ISESSAH

International Society for Economics and
Social Sciences of Animal Health

2019 Annual Meeting

Atlanta, GA, USA

20 and 23 July 2019

Scientific Committee

Local Organizing Committee

Center for Outcomes Research & Epidemiology
CORE
KANSAS STATE UNIVERSITY

USDA
United States Department of Agriculture
National Institute of Food and Agriculture

Program ISESSAH 2019

Saturday, July 20, 2019

Session I: Human behaviour in animal health

8:30 a.m. – 9:00 a.m.

Keynote Speaker
Economic values and farmer behavioural change: Inertia, path dependence and choices for farm animal health
Carl Johan Lagerkvist (*The Swedish University of Agricultural Sciences, Sweden*)

9:00 a.m. – 10:00 a.m.

Consumer perceptions regarding production practices to improve animal welfare in beef and dairy production
Jarkko Niemi (*Natural Ressources Institute Finland (Luke), Finland*)

A typology of farmers' behaviours toward avian colibacillosis: A comparison between a qualitative and a quantitative approach
Florence Beaugrand (*ONIRIS, France*)

Network analysis of cattle movement in Mato Grosso do Sul (Brazil) and implications for FMD outbreaks
Tais Menezes (*University of Sao Paulo, Brazil*)

Human cognition and sources of Contagious Bovine Pleuropneumonia risk information
Richard Iles (*Washington State University, USA*)

10:00 a.m. – 10:30 a.m. Break with poster viewing in Marquis Ballroom A & B

Session II: AMR & One Health

10:30 a.m. – 11:00 a.m.

In the absence of developed infrastructure, transmission factors best predict carriage of antimicrobial-resistant bacteria in people and their animals
Mark Caudell (*Food and Agriculture Organization of the United Nations, Kenya*)

11:00 a.m. – 12:00 p.m.

Will climate change contribute to larger financial impacts on liver fluke infected dairy farms in future?
Shailesh Shrestha (*Scotland's Rural College, UK*)

A modelling and economic framework to support Cystic echinococcosis control in Peru
Matthew Dixon (*Imperial College London, UK*)

Antimicrobial policies in beef production: choosing the right instruments to reduce antimicrobial resistance under structural and market constraints
Guillaume Lhermie (*Cornell University, USA*)

How much do consumer's value antimicrobial residue in food products?

Elliott Dennis *(University of Nebraska-Lincoln, USA)*

12:00 p.m. – 1:30 p.m. **Lunch Keynote Speaker**

Spillover: Uncovering animal disease outbreaks through human enteric disease surveillance

Megin Nichols (*Centers for Disease Control and Prevention, USA*)

Poster viewing in Marquis Ballroom A & B

Session III: Decision making and biosecurity

1:30 p.m. – 2:00 p.m. **Keynote Speaker**

A deeper look at biosecurity economics

Glynn Tonsor (*Kansas State University, USA*)

2:00 p.m. – 3:00 p.m. **Economic assessment of vaccination against porcine reproductive and respiratory syndrome and associated vaccine characteristics**

Beat Thomann (*University of Bern, Switzerland*)

The intention of Western Java smallholder broiler farmers to control Highly Pathogenic Avian Influenza

Muchammad Gumilang Pramuwidyatama (*Wageningen University & Research, Netherlands*)

Feedlot producer perceptions of animal traceability systems

James Mitchell (*Kansas State University, USA*)

Risk messages, biosecure behaviors and economic effects: connecting livestock disease to human decision-making

Gabriela Bucini (*University of Vermont, USA*)

3:00 p.m. – 3:30 p.m. Break with poster viewing in Marquis Ballroom A & B

3:30 p.m. – 5:00 p.m. **Lightning Round**

Market Profiling Application (MPA): An online data collection and decision support tool for surveillance and management of animal & human disease risks

Tabitha Kimani (*Food and Agriculture Organization of the United Nations, Italy*)

Economic evaluation of the bluetongue disease impacts on the Italian sheep industry and the National Health Service

Massimo Canali (*University of Bologna, Italy*)

Multi-criteria optimisation to fix the limits of present standards in microeconomics of animal health: the example of dairy production

Didier Raboisson (*INRA-ENVT, France*)

Economic impact assessment of foot and mouth disease in Turkey

Nursen Ozturk (*Istanbul Univ-Cerrahpasa, Turkey*)

Dynamic of small scale poultry farmers' behavior in response to diseases

Alexis Delabouglise (*The Pennsylvania State University, USA*)

Simulating outbreak scenarios for distinguishing risk mitigation behavioral strategies across agricultural production networks
Eric Clark (*University of Vermont, USA*)

The value of genetic selection in reducing Bovine Respiratory Disease incidence
Alexander Kappes (*Washington State Univ, USA*)

A novel protocol for calculating tropical livestock units
Peregrine Rothman-Ostrow (*Univ of Liverpool, UK*)

Vaccines for coccidiosis: Pricing, efficacy and the productivity of intensive broiler systems
Jonathan Rushton (*University of Liverpool, UK*)

Strengthening the epidemiologic and economic simulation analysis link through an Outbreak Complexity Index
Amy Hagerman (*Oklahoma State University, USA)*

5:00 p.m. – 5:30 p.m. Business Meeting and Conference Wrap-up
Thomas Marsh (*Washington State University, USA*) Dustin Pendell (*Kansas State University, USA*) Jonathan Rushton (*University of Liverpool, UK*)

6:30 p.m. Conference Reception and Dinner at Pittypat's Porch

Tuesdays, July 23, 2019: ISESSAH/AAEA Sessions

2:45 p.m. – 4:15 p.m. **Measuring the Global Burden of Animal Diseases**
Thomas Marsh (*Washington State University, USA*)
Dustin Pendell (*Kansas State University, USA*)
Ann Hillberg Seitzinger *(CSIRO, Australia*)
Kamina Johnson (*USDA- Animal and Plant Health Inspection Service, USA*)
Amy Hagerman (*Oklahoma State University, USA*)

4:45 p.m. – 6:15 p.m. **On the optimal policy for infectious animal disease management: A principal-multiple agents' approach**
Abdel Fawaz Osseni (*INRA, France*)

Measuring impact of animal diseases on livestock productivity across countries
Thomas Marsh (*Washington State University, USA*)

Sustainability in action: Observations from year one of the integrity beef sustainability pilot project
Myriah Johnson (*Noble Research Institute, USA*)

A benefit cost ratio approach to evaluating adoption of a Johne's disease vaccination for dairy cattle in Canada

David Hall (*University of Calgary, Canada*)

Foot-and-mouth disease transmission between wildlife and livestock populations of smallholder farmers: What are the emerging policy implications?
Ndiadivha Tempia (*Tshwane University of Technology, South Africa*)

Epidemiologic and economic consequences of African Swine Fever in the United States
Kamina Johnson (*USDA-Animal and Plant Health Inspection Service, USA*)

4:45 p.m. – 6:15 p.m. **Topics in One Health, Zoonotic Diseases and Biosecurity**

Effects of drought and media-reported violence on Cattle Fever Tick incursions
Jada Thompson (*University of Tennessee, USA*)

Incorporating containment zones into emergency response options for highly infectious livestock diseases
Ann Hillberg Seitzinger (*CISRO, Australia*)

Empirical evidence on the substitution between antibiotics and vaccination: Livestock in East Africa
Ashley Railey (*Washington State University, USA*)

Incorporating biological feedback of Rhipicepalus microplus & R. annulatus eradication efforts into simulating eradication costs to agencies and ranchers
David Anderson (*Texas A&M AgriLife Extension, USA)*

Poster Presentations

Poster Viewing 10:00 a.m. – 5:00 p.m. in Marquis Ballroom A & B

Strengthening the epidemiologic and economic simulation analysis link through an Outbreak Complexity Index
Amy Hagerman (*Oklahoma State University, USA)*

Assessing farmers' trust in their veterinarian: Development and validation of the Trust in Veterinarian Scale (TiVS)
Florence Beaugrand (*ONIRIS, France*)

Assessment of knowledge and moral hazard behavior of shrimp farmers regarding food safety management in Vietnam
Hiroichi Kono *(Obihiro University of Agriculture and Veterinary Medicine, Japan)*

Nutrient Costs in Western Kenya
Alexander Kappes *(Washington State University, USA)*

Adaptive CBPP vaccine decision-making among agro-pastoralists: results from modeling the cognition and decision dynamics in an agent-based model
Richard Iles *(Washington State University, USA)*

Sustainability in action: Observations from year one of the Integrity Beef Sustainability Pilot Project
Myriah Johnson (*Noble Research Institute, USA*)

Six dimensions of veterinary vaccine adoption in agriculture: the cultures of cattle and poultry farming in France
Jonathan Rushton (*University of Liverpool, UK*)

Market Profiling Application (MPA): an online data collection and decision support tool for surveillance and management of animal & human disease risks
Tabitha Kimani (*Food and Agriculture Organization of the United Nations, Italy*)

Characterizing antimicrobial use in the livestock sector in three South East Asian countries (Indonesia, Thailand and Vietnam)
Jonathan Rushton (*University of Liverpool, UK*)

Cost-benefit analysis of automatic detection of lameness in dairy cows using dynamic programming
Guillaume Lhermie (*Cornell University, USA*)

Measurement of disease burden: The use of economic meta-analysis
Didier Raboisson (*INRA-ENVT, France*)

Balancing private and public efforts in animal health risk management: a literature review
Abdel Fawaz Osseni (*INRA, France*)

Modelling economics of antimicrobial use in a pig fattening farm
Jarkko Niemi (*Natural Resources Institute Finland (Luke), Finland*)

Impacts of African Swine Fever on pigmeat markets in Europe
Jarkko Niemi (*Natural Resources Institute Finland (Luke), Finland*)

Economic consequences of the FMD outbreak in Mato Grosso do Sul (Brazil), 2005/2006
Tais Menezes (*University of Sao Paulo, Brazil*)

Newcastle disease vaccine adoption by smallholder households in Tanzania: Identifying determinants and barriers
Thomas Marsh (*Washington State University*)

Modelling Salmonella spread: From risk analysis to on-farm optimal control methods
Pedro Celso Machado Junior (*Oklahoma State University, USA)*

Water quality: differences of perception and management between poultry and pig producers
Florence Beaugrand (*ONIRIS, France*)

Antimicrobial usage: Pig farmers' perceptions, attitudes and management
Florence Beaugrand (*ONIRIS, France*)

Bacterial transmission, not antibiotic use, is associated with antimicrobial resistance in people and animals
Mark Caudell (*Food and Agriculture Organization of the United Nations, Kenya*)

The multitude of lameness detection and classification methods in British dairy cattle research: a meta-analysis
Joao Afonso *(University of Liverpool, UK)*

MERS-CoV exposure and transmission risks along camel value chains in the Horn of Africa and the Arabian Peninsula
Tabitha Kimani (*Food and Agriculture Organization of the United Nations, Italy*)

Identification of barriers and incentives to reduce antibiotic use in beef farming: a cross-country comparison between the French and Canadian systems
Florence Beaugrand (*ONIRIS, France*)

Food and Agriculture Organization
of the United Nations

Market Profiling Application for Livestock Markets

Sergei Khomenko, Sophie von Dobschuetz, Tabitha Kimani, Ryan Aguanno, Astrid Tripodi, Pawin Padungtod, Nguyen Thi Thanh Thuy, Leo Loth, Nguyen Thi Phuong Bac, Damian Tago Pacheco, Charles Bebay, Juan Lubroth, Yilma Makonnen

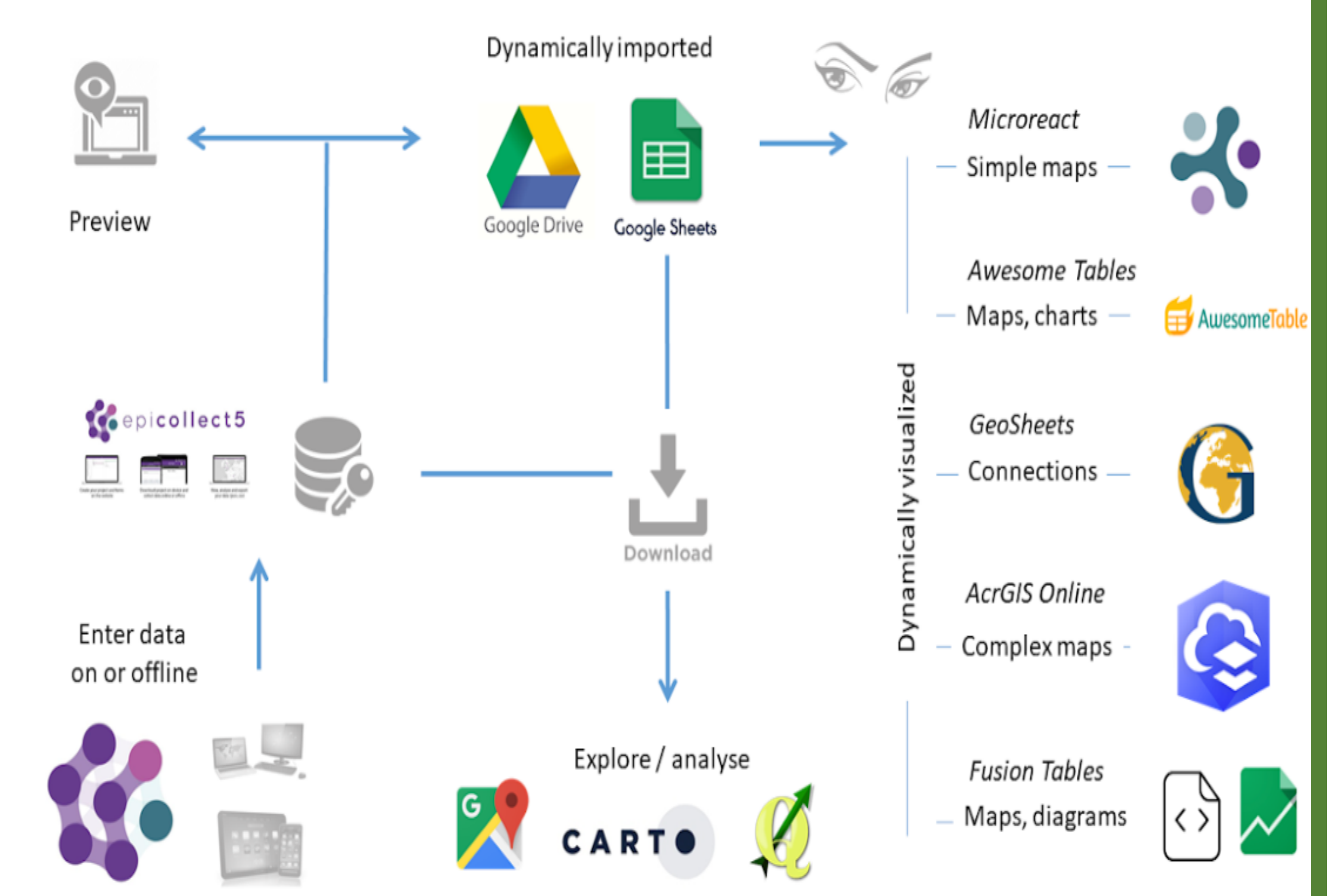
ISESSAH, July 2019

Live animal markets – important for disease transmission

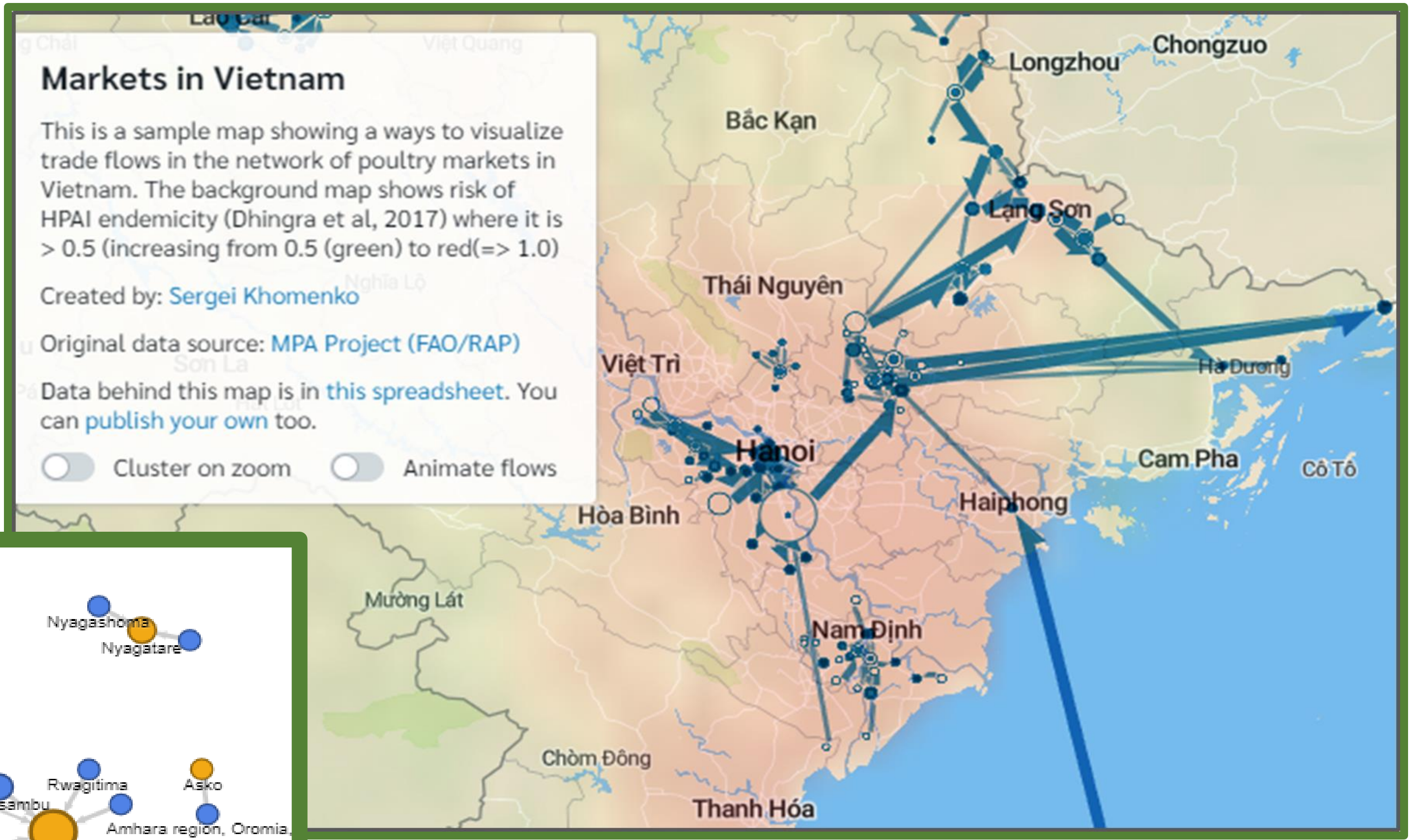
MPA, Application and Pilots

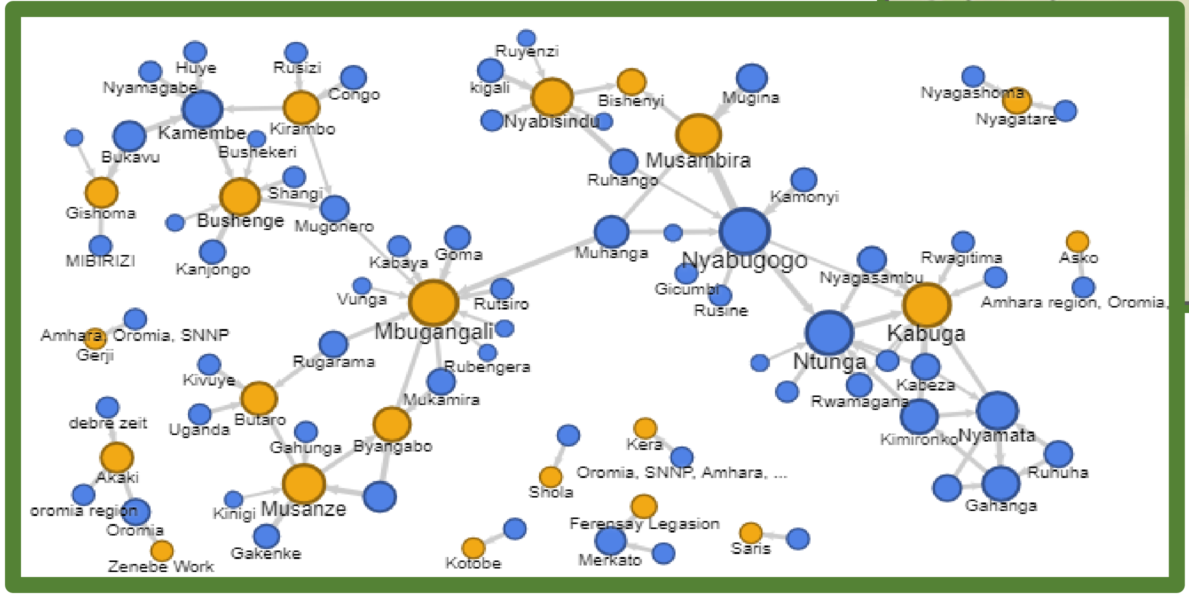
- The **Market Profiling Application (MPA)** is an online, dynamic, real-time application for the systematic collection, display, and analysis of epidemiologically relevant market data.
  - Species, volumes, # of traders, seasonality, catchment areas, sanitary measures , biosecurity
- **Why ?**
  - To inform decisions on preventing or mitigating disease transmission.
- **Where ?**
  - Vietnam and Africa
- **Focus ?**
  - Live bird markets

Data flow chart of the MPA:



MPA outputs are visualised automatically via web maps, statistics, or graphs using Google Spreadsheets, Google My Maps, Fusion Tables, Microreact, Awesome Tables, GeoSheets and ArcGIS Online.





Thank you

Protecting people, animals, and the environment every day

Drawings: FAO/Chiara Caproni

Risk attitudes, biosecure behaviors and economic effects: connecting livestock disease to human decision-making

G. Bucini, E. Clark, S.C. Merrill, A. Zia, C.J. Koliba, S. Wiltshire, S.M. Moegenburg, G. Tonsor, L.L. Schulz, L. Trinity and J.M. Smith

ISESSAH
Atlanta, 7/20/2019

SEGS Lab
social ecological gaming and simulation
Harnessing complexity to solve problems.

Animal Disease Biosecurity
Coordinated Agricultural Project

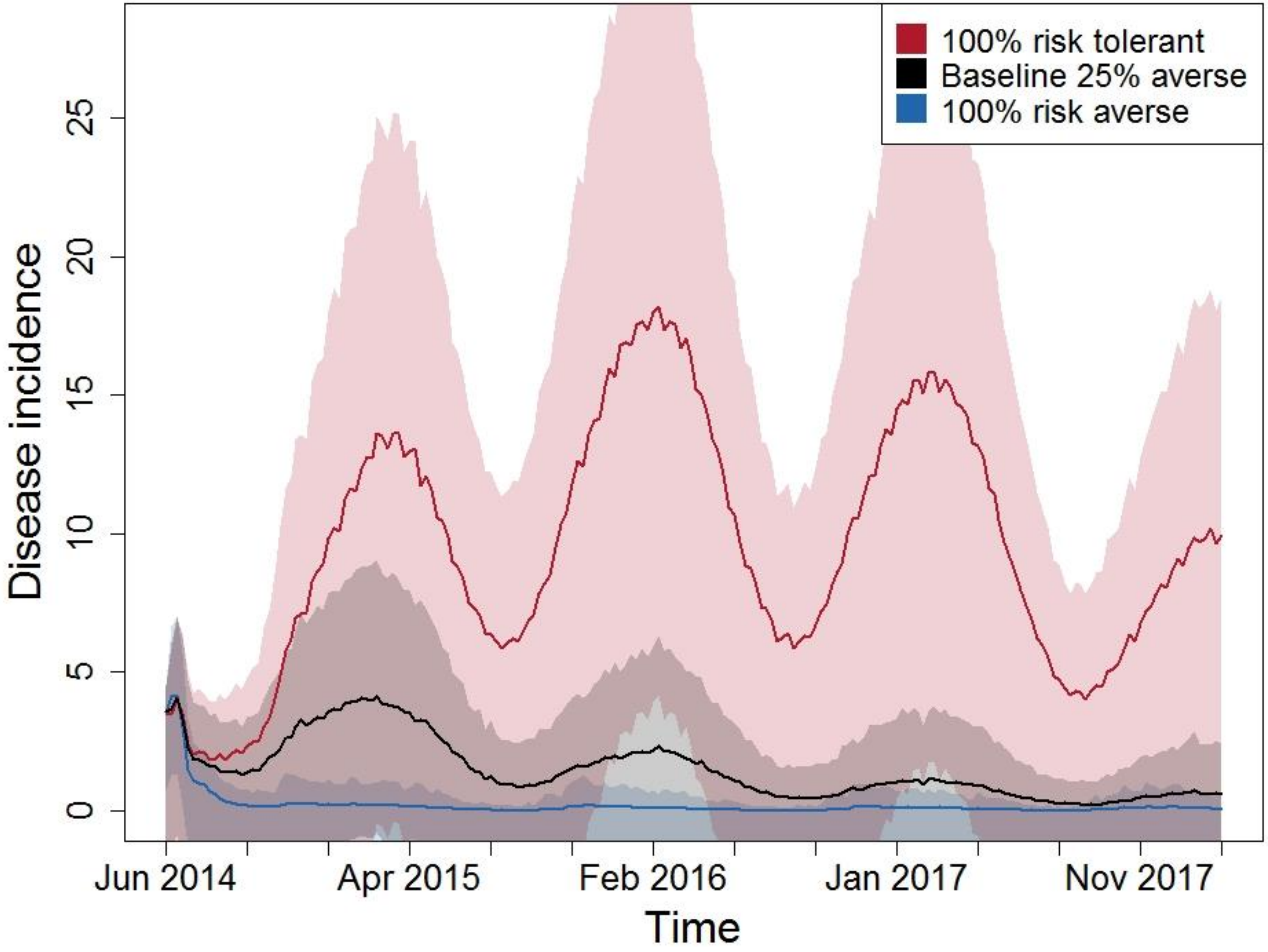
Acknowledgement

USDA

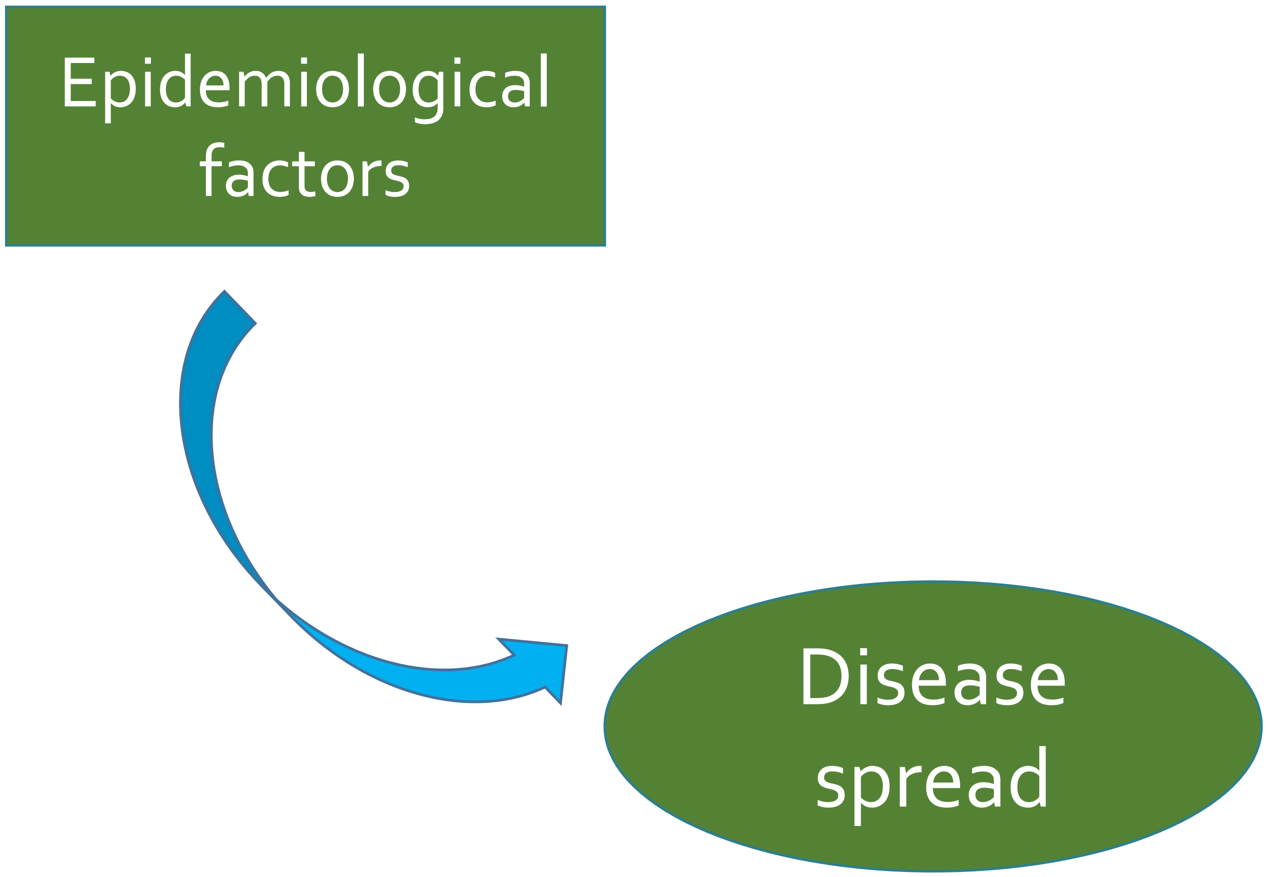
United States Department of Agriculture
National Institute of Food and Agriculture

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-69004-23273.

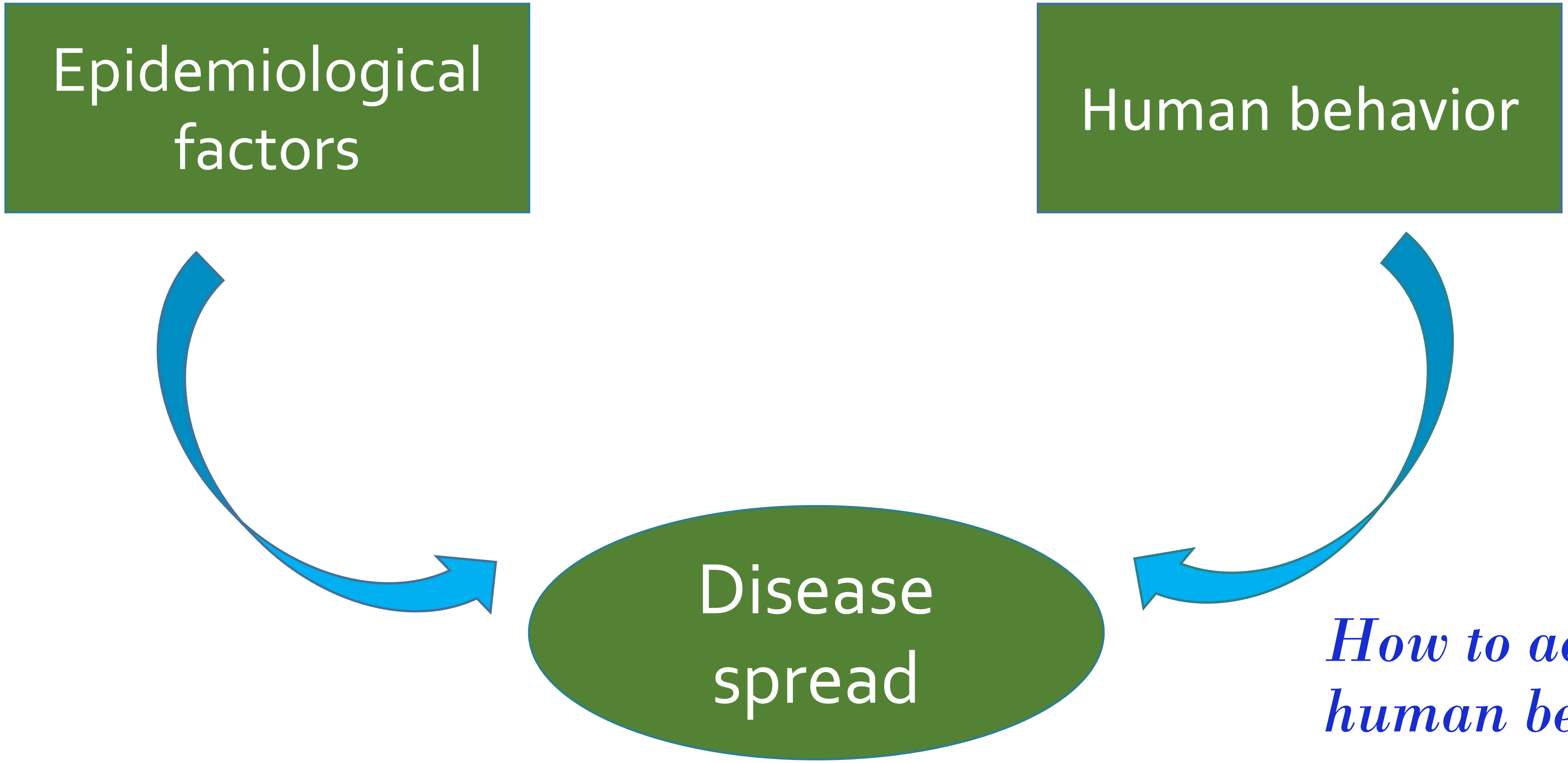
Porcine Epidemic Diarrhea virus simulations



What affects disease spread?



What affects disease spread?



How to account for human behavior?

Key information

RISK BEHAVIOR

- How do people respond to the risk of disease entering their farm?

Key information

RISK BEHAVIOR

- How do people respond to the risk of disease entering their farm?

SCALING BEHAVIOR

- How do individual behaviors scale up to the production system?

