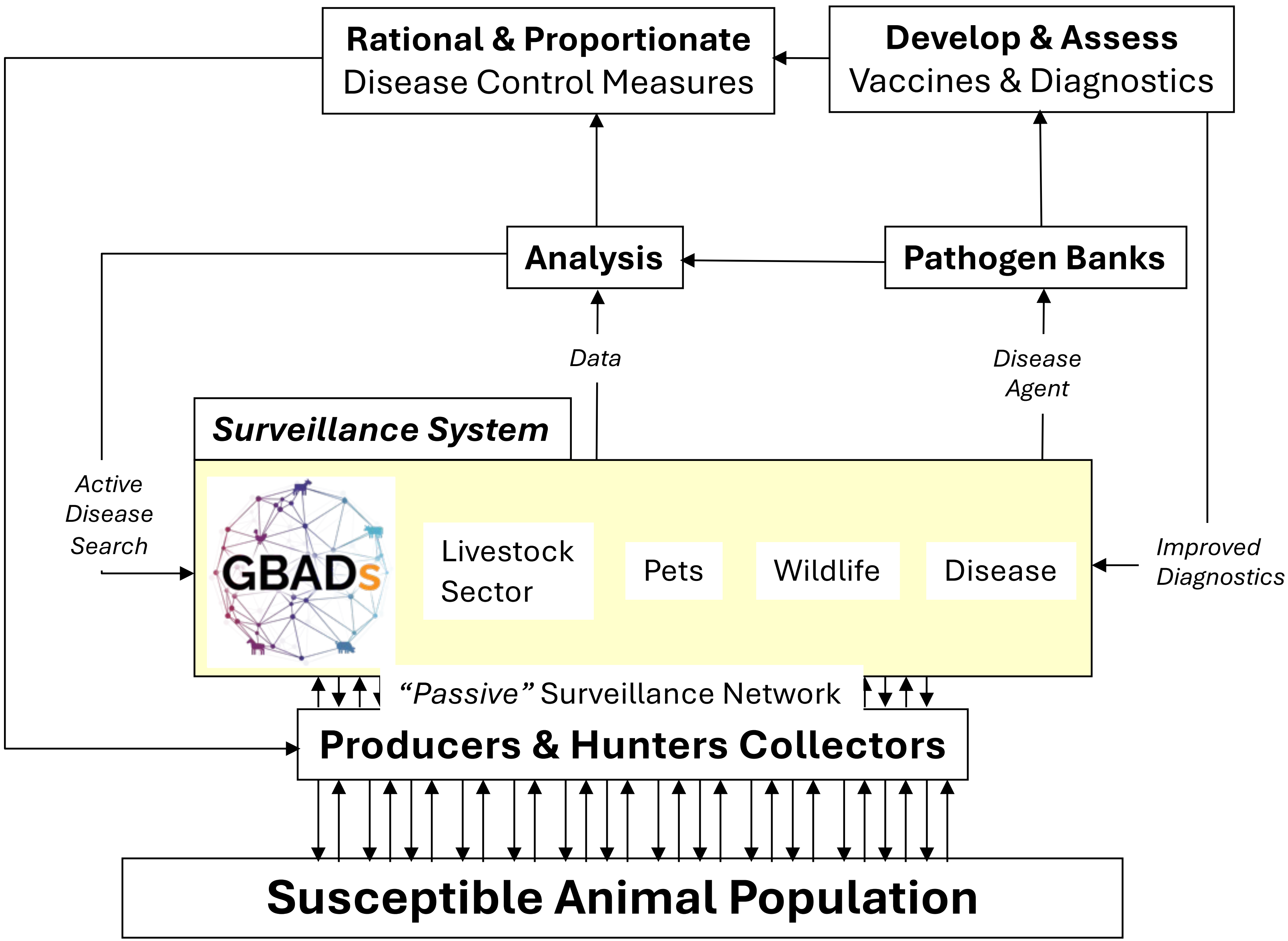


Figure 3 **Significant patterns of movement.**

Level of complexity of economic models



Modified from Perry et al, 2020 – https://link.springer.com/article/10.1007/s10393-020-01489-6



Rational & Proportionate Disease Control Measures
Develop & Assess Vaccines & Diagnostics
Analysis
Pathogen Banks
Data
Disease Agent
Surveillance System
Active Disease Search
GBADs
Livestock Sector
Pets
Wildlife
Disease
Improved Diagnostics
"Passive" Surveillance Network
Producers & Hunters Collectors
Susceptible Animal Population