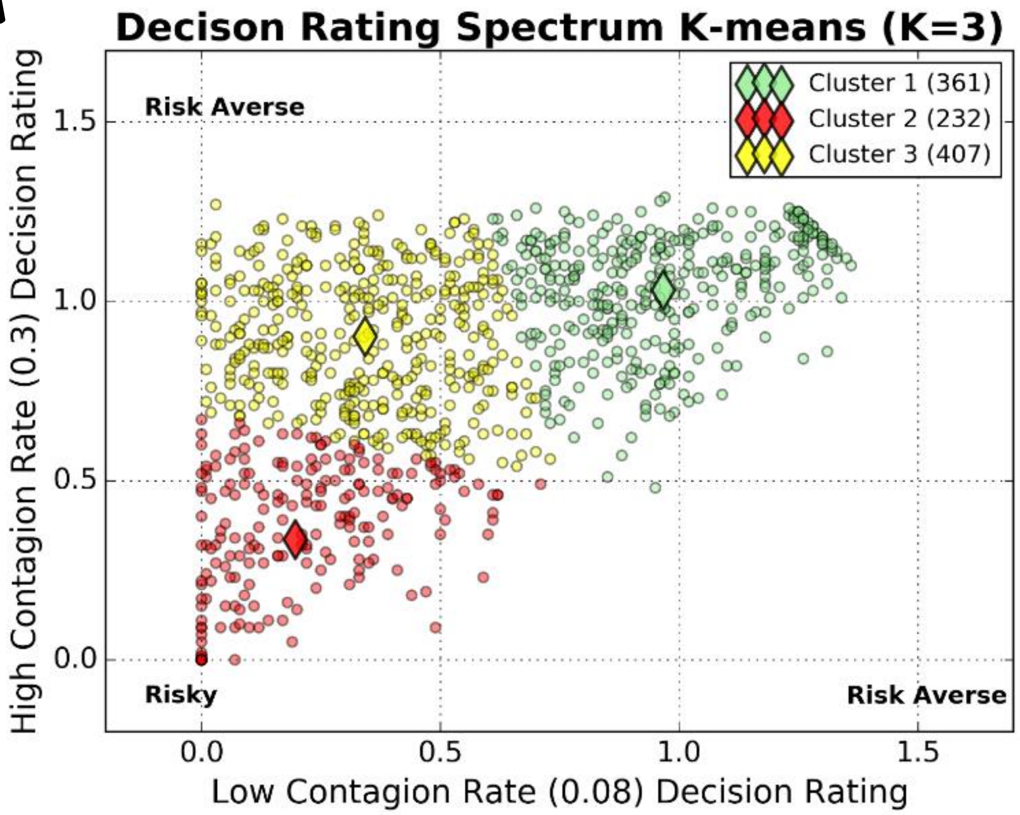
Human risk strategy

Risk opportunist

Varying biosecurity

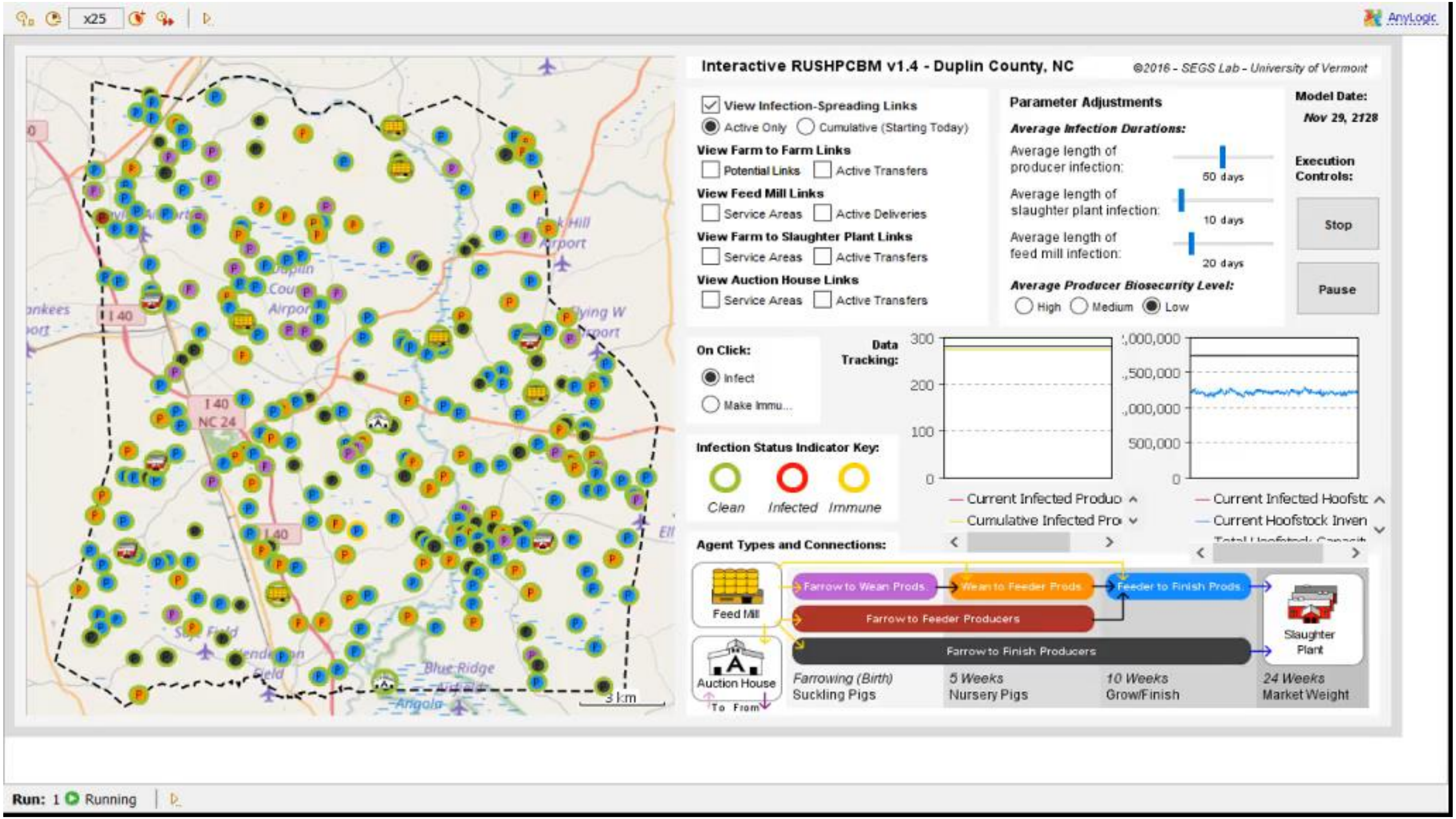
Risk averse

High biosecurity



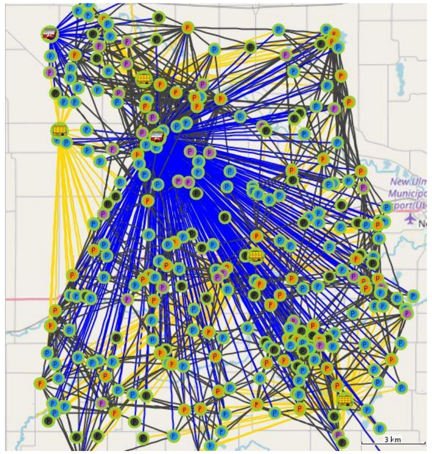
Risk tolerant

Low biosecurity

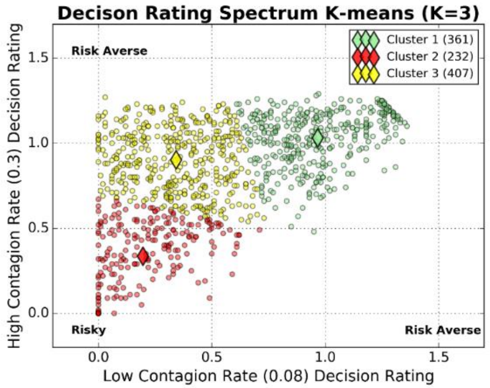


x25
AnyLogic
Interactive RUSHPCBM v1.4 - Duplin County, NC
©2016 - SEGS Lab - University of Vermont
View Infection-Spreading Links
Active Only
Cumulative (Starting Today)
View Farm to Farm Links
Potential Links
Active Transfers
View Feed Mill Links
Service Areas
Active Deliveries
View Farm to Slaughter Plant Links
Service Areas
Active Transfers
View Auction House Links
Service Areas
Active Transfers
Parameter Adjustments
Average Infection Durations:
Average length of producer infection:
50 days
Average length of slaughter plant infection:
10 days
Average length of feed mill infection:
20 days
Average Producer Biosecurity Level:
High
Medium
Low
Model Date:
Nov 29, 2128
Execution Controls:
Stop
Pause
On Click:
Infect
Make Immu...
Data Tracking:
Current Infected Produ
Cumulative Infected Pro
Current Infected Hoofstc
Current Hoofstock Inven
Infection Status Indicator Key:
Clean
Infected
Immune
Agent Types and Connections:
Feed Mill
Auction House
To From
Farrow to Wean Prods
Wean to Feeder Prods
Feeder to Finish Prods
Farrow to Feeder Producers
Farrow to Finish Producers
Slaughter Plant
Farrowing (Birth) Suckling Pigs
5 Weeks Nursery Pigs
10 Weeks Grow/Finish
24 Weeks Market Weight
3 km
Run: 1 Running

Epidemiology

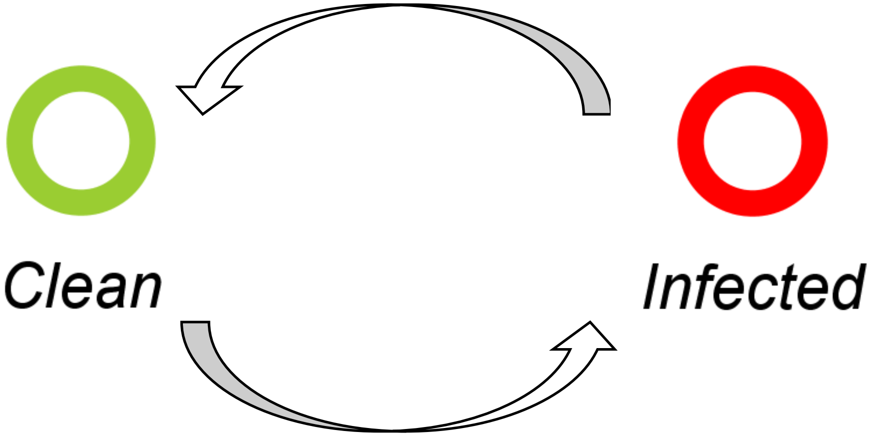


Human behavior



SIS model

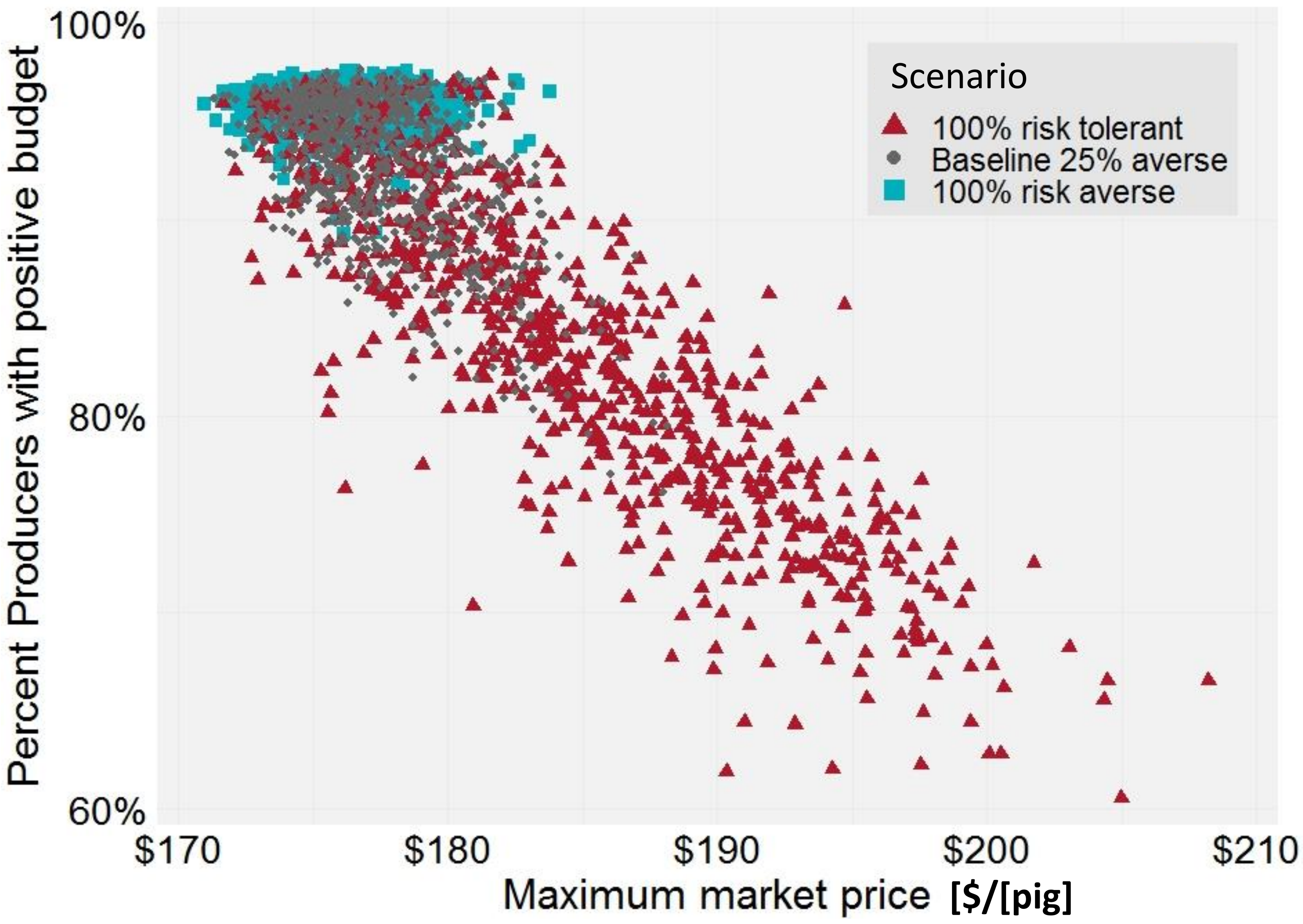
Recovery time



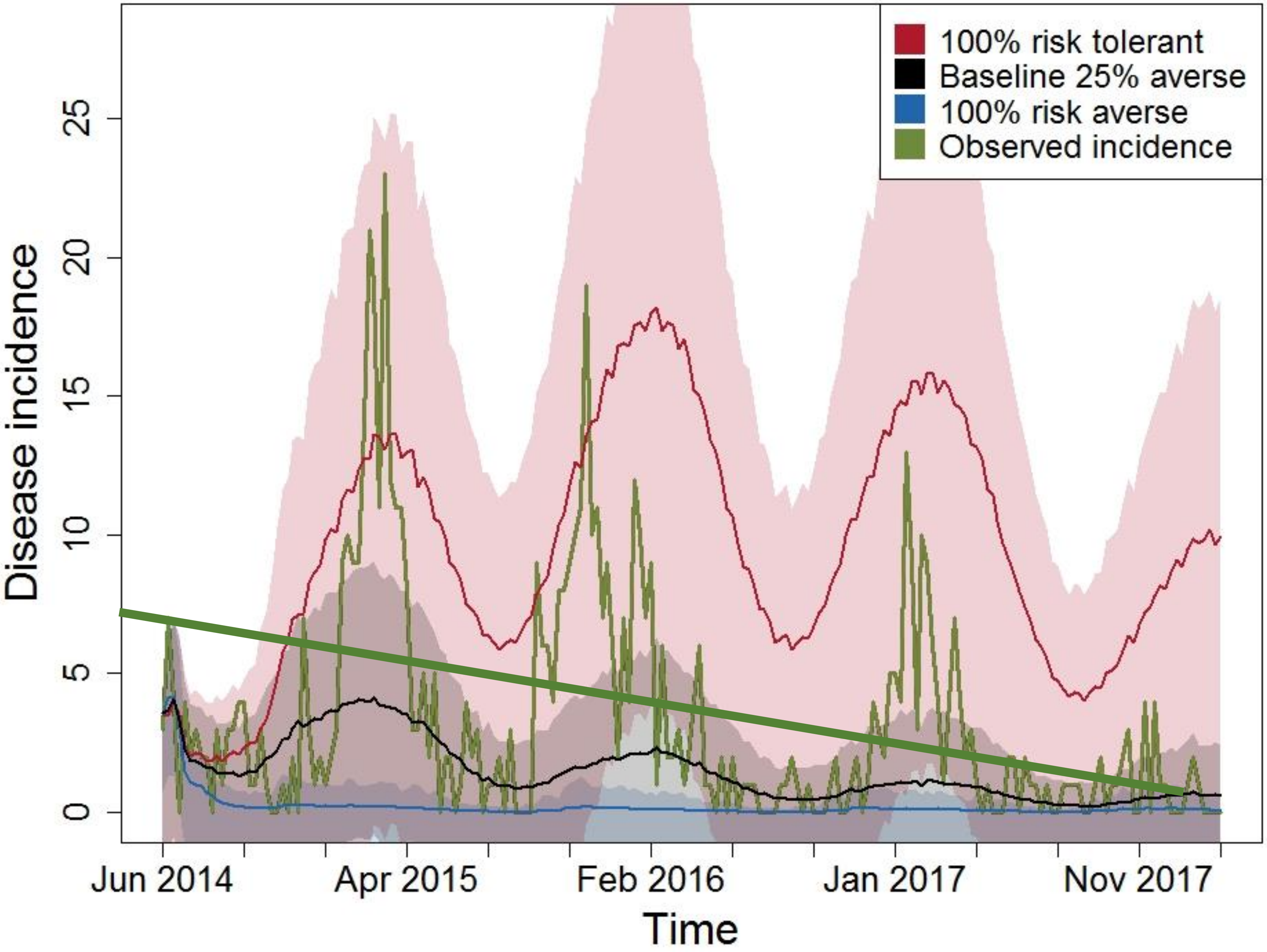
Transmission probability

Main Findings

Market price and producer's budget



Higher hog market prices benefit only a fraction of producers



100% risk tolerant
Baseline 25% averse
100% risk averse
Observed incidence
Disease incidence
0
5
10
15
20
25
Jun 2014
Apr 2015
Feb 2016
Jan 2017
Nov 2017
Time

Summary

- Human behavior is a critical piece in the spread of disease and must be included in models.

- Risk tolerance increases variability in disease spread and market dynamics. Risk aversion allows control!

Questions?

Gabriela Bucini
University of Vermont
E-mail: gbucini@uvm.edu

Simulating Outbreak Scenarios For Distinguishing Risk Mitigation Behavioral Strategies Across Agricultural Production Networks

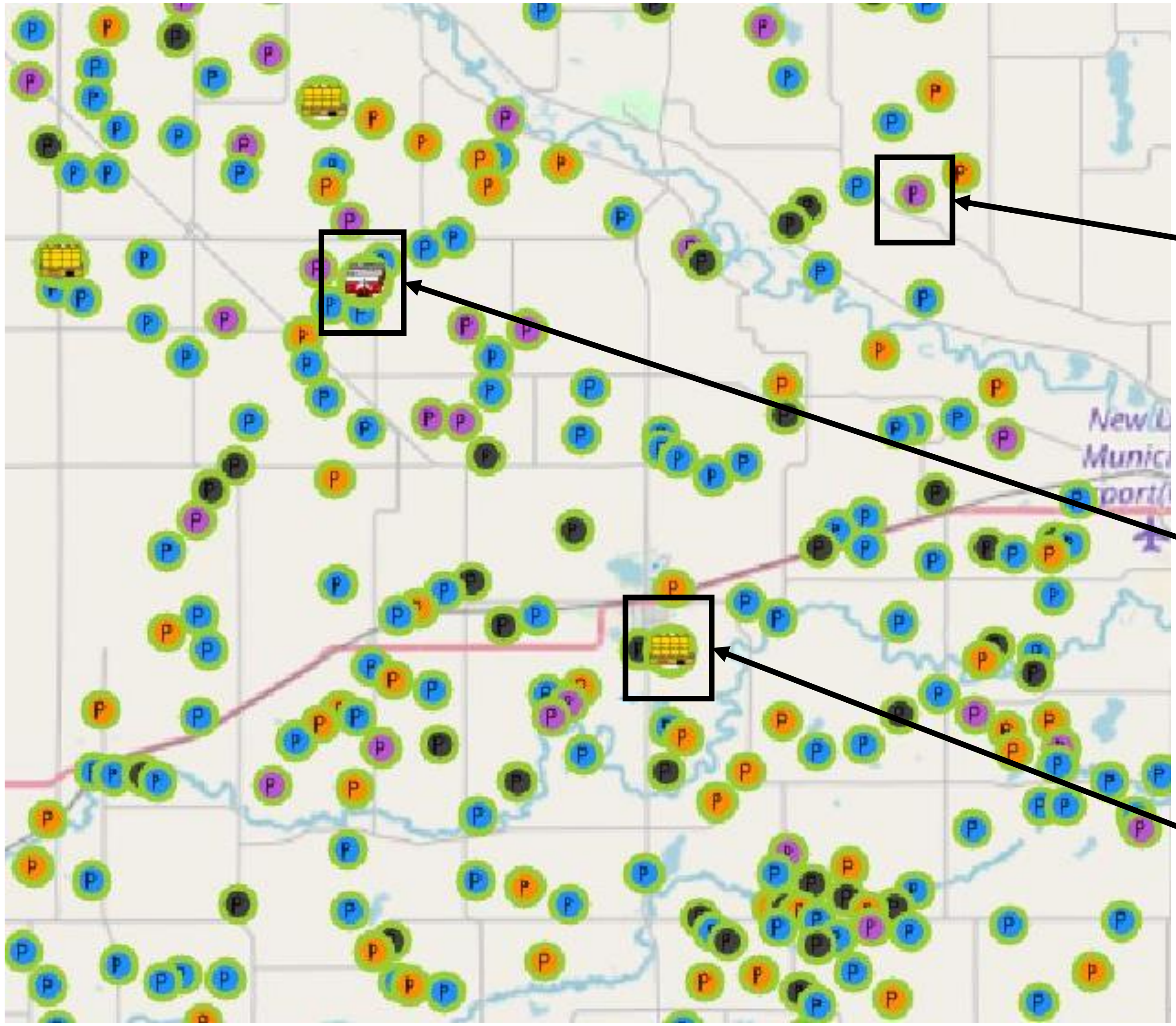
Eric M. Clark, Scott Merrill, Susan Moegenburg , Luke Trinity, Gabriela Bucini, Christopher Koliba, Asim Zia, and Julia M. Smith

ISESSAH
eclark@uvm.edu
July 2019

SEGS Lab
Social Ecological Gaming & Simulation

July 20, 2019

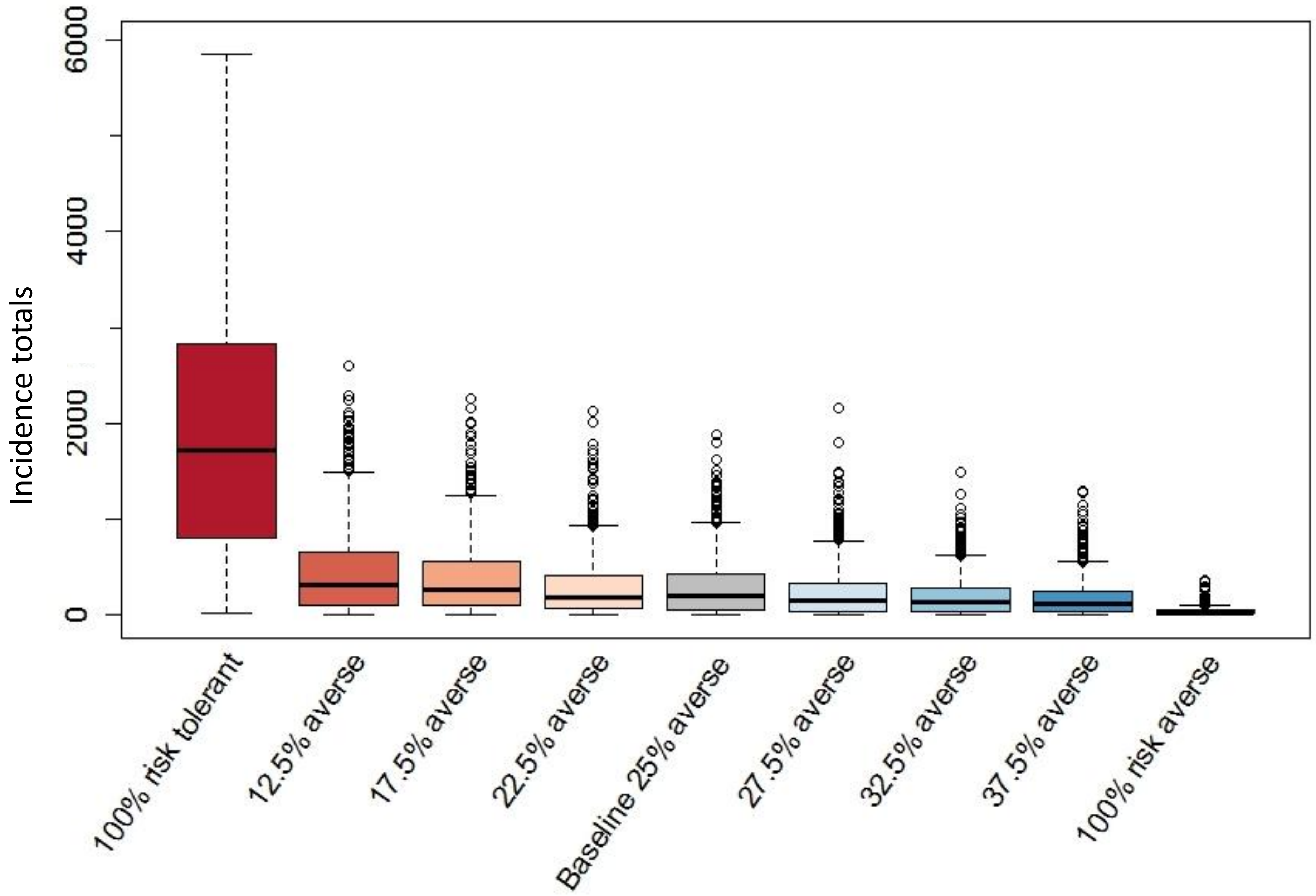
Agents and Behaviors



Hog facility/producer:
- Grow and exchange hogs
- Facility type (inner circle color)

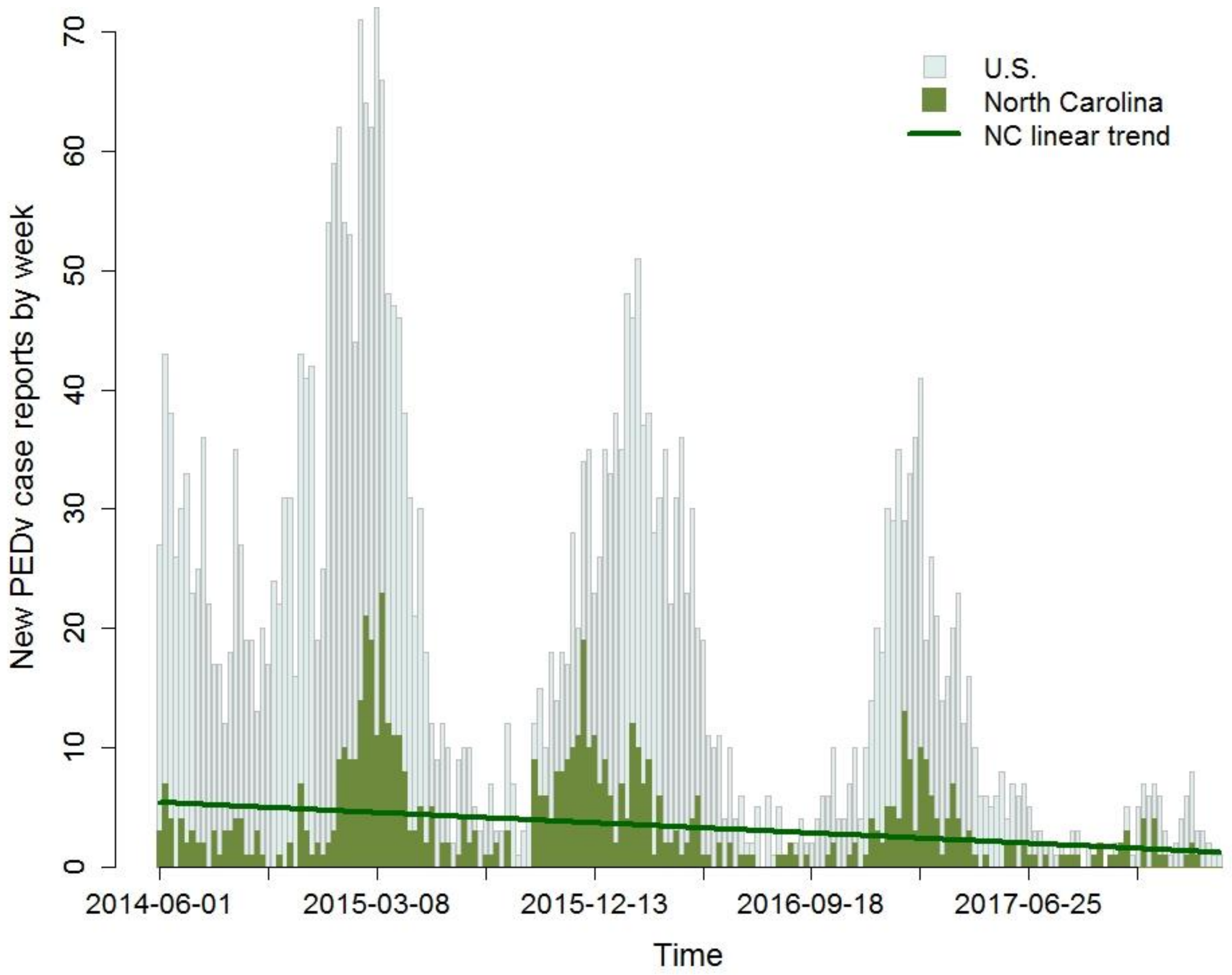
Slaughter plant:
Receive market-weight hogs from finishing producers

Feed mill:
Deliver feed to producers



- High **unpredictability** in a risk tolerant system
- **Control** of disease incidence higher with increasing risk averse behaviors

Porcine epidemic diarrhea virus records



A Benefit Cost Ratio Approach to Evaluating Adoption of a Johne's Disease Vaccine for Dairy Cattle in Canada

David C. Hall (DVM, PhD) and Philip Rasmussen (MA, PhD-cand)
Faculty of Veterinary Medicine, University of Calgary

ISESSAH
International Society for Economics and Social Sciences of Animal Health

UNIVERSITY OF CALGARY

Introduction

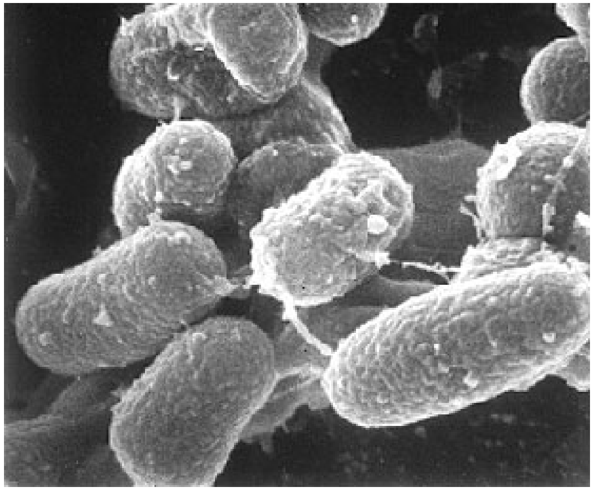
- Background
  - Johne’s disease in Canada
  - Effect on Canadian dairy industry

- Focus of this presentation
  - **Simulation of vaccine adoption in Canada**
    - Models and assumptions
    - Simulation results
    - Policy implications

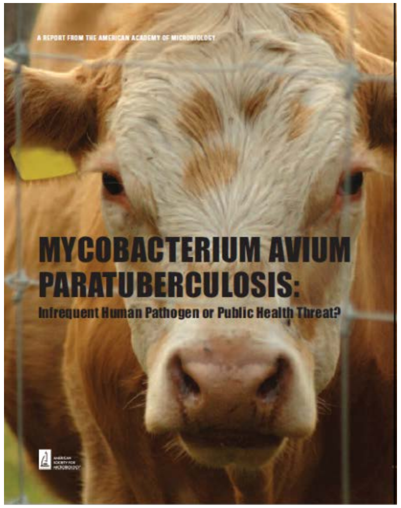
Background

- Johne's disease (Paratuberculosis)
  - *Mycobacterium avium ssp. paratuberculosis* (MAP)
- Affects ruminants and non-ruminants (Humans?)
- Chronic wasting disease, wide distribution
- Control: biosecurity (weak vaccine available)

Photo credit: Dr. Mike Collins, School of Veterinary Medicine, University of Wisconsin/Madison



Source: School of Veterinary Medicine, University of Wisconsin



Source: American Academy of Microbiology

Effect of JD on Canadian Dairy Industry

UNIVERSITY OF CALGARY

Main source of losses in dairy

- Reduced milk production, slaughter value
- Premature culling
- Economic effects: **$40 - $50/cow/year** (Tiwari, 2008; Shephard, 2016)

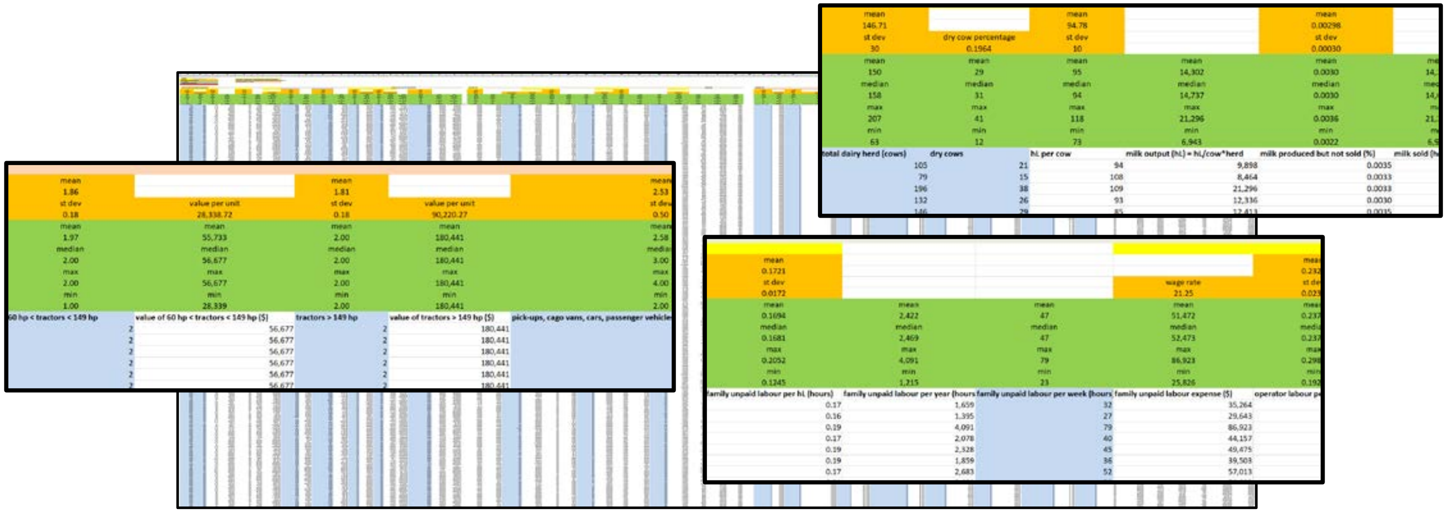
- 24 studies report significant economic losses
- 4 studies report insignificant losses
- 2 studies report no losses

Hall and Ci (2017), Ci and Hall (2017) – Working Papers

Production Model

UNIVERSITY OF CALGARY

- Standard production model
  - Inputs (labour, feed, capital) and outputs (hL of milk)
  - Farm-level data pending
  - **For this presentation, simulations based on aggregated data**
  - 500 simulated farms
  - Each farm has a specific herd size, efficiency, capital/labour ratio, feed per cow, labour per cow, etc.



Adoption Model

- Simulate 3 vaccine adoption scenarios
  - Elimination (low within-herd prevalence)
  - Reduction and Control (high within-herd prevalence)
  - Prevention (herd is MAP-neg.)
- Benefits
  - Prevalence decreases over time due to vaccination
  - Ratio of MAP-neg. to MAP-pos. cows in herd increases
  - Herd-level output per cow increases
  - With output fixed, feed and labour costs decrease
- Costs (materials and labour)
  - Testing, vaccinating, culling and replacing
- **Consider benefit-cost ratio (BCR) over 10-year horizon to determine value of vaccine programme in Canada**

Simulation Assumptions (1 of 2)

- 10-year horizon, not closed herds
  - Benefits and costs are discounted at rate of 0.05
- **MAP+ve produce at 94% of MAP-ve cows**
  - McAloon et al. (2016)
  - Large standard deviation
- 30% of dairy herd is replaced each year
- 3.75% of infected are culled and replaced
  - Mature off-farm MAP-neg. replacements = CAN$1,650 + labour

Simulation Assumptions (2 of 2)

UNIVERSITY OF CALGARY

- Vaccine is administered yearly to total herd
  - 1 dose/year
  - Young stock is vaccinated at 3, 6, 12, 24 months
- Vaccine = CAN$7/dose + labour
- Environmental testing = CAN$420/year + labour
  - CAN$70/sample, 6 samples/farm
- PCR testing = CAN$30/test + labour
  - 5 animals pooled per test
- **All tests have sensitivity and specificity of 1.00**

Scenario 1: Elimination

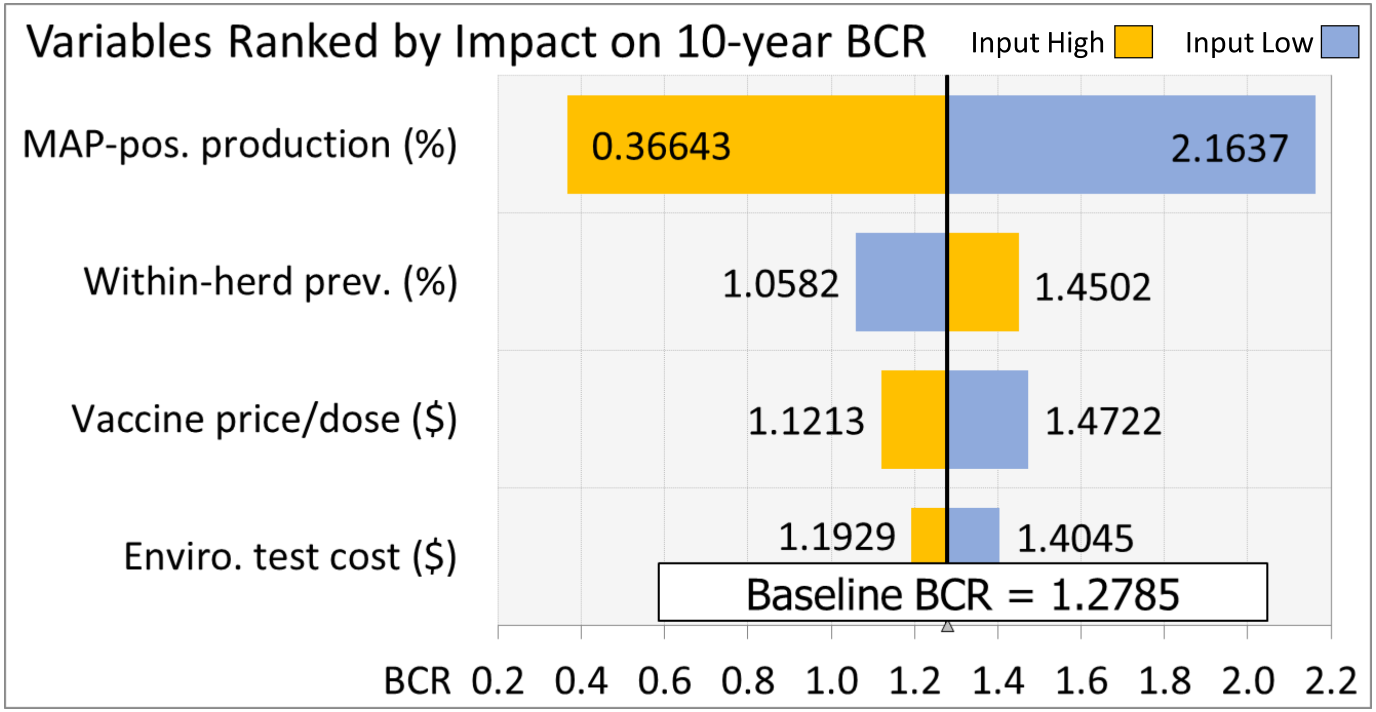
- Herd is MAP-pos. with **low prevalence** (0.05)
- Environmental testing yearly
- Herd is **vaccinated yearly** and shedders culled
  - ~1 animal culled prematurely over 10 years
- Within-herd prevalence drops to 0 over 10 years

- Yearly cost ≈ CAN$2,700
- 10-year total cost ≈ CAN$27,000
- 10-year total benefit ≈ CAN$35,000
  - Potential decrease in herd size is ~3 cows, holding output fixed
- **10-year BCR ≈ 1.28**
  - BCR > 1.00 implies adoption is worthwhile

Scenario 1 – Sensitivity Analysis

UNIVERSITY OF CALGARY

- Ranks variables according to their effect on the BCR
- 1,000 iterations / scenario
- *Ceteris paribus*, effect on production most influential
  - ***Cost per dose has little impact***
- **BCR ranges suggest vaccine possibly of value to producers with low in-herd prevalence**

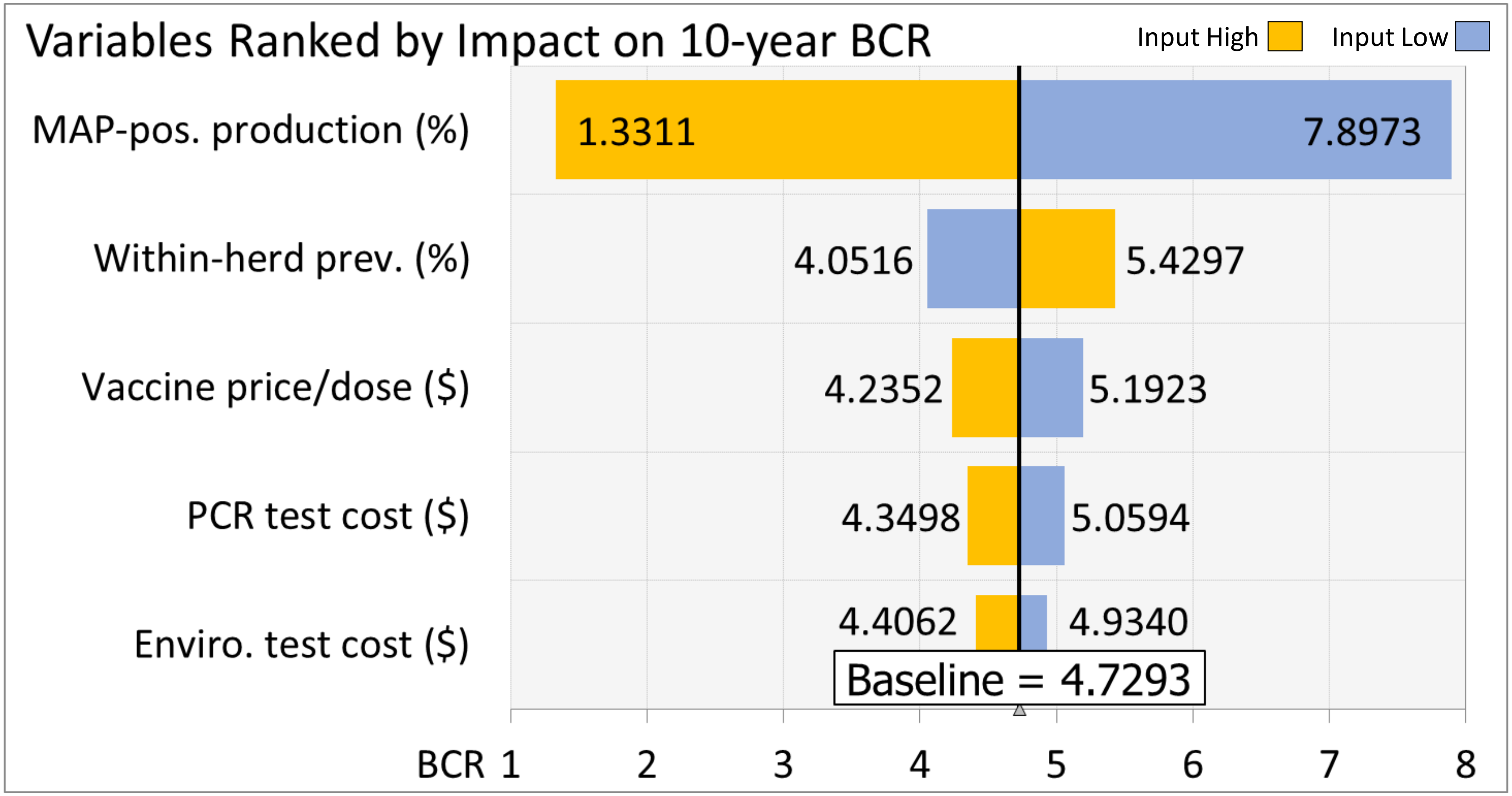


Scenario 2: Reduction and Control

- MAP+ve, high prevalence (0.30)
  - Environmental, then pooled + individual PCR in year 1
  - Tested annually
- Herd vaccinated yearly, shedders culled
  - Additional cull in year 1 (5% of infected)
  - ~4 animals culled in year 1, ~8 total culled over 10-year period
- Off-farm MAP-neg. replacements until prev. reaches ~0.05
  - Prevalence drops to 0.02 over 10 years
- First year cost ≈ CAN$14,000
- 10-year total costs ≈ CAN$45,000
- 10-year total benefits ≈ CAN$250,000
  - Potential decrease in herd size is ~17 animals, holding output fixed
- **10-year BCR ≈ 4.73**

Scenario 2 – Sensitivity Analysis

- Effect on production most influential variable
- **BCR ranges suggest that vaccine is highly likely to be beneficial to herds with high within-herd prevalence**



Scenario 3: Prevention

- Herd MAP-ve
- Herd vaccination and environmental testing yearly
- In-herd prevalence maintained at 0 over 10 years

- Difficult to directly estimate benefits
    - Sale of MAP-ve livestock as replacements
    - Nearby herds are MAP+ve?
    - Benefits ≈ avoiding losses of MAP+ve farms nearby

- **1.28** (Scenario 1) **≤ 10-year BCR ≤ 4.73** (Scenario 2)
    - Rough approximation
    - Highly dependent on regional herd-level prevalence

Canada-wide Adoption?

UNIVERSITY OF CALGARY

- Probably of value to producers with:
  - MAP-ve herds
  - low within-herd prevalence

- **Highly likely of value to producers with high within-herd prevalence**

- However, BCRs only consider direct benefits and costs
  - Underestimate true value of the programme

- **Must also consider potential losses due to an external shock (shift in demand)**

External Shocks

UNIVERSITY OF CALGARY

- Impact of Canada losing its “JD-free” status?
- Designation of MAP or JD as a public health risk?

- Canadian exports in 2016 (CDIC, 2018)
  - ~ CAN$235M in dairy products
  - ~ CAN$155M in dairy genetics
  - USA, Republic of Korea, Columbia, Netherlands, Brazil, etc.

- **Significant producer losses if export markets begin requiring MAP-negative certification**
  - Potential leverage in trade negotiations
  - Could be used to circumvent WTO trade regulations

Next Steps

- Integrate farm-level production data from nationwide questionnaire
  - Simulations presented today based on aggregated data

- Refine adoption model
  - Consider test sensitivities and specificities
  - Markov Chain to develop more realistic herd model

- **Estimate potential losses due to external shocks**
  - **Impact of Canada losing its JD-free designation**
  - **Impact of export markets closing**
  - **Impact of designation as a public health risk**

Acknowledgements

This research was supported by Genome Canada, Genome Prairie and Genome British Columbia [225RVA].

References

- CANSIM 004-0234 (2017)
- CANSIM 004-0241 (2017)
- Ci and Hall (2017) - Working Paper
- CDIC (2017)
- CDIC (2018)
- Corbett et al. (2018)
- Dairy Farmers of Ontario (2016)
- Hall and Ci (2017), Working Paper
- Hendrick et al. (2005)
- McAloon et al. (2016)
- Tiwari et al. (2008)
- Van Biert (2016)

Johne's Disease in Canada

UNIVERSITY OF CALGARY

- Canadian within-herd prevalence
  - 12.7% - Tiwari et al. (2008)
  - 18.9% - Hendrick et al. (2005)
- Canadian herd-level prevalence
  - 42% - Corbett et al. (2018)
- Canadian dairy industry at a glance (2016)
  - 11,280 farms
  - CAN$6.17 billion in cash farm receipts
  - 1.4 million head of dairy cattle
  - 84.7 million hL of milk produced

CDIC (2017)

Consumer perceptions regarding production practices to improve animal welfare in beef and dairy production

Jarkko K. Niemi[1], Katriina Heinola[1], Terhi Latvala[1], Tapani Yrjölä[2], Tiina Kauppinen[3] and Satu Raussi[3]

[1]Natural Resources Institute Finland (Luke), Bioeconomy and environment

[2]Pellervo Economic Research

[3]Natural Resources Institute Finland (Luke),

The Finnish Centre for Animal Welfare

NATURAL RESOURCES INSTITUTE FINLAND

Introduction and objective

- Previous research shows that the public has concerns on whether animal welfare is satisfactory in modern animal production systems
  - The concerns are related especially to the naturalness of production method and humane treatment of animals
- Consumers are willing to pay a price premium for animal welfare
- A labelling scheme can be used to help consumers in their food choices
- A labelling scheme can improve animal welfare by certifying that specific requirements are actuarially met in labelled production.
- The aim of this study was to test how the public views different approaches to improve animal welfare in beef and dairy cattle production.

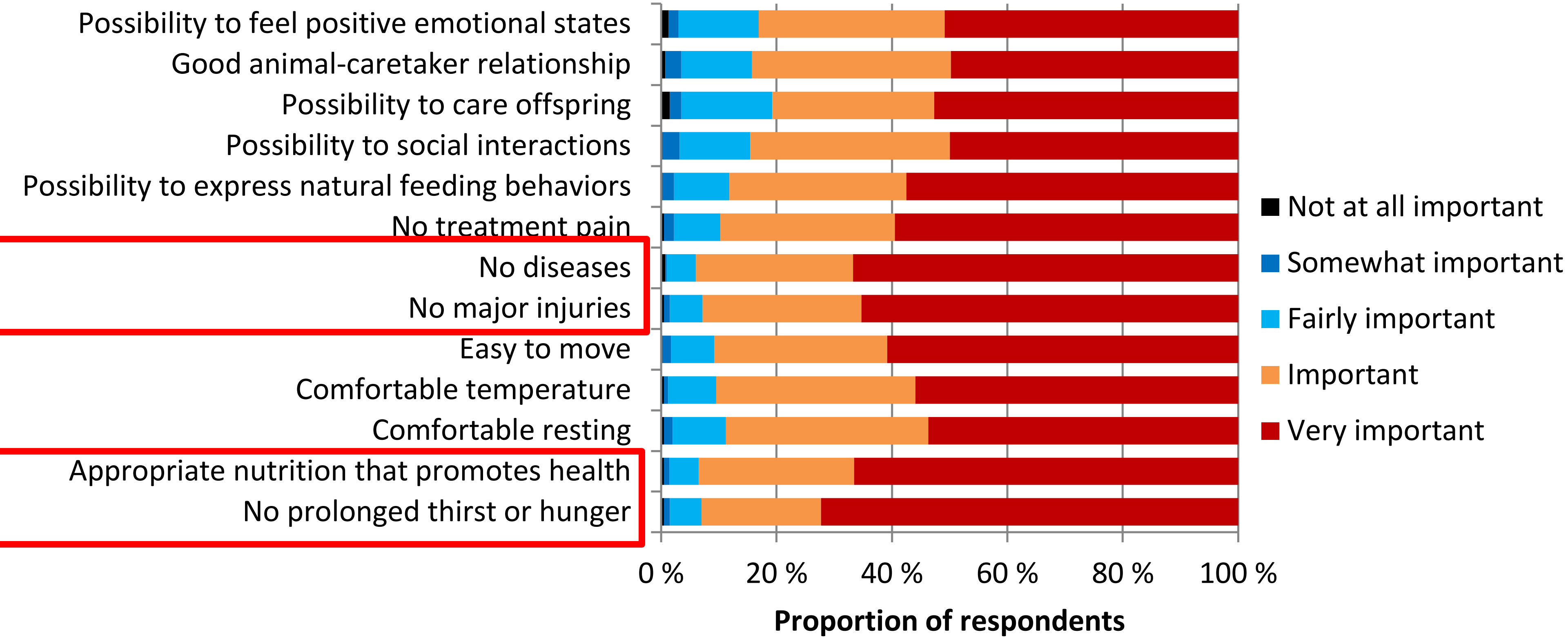
Data and methods

- An on-line consumer survey instrument was developed to study people's views regarding animal welfare, improvement needs and production patterns influencing animal welfare
- The survey was distributed in September 2018 by a market research company (by using an on-line panel of respondents)
- The data were a representative sample of population of Finland (N=400 respondents)
- The respondents were clustered into four groups
- A multinomial logit regression was used to characterize respondent profiles

11 attributes of production were studied

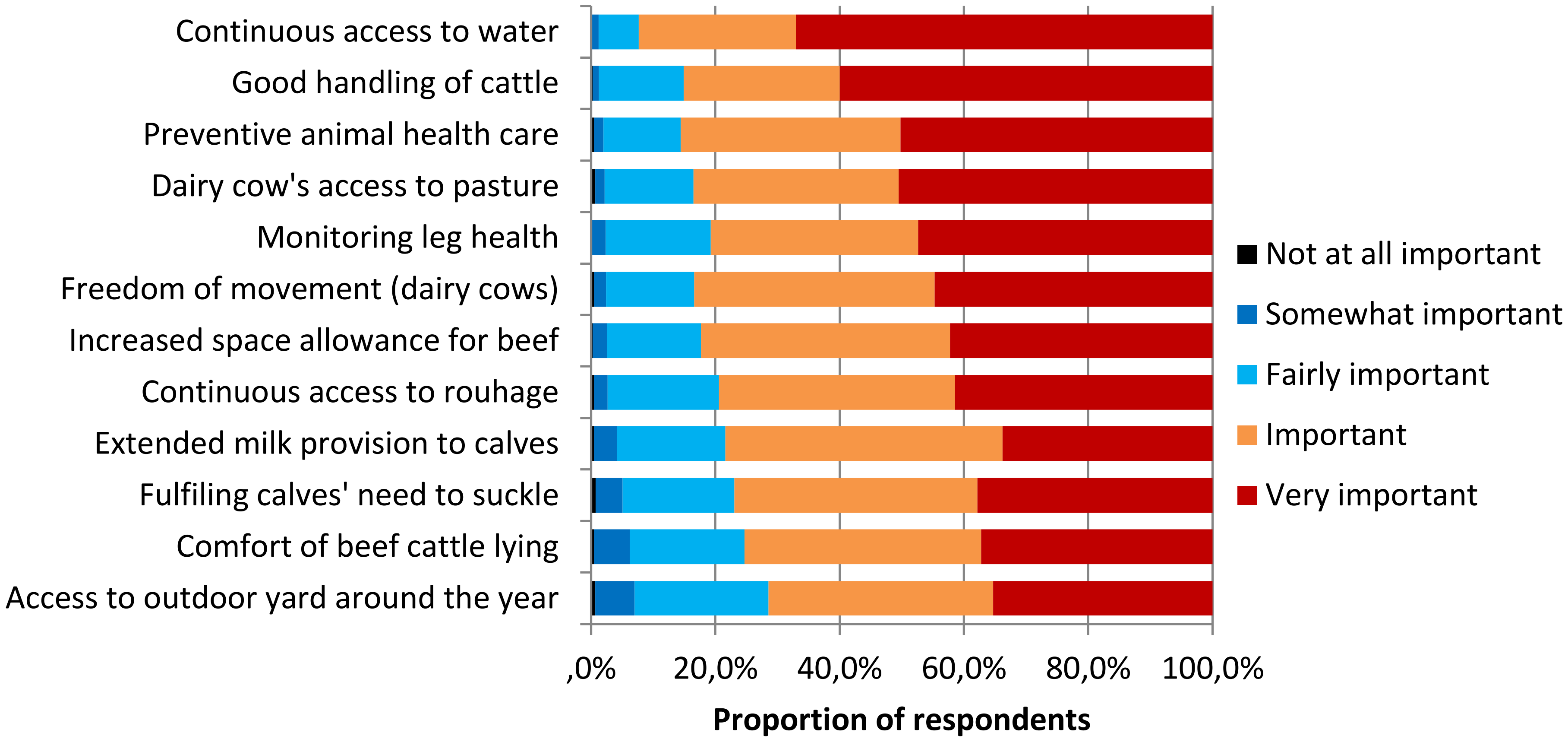
- In this study 11 attributes of production representing different aspect of animal welfare were selected for more detailed analysis:
  - Access to pasture or outdoor yard
  - Freedom of movement in dairy cows and beef cattle
  - Extended milk provision to calves and need to suckle
  - Comfort around dairy cows’ lying
  - Access to water
  - Measures to improve leg health
  - Friendly handling of cattle
  - Space allowance
  - Preventive animal health care

The public's vews regarding different areas of animal welfare



NATURAL RESOURCES INSTITUTE FINLAND

Perceived importance of selected measures to enhance animal welfare in cattle



NATURAL RESOURCES INSTITUTE FINLAND

Consumer groups

- Four consumer groups were identified
  - Group 1 (40% of respondents) typically considered **all 11 attributes** as a very important characteristic of a labelled product.
  - People in group 2 (11%) typically considered **good handling of animals** as a very important characteristic and other characteristic also as important
  - Group 3 (19%) typically considered **good handling, preventive animal health care and increased space allowance** important, and other attributes as important or fairly important product characteristic
  - Group 4 (11%) were **the least-demanding group**: they tended to consider all attributes as a quite important characteristic of a product
- About 61% of respondents were interested in buying welfare-labelled products if they were available
  - Willingness to pay was also estimated by a choice experiment included in the survey, but WTP is not in focus today
  - WTP study also identified four groups of respondents

Consumer groups

- Blue=important or very important
- White and light red=fairly important…important
- Red=somewhat important….fairly important

	1	2	3	4
Access to pasture (dairy)				
Freedom of movement (dairy)				
Extended milk provision to calves				
Fulfilling calves need to suckle				
Space allowance (beef)				
Comfort around dairy cows' lying				
Access to outdoor yard				
Access to roughage				
Friendly handling of animals				
Preventive animal health care				
Continuous access to water				
Measures to improve leg health				

How the four groups differed?

Summary of logistic regression model (likelihood of membership to groups 1-3 instead of group 4)

- Respondents aged 18-24 years were less likely to be belong to groups 1-3 when comparing with group 4
  - Other cohorts did not obtain a statistically significant estimate
- Respondents who had relatives or friends owning a livestock farm were less likely to belong to groups 1 and 2
- Respondents who purchased food directly from farms *less frequently than once a week* were less likely to belong to group 1-3
- Consumption of red meat is connected quite strongly to animal welfare attributes.
  - This applied especially to beef consumption and was observed also in other parts of the study.
  - The more respondent consumed red meat, the more likely s/he was to belong to group 2, which emphasized good handling of animals

Conclusions

- Preventive animal health care and hood animal handling are seen as an essential part of animal welfare. However, people face challenges in understanding specific measures taken on farms.
- Factors such as the respondent living in a city or a suburb, age and reduced familiarity with farming through relatives contributed to an increased likelihood of respondent belonging to the consumer groups which consider products' animal welfare attributes important.
- Connections to farming are associated with the way people see livestock farming
- Red mead consumption is a useful proxy for both animal welfare concerns and characteristics required from a product.
- The results provide guidance on which are the most essential criteria the consumers would like a labelling scheme to address.

Thank you!

Funding from the Ministry of Agriculture and Forestry, Atria, HKScan, Valio, Arla foods, Juustoportti, Lidl, Central Union of Agricultural Producers and Forest Owners, and SEY Finnish Federation for Animal Welfare Associations is gratefully acknowledged

NATURAL RESOURCES INSTITUTE FINLAND

Sustainability in Action: Observations from Year One of the Integrity Beef Sustainability Pilot Project

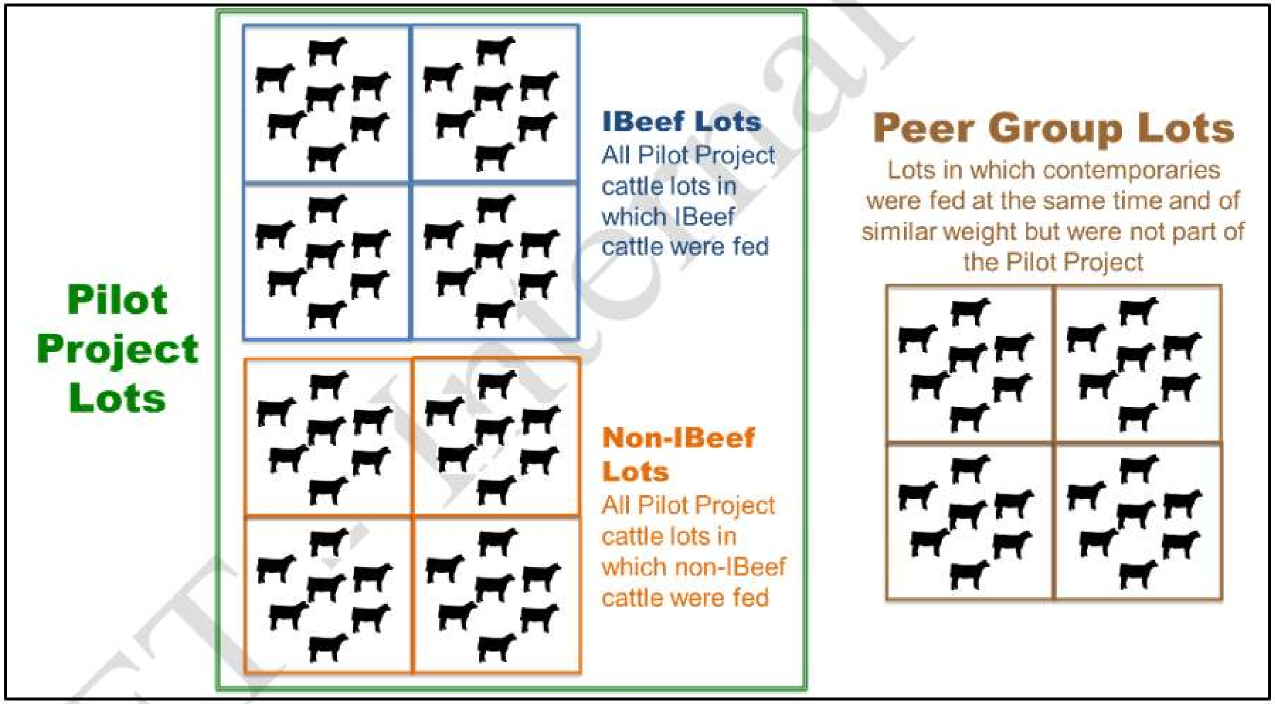
Myriah D. Johnson,
Deke O. Alkire,
Sharon K. Bard, &
Ryan C. Feuz
July 23, 2019

PILOT PROJECT GOALS

NOBLE RESEARCH INSTITUTE

1. **Determine health differences** between sustainably managed cattle and peers
2. **Quantify the effects of illness** on growth performance, carcass characteristics and profitability
3. **Determine profitability differences** between sustainably managed cattle and peers

Year One Results

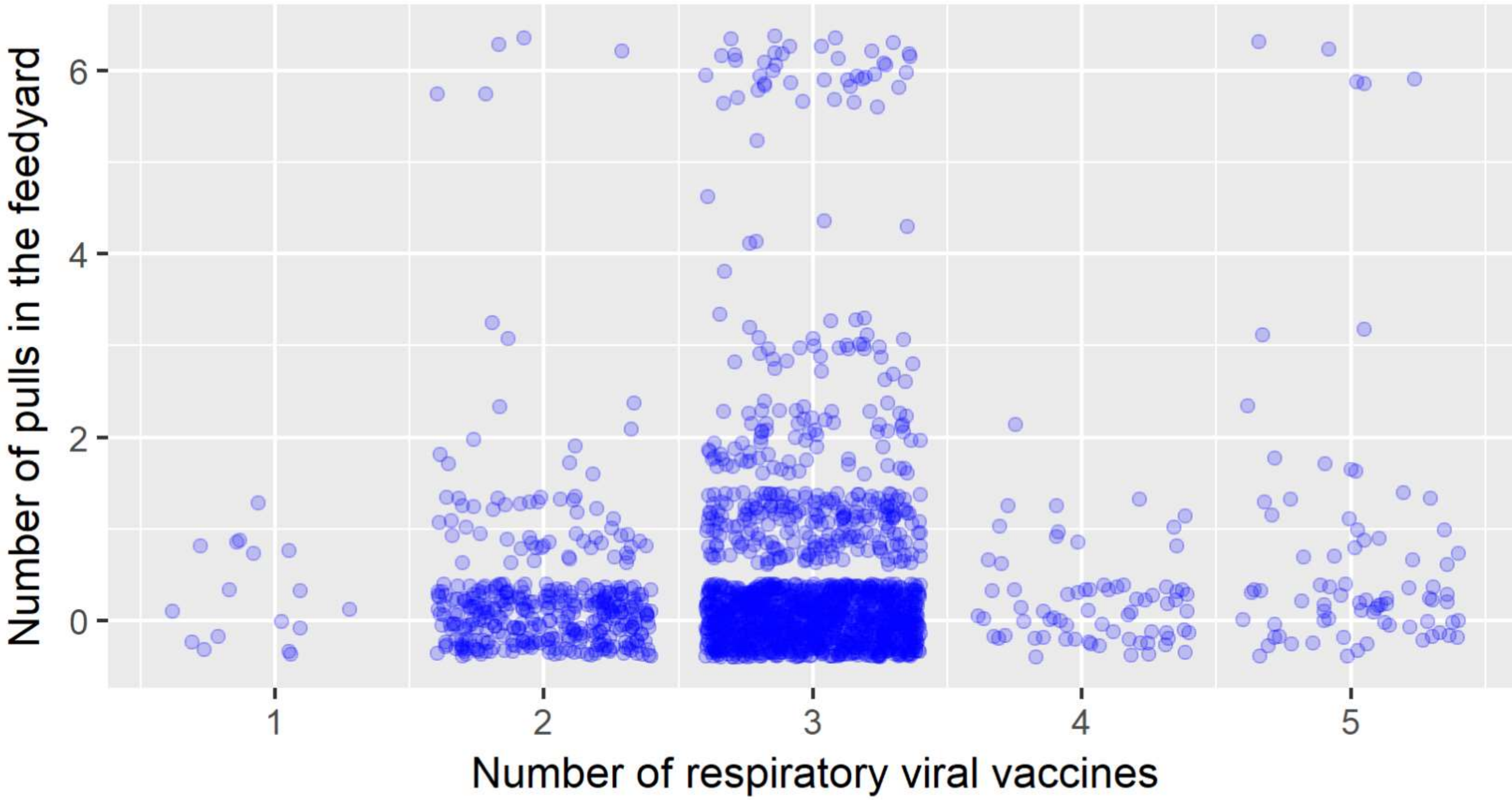


Animal Health

	Number of times treated for illness in the feedyard			
	0	1	2	3
ADG*	3.41	3.32	3.23	3.14
F:G*	5.84	5.90	5.95	6.01
HCW*	873	845	817	789
Dressing %*	64.3	64.2	64.1	64.0
YG*	2.5	2.3	2.1	1.9
Marbling*	476	446	416	386
REA†	14.50	14.38	14.25	14.13

* p=0.001 † p=0.05

Animal Health



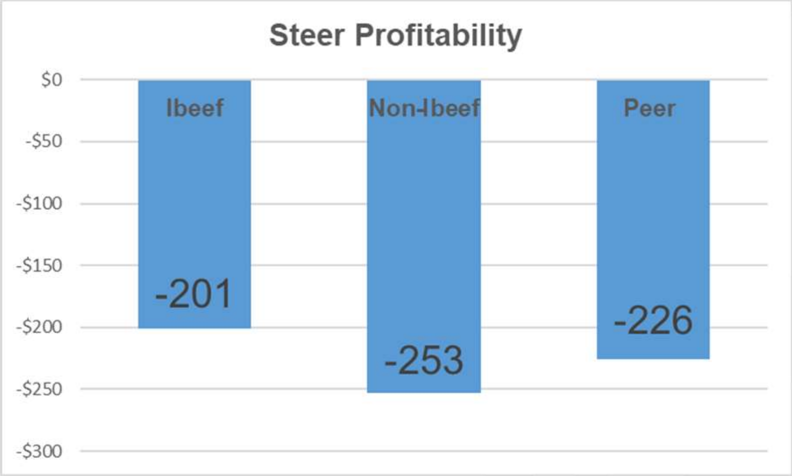
Animal Profitability

IBeef and Non-IBeef Cattle Only

	Sales, $/head (based on Tyson's grid pricing)
Minus	Purchase Price, $/head (based on actual prices paid for project cattle)
Minus	Cost of Gain, $/head (based on ILS information)
	Profit Proxy, $/head

Peer Group Cattle Only

	Sales, $/head (based on Tyson's grid pricing)
Minus	Purchase Price, $/head (based on USDA-reported cash feeder cattle prices and a price slide within each weight class)
Minus	Cost of Gain, $/head (based on ILS information)
	Profit Proxy, $/head



Conclusions

- Calves that experienced illness in the feedlot had decreased growth and carcass performance.
- Calculated profitability in the feedlot phase was similar for sustainably managed and peer cattle.
- Managing calves sustainability resulted in similar health in the feedlot phase.
- Vaccinating above industry standards did not result in improved health suggesting the need for alternative management strategies.

NOBLE RESEARCH INSTITUTE

QUESTIONS

Myriah D. Johnson, PhD
Economic Program Lead &
Ag Economics Consultant
mdjohnson@noble.org
580-224-6432
www.noble.org

NOBLE RESEARCH INSTITUTE

Network analysis of cattle movement in Mato Grosso do Sul (Brazil) and implications for FMD outbreaks

Taís C. de Menezes[1], Ivette Luna[2], Sílvia H. G. de Miranda[1]

[1]Graduate Program in Applied Economics, Luiz de Queiroz College of Agriculture, University of São Paulo, Brazil

[2]Economics Institute, Campinas State University, Brazil

ISESSAAH 2019 Conference
Atlanta, USA
July 20, 2019

Outline

1) Introduction

2) Data and Methods

3) Data analysis: Cattle raising in Mato Grosso do Sul and animal movement networks

4) Simulations: Potential impacts of an eventual FMD outbreak in Mato Grosso do Sul

5) Final comments

1) Introduction

	Brazil	Mato Grosso do Sul (MS)
	214,9 million	21,5 million
	41,1 million	1,4 million
	1,4 million	12,7 thousand

Brazil in the world ranking:
1st beef exporter
2nd cattle producer
4th pig producer and exporter

1) Introduction

- Last outbreak of foot-and-mouth disease (FMD) in Brazil: Sep/2005-Apr/2006
- **March 2017**: Launch of the National Foot And Mouth Disease Prevention and Eradication Program (PNEFA) - **Strategic Plan (2017-2026)**

  Proposal to **suspend vaccination** against foot-and-mouth disease throughout Brazil, **starting in 2019**

- Currently, Brazil has only one state free of FMD without vaccination: Santa Catarina (since 2007)

FMD is an important issue for Brazil → THIS PAPER → Analyzes the movement of animals in Mato Grosso do Sul (Brazil) and simulates outbreak scenarios, in order to highlight the relevance of sanitary crises

2) Data and Methods

- **Data:** Animal Traffic Guides (Guias de Trânsito Animal - GTAs)
  - **Official control** data of animal movements in Brazil
  - We considered: **bovine** animals in Mato Grosso do Sul
  - **Daily** registers of animal movements with information about:
    - municipality of origin and destiny of the animals transported inside the state (79 municipalities)
    - number of animals moved
    - purpose of transporting animals, i.e: to slaughterhouses, replacement, events
  - Base year: 2015 (416,743 cattle movement records)

Limitations:

1) Disaggregated data at the property level were not made available by the government;
2) No information about animals imported from other states or countries;
3) It is known that official databases do not cover 100% of the flow of animals within the country. However, there are no means to trace unreported movements nowadays.