The GBADs Technical Guide

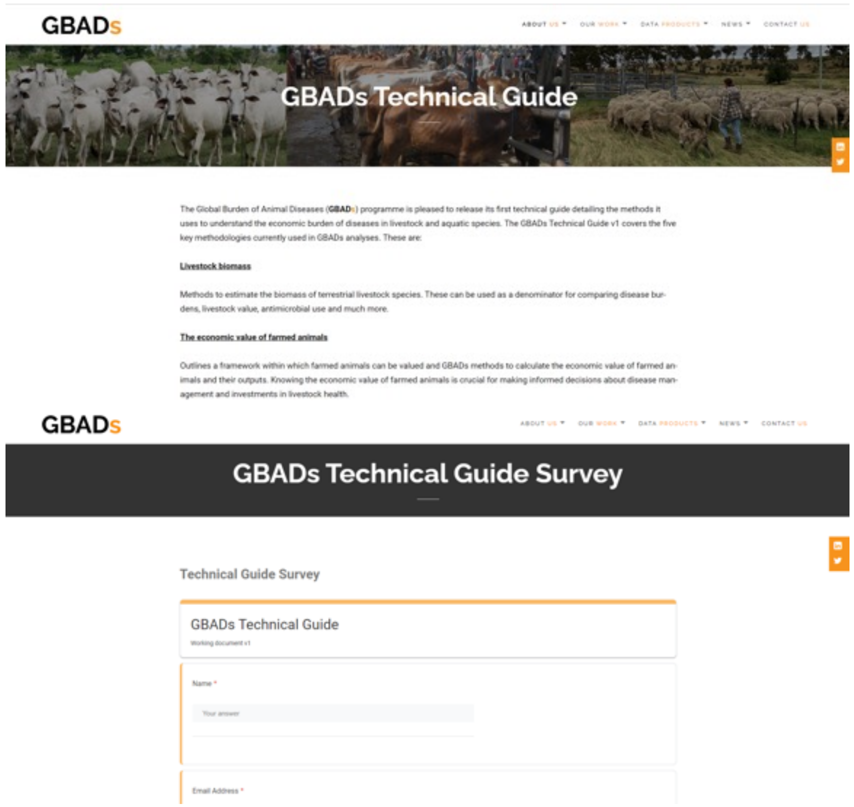
Released 30th July 2024

Available via the GBADs website - https://animalhealthmetrics.org/gbads-technical-guide/

Contact details requested at download

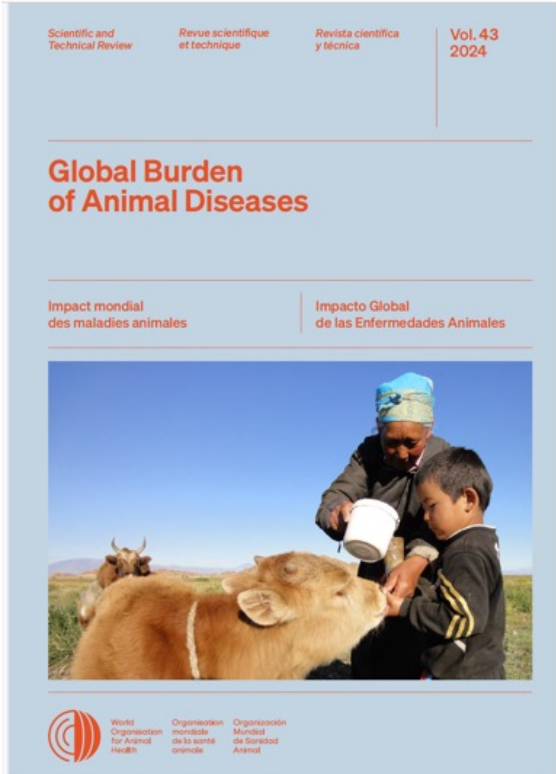
→ enable follow up and feedback

~500 downloads to date



GBADs special edition of WOAH Scientific and Technical Review (Rev Tech Sci)

- GBADs special edition of WOAH's Rev Tech Sci
- 18 articles from methods and data to links with crop and human burden estimations
- Also papers on policy issues
- https://doc.woah.org/dyn/portal/index.xhtml



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UKaid from the British people
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Cefas
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GBADs Animal health metrics for sustainable food systems