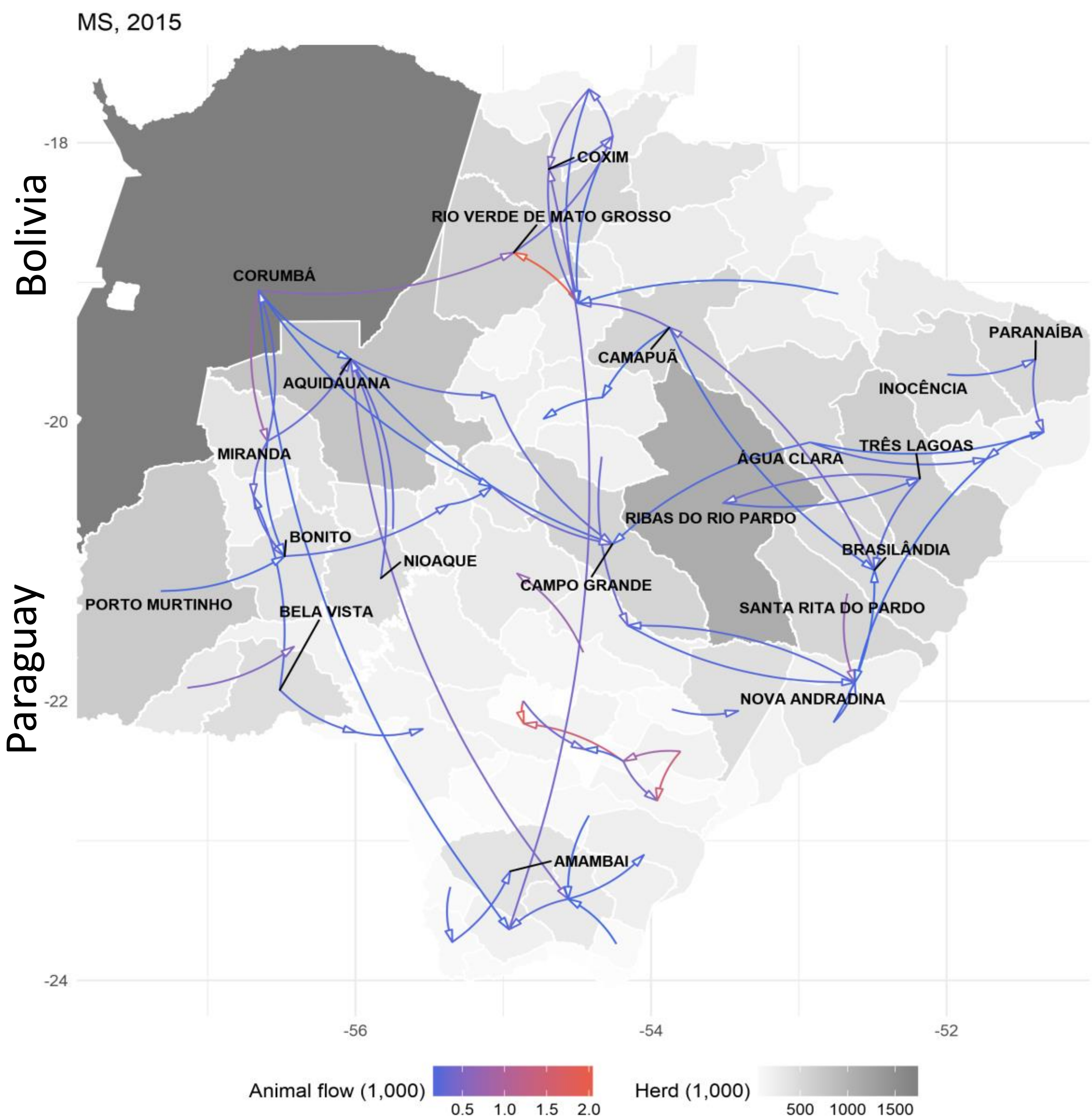
2) Data and Methods

- **Methods:** socioeconomic network analysis to examine cattle movements in MS
  - **Node:** actor of the network ➡ municipality
  - **Link:** relation or bond between two actors ➡ animal movement
  - weighted by the number of animals moved
- **R software:** compile the animal flows; build the daily networks and their descriptive analysis; simulations of outbreaks

Limitations:

1) Transit between states, inward and outward MS, was excluded from the analysis of the animal movement networks;
2) Considers only bovine animals;
3) Exploratory analysis: nonparametric simulations - constructed only with animal movement data

3) Data analysis: Cattle raising in Mato Grosso do Sul and animal movement networks



- High concentration of FMD susceptible animals in the international border;
- Minority of nodes with many connections;
- Greater heterogeneity in animal input than in output measurements;
- Process of "supply" that preceded more intense movements between central municipalities.

Fig. 1 Representation of daily cattle movement networks in MS: 2015

Source: Elaborated from GTAs and IBGE (2017)

3) Data analysis: Cattle raising in Mato Grosso do Sul and animal movement networks

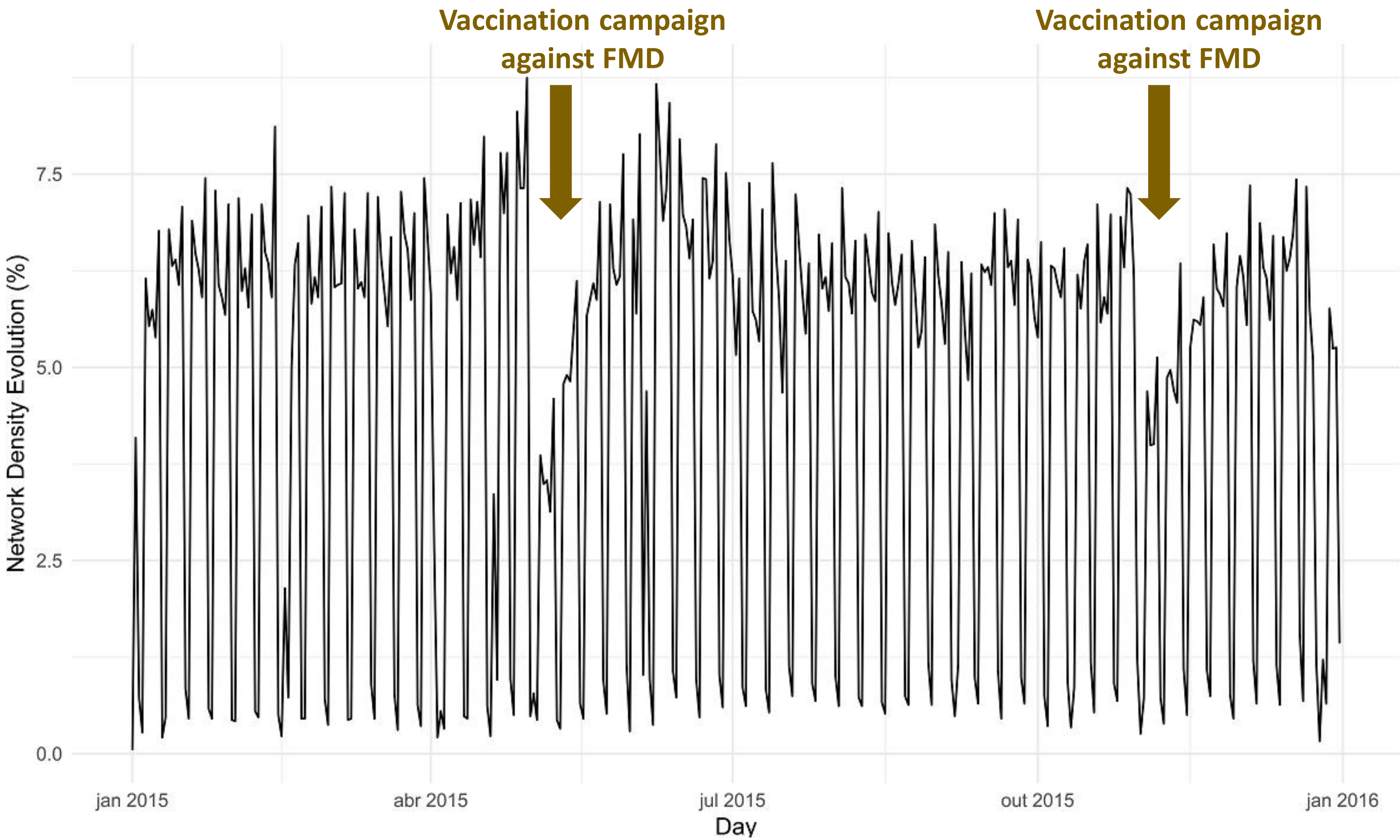


Fig. 2 Temporal evolution of cattle movement networks density in MS: 2015

Source: Elaborated from GTAs

4) Simulations: Potential impacts of an eventual FMD outbreak in Mato Grosso do Sul

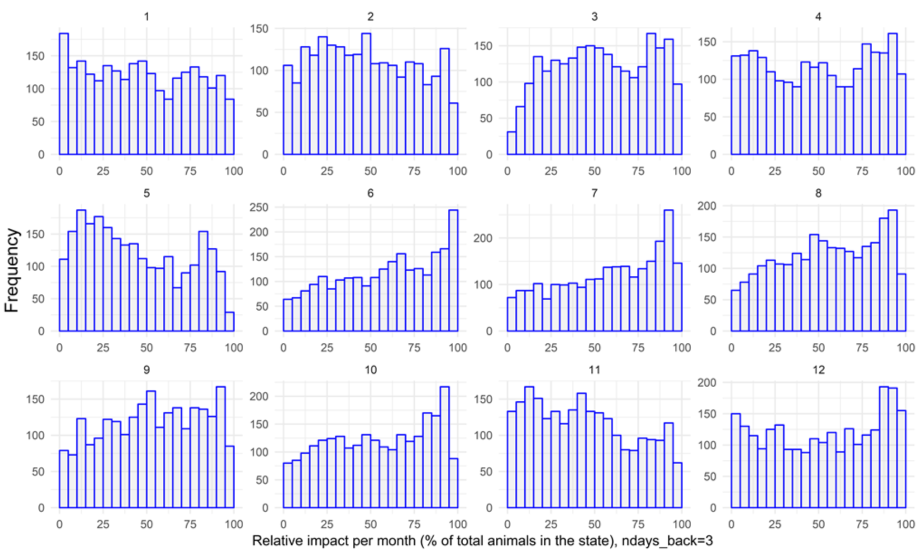


Fig. 3 Simulation of the percentage of affected animals per month in the presence of an FMD outbreak: MS, 2015. Scenario: **3 days of lag**
Source: Elaborated from GTAs

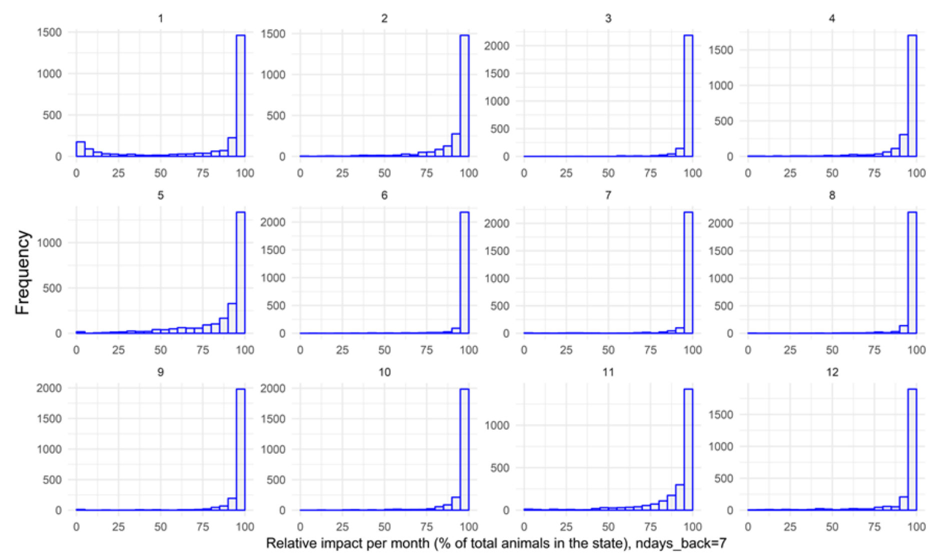


Fig. 4 Simulation of the percentage of affected animals per month in the presence of an FMD outbreak: MS, 2015. Scenario: **7 days of lag**
Source: Elaborated from GTAs

Limitation: Overestimation of outbreak size

4) Simulations: Potential impacts of an eventual FMD outbreak in Mato Grosso do Sul

Central node

Peripheral node

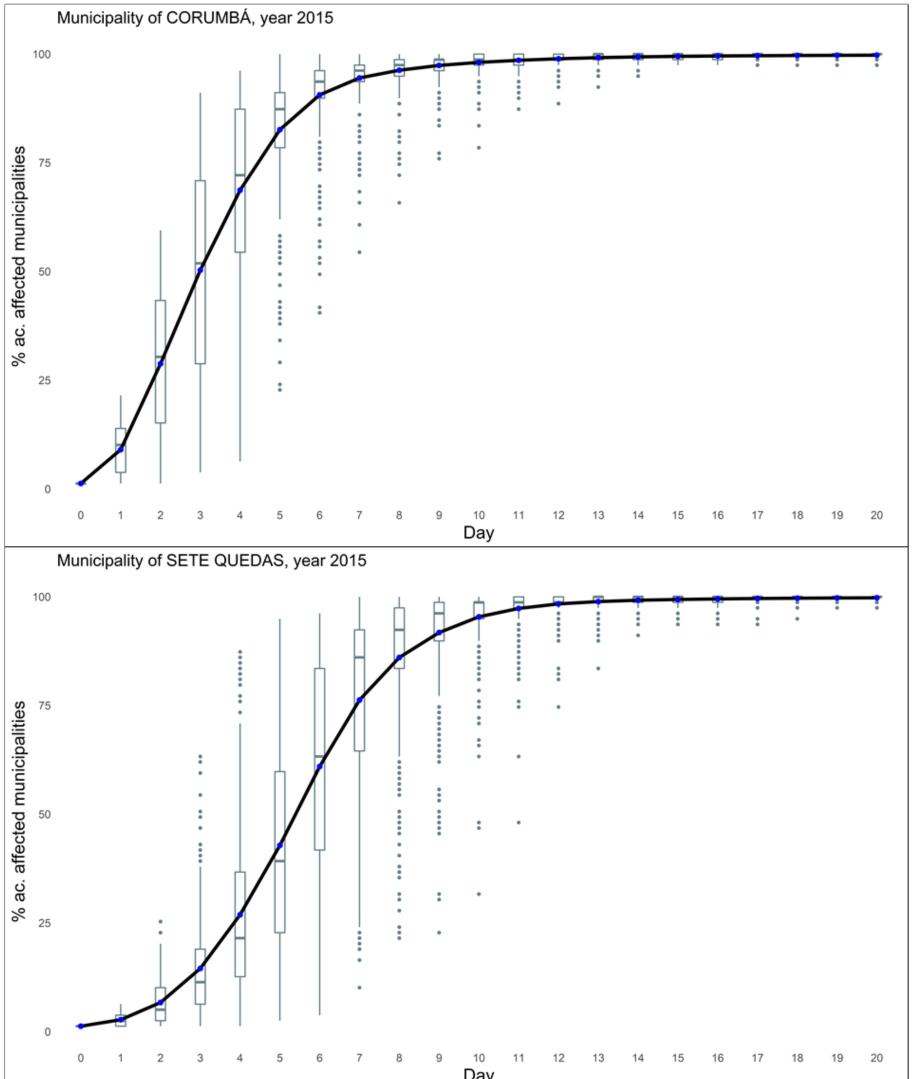


Fig. 5 Annual diffusion curves in MS for simulations of outbreaks initiated in Corumbá and Sete Quedas: 2015
Source: Elaborated from GTAs

Hypotheses:

i) In a dense network, the spread of disease is easier and faster;

ii) All animals are 100% likely to become infected from contact with an animal carrying the virus;

iii) A central position increases the chance of infection;

iv) The diffusion from a central node is faster than from a peripheral one.

5) Final comments

- This nonparametric exercise demonstrated the need and importance of investing in animal health services, health education of producers and equipment and technologies that help in the early detection, diagnosis and eradication of outbreaks in a fast and efficient way, in case of reintroduction of the virus, thus preventing the outbreak from spreading to many regions.

- **Next steps:** consider other factors to evaluate the disease dissemination in a more robust model, such as: quantity of animals crossing the borders; density of animals; the rate of transmission; the effective vaccination ratio; and the effectiveness of the sanitary monitoring.

- **Problem:** there is not much epidemiological data on foot-and-mouth disease for Brazil

- This paper is derived from a master's thesis and served as a pilot for a larger research project covering all Brazilian states.
- In general, there are no papers like this for Brazil.

Any ideas that might contribute to our paper and any tips to ease our limitations are welcome!

Network analysis of cattle movement in Mato Grosso do Sul (Brazil) and implications for FMD outbreaks

Taís C. de Menezes*, Ivette Luna, Sílvia H. G. de Miranda

***taismenezes@usp.br**

ISESSAAH 2019 Conference
Atlanta, USA
July 20, 2019

An Economic Impact Assessment of Foot and Mouth Disease (FMD): Vaccination in 6 month Vs Vaccination in 4 month intervals

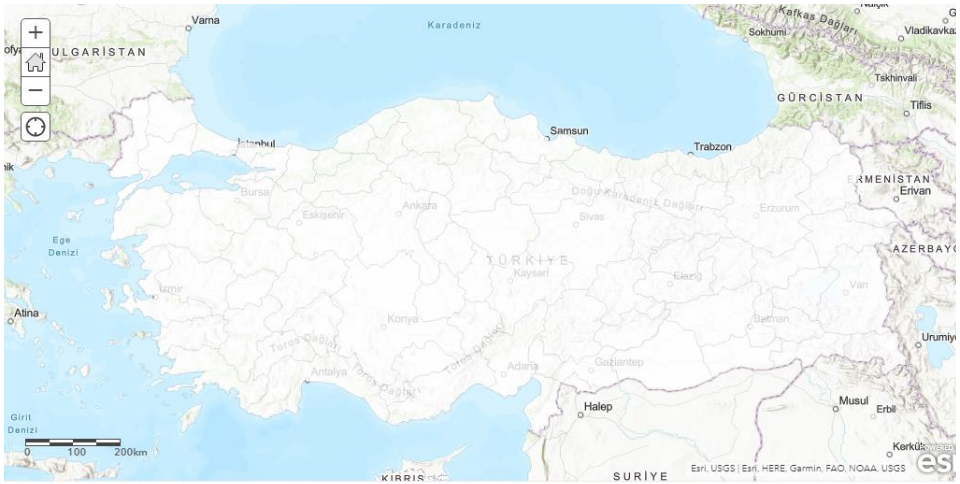
Nursen Ozturk[1], Rafael De Olieviera[2], Bouda Vosough Ahmadi[3]

[1]Istanbul University-Cerrahpasa, The Faculty of Veterinary Medicine, The Department of Animal Breeding and Husbandry

[2] Global Academy of Agriculture and Food Security, The University of Edinburgh, Midlothian, Edinburgh, UK

[3] European Commission for the Control of Foot-and-Mouth Disease, Food and Agriculture Organization of the United Nations.

Introduction: FMD in TURKEY



✓FMD is an endemic disease in Turkey

✓Controlling the disease and reducing the risks to the neighbouring countries and the EU

✓Collaborating with EU since 1960s

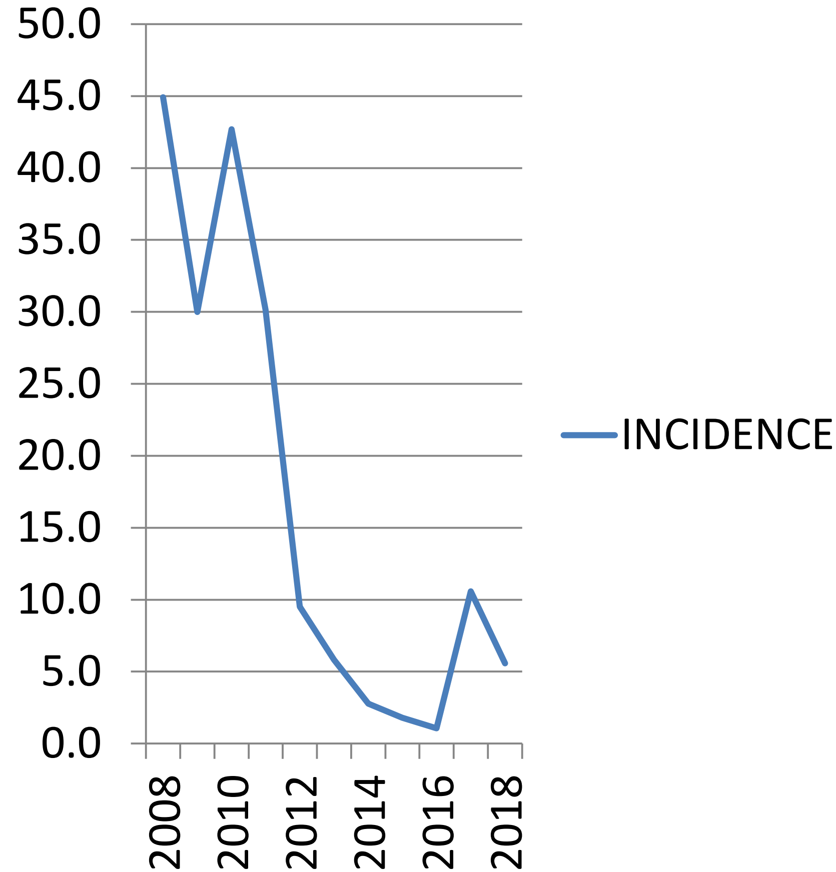
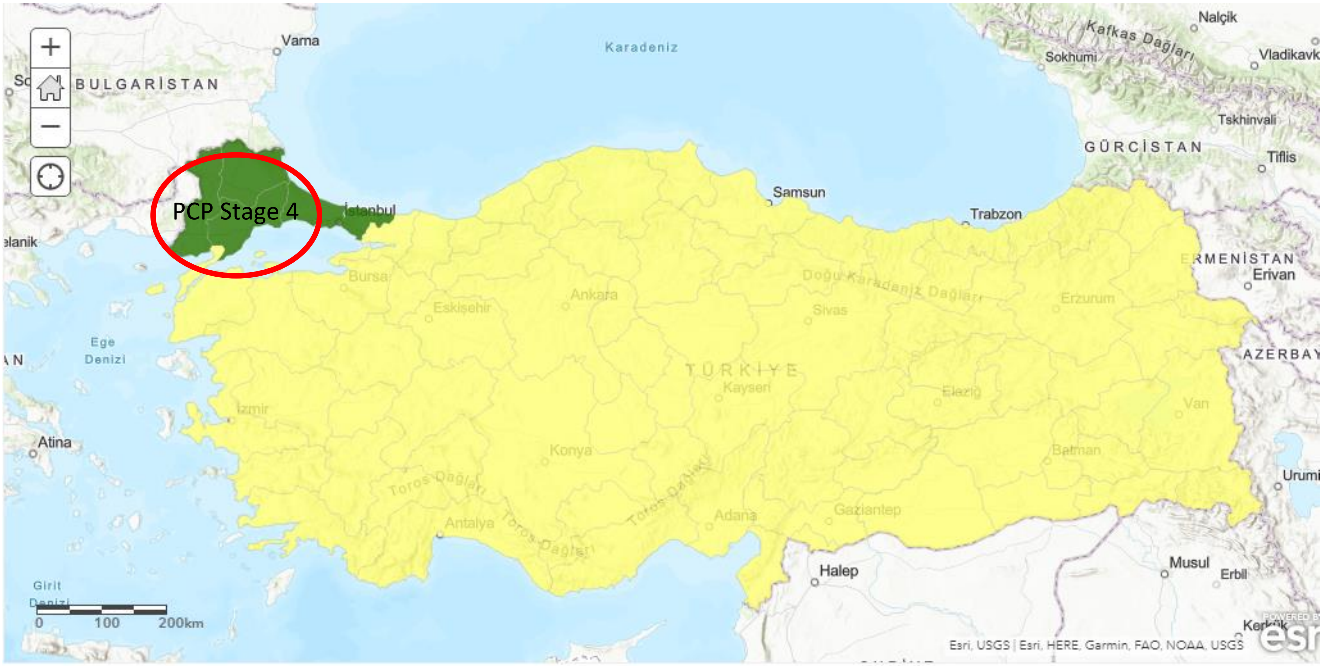


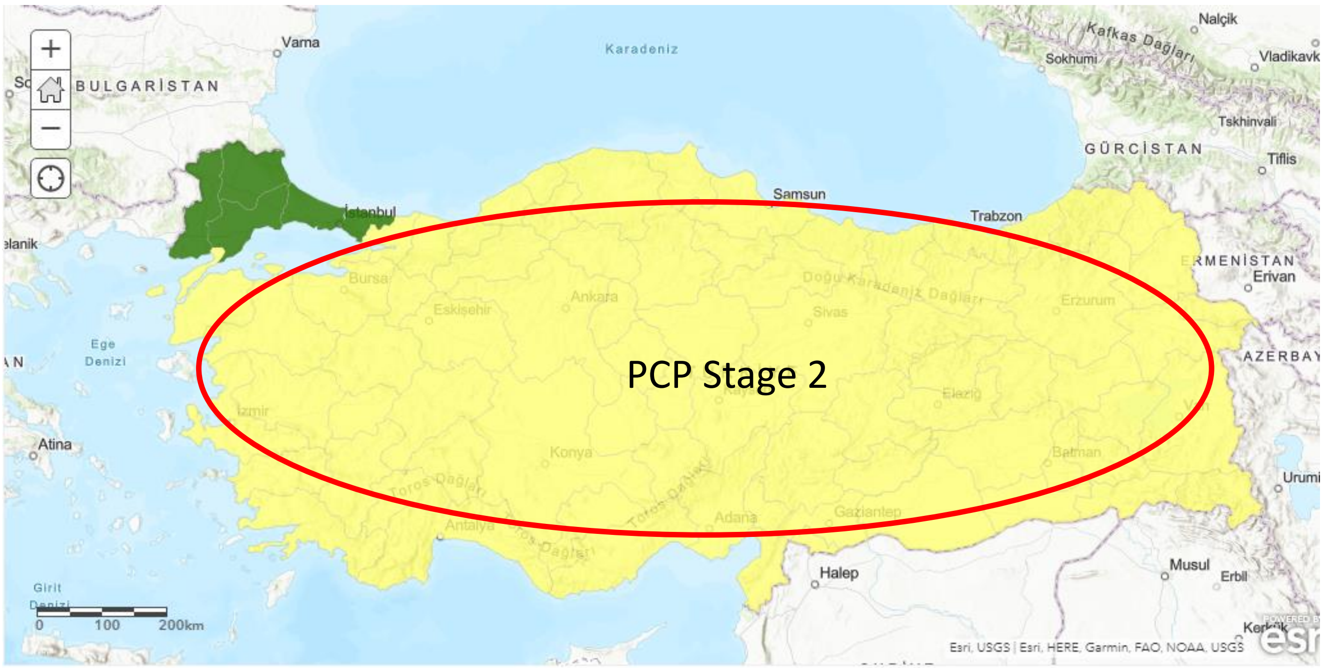
Figure 1: FMD incidence change between 2008 and 2018

Introduction: FMD in TURKEY



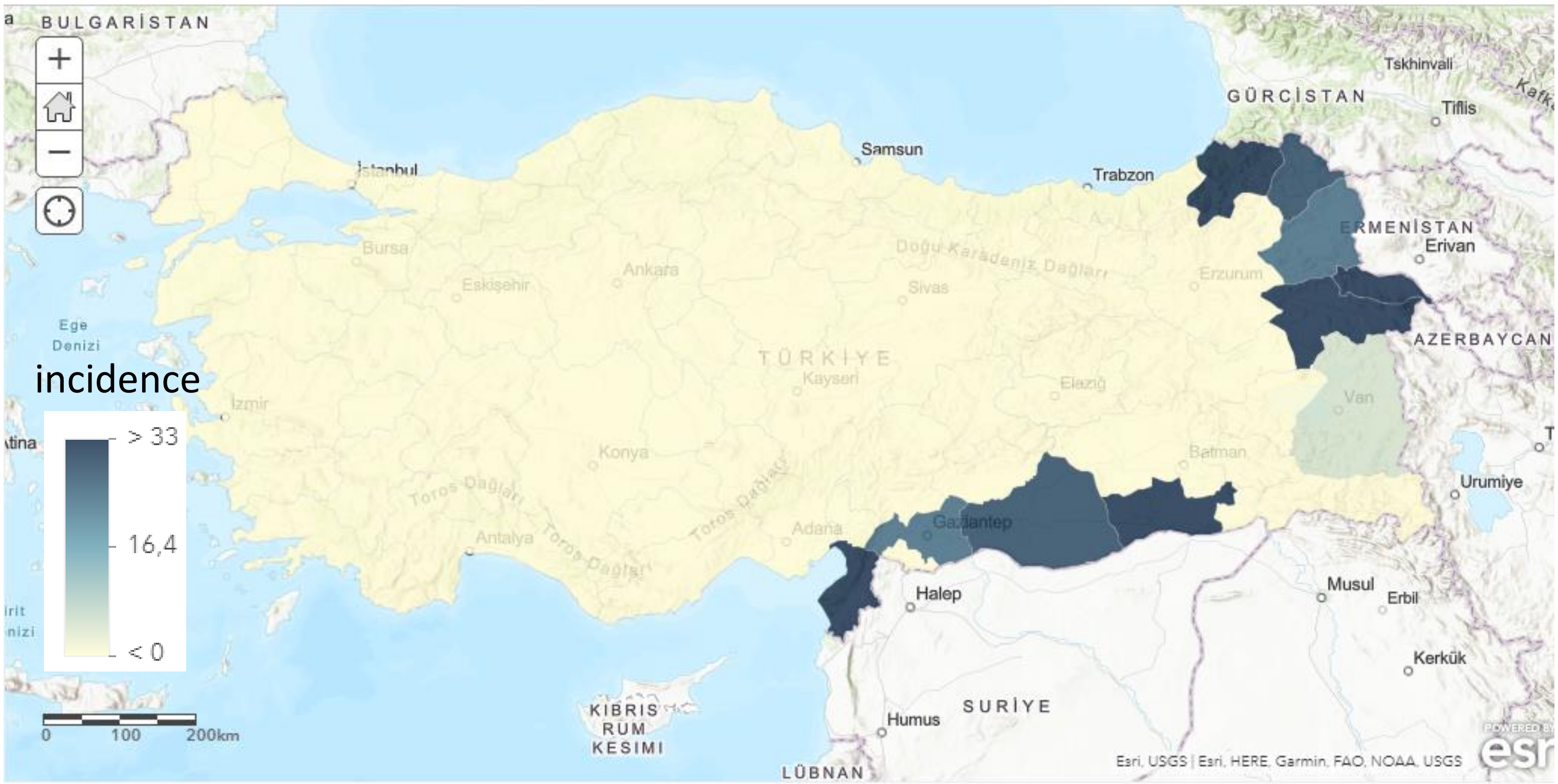
✓Current PCP: Thrace is at PCP Stage 4 while rest of Anatolia is at PCP stage 2
✓Aiming to proceed to PCP Stage 4 until 2023

Introduction: FMD in TURKEY



✓Current PCP: Thrace is at PCP Stage 4 while rest of Anatolia is at PCP stage 2
✓Aiming to proceed to PCP Stage 4 until 2023

Research question: comparing financial impacts of two vaccination strategies (6m. vs 4m. intervals)



✓Chalanges: animal movements, common grazing, and wild life

Material & Method

- Partial budget analysis
  - Additional return: Weight gain by healthy animal
  - Reduced costs: Cost of disease treatment, cost of weight loss, cost of replacement
  - Return forgone: not considered
  - Additional costs: Vaccination cost, additional feed cost for healthy animal, additional vet costs for healthy animal

Epidemiological data: Obtained from OIE WAHIS SYSTEM

Disease data: Obtained from expert survey

Financial data: Market values

Table 1. Input parameters that were used in partial budget analysis

	Baseline (6M)	Scenario (4M)
FMD incidence, %	12.4	0
min	1.1	
max	32.8	
Morbidity rate, %	60.0	0
min	42.2	
max	76.2	
Mortality rate, %	1.4	0
min	0.0	
max	6.4	
Weight loss when infected, %	25	0
Average duration of illness, d	13.3	0
Average value per cow, USD	1384.5	1384.5
Value of live weight, USD	3.4	3.4
Cost of FMD treatment, USD	97.5	0
Cost of FMD vaccination, USD	2	3
Cost of feed, USD	2.5	2.5
Cost of veterinary services, USD	0.2	0.2

Results

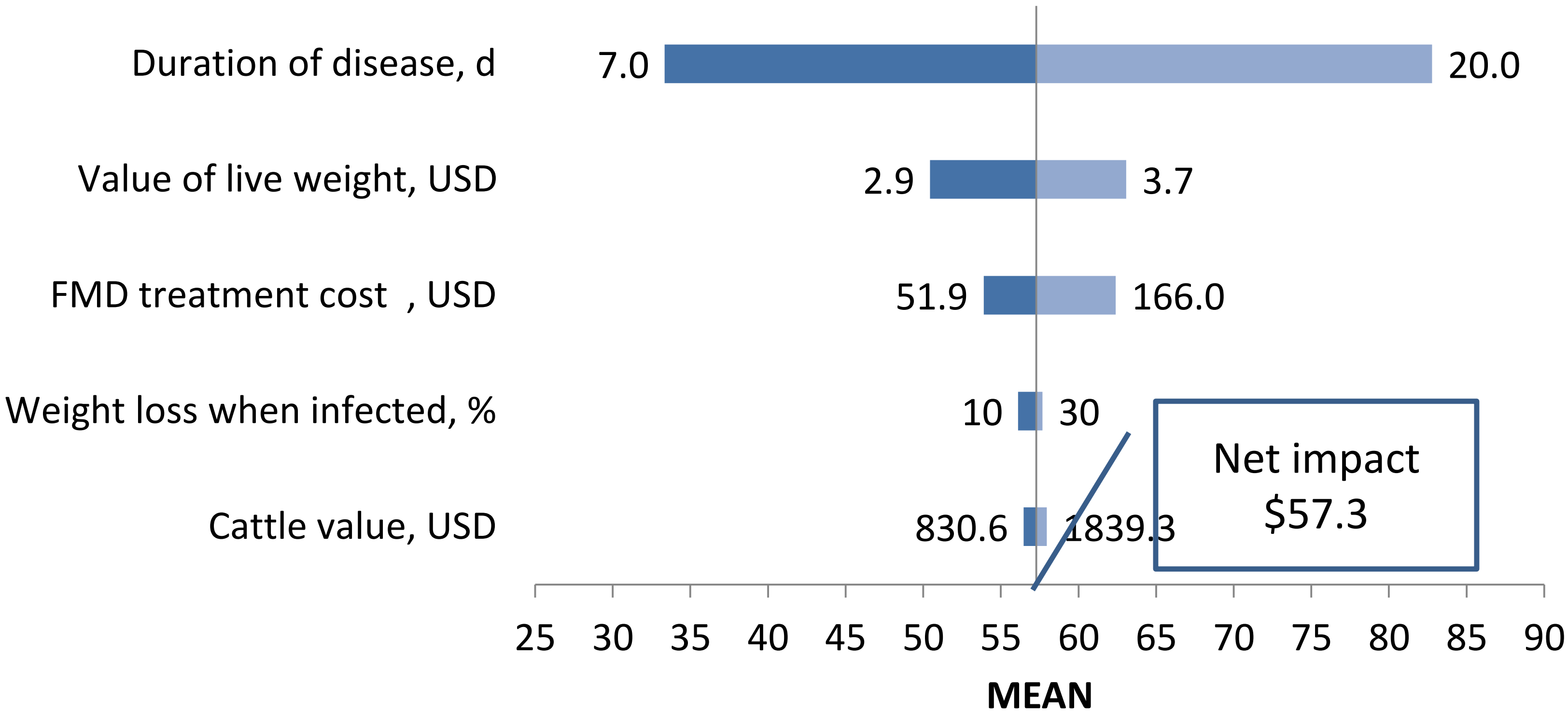


Figure 1. Changes in partial budget analysis of vaccination in 4m strategy results by applying minimum, most likely and maximum input values

Results

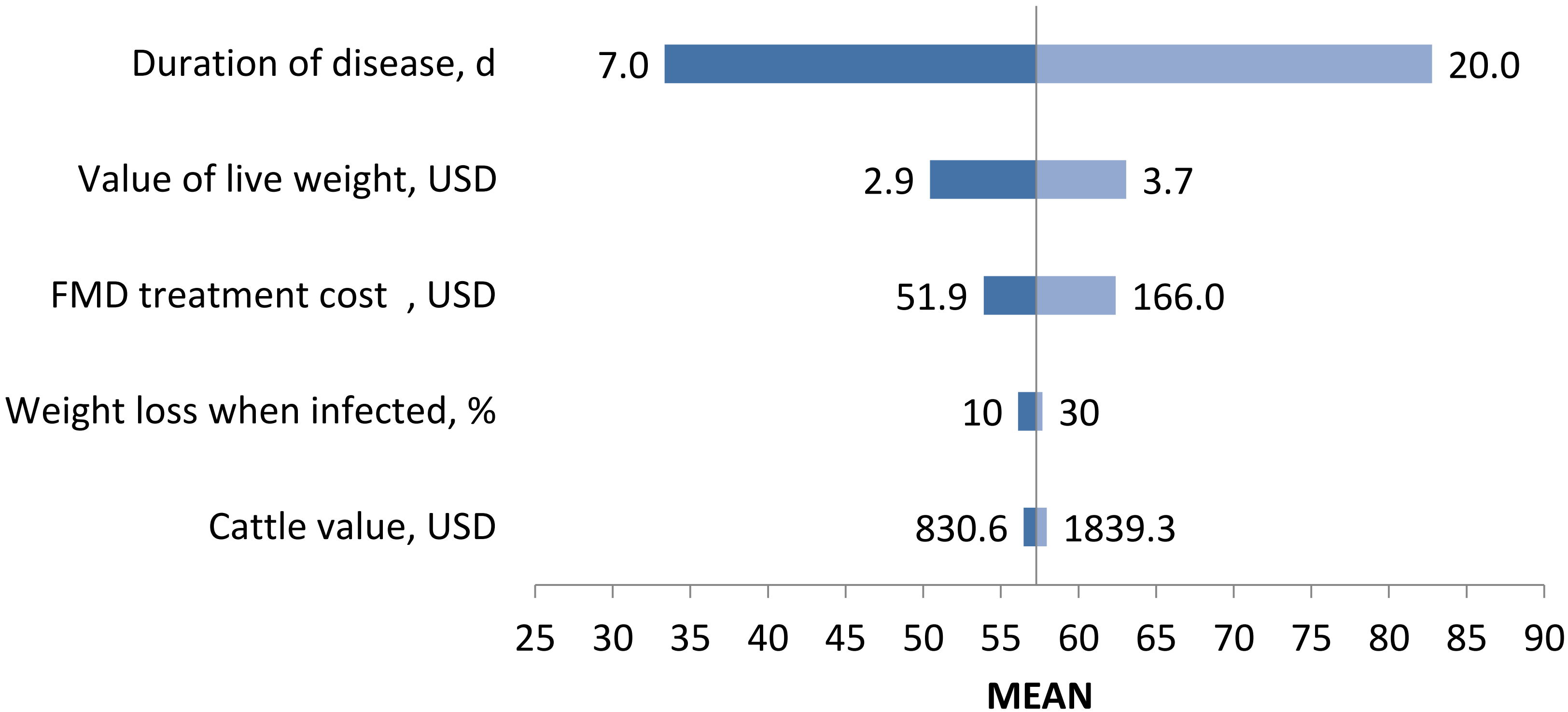


Figure 2. Changes in partial budget analysis of vaccination in 4m strategy results by applying minimum, most likely and maximum input values

Results

Table 2. Sensitivity analysis of annual FMD disease incidence

Variable	**Value**	**Net impact of PB (USD)**
FMD incidence (Baseline)	0.12	57.3
Lower incidence estimation	0.05	53.8
Upper incidence estimation	0.50	74.4

Results

Table 3. Gain , loss, and net impact from partial budget analysis of vaccination in four months strategy compared with baseline strategy of six months intervals reported per each border cities in 2018

City	Gain (USD)	Cost (USD)	Net impact (USD)
Agri	1,121,542	50,492	1,071,050
Ardahan	156,115	8,300	147,814
Artvin	265,772	33,584	232,188
Gaziantep	203,939	12,425	191,513
Hatay	241,381	18,562	222,819
Igdir	356,876	16,553	340,323
Kars	210,871	11,346	199,525
Mardin	205,406	26,005	179,401
Sanliurfa	289,005	15,257	273,748
Van	18,991	1,070	17,921
TOTAL	3,069,897	193,594	2,876,303

Conclusion

- Partial budget analysis is a useful tool to see the net impact of implementing alternative control scenarios.
- Purposed scenario for the border regions was financially profitable.
- Further studies are needed which includes dynamic modeling in order to assess the bio-economic impact of virus spread considering alternative control strategies.

Thank you for your attention

nursen.dogan@istanbul.edu.tr

Annex. 1 Reported disease parameters for border cities in Turkey by World Organization for Animal Health (OIE) in 2018

City	Suscep.	Cases	Deaths	Killed and disposed	Slaugh.	Incidence (%)	Mortality (%)
Agri	235	50	0	0	0	21.3	0.0
Ardahan	1680	99	0	0	0	5.9	0.0
Artvin	67	22	2	0	0	32.8	3.0
Gaziantep	5764	274	86	4	1	4.8	1.6
Hatay	362	42	6	0	4	11.6	2.8
Igdir	682	125	0	0	0	18.3	0.0
Kars	1208	59	0	0	0	4.9	0.0
Mardin	47	8	3	0	0	17.0	6.4
Sanliurfa	354	23	0	0	0	6.5	0.0
Van	6573	71	0	0	0	1.1	0.0

Source: World Animal Health Information System (WAHIS), 2018 country report

Financial impacts of liver fluke on dairy farms under climate change - a farm level approach

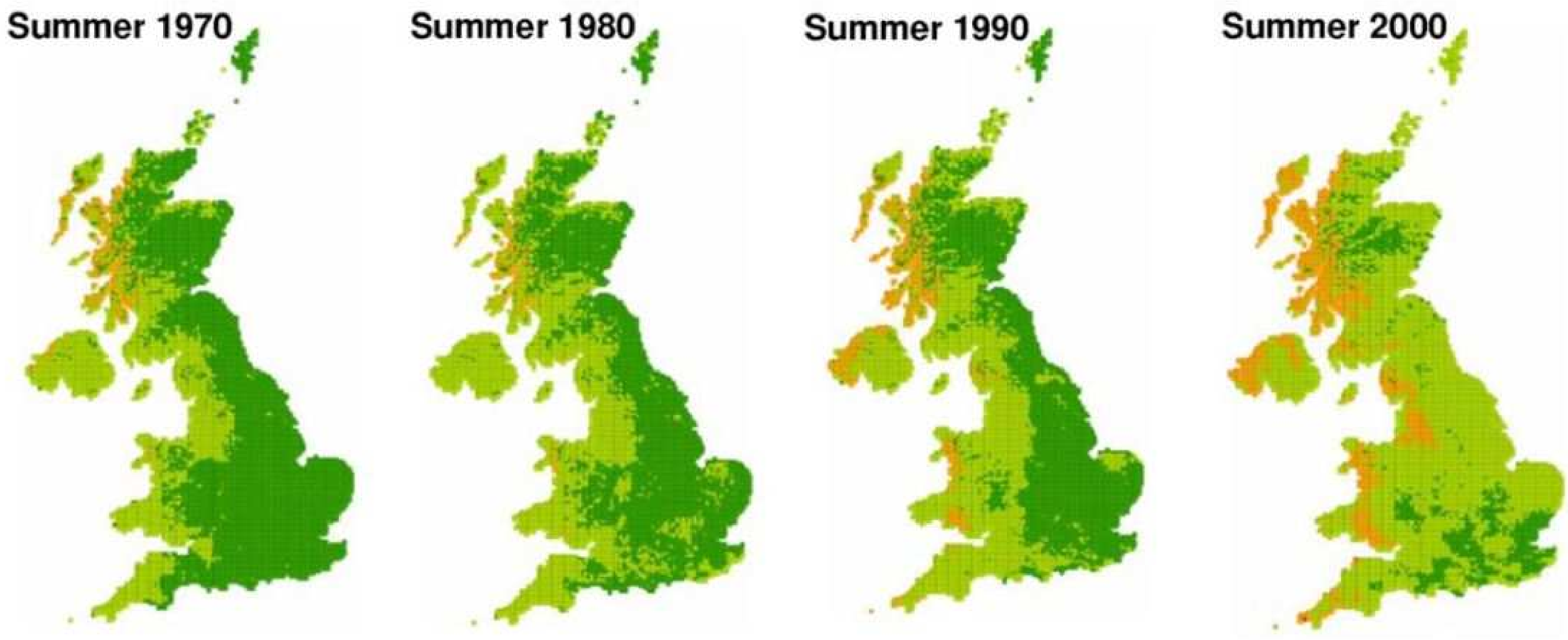
Shailesh Shrestha[1], Alyson Barratt[1], Naomi Fox[2], Bouda Vosough Ahmadi[3] and Mike Hutchings[2]
[1] Department of Rural Economy, Environment and Society, SRUC
[2] Animal and Veterinary Sciences, SRUC
[3] EU-FMD, FAO, Rome

Leading the way in Agriculture and Rural Research, Education and Consulting

Introduction

- Liver fluke has an economic consequence on livestock sector
- Estimated to cost an average UK dairy farm at around $5k to $7k per year
- Incidence of liver fluke has increased over the last few decades

Incidence of LF

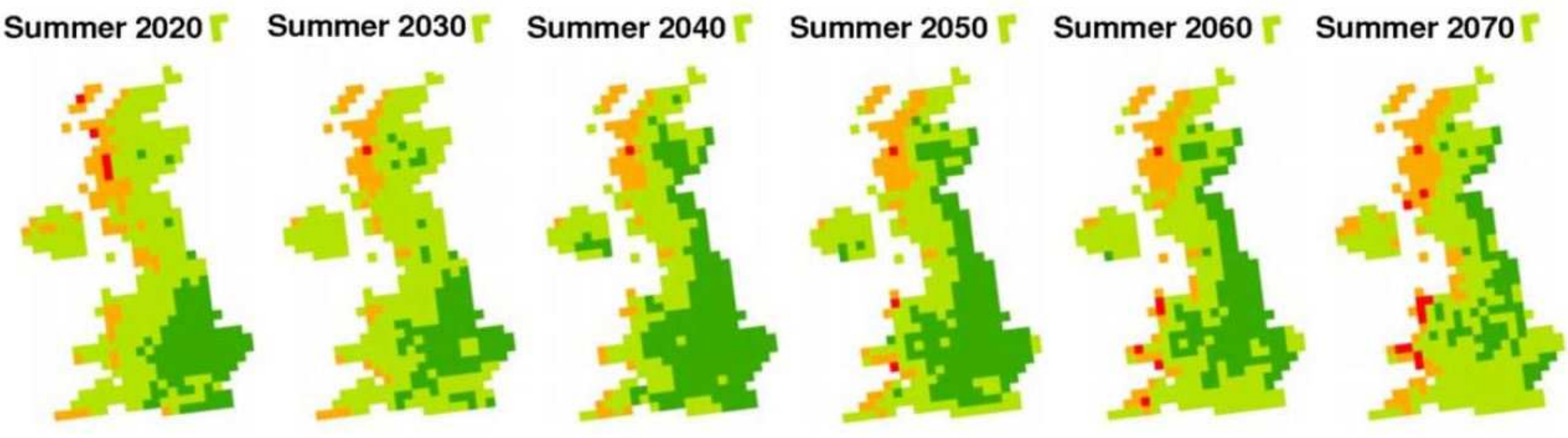


Fox et al., 2011

Introduction

- Liver fluke has an economic consequence on livestock sector
- Estimated to cost an average UK dairy farm at around $5k to $7k per year
- Incidence of liver fluke has increased over the last few decades
- Expected to increase incidence and frequency in future - CC

Incidence of LF



Fox et al., 2011

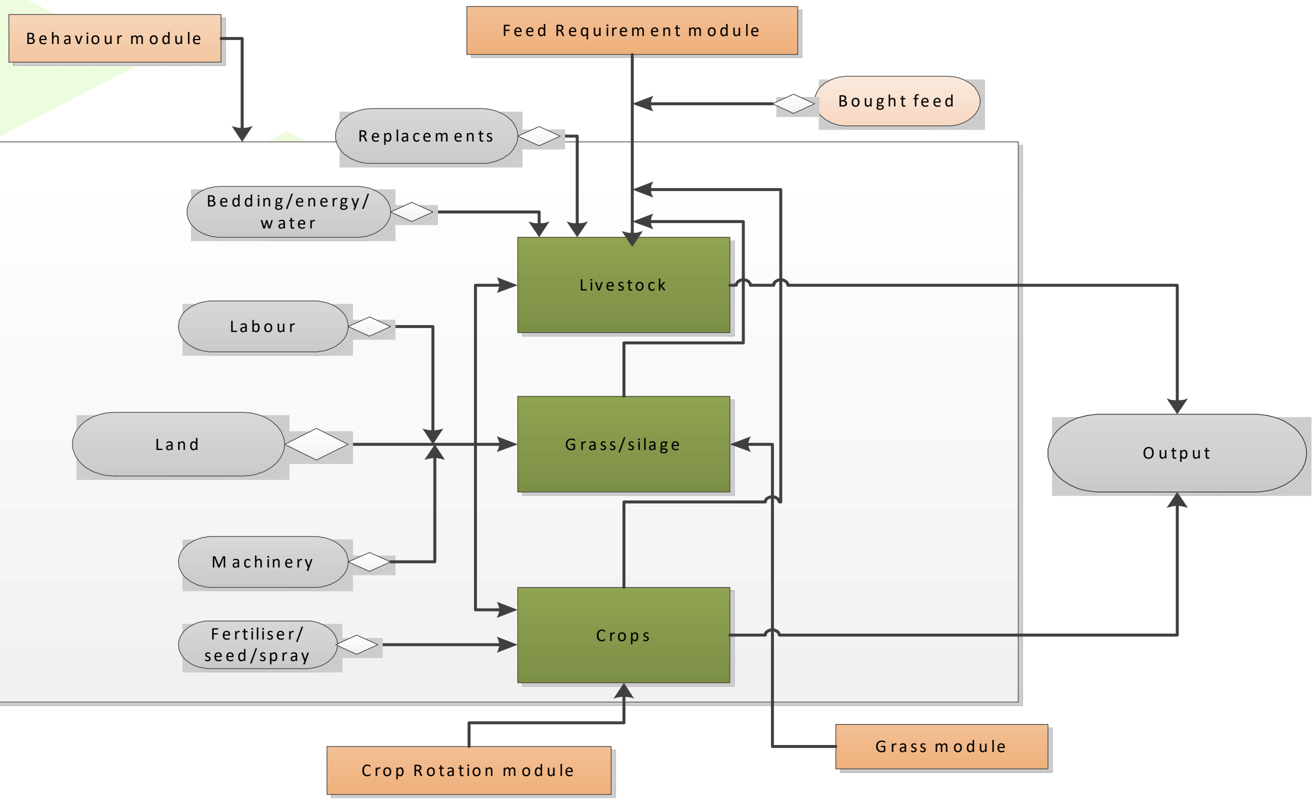
Use of farm level model

- Takes account of whole farming system
- Disease impact + farm management changes
- Optimising farm profits
- Use of biosecurity, prevention, control and treatments choices
- Multiple-disease impacts can be analysed

ScotFarm

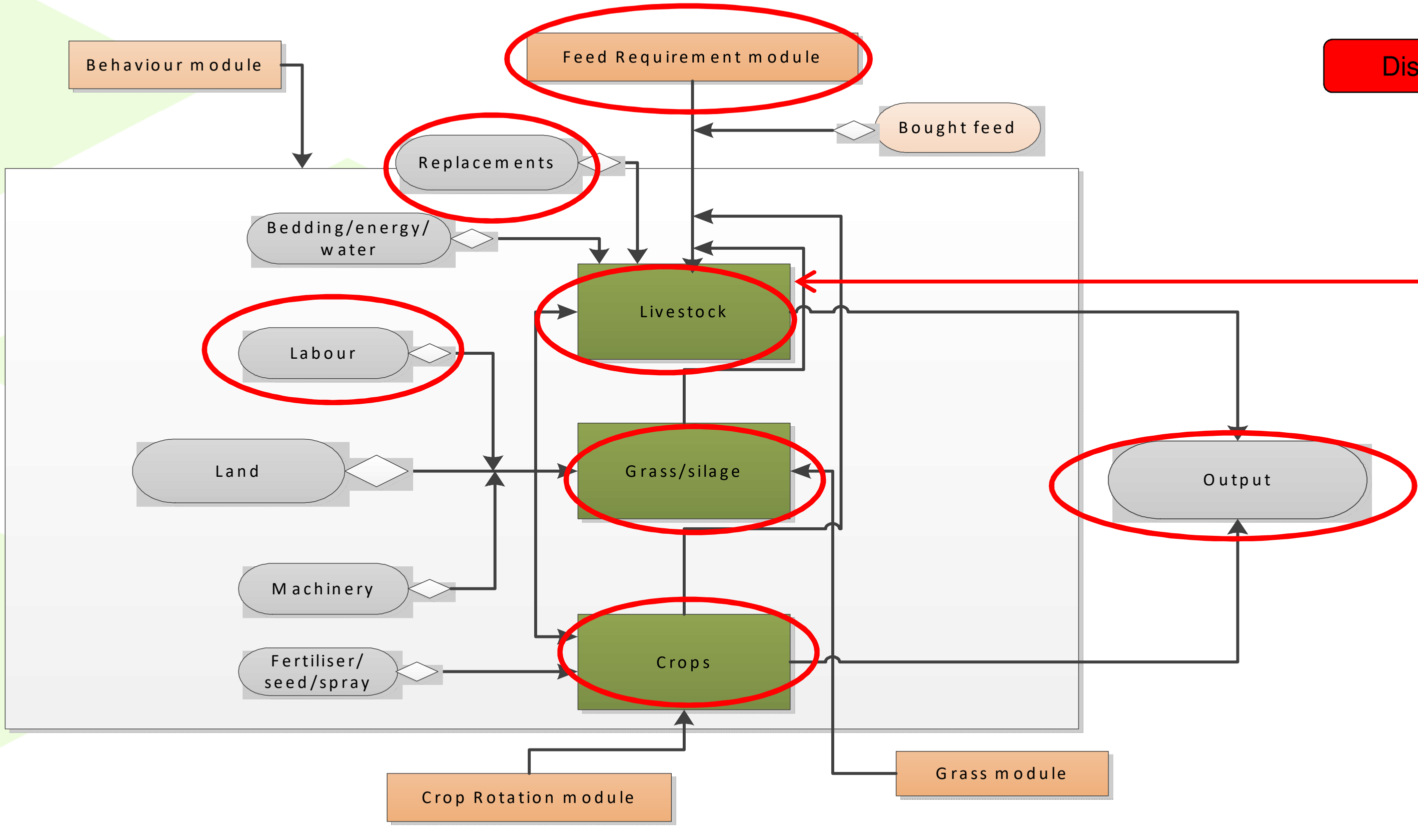
- Based on farming system analysis and LP technique of optimisation
- Maximises farm profit within a set of limiting farm resources
- Represents existing farm practices but flexible to move in selecting farm activities
- Dynamic – herd dynamics, farmers' decisions

ScotFarm



Behaviour module
Feed Requirement module
Bought feed
Replacements
Bedding/energy/ water
Livestock
Labour
Land
Grass/silage
Output
Machinery
Fertiliser/ seed/spray
Crops
Crop Rotation module
Grass module

ScotFarm


Behaviour module
Feed Requirement module
Disease
Bought feed
Replacements
Bedding/energy/ water
Livestock
Labour
Land
Grass/silage
Output
Machinery
Fertiliser/ seed/spray
Crops
Crop Rotation module
Grass module

Data

- Farm level data
  - Farm Business Survey 2016
  - 50 dairy farms
- Disease data
  - Partial Budget Epidemiological model
- Climate change data
  - Disease prevalence – Ollerenshaw index
  - Grass production – SPACSYS model
  - Heat stress – MACSUR EU project

Disease impact

- Production
- Culling rate
- Variable costs
- Reproduction
- Feed and labour

CC impact

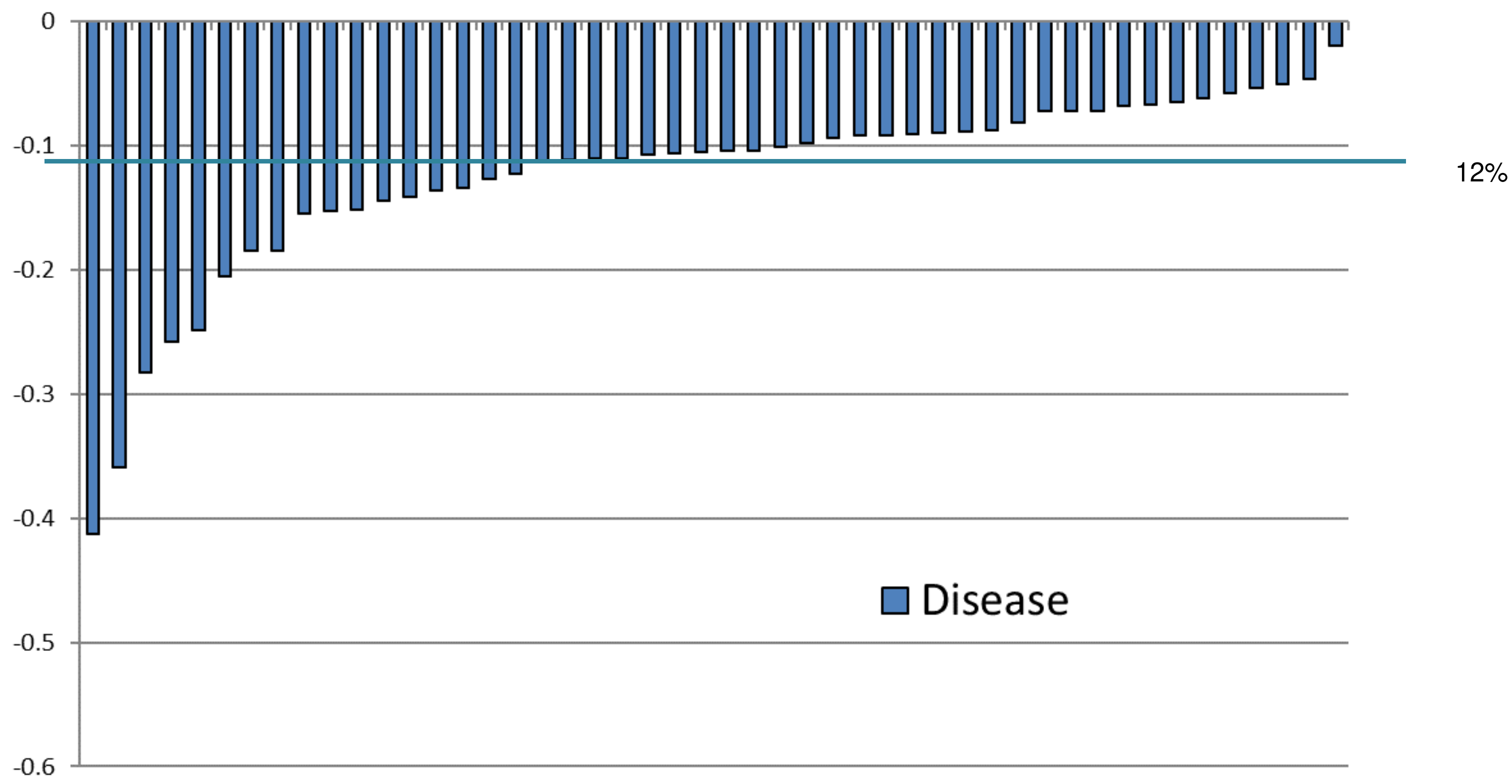
- Disease prevalence
- Grass production
- Heat stress
  - Production
  - Variable costs

Scenarios

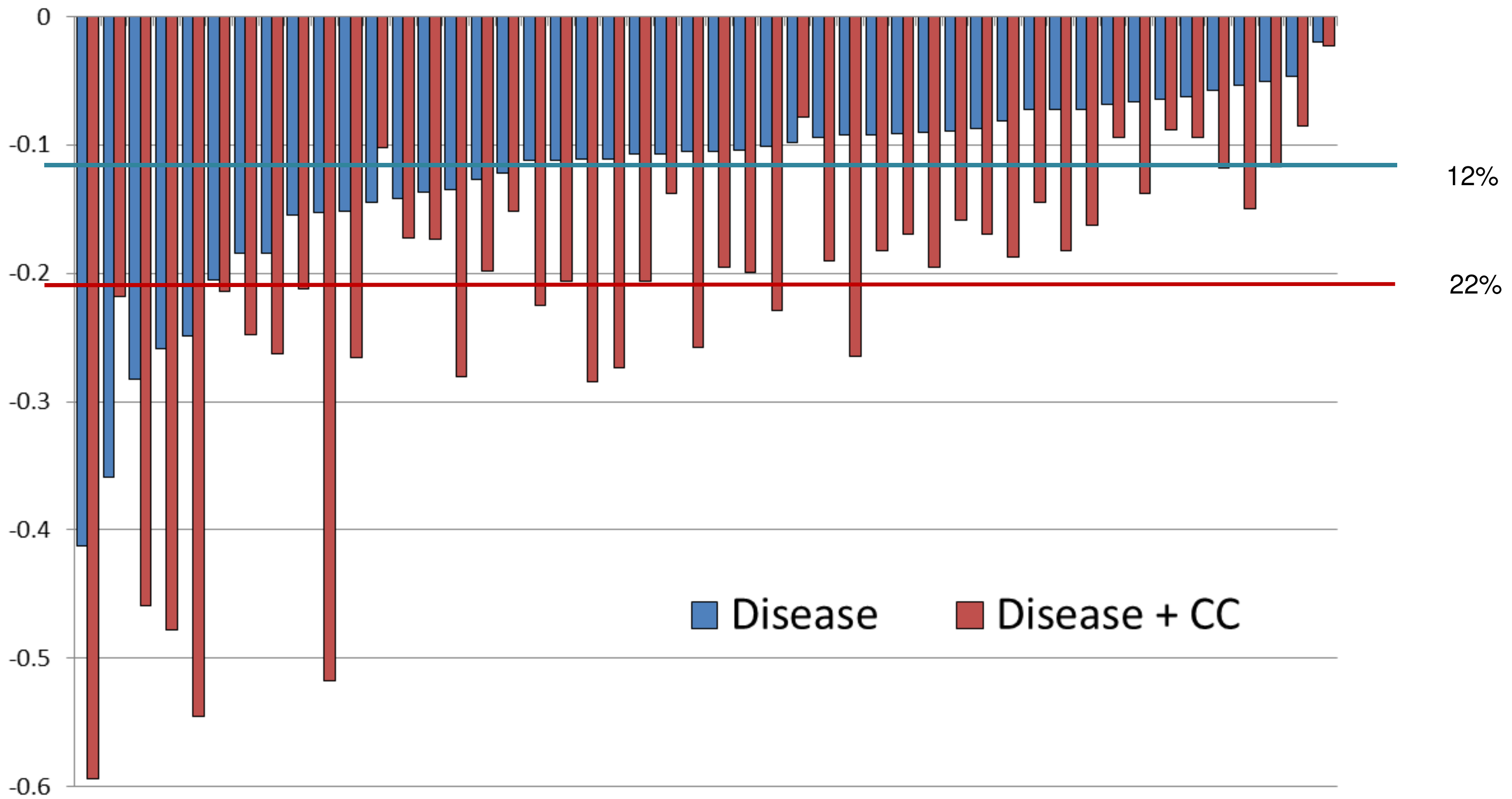
- Baseline – current conditions
- Disease –
  - Prevalence 19.5%
  - Production loss 7%
  - Culling rate 5%
  - Costs 19%

- Disease + CC
  - Prevalence 50%
  - Production loss 7%
  - Grass production 25%
  - Costs 29%

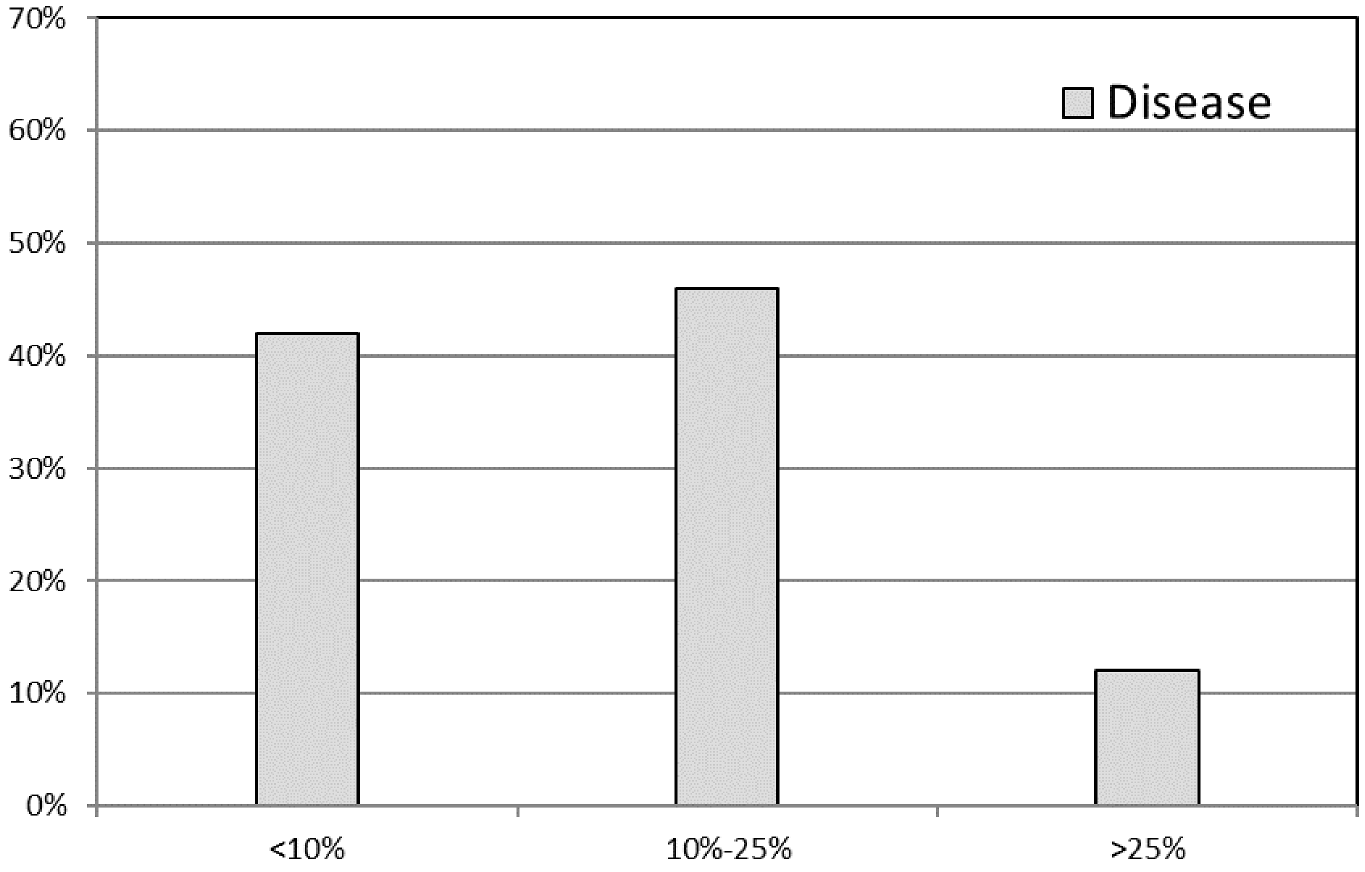
Results (Farm profits)



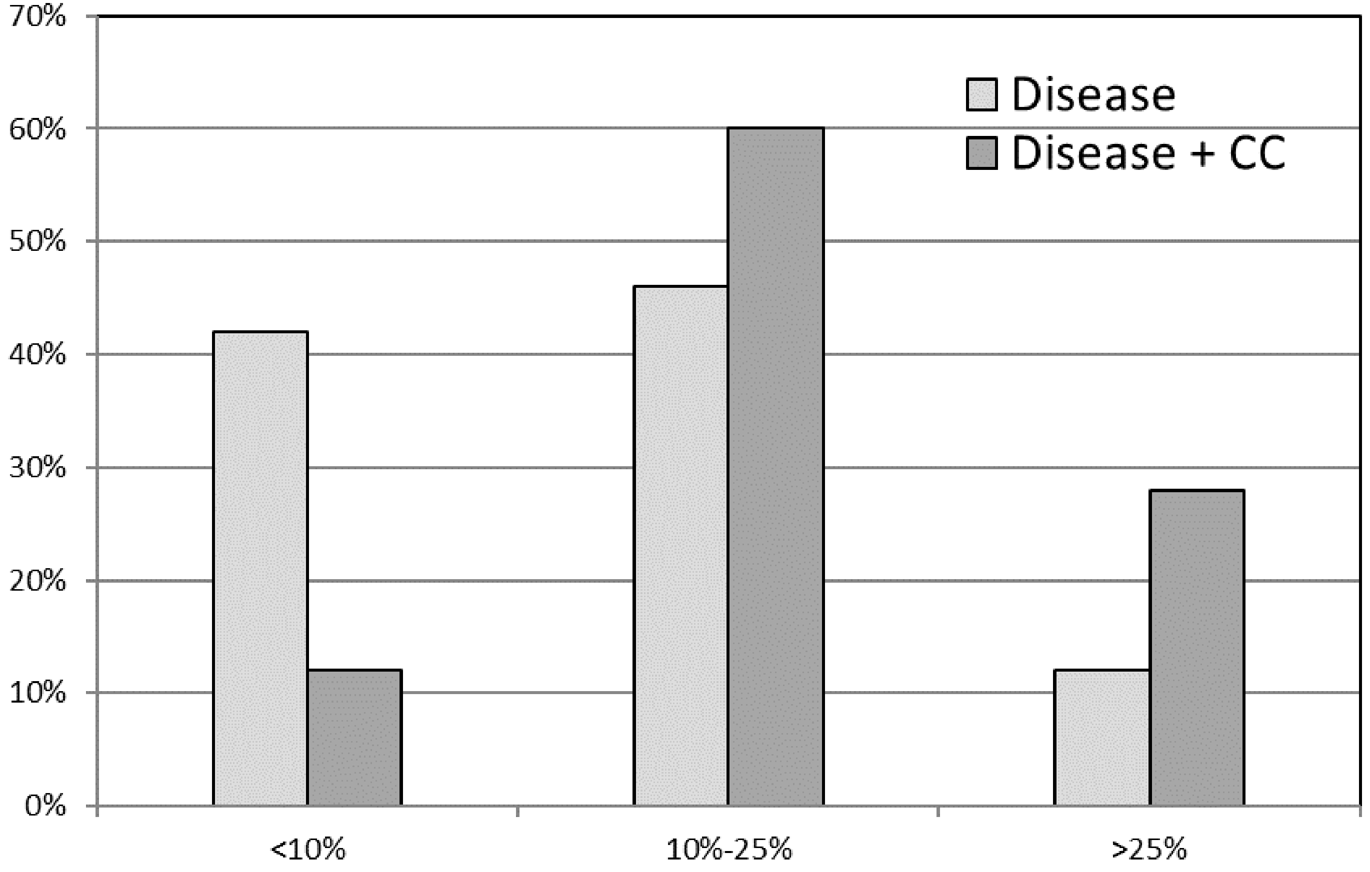
Results (Farm profits)



Results (Profits)



Results (Profits)



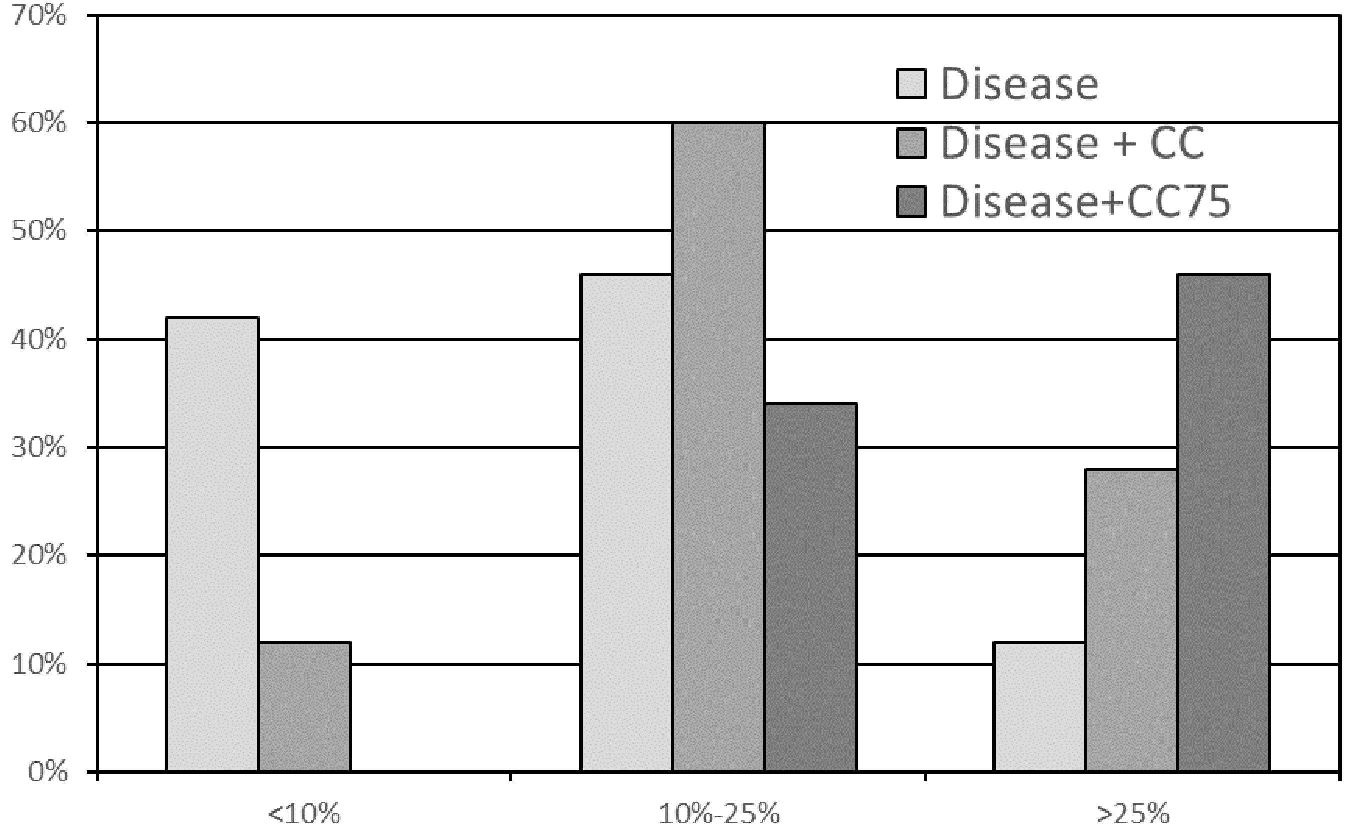
Uncertainties

- Prevalence
- Costs
- Production

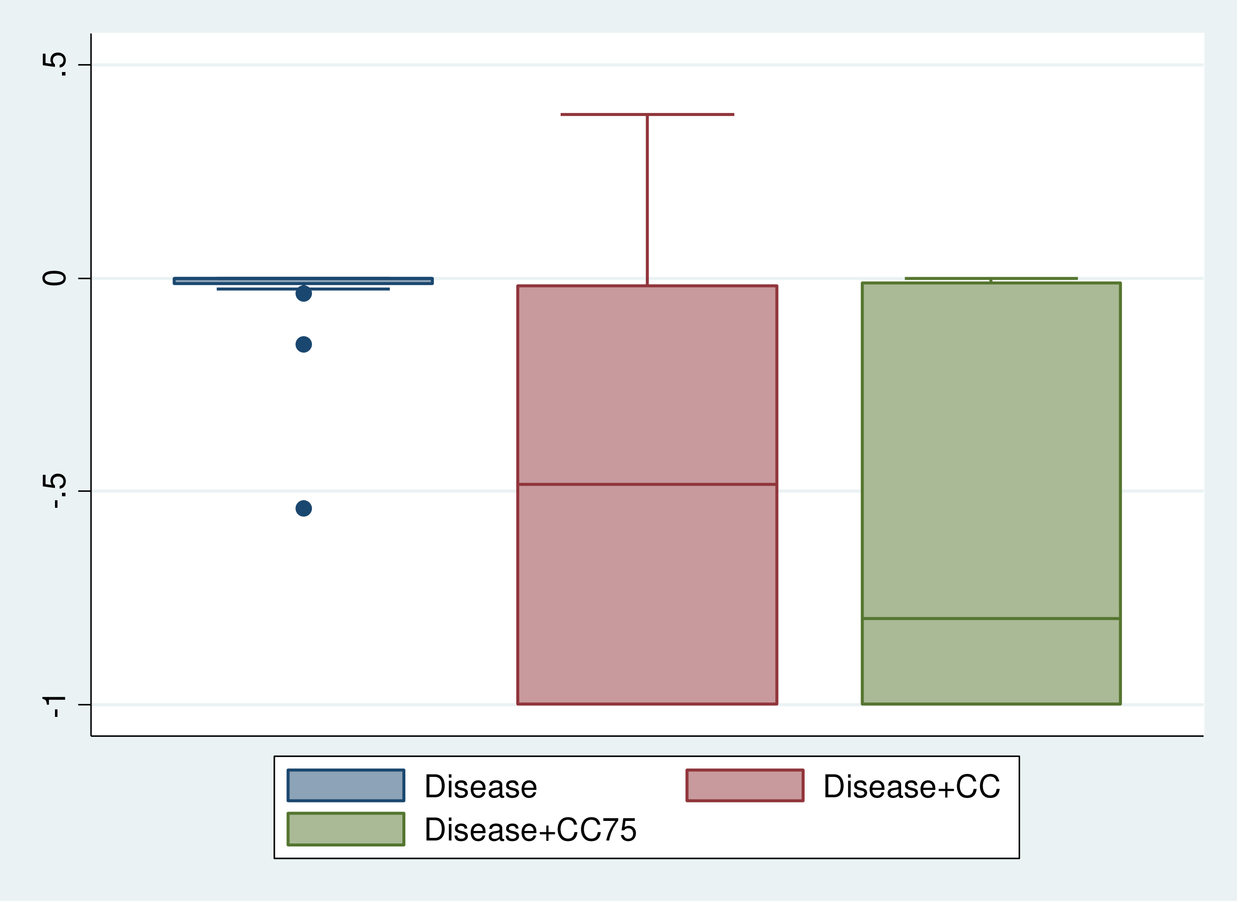
Uncertainties

- Prevalence : 25% - 75%
- Costs
- Production

Results (Profits)



Results (Production)



Conclusions

- Higher economic impact under CC
- more farms move to higher economic impact (>25% reduction to farm profits)
- Almost half of the sampled farms were expected to reduce production by more than 60%
- Farmers may need to make decisions to reduce heavy economic losses

Strengths

- Economic impacts
- Holistic approach – considers all farming activities
- Structural change/adaptations
- Decision making
- Cost benefit – mitigation measures

Limitations

- Uncertainty – disease, CC
- Data - unavailability
- Variability – breeds, management
- Compounding factors

Thank you

Multi-criteria optimisation to fix the limits of present standards in microeconomics of animal health:

the example of dairy production

D. Raboisson – A. Ferchiou

I. Bouzid, G. Lhermie & P. Sans

national veterinary school toulouse

INRA SCIENCE & IMPACT

ISESSAH

Atlanta

20th july 2019

What is the problem with the current bio-economic approaches ?

- Literature overview : 3 main concerns with the models

CLOSED	RISK vs UNCERTAINTY	DIS-EQUILIBRIUM
Holistic exhaustive mechanistic systematic dynamic modelling multi-diseases, all events explained Global scenarisation	Diet costs, labor costs, cash May be considered as constraints	Question answered Decision process represented

national veterinary school toulouse

INRA SCIENCE & IMPACT

Bio-economic modelling

1 Biologic scenario

2 Coupling

3 Economic optimisation

Biological Model → « activities » Input / output matrix → Economic Model (GAMS) → Utility

Market risk : price volatility

Climatic risk : forage quality

MAX | Objective Function | $$max\ U = E[Z_{k,t}] - \phi\sigma(Z_{k,t})$$

UNDER | Technical, biological, structural, AMU, welfare & labor constraints

national veterinary school toulouse

INRA SCIENCE & IMPACT

Bio-economic modelling

- Monetary calculation in a given context **I**
  - See literature
- Monetary calculation with risk-adjusted income **II**
  - As often observed in economics of dairy health
- Economic optimisation between strategies & under constraints **III**
  - Multi-criteria optimisation
- Sequential economic optimisation between strategies & under constraints **IV**
  - Optimality for each period

Bio-economic modelling

Proof of concept

9 strategies proposed (S1→ S9)

Monetary calculation — II — S1

Optimisation

One strategy for the 10-year period — III

No constraint	Constraint AMU	Constraint Labor
S7	S7	S8

One strategy per year (sequential) — IV

	NO	AMU	Labor
Year 1	S1	S1	S8
Year 2	S7	S7	S8
Year 3	S8	S1	S8
Year4	S2	S4	S2
Year 5	S1	S1	S2
Year 6	S7	S7	S8
Year 7	S1	S1	S8
Year 8	S1	S1	S8
Year 9	S7	S7	S8
Year 10	S7	S7	S2

Conclusions

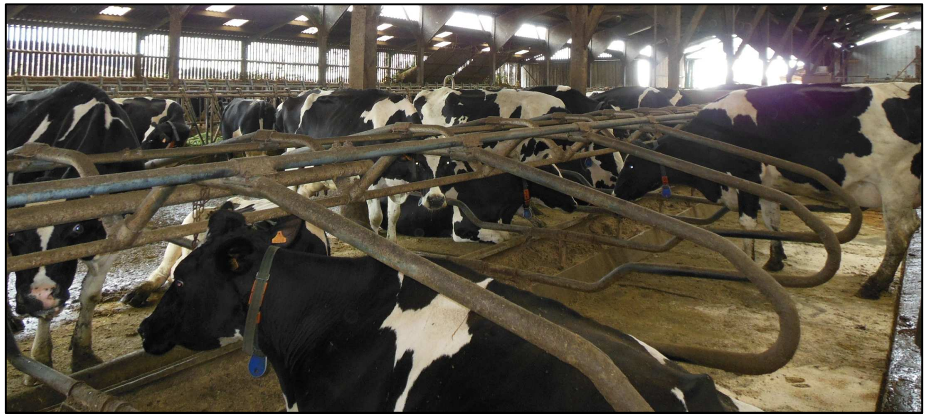
- Improvement in the answer provided : defining strategic approach of diseases management

- To go further : Leontief matrix of technical marginal coefficients (for a given context of health and production)

- A normative approach

national veterinary school toulouse

INRA SCIENCE & IMPACT

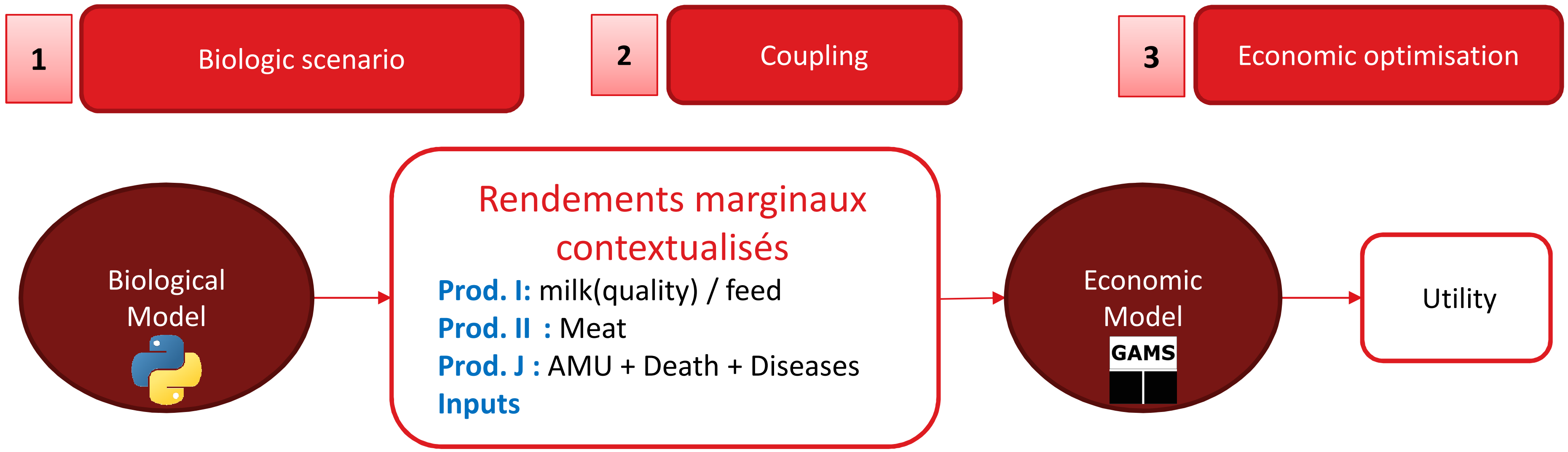


Thank you for your attention

d.raboisson@envt.fr
+ 33 5 61 19 32 30

https://eriahnetwork.weebly.com
https://epidec.weebly.com

Bio-economic modelling



Marginal yield				Technical parameters								
QL1	QL2	QL3	QL4	Vd1	Vd2	Vd3	Pr1	Pr2	Pr3	Pr4	ALEA	…
0,65	0,60	0,55	0,48	52	25	12	1,5	25	23	43	0,25	
0,64	0,61	0,54	0,43	54	58	28	2	35	53	45	0,10	
0,60	0,45	0,55	0,45	52	48	10	3	20	20	45	0,05	

The multitude of lameness detection and classification methods in British dairy cattle research: a meta-analysis

Joao Afonso (jafonso@Liverpool.ac.uk)[1], George Oikonomou[2], Stuart Carter[3], Jonathan Rushton[1]

[1]Department of Epidemiology and Population Health, Institute of Infection and Global Health, University of Liverpool, UK

[2]Department of Livestock Health and Welfare, Institute of Veterinary Science, University of Liverpool, UK

[3]Department of Infection Biology, Institute of Infection and Global Health, University of Liverpool, UK

Myriad of lameness detection and classification systems in British dairy cattle hampers comparisons and hinders analysis for which lameness frequency is a key parameter

- Besides being an important animal welfare issue Lameness is currently the second most costly disease for the British dairy sector
- Lameness frequency levels are assessed through different methods and at different levels
- Research has highlighted:
  - the subjectivity of the mobility scoring to assess lameness in dairy cattle,
  - Farmers' under-reporting of lameness frequency

Objective:

- To present a chronological overview of the different lameness detection and classification methods used in British dairy cattle to understand the patterns of method usage in time and which methods have been consistently used over others
- To conduct a meta-analysis for the reported lameness frequency in the same population in order to inform more precisely other analysis as to this key parameter

Systematic Literature Review (LR) and Meta-Analysis

- Search for peer reviewed publication on lameness in British dairy cattle since 1985 in Web of Science, PubMed, Cab Direct and Agricola in English, Spanish, Portuguese and French
- Selection of papers reporting frequency of lameness (prevalence and/or incidence) for obtaining a pooled estimate through a meta-analysis (random effects)

Results

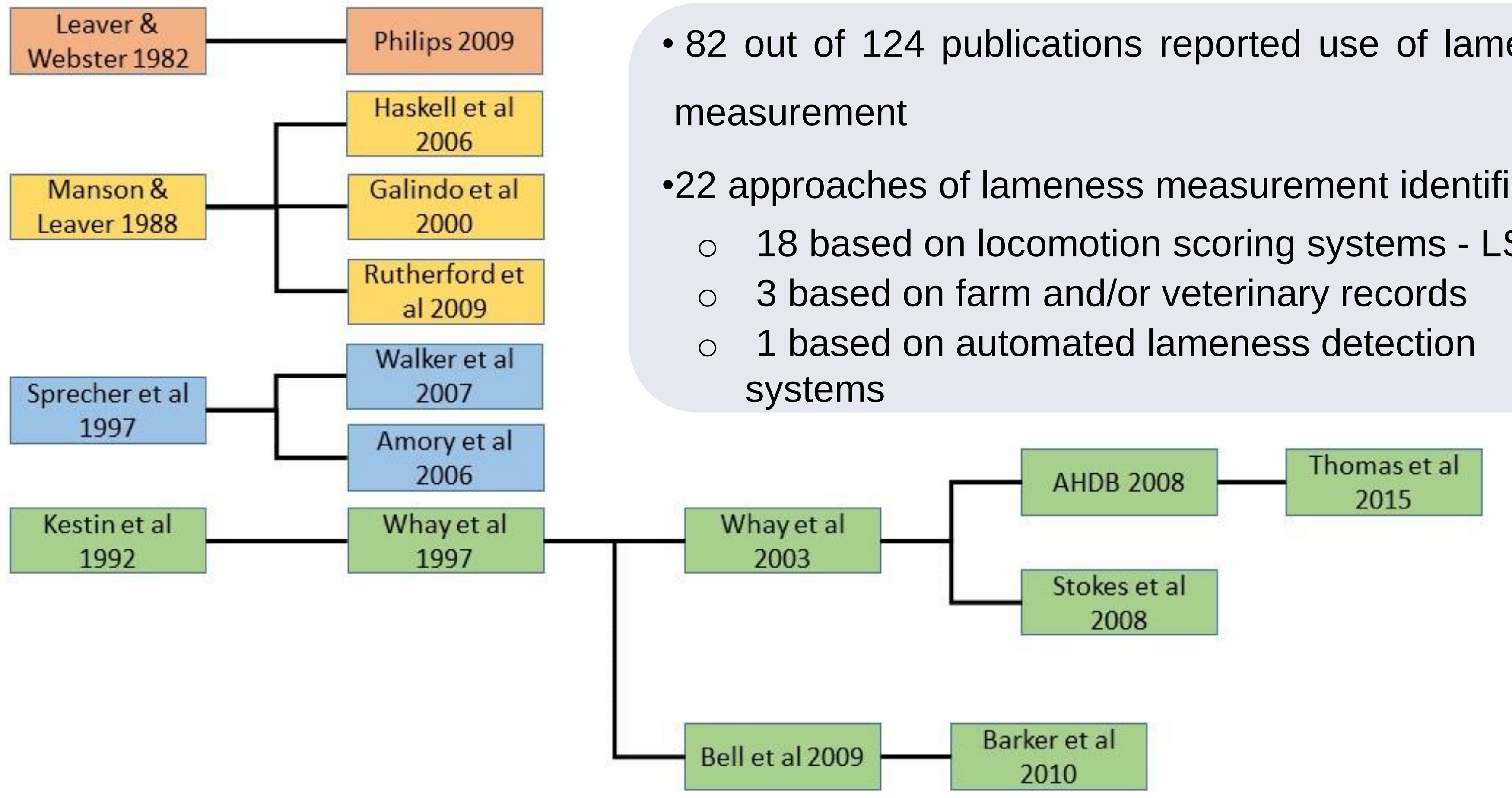
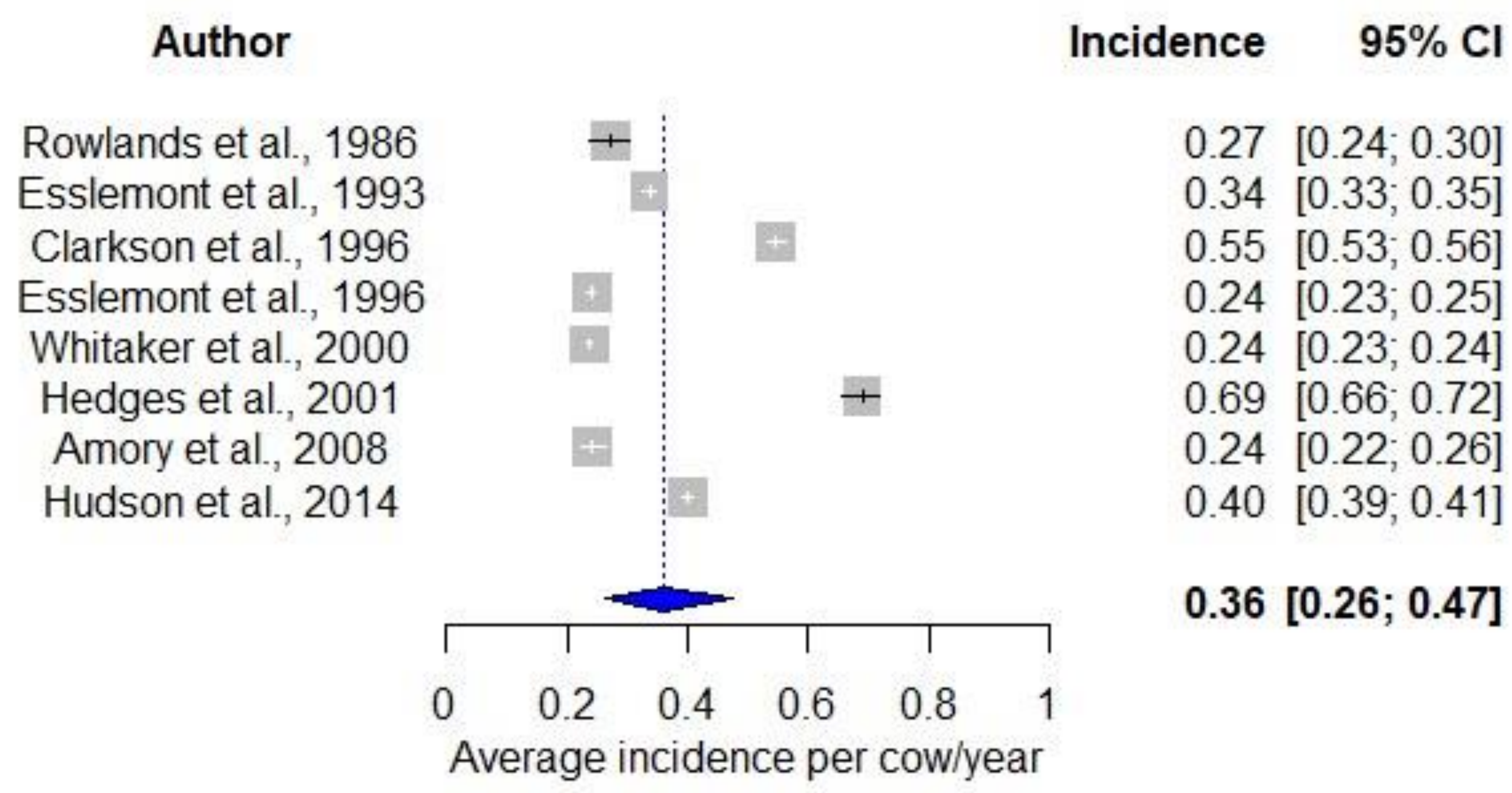
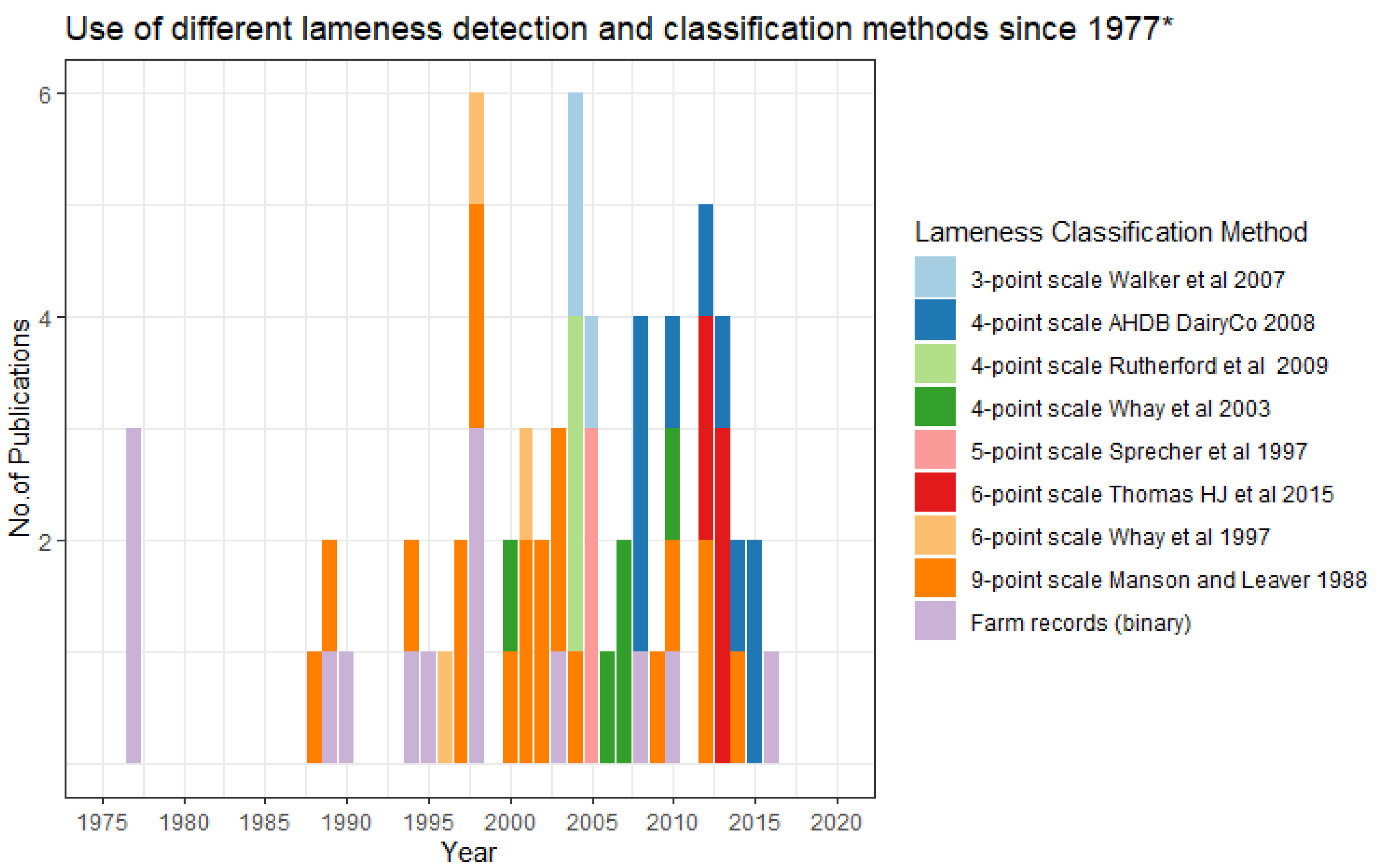


Fig 1. "Phylogenetic" tree of the different LSS identified (Note: 3 systems are not presented)

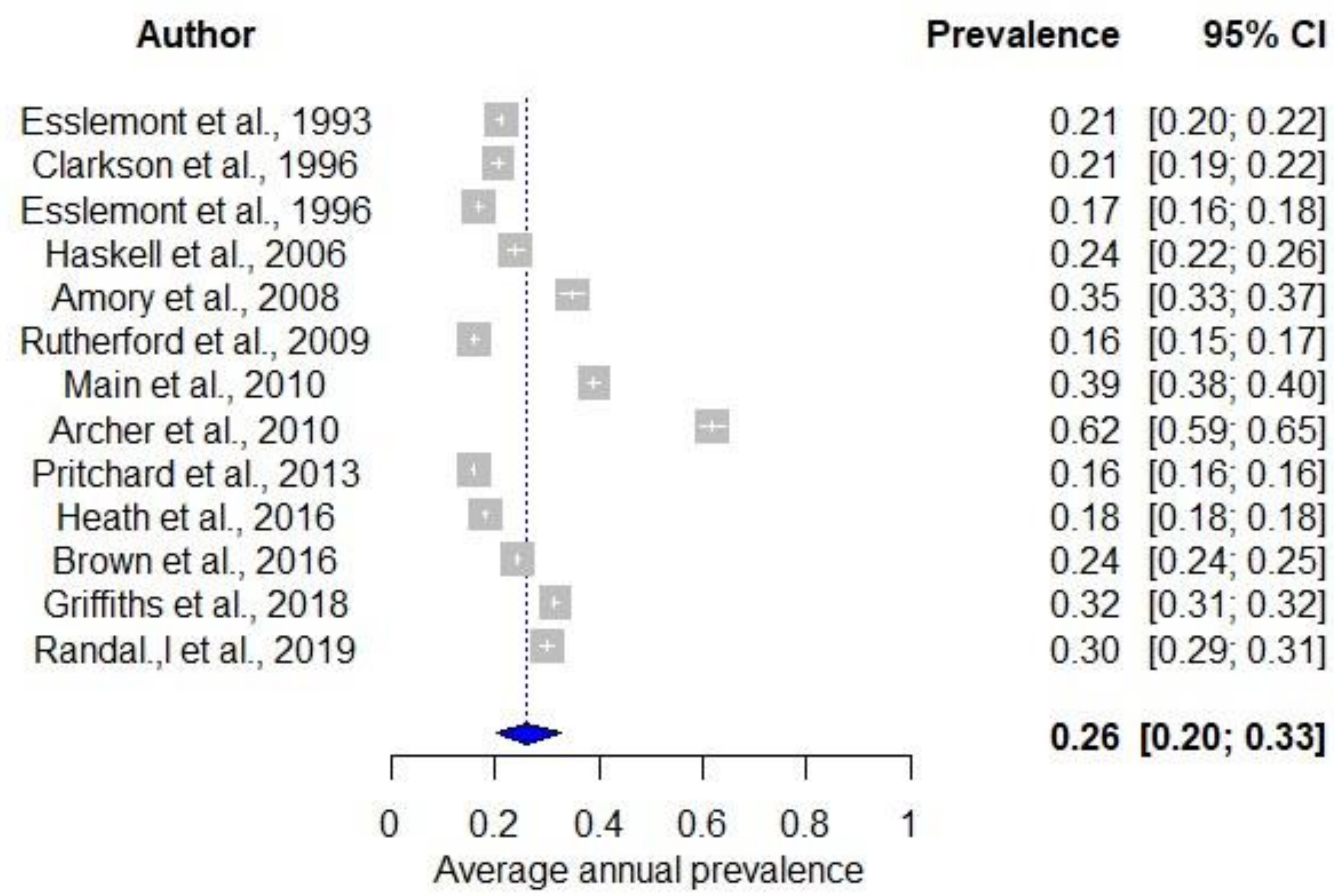
- 82 out of 124 publications reported use of lameness measurement
- 22 approaches of lameness measurement identified:
  - 18 based on locomotion scoring systems - LSS
  - 3 based on farm and/or veterinary records
  - 1 based on automated lameness detection systems



Graph 2. Forest plot from meta analysis on selected papers reporting lameness incidence



Graph 1. Lameness detection and classification methods usage in research in British dairy cattle published since 1985 and based on the year of the beginning of the data collection period (*Note: only methods reported in more than 2 publications were considered)



Graph 3. Forest plot from meta analysis on selected papers reporting lameness prevalence

Conclusions and Discussion

- Although the DairyCo AHDB method was adopted as the dairy sector's standard other methods are used depending on the investigator
- The Manson & Leaver 1988 and the DairyCo AHDB are the two most frequently used LSS – 20 and 9 out of 82 studies respectively
- Automated lameness detection system could offer a solution for the subjective nature of LSS – yet only one study from the LR used such systems
- The pooled estimates offer a more precise figure for lameness frequency
- Studies for the meta-analysis were selected in order to make comparison reasonable, however the different data sources for assessing lameness frequency along with other factors such as different observers conducting the locomotion scoring could introduce error to the analysis
- This work will link to a study on the economic impact of lameness in British dairy cattle

MERS-CoV exposure and transmission risk along camel value chains: production systems in the Horn of Africa and live animal trade with the Near East

Minoves M, VonDobschuetz S, El Masry I, Aguanno R, Bebay C, Walelign E, VantKlooster G, Kimani T, Tadesse Z, Wangila R, Gikonyo S, Mirkena T, Mansour A, Ettel T, Hijazeen Z, Kiambi S, VelascoGil G, Lubroth J, Bengoumi M, Tibbo M and Makonnen Y.

Food and Agriculture Organization of the United Nations (FAO)

Introduction

Horn of Africa (HoA) is home to almost 60% of the world's dromedary camel population, one of the main livelihood resources for pastoralists and rural communities. Ethiopia has three livestock production zones, of them the lowlands grazing area (arid, semi-arid and sub-humid agro-ecological zones), hosts 95% of the camels making it the main camel belt. In Kenya , Somalia, Djibouti and Sudan most of the camel population is reared in similar agro-ecological zones.

Camel movement and trade have gained global attention in the last few years following strong consensus on the zoonotic risk of dromedary camels infected with Middle East Respiratory Syndrome Coronavirus (MERS-CoV). However, little is known on the virus dynamics along dromedary camel value chain, especially at the epizonal level between production countries in the HoA and destination countries in the Near East. Thus far, there is circulation of distinct MERS-CoV clades, namely A and B in the Near East, and C in Africa. While none of the human cases were affected by clade C, this situation has added further importance to the analysis of camel value chains in order to understand the virus transmission risks and the interfaces between camels originating from different regions.

Objectives

This study discuss the general findings of a literature review based regional overview of the HoA dromedary camel value-chains (excluding racing and by-product studies such as camel milk and meat) and the trade linkages with Egypt and Saudi Arabia. The analysis is undertaken from an animal health perspective to identify knowledge gaps and associated risk factors of MERS-CoV transmission in the camel value chains.

Results

1. Production systems

- **Traditional pastoralist and agropastoral production systems**
  - Are dominant
  - Kept by several cross-border ethnic groups distributed over the HoA.
- **Other camel production systems**
  - Semi-sedentary emerged over the past decades,
  - Peri-urban, off-farm, commercial ecotourism, ranching systems
  - Mainly linked with settlement of some pastoralist communities, and the growing demand for camel milk in urban centres.

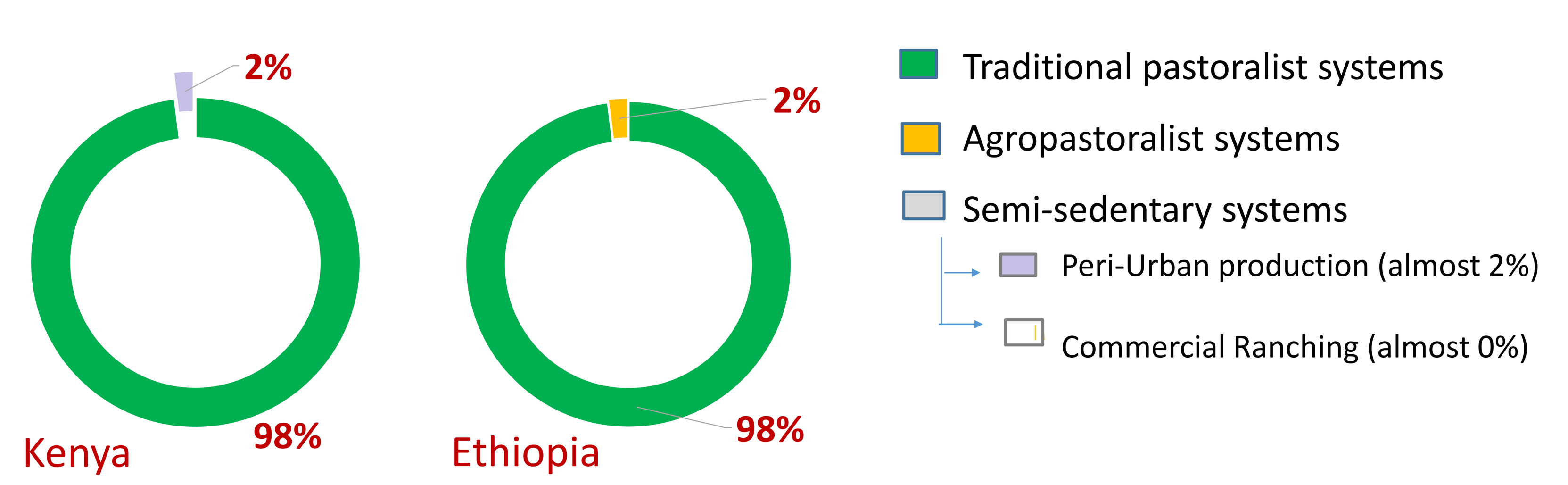


Fig. 1: Importance of the different production systems in Kenya and Ethiopia

2. Camel migration in the HoA

Migration is an important component of camel rearing systems. The amplitude and direction of the migration is a function of several factors, ranging from water and feed scarcity, rangeland availability, and changing landscapes and conflicts along the migration roads. As migration can take place across borders, it creates non-trade interaction between camels from Kenya, Ethiopia, Somalia, or Sudan, and consequent risk for cross border disease spread.

Jan – Mar	Apr – May	Jun – Sep	Oct – Dec
Jilaa 1st dry season	*Guu* 1st rainy season	*Hagaa* 2nd dry season	*Deyr* 2nd rainy season
High offtake Low camel prices	Low offtake High camel prices	High offtake Low camel prices	Low offtake High camel prices
• Low camel milk production • Herds moved far off in search of pasture / water	Adequate camel milk production	• Low camel milk production • Herds moved far off in search of pasture / water	Adequate camel milk production
Cash to purchase grains and other foods	No pressure to sell camels	Cash to purchase grains and other foods	No pressure to sell camels

Fig 2. Camel migration season

3. Live camel trade routes in the HOA

Kenya: three major camel trekking routes. Of them, the North East to South West (Mandera-Wajir-Garissa-Mwingi-Thika-Mlolongo) route has been predominant. However, new trade flow is emerging as more camels are diverted North to Moyale - Nazareth and to: Sudan through Hamara; Egypt through Djibouti; or the Arabian Peninsula through Djibouti; or, Bossaso and Berbera ports.

Ethiopia: the major routes are: (i) Melka Oda – Humera – Sudan where camels are trekked for 46-52 days with an additional 5-6 days of trucking to reach Sudan, (ii) Dire Dawa – Metema by trucks, (iii) Dire Dawa – Djibouti is considered a formal trade route, (iv) Jijiga / Togochale – Somaliland route which include formal and informal trade, and (v) Southern Ethiopia to Northeastern Kenya route.

Somalia: the trade routes encompasses the Bossasso chain located in Somalia and the Berbera one located in Somaliland. Both chains are used to export camels to the Middle East.

Formal trade through the HoA includes three legal circuits; Metema (Sudan route), Dire Dawa (Djibouti route), and Jijiga / Togochale (Somaliland route). The legality comes from the traders' compliance with veterinary inspections and associated financial procedures. The semi-informal chain refers to the ongoing trade between Ethiopia and Somalia, whereas the informal sub-chain encompasses hybrid systems ranging from clandestine to a semi-informal arrangement between Ethiopia and Somalia.

4. Trade links between HoA , Saudi Arabia and Egypt

Saudi Arabia imports camels to serve 3 main purposes (i) commercial rearing, and therefore linking HOA camel value chains to local livestock value chains. Dominates during the lunar months of Muharram to Jamadul Akhir with relatively low demand, (ii) Religious sacrifice during the lunar months of Rajab to Dul Hijja associated with Hajj and Umra pilgrim, and (iii) Racing and beauty pageants competitions. Whereas camels exported to Egypt are mainly intended for slaughter (within 1 week) after arrival, a small proportion of the young camels are kept for 2-3 months for fattening before being sold again in markets for slaughter.

5. MERS-CoV risk factors

Three categories related to,

- Trade : possible transmission pathways and strategic points where camels are concentrated along the trade routes- within countries, across HOA, and Saudi Arabia and Egypt
- Management: Seasonal within country and cross – border migration, poor husbandry systems.

GAPS: What remains unknown

- Precise identification of practices that could enhance zoonotic MERS-CoV transmission

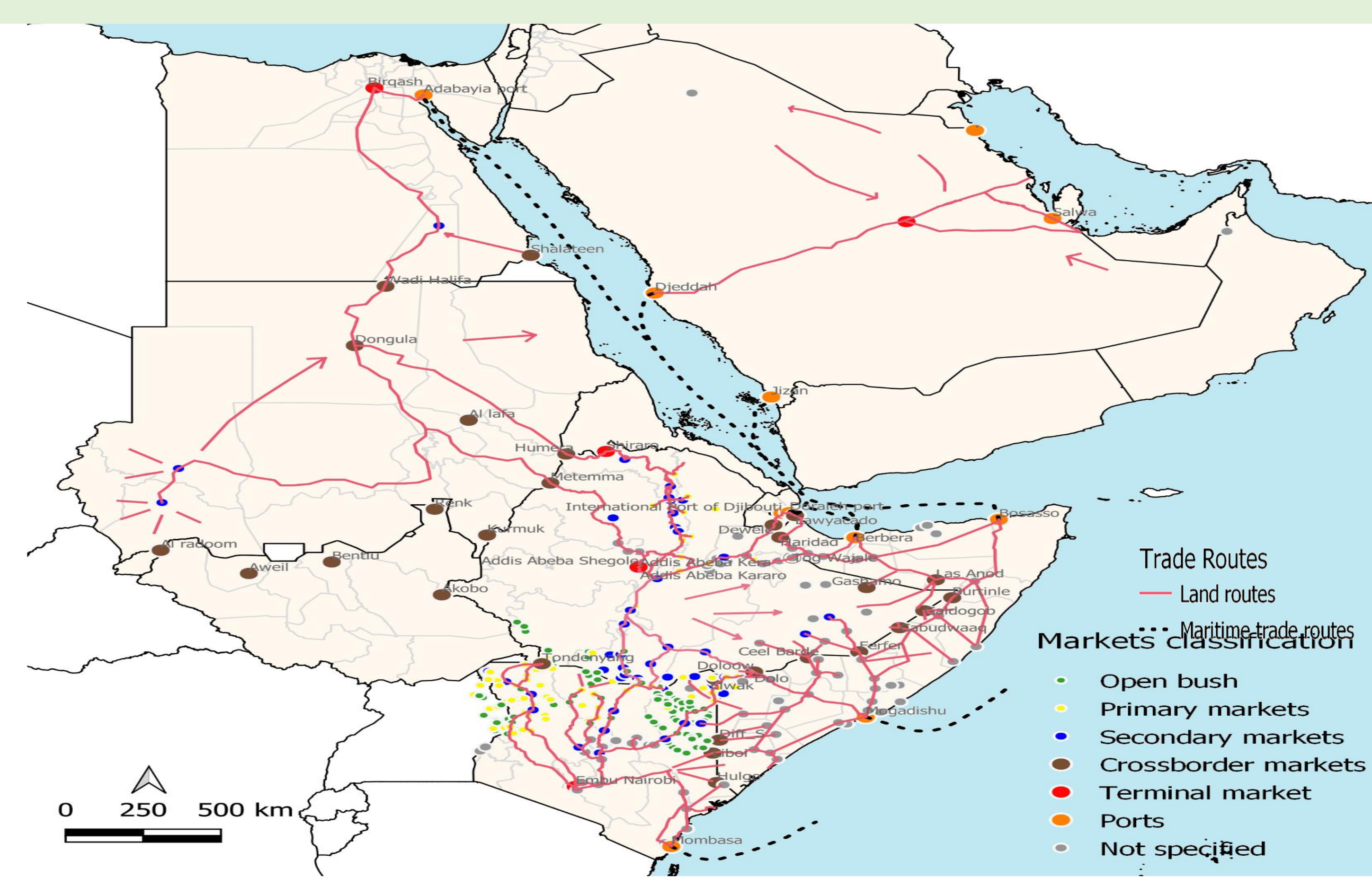


Fig 3. Live camel trade map in the Horn of Africa

Conclusion

One important feature of the HoA livestock value chains revolves around cross-border trade (between Kenya, Ethiopia and Somalia) and trade links with North Africa and Middle East. Implementation of MERS-Cov risk-based surveillance systems required good understanding of the regional camels value chains and links to major disease hotspots (Middle East). Major transhumance and trade routes were mapped and important nodes visualized, including main camel markets and production areas specifically, husbandry and marketing practices, trade flows or interaction along value chains were described and are expected to guide further studies on the subject matter.

References

1. Mirkena, T., Walelign, E., Tewolde, N., Gari G., Abebe G., Newman, S. 2018. Camel production systems in Ethiopia: a review of literature with notes on MERS-CoV risk factors. Pastoralism. 8: 30.
2. Mukasa-Mugerwa, E. 1981. . The camel (Camelus dromedarius): a bibliographical review. Addis Ababa, Ethiopia: International Livestock Centre for Africa. 147pp
3. Mwanyumba P M, Wahome R G, MacOpiyo L and Kanyari P 2015: Pastoralist livelihoods, resources and strategies in Garissa County, Kenya. Livestock Research for Rural Development. Volume 27, Article #202. Retrieved July 11, 2019, from http://www.lrrd.org/lrrd27/10/mwan27202.html
4. Shapiro, B.I., Gebru, G., Desta, S., Negassa, A., Nigussie, K., Aboset G. and Mechale. H. 2017. Ethiopia livestock sector analysis. ILRI Project Report. Nairobi, Kenya: International Livestock Research Institute (ILRI)..
5. USAID (2013). Agricultural Growth Project - Livestock Market Development: Value Chain Analysis for Ethiopia. 153pp.
6. FAO. 2013. World Livestock 2013 – Changing disease landscapes. Rome
7. Aklilu, Y., Catley, A. 2011. Shifting Sands: The Commercialization of Camels in Mid-altitude Ethiopia and Beyond. Feinstein International Center, Tufts University, Addis Ababa. https://fic.tufts.edu/assets/shifting_sands.pdf
8. Gikonyo, S., Kimani, T., Matere, J. et al. EcoHealth (2018) 15: 372. https://doi.org/10.1007/s10393-018-1317-6

Acknowledgement

This study was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of FAO and do not necessarily reflect the views of USAID or the government of the United States of America.

Contact

For further information please contact us at the following email addresses:
marie.minoves@gmail.com; sophie.vondobschuetz@fao.org; tabitha.Kimani@fao.org;

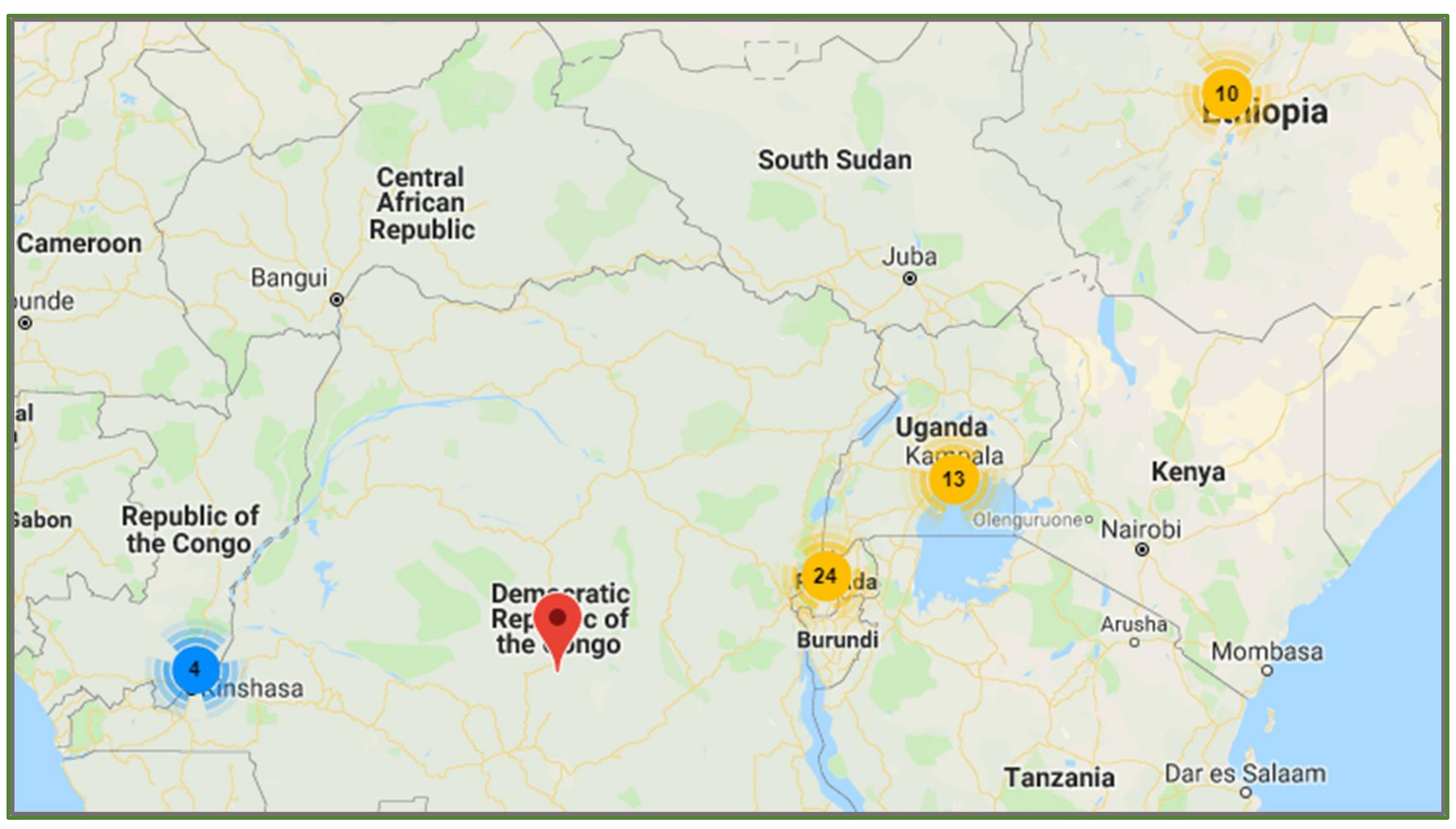
Profiling Application for Livestock Markets

Food and Agriculture Organisation of the United Nations

Sergei Khomenko, Sophie von Dobschuetz, Tabitha Kimani, Ryan Aguanno, Astrid Tripodi, Pawin Padungtod, Nguyen Thi Thanh Thuy, Leo Loth, Nguyen Thi Phuong Bac, Damian Tago Pacheco, Charles Bebay, Juan Lubroth, Yilma Makonnen

INTRODUCTION AND OBJECTIVES

Numerous studies document the risks of disease transmission and spread through livestock markets. However, these studies were limited to mostly static data gathering and obsolete processing technologies. The Market Profiling Application (MPA) developed by the Food and Agriculture Organisation (FAO) is an online, dynamic, real-time application for the systematic collection, display, and analysis of epidemiologically relevant market data. It informs decisions on preventing or mitigating (zoonotic) disease transmission and ultimately contributes to minimizing the risk of transboundary animal and zoonotic disease outbreaks.



Map 1: Markets profiled in countries of East and Central Africa as of 3 July 2019

METHODS

In 2016 FAO began piloting the MPA with the aim to categorise live bird markets (LBMs) based on risk factors such as infrastructure, services facilities, slaughter, and map the catchment areas of the LBMs to further study the market networks of a country. The MPA utilises Google Forms or Epicollet5 (desktop and mobile) for data collection and Google Docs for storage. Thus far, data collection has been organised through the veterinary services in Vietnam, and through consultants specifically recruited for data collection in project countries of eastern and central Africa (Ethiopia, Uganda, Democratic Republic of the Congo, Rwanda, and Mozambique). Data is validated at the central level to check for location and other errors.

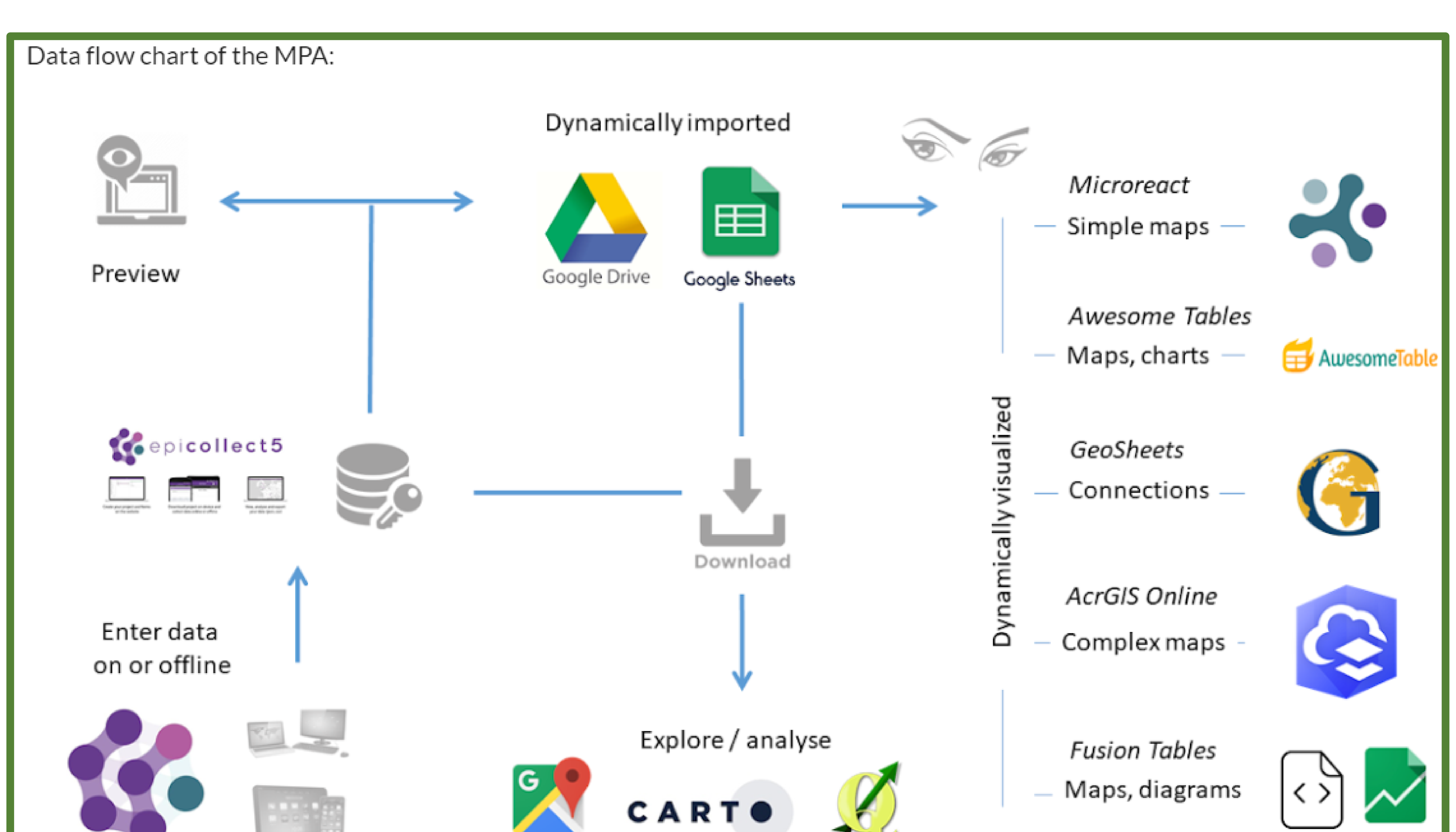


Image 1: Data flow options for the MPA including data collection, entry, analysis, and visualisation steps

Outputs are visualised automatically via web maps, statistics, or graphs using Google Spreadsheets, Google My Maps, Fusion Tables, Microreact, Awesome Tables, GeoSheets and ArcGIS Online. The online interface offers the opportunity for data to remain privately accessible for individual country users. Routine use of the tool by veterinary services as an intervention for disease surveillance or control has not yet been initiated.

RESULTS AND DISCUSSION

Of the 777 LBMs mapped in 58/63 provinces in Vietnam, 376were fully profiled, including infrastructure, operation, turnover, catchment areas, and biosecurity practices. To study trade networks, 433 connections were described with data on commodity type, volume, direction, and seasonality collected. In Africa, a further 73 markets were profiled across 5 countries with data collection ongoing. Records for all markets can be accessed and updated online, while market and network mapping as well as basic visual analytics are automatically performed by the application's tools. A participatory approach is fundamental to the sustainability of the MPA and ensuring appropriateness of the data collected. Additionally, monitoring and evaluation can be utilised during cost-effectiveness analysis to help determine the appropriate action for different disease event scenarios.

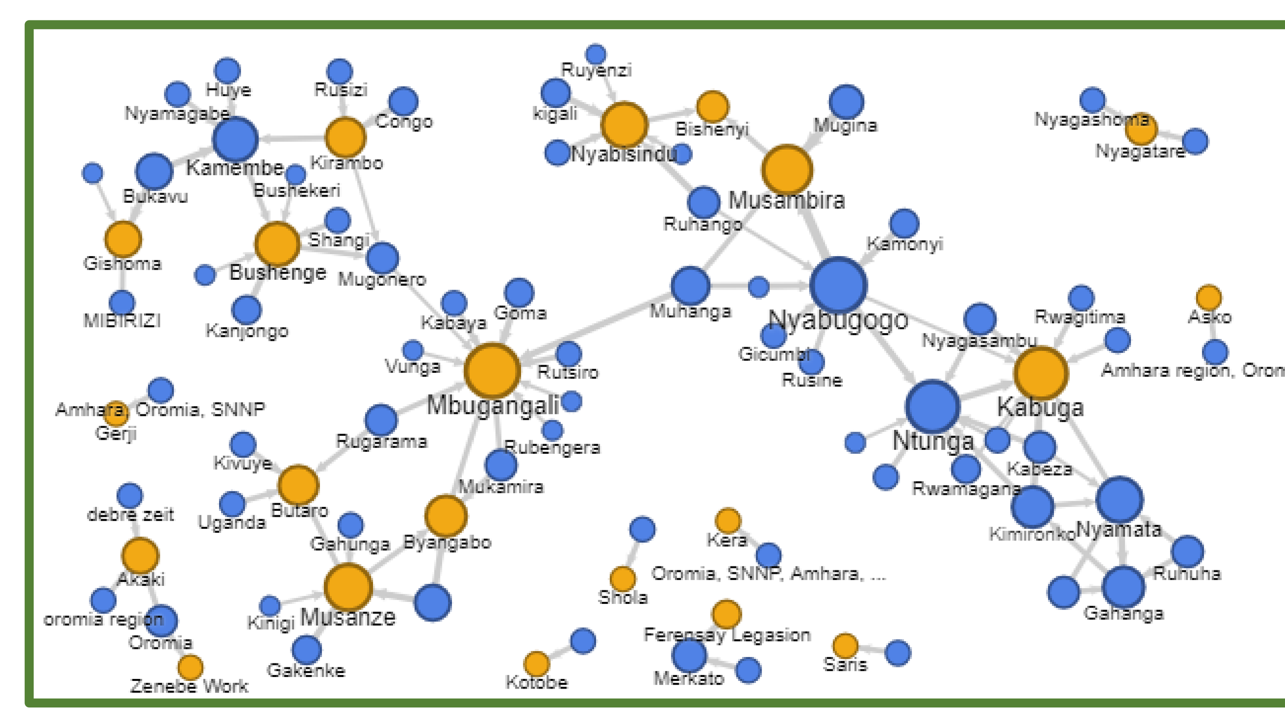
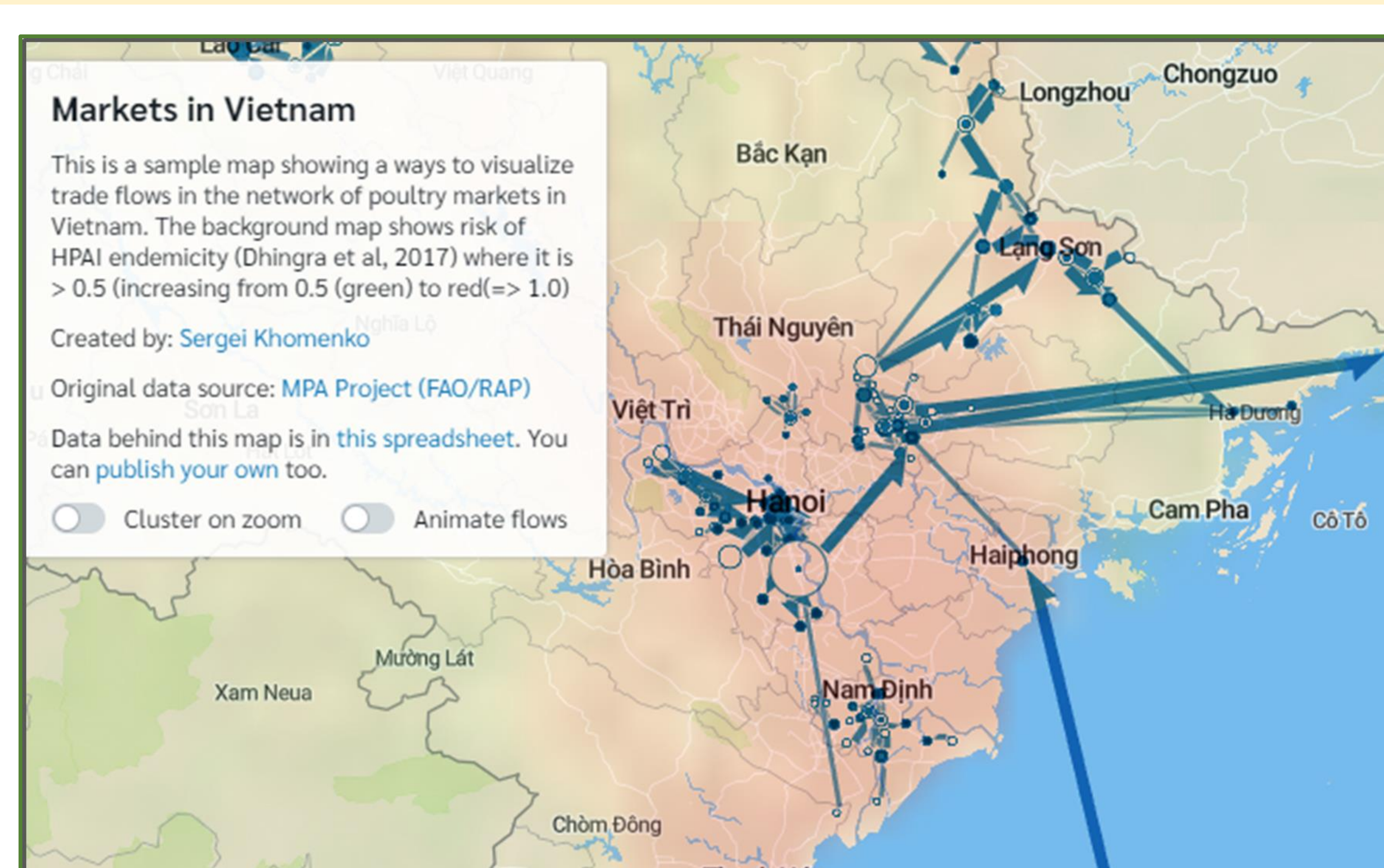


Image 2: Data visualisation option for the MPA displaying 87 connection nodes for East and Central Africa

CONCLUSION

In Vietnam the MPA has proven practical and versatile, with lessons learnt on cost-effective implementation. The knowledge generated can already lend itself to influencing policies and advocating for control options, including targeted surveillance, which will contribute to validating the application. While FAO works on expanding the MPA into Africa and incorporates other livestock markets, there are key challenges that must be overcome that are fundamental to the sustainability and uptake of the application. These include:

- Determining a sustainable method for continued market data collection, both for live-bird and other livestock markets,
- Generating dialogue between policy makers and field staff to ensure effective uptake of the tool into the national surveillance system.



Map 2: Data visualisation option for the MPA with market trade flow (connections) displayed over HPAI endemnicity

CONTACT

For further information please contact us at the following email addresses:
sophie.vondobschuetz@fao.org
ryan.aguanno@fao.org
serhiy.khomenko@fao.org

Food and Agriculture Organization of the United Nations

Modelling economics of antimicrobial use in a pig fattening farm

Luke
NATURAL RESOURCES INSTITUTE FINLAND

Jarkko K. Niemi and Anna H. Stygar

Natural Resources Institute Finland (Luke)

Introduction

Rising threat of antimicrobial resistance (AMR) is a challenge to future health care. Prudent antimicrobial use is essential in order to tackle the challenge of AMR. Prudent antimicrobial use use concerns especially human critically important antibiotics which are most frequently prescribed for diseases such diarrhea, respiratory and locomotory disorders, or postpartum dysgalactia syndrome in pigs.

Preventive animal health management is a substitute for antimicrobial use because healthy animals do not require antimicrobials. The aim of this study was to analyze tradeoffs between antimicrobial use and preventive animal health management in pigs and implications of this to prudent antimicrobial use.

Methods

A dynamic stochastic optimization model which characterized the most important health management practices, antimicrobial use and occurrence of disorders in pig fattening and which maximized return on pig space unit was developed. The model was parametrized by using previously analyzed data originating from a large number of fattening farms in Finland. Farmer's incentives to improve housing and management were analyzed.

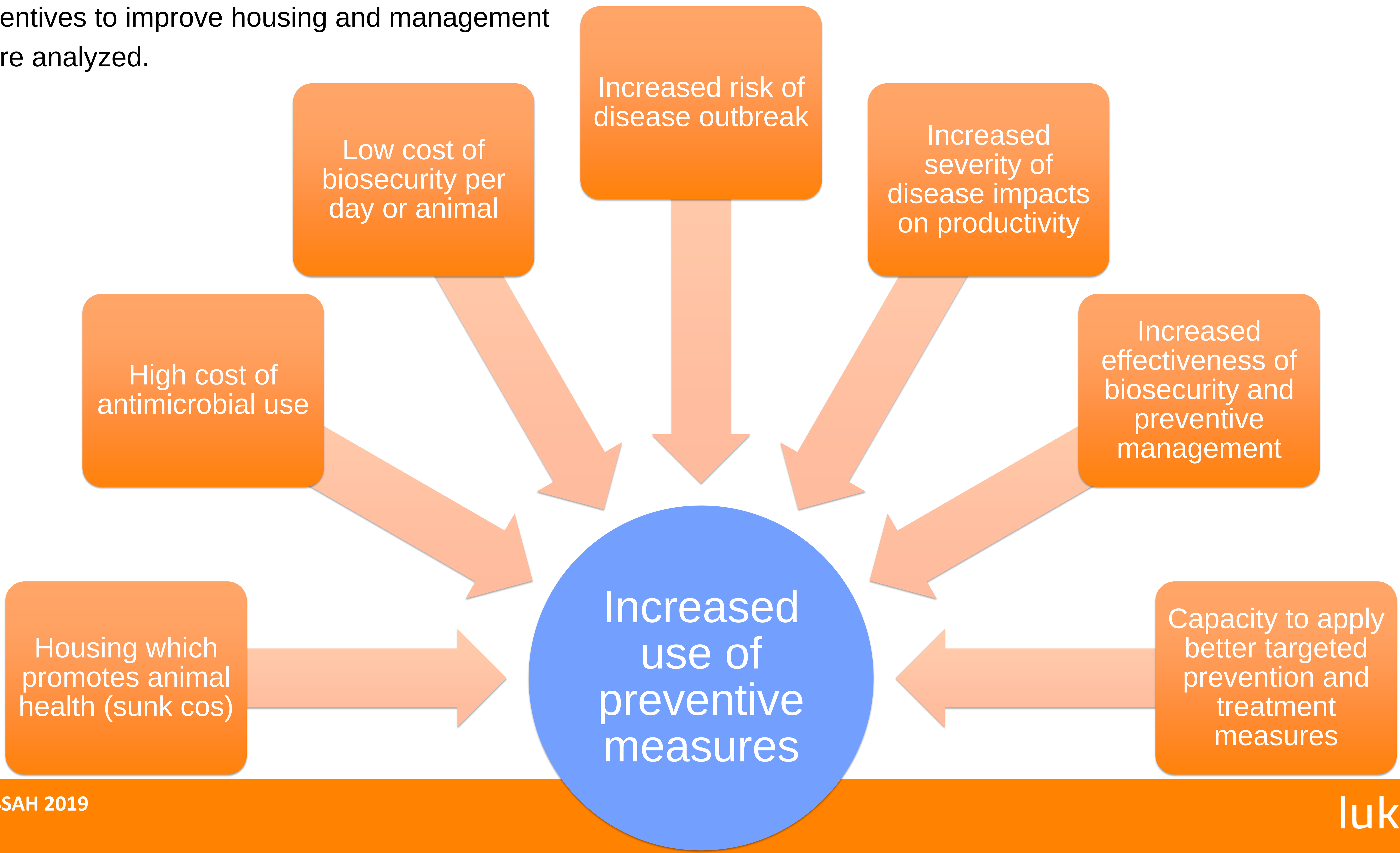
Results

Low antimicrobial usage and good pig health is associated with improved biosecurity and pig welfare factors such as the use of enrichment, appropriate stocking density and pen conditions.

Figure below illustrates how some cost and efficiency factors influence the use of preventive measures. Some factors can nevertheless increase antimicrobial use. The results suggest that improving these housing and management measures can be economically viable on farms particularly when the costs of implementing the measures are reasonably low or when there is a substantial risk for an animal diseases to occur in the batch. The benefits were also associated with the accuracy of targeting the measures within the farm. Repeatedly applied measures are sensitive to alterations in the cost of implementation and efficiency. Efficiency of measure is essential for farmers to have economic incentives to apply preventive animal health management.

Conclusion

Antimicrobial use can be reduced by preventative animal health care. The costs of antimicrobial use and preventive measures are important when deciding about their use.



Impacts of African swine fever on pigmeat markets in Europe

Luke
NATURAL RESOURCES INSTITUTE FINLAND

Jarkko K. Niemi, Natural Resources Institute Finland (Luke), jarkko.niemi@luke.fi

Introduction and objective

African Swine Fever (ASF) is an OIE-listed highly contagious animal disease which can cause disruptions in the international trade of pigs and products derived from pigs. Since year 2013, ASF has been has been introduced into several member states in the European union (EU), including the Baltic states, Poland, Romania (Figure 1) and most recently, Belgium in 2018. However, it has not been analyzed how the disease has influenced pig production sectors in these countries

The aim of this study was to investigate how ASF outbreak has influenced pig markets in the EU member states where the disease has been introduced since 2013.

Data and methods

- Annual market information on prices, supply, demand, and foreign trade of pigs and pigmeat as well as farm and pig numbers in the EU member states for years 2010-2017
- The data were analyzed and results for countries with and without ASF outbreaks were compared.

Results

- The impacts of ASF to market prices and quantities traded are **confounded** with other changes and systemic changes in the EU pig markets, especially the ban to import products of pig origin to Russia.
- **Changes** observed in the pig market during and after an outbreak vary by country (Figures 2 and 3)

Results (continued)

- In some countries, particularly the Baltic countries where the disease was spreading over large part of the country, the number of pigs in stock has reduced.
- In some countries, meat prices or production volumes, or value or quantity of export have reduced during the outbreak. Reductions in exports have been primarily in exports to countries outside the EU. However, changes are resulting from multiple factors.

Conclusion

- Market losses have been expecienced since the introduction of ASF, but the effects are complex.

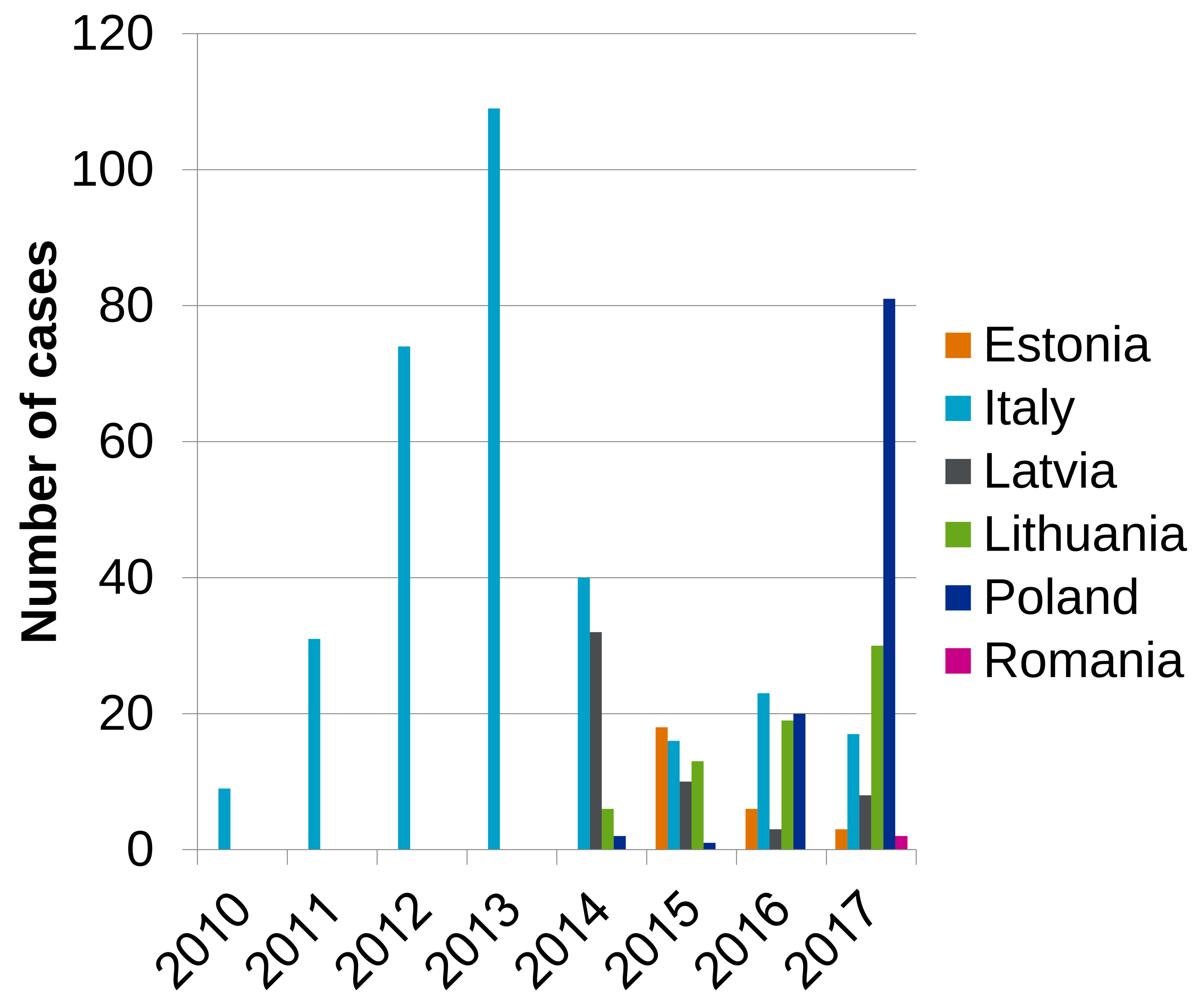


Figure 1. Number of African Swine Fewer cases reported in domestic pigs in the EU member states during the years 2010-2017. Source: OIE.

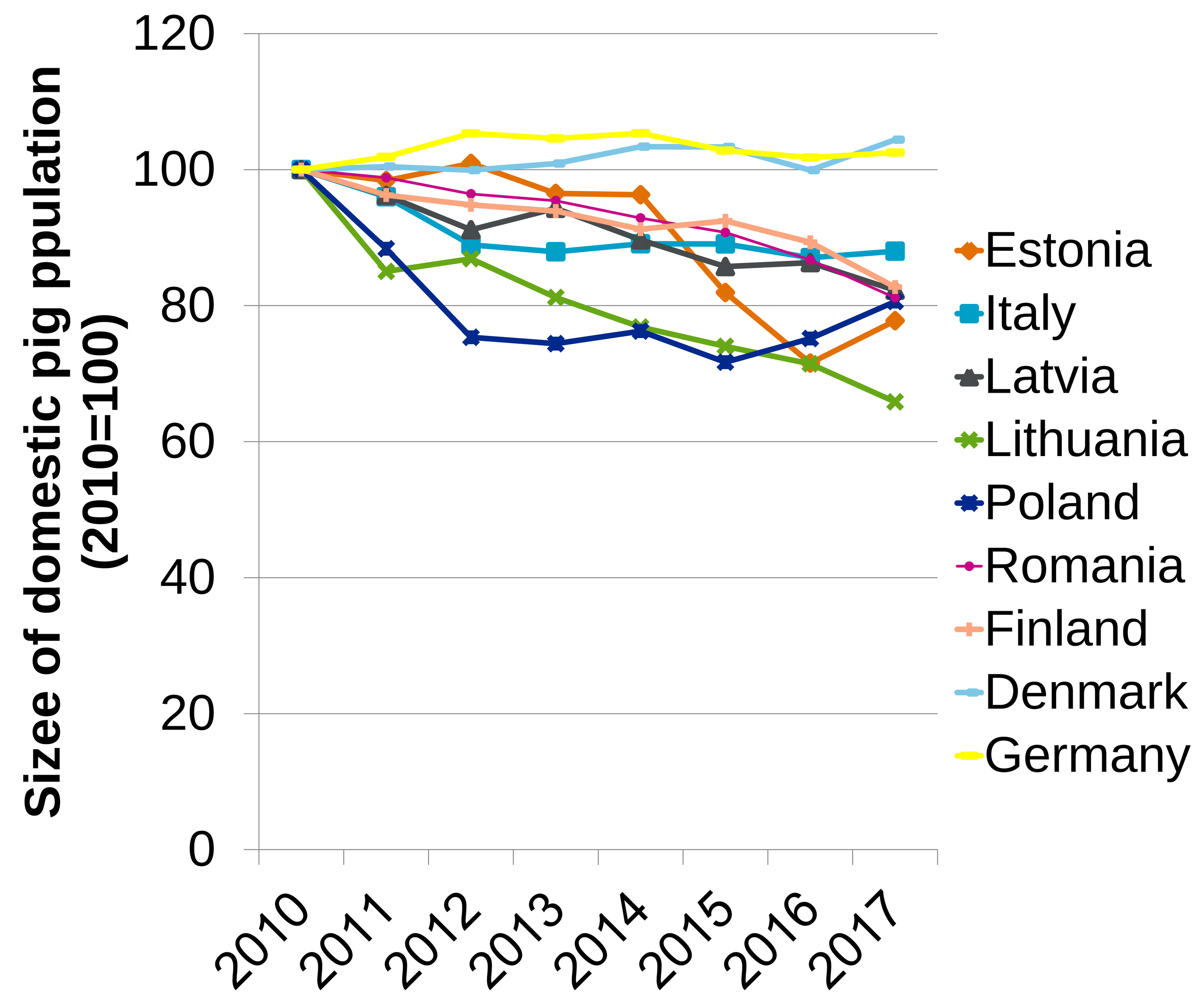


Figure 2. In index (2010=100) representing the size of pig population in selected EU member states during the years 2010-2017. Source: Eurostat.

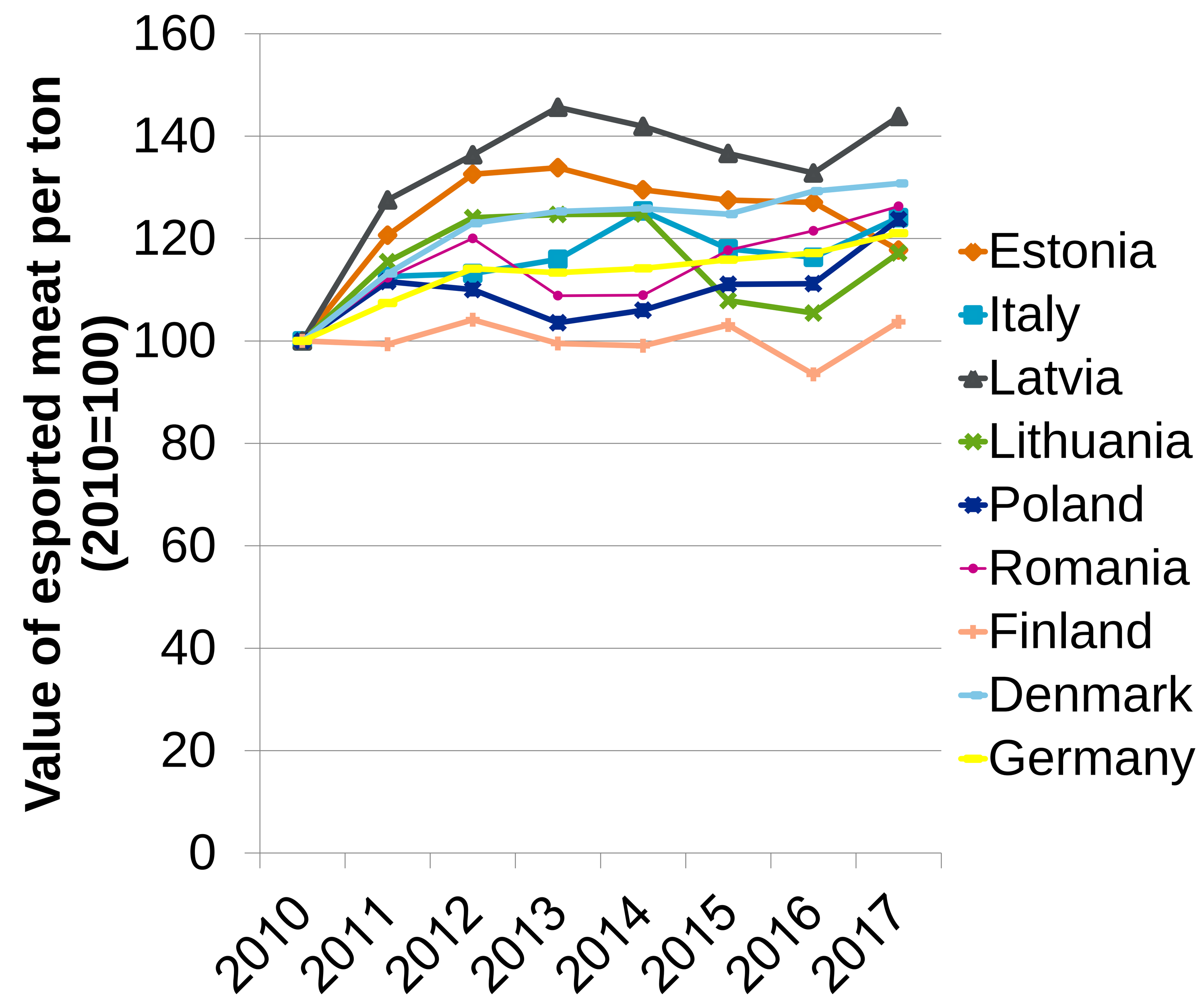


Figure 3. In index (2010=100) representing the unit value of exported pigmeat in selected EU member states during the years 2010-2017. Source: Calclulated based on Eurostat data.

LIVESTOCK HEALTH EFFECTS ON COST OF NUTRIENT CONSUMPTION IN WESTERN KENYA

Alexander J. Kappes, Thomas L. Marsh

Washington State University

INTRODUCTION

Attributed to recurrent food insecurity issues, north eastern sub-Saharan Africa has the lowest per person per day energy availability ranking worldwide (Schmidhuber et al., 2018). Understanding food insecurity issues is in part contingent on understanding nutrient consumption and its costs.

We develop estimates of protein, lipid, and carbohydrate macronutrient consumption from food consumption. We then calculate the shadow price per gram of macronutrient consumption as a share-weighted consumption-expense ratio.

Smallholder agriculture provides the primary supply of subsistence and community market foodstuffs in rural western Kenya. Using household bovine, goat, and sheep livestock health observations we analyze the effect livestock illness has on macronutrient consumption prices.

HYPOTHESIS:

Livestock illness increases costs of nutrient consumption in developing areas reliant on smallholder agriculture.

RESULTS:

Village-level bovine and sheep illness occurrence has positive marginal effects on costs of protein and lipids macronutrient consumption.

Increases in average household bovine and sheep illness occurrences result in increases of protein and lipids shadow prices.

Average bovine illness occurrence significantly explains an increase of 0.1113 Ksh/g in protein's shadow price and an increase of 0.121 Ksh/g in the shadow price of lipids. Average sheep illness occurrence significantly explains increases of 0.1405 Ksh/g and 0.182 Ksh/g in the shadow prices of protein and lipids, respectively.

IMPLICATIONS:

Agriculture production losses from livestock illness directly influence energy availability. Further, livestock illness is empirically shown to increase prices, and hence the costs of available energy consumption in terms of macronutrient shadow prices.

Increasing livestock health lowers prices, and hence the costs of nutrient consumption, making consumption more attainable in constrained-resource environments.

Empirical marginal effect estimates of livestock illness on nutrient consumption critically informs policy decision-making in undernourished, developing areas.

REFERENCES

J. Schmidhuber, P. Sur, K. Fay, B. Huntley, J. Salama, A. Lee, L. Cornaby, M. Horino, C. Murray, and A. Afshin, "The global nutrient database: availability of macronutrients and micronutrients in 195 countries from 1980 to 2013," The Lancet Planetary Health, vol. 2, no. 8, pp. e353–e368, 2018.

S. Thumbi, M. K. Njenga, T. L. Marsh, S. Noh, E. Otiang, P. Munyua, L. Ochieng, E. Ogola, J. Yoder, A. Audi, et al., "Linking human health and livestock health: a "one-health" platform for integrated analysis of human health, livestock health, and economic welfare in livestock dependent communities," PloS one, vol. 10, no. 3, p. e0120761, 2015.

USDA Food Composition Databases. United States Department of Agriculture. https://ndb.nal.usda.gov/ndb/

DATA & METHODS

Data consists of once-a-month weekly food consumption and expense observations for western Kenyan households from 2013 to 2016, and is provided by the ongoing Population Based Animal Syndromic Surveillance Socioeconomic Survey (Thumbi et al., 2015).

NUTRIENT CONSUMPTION AND COSTS

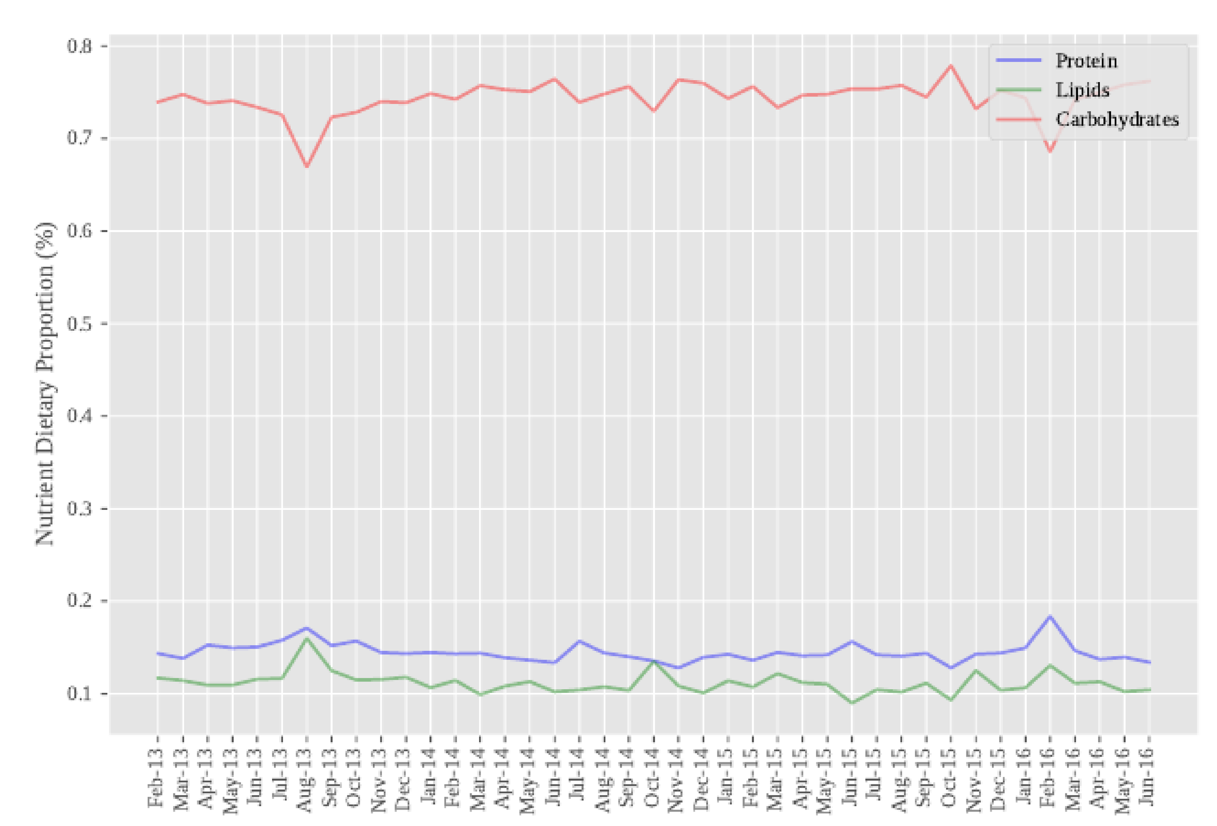
$$N_h = \sum_{l}^{L} \sum_{j}^{J} \gamma_l F_j$$

$$P_{l,h} = \theta_{l,h} \frac{E_h}{N_{l,h}}$$

- N_h represents total nutrient consumption in grams for nutrient l conversion factor γ (Schmidhuber et al., 2018; USDA Food Composition Databases) and food F item j in household h
- $P_{l,h}$ represents the shadow price of nutrient l for nutrient consumption share θ and total consumption expense E in household h

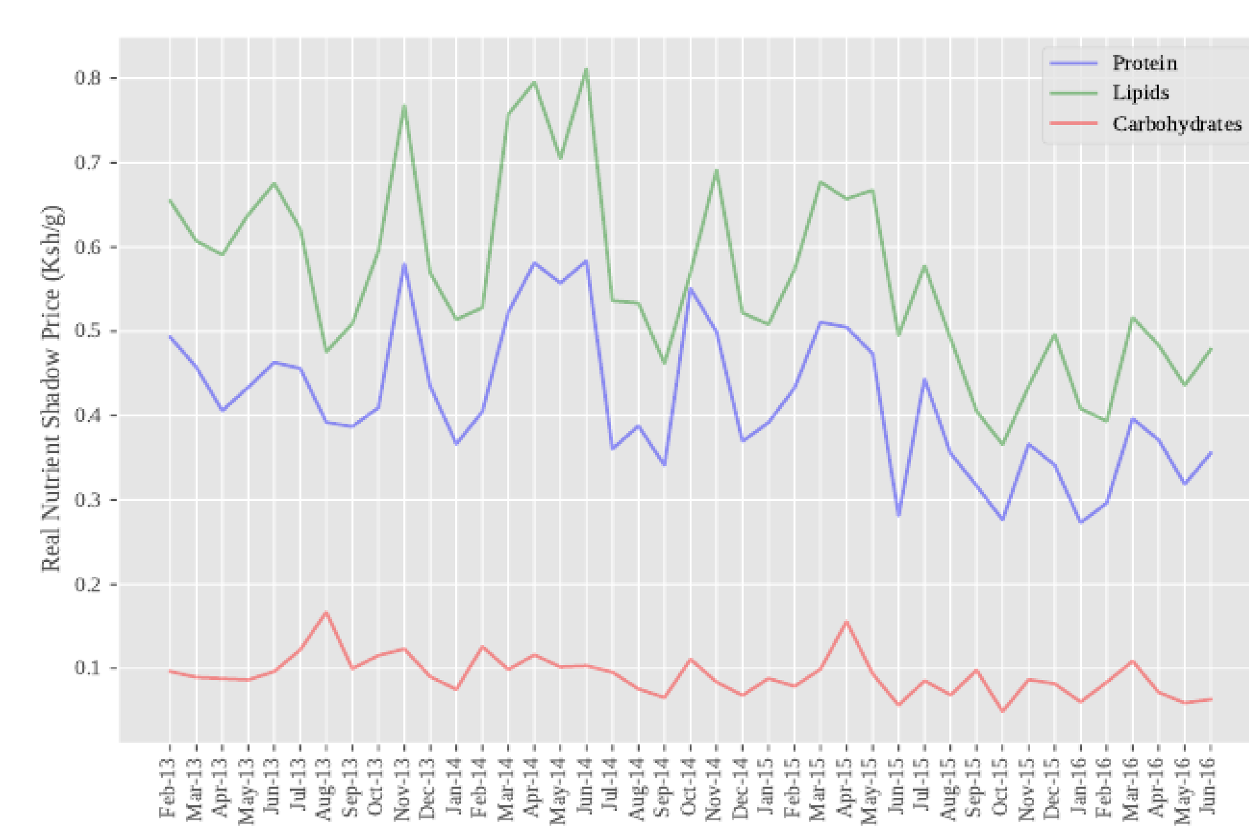
RESULTS

Figure 1: Sample Mean of Nutrient Dietary Proportions (%)



Note: Nutrient dietary proportions are computed from nutrient-food item consumption conversions. Mean consumption proportion values are the computed for each month across sample time.

Figure 2: Sample Mean of Nutrient Shadow Price (Ksh/g)



Note: Mean shadow prices for each nutrient are computed for each month across sample time.

LIVESTOCK ILLNESS EFFECTS ON NUTRIENT SHADOW PRICES

$$P_{l,h} = \alpha_l + \beta_1 I_{v,m} + \beta_2 THM_h + \varepsilon_h$$

- *I* represents village *v* average livestock illness occurrence in month *m*
- *THM* represents total household members in household *h*
- *ε* represent the stochastic error component for household *h*
- β_1 represents the estimable parameter of interest for livestock health effects on the shadow price $P_{l,h}$ for nutrient *l* in household *h*
- *Cov(β)* is estimated using the Newey and West (1987) Heteroskedastic and Autocorrelation Consistent Covariance Estimator

Table 1: Variable Summary Statistics ($N = 1078$)

	Dietary Proportion (%)			Shadow Price (Ksh/g)				
	Protein	Lipids	Carbohydrates	Protein	Lipids	Carbohydrates	Household Livestock Illness Average	Total Household Members
mean	0.1433	0.1116	0.7451	0.4374	0.5938	0.0936	1.1531	4.8692
std	0.0338	0.0577	0.0736	0.2878	0.4020	0.1525	0.2412	2.3239
min	0.0066	0.0293	0.0345	0.0095	0.0041	0.0012	0.0000	1.0000
max	0.5321	0.9588	0.9046	2.8381	4.9541	3.2035	3.0000	17.0000

Note: Nutrient shadow prices are computed as share-weighted consumption-expense ratios and provide nutrient consumption costs in terms of Ksh/g. Sample data spans February 2013 - July 2016. Nutrient Shadow prices are deflated using the February 2013 Kenya CPI. Livestock illness village averages are computed for each time period and averaged over the sampling period, representing the average number of ill livestock per household across all villages.

Table 2: Bovine Health Effects on Nutrient Shadow Prices

Dependent	Independent	Coef	Std Errors	t-value	$Pr(>\|t\|)$	
Protein	Intercept	0.3197	0.0617	5.1796	0.0000	***
	Livestock Illness Avg	**0.1113**	0.0507	2.1934	0.0283	**
	Total HH Members	-0.0044	0.0058	-0.7659	0.4438	
Lipids	Intercept	0.4172	0.0934	4.4678	0.0000	***
	Livestock Illness Avg	**0.1210**	0.0726	1.6658	0.0958	*
	Total HH Members	0.0047	0.0071	0.6541	0.5131	
Carbohydrates	Intercept	0.0647	0.0162	3.9961	0.0001	***
	Livestock Illness Avg	**0.0341**	0.0142	2.4110	0.0159	**
	Total HH Members	-0.0031	0.0024	-1.2785	0.2011	

Note: OLS specified regression results for bovine livestock health effects on costs of nutrient consumption at the household level. Covariance matrix is estimated using the Newey and West (1987) Heteroskedastic and Autocorrelation Consistent Covariance Estimator. {***,**,*} significant at the {.01, .05, .1} level.

Table 3: Sheep Health Effects on Nutrient Shadow Prices

Dependent	Independent	Coef	Std Errors	t-value	$Pr(>\|t\|)$	
Protein	Intercept	0.3072	0.0627	4.8987	0.0000	***
	Livestock Illness Avg	**0.1405**	0.0601	2.3364	0.0195	**
	Total HH Members	-0.0047	0.0064	-0.7417	0.4582	
Lipids	Intercept	0.3334	0.0871	3.8271	0.0001	***
	Livestock Illness Avg	**0.1820**	0.0675	2.6980	0.0070	***
	Total HH Members	0.0133	0.0081	1.6417	0.1006	
Carbohydrates	Intercept	0.0706	0.0182	3.8862	0.0001	***
	Livestock Illness Avg	**0.0455**	0.0263	1.7281	0.0840	*
	Total HH Members	-0.0055	0.0045	-1.2164	0.2238	

Note: OLS specified regression results for sheep livestock health effects on costs of nutrient consumption at the household level. Covariance matrix is estimated using the Newey and West (1987) Heteroskedastic and Autocorrelation Consistent Covariance Estimator. {***,**,*} significant at the {.01, .05, .1} level.

Table 4: Goat Health Effects on Nutrient Shadow Prices

Dependent	Independent	Coef	Std Errors	t-value	$Pr(>\|t\|)$	
Protein	Intercept	0.5620	0.1400	4.0134	0.0001	***
	Livestock Illness Avg	-0.0363	0.0605	-0.5994	0.5489	
	Total HH Members	-0.0088	0.0152	-0.5810	0.5613	
Lipids	Intercept	0.7038	0.2005	3.5097	0.0004	***
	Livestock Illness Avg	-0.0495	0.1005	-0.4925	0.6223	
	Total HH Members	-0.0009	0.0195	-0.0459	0.9634	
Carbohydrates	Intercept	0.1469	0.0506	2.9045	0.0037	***
	Livestock Illness Avg	-0.0373	0.0270	-1.3785	0.1681	
	Total HH Members	0.0013	0.0074	0.1749	0.8612	

Note: OLS specified regression results for goat livestock health effects on costs of nutrient consumption at the household level. Covariance matrix is estimated using the Newey and West (1987) Heteroskedastic and Autocorrelation Consistent Covariance Estimator. {***,**,*} significant at the {.01, .05, .1} level.

Sustainability in Action: Observations From Year One of the Integrity Beef Sustainability Pilot Project

Myriah D. Johnson, Deke O. Alkire, Sharon K. Bard and Ryan C. Feuz*

Abstract

The aim of the Integrity Beef Sustainability Pilot Project is to improve the sustainability of the entire beef production value chain. In this two-year project, cattle were managed according to the U.S. Roundtable for Sustainable Beef metrics. Cattle were tracked, allowing for data collection throughout the animal's entire life. In year one, 2,246 head from 14 ranches participated. Herd health and preconditioning information were captured from cow-calf producers. Animal performance and carcass characteristics were also tracked throughout the feedyard and packer phases. Data were analyzed using R (v. 3.5.0). Respiratory vaccines were grouped by manufacturer and bacterin component presence. Effects of weaning weight, calculated feedyard average daily gain, feed efficiency, hot carcass weight, dressing percentage, yield grade, ribeye area and marbling score, plus respiratory viral and bacterin vaccine status on number of health treatments in the feedyard, were determined by linear regression with days preconditioned and initial weight as covariates. The effect the number of treatments in the feedyard had on dependent variables of interest was also determined by regression.
Growth performance in the feedyard decreased each time an animal was pulled for illness ($p<0.05$). All carcass traits, except yield grade, were negatively impacted each time an animal was pulled ($p<0.05$). There were 921 total pulls, including animals pulled multiple times. Interestingly, the number of viral vaccines an animal received prior to entering the feedyard had no effect on the number of times the animal was pulled for illness ($p>0.05$). Feedyard profitability for project cattle and contemporary cattle on feed was estimated. Steers were $11 per head more profitable than their peers, while heifers were $23 per head less profitable. Managing calves' sustainability resulted in similar health in the feedlot phase. However, vaccinating above industry standards did not result in improved health, suggesting the need for alternative management strategies.
Are we talking about one animal here or multiple? The sentences starts with "an animal received," singular and then says "number pulled for illness," insinuating multiple.

Introduction

The Integrity Beef Sustainability Pilot Project aims to improve the sustainability of the entire beef production value chain and act as a model for the U.S. beef industry. Utilizing the U.S. Roundtable for Sustainable Beef (USRSB) metrics, vision and indicators as a guide, this project integrates all phases of the beef supply chain. To improve the sustainability of the beef industry, all production levels must work together. This two-year project engages the full beef supply chain to test the USRSB metrics and explore scalable solutions that could be applicable to beef producers across the country.
Integrity Beef is a land and cattle management program created by Noble Research Institute's consulting group. These protocols help cattle producers optimize beef cattle production while sustainably managing their land resources. Specifically, this program focuses on grazing management, cattle genetics, animal health, humane treatment and marketing strategies.

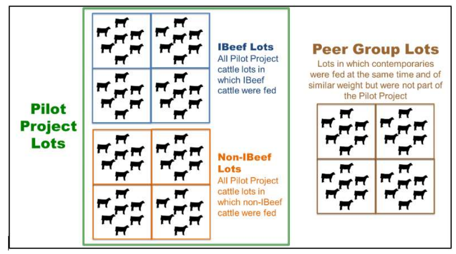
Objectives

Objectives of this project were to:

- Determine health differences between sustainably managed cattle and peers
- Quantify the effects of illness on growth performance, carcass characteristics and profitability
- Determine profitability differences between sustainably managed cattle and peers

Methods

Data were collected on 2,246 calves, each fitted with a unique, electronic identification tag.
Fourteen ranches provided the following data for year one: sex, herd health records, all vaccines administered and preconditioning information. Seventy percent of the project cattle were purchased from Integrity Beef (IBeef) herds. The remaining cattle (Non-IBeef) were purchased from ranchers willing to provide the necessary ranch-level information. This allowed for a comparison group with complete production data.



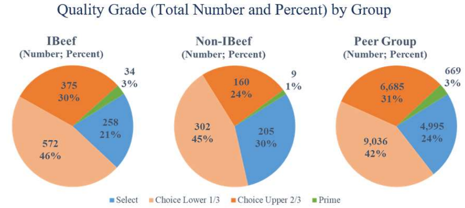
Additionally, only summary data were available from the feedyard for all other calves on feed at the same time (Peer). Therefore, statistical differences were not determined between the peer group and project groups but are included for numerical comparisons.
Feedyard data included starting and final body weight, days on feed, feed intake, total cost of gain and occurrence of illness.
Packer data included hot carcass weight, dressing percentage, yield grade, marbling score and ribeye area.

	--- Project Cattle ---		
	IBeef	**Non-IBeef**	**Peer Group**
Number of Lots	**23**	**4**	**338**
Total Number of Cattle	**1,588**	**658**	**43,263**
In Weight (lbs/hd)			
Heifers	721	671	747
Steers	761	728	753
Out Weight (lbs/hd)			
Heifers	1,253	1,239	1,232
Steers	1,413	1,410	1,367

	---------- Project Cattle ----------					
	--- IBeef ---		-- Non-IBeef --		-- Peer Group --	
	Heifers	Steers	Heifers	Steers	Heifers	Steers
Hot Carcass Weight† (lbs)	760	852	761	853	777	869
Dressing Percentage *† (%)	63.9	63.5	63.4	62.9	N/A	N/A
Yield Grade†	2.71	3.00	2.78	3.07	2.61	2.54
Marbling Score	485	479	456	450	496	456
Ribeye Area† (sq. inches)	12.90	13.20	13.00	13.30	13.48	14.13

* IBeef vs Non-IBeef: p=0.001 †Steers vs Heifers: p=0.001

Quality Grade (Total Number and Percent) by Group



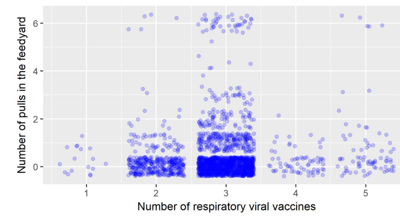
Results and Discussion

Growth performance and feed efficiency in the feedyard decreased each time an animal was pulled for illness. In addition, all carcass traits, except yield grade, were negatively impacted each time an animal was pulled.

	Number of times treated for illness in the feedyard			
	0	**1**	**2**	**3**
ADG*	3.41	3.32	3.23	3.14
F:G*	5.84	5.90	5.95	6.01
HCW*	873	845	817	789
Dressing %*	64.3	64.2	64.1	64.0
YG*	2.5	2.3	2.1	1.9
Marbling*	476	446	416	386
REA†	14.50	14.38	14.25	14.13

* p=0.001 † p=0.05

The number of viral vaccines an animal received prior to entering the feedyard had no effect on the number pulled for illness.



A profit proxy was estimated for the Project Cattle and Peer Group Cattle as shown below.

	IBeef and Non-IBeef Cattle Only		**Peer Group Cattle Only**
	Sales, $/head (based on Tyson's grid pricing)		Sales, $/head (based on Tyson's grid pricing)
Minus	Purchase Price, $/head (based on actual prices paid for project cattle)	Minus	Purchase Price, $/head (based on USDA-reported cash feeder cattle prices and a price slide within each weight class)
Minus	Cost of Gain, $/head (based on ILS information)	Minus	Cost of Gain, $/head (based on ILS information)
	Profit Proxy, $/head		Profit Proxy, $/head

IBeef steers were similar in profitability to the Peer Group steers. Non-IBeef steers were the least profitable, losing more per head compared to the Peer Group and IBeef steers.
The Peer Group heifers were the most profitable, with the Non-IBeef heifers being the least profitable. The IBeef he IBeef steers were similar in profitability to the Peer Group steers. Non-IBeef steers were the least profitable, losing more per head compared to the Peer Group and IBeef steers.
The Peer Group heifers were the most profitable, with the Non-IBeef heifers being the least profitable. The IBeef heifers were more profitable than Non-IBeef, but still lost more than the Peer Group heifers.
ifers were more profitable than Non-IBeef, but still lost more than the Peer Group heifers.

Conclusions

- Calves that experienced illness in the feedlot had decreased growth and carcass performance.
- Calculated profitability in the feedlot phase was similar for sustainably managed and peer cattle.
- Managing calves sustainability resulted in similar health in the feedlot phase.
- However, vaccinating above industry standards did not result in improved health suggesting the need for alternative management strategies.

Acknowledgements

Modelling *Salmonella* spread in broiler production: Identifying determinants and control strategies

Pedro Celso Machado Junior[1*], Amy Hagerman[1] and Chanjin Chung[1]

[1]Department of Agricultural Economics, Oklahoma State University, *pedrocm@okstate.edu

Introduction

Poultry meat is the world's most consumed and affordable meat type among animal sources (OECD-FAO, 2018).

Consumption of contaminated poultry meat has been linked to foodborne diseases and *Salmonella spp.* figures among the main etiological agents (Painter et al., 2013).

Salmonella spp. contamination at the production site (farm level) is an important source of carcass contamination (Volkova et al., 2010; Vandeplas et al., 2010).

Risk factors for *Salmonella spp.* isolation are related to hygiene measures and management practices (Namata et al, 2009; Le Bouquin et al, 2010).

Few studies use longitudinal field data to identify risk factors related to *Salmonella spp.* isolation in litter before slaughter.

Longitudinal data requires proper approach to account for spatial and time autocorrelation.

Objectives

Determine risk factors related to *Salmonella spp.* isolation from litter of broiler flocks serving an integrated broiler enterprise in southern Brazil:

- Covariates related to consistently recorded farm characteristics and practices;
- Spatial and temporal random effects

Discuss potential control strategies and economic implications for the enterprise

Methods

Data

Salmonella spp. isolation from litter of 139 broiler houses from three consecutive flocks: 417 observations.

Isolation from drag swabs collected 14 days before slaughter: dichotomous variable.

Unique GPS identification for each broiler house: neighborhood matrix established by Euclidean distance (20km cut-off point).

Model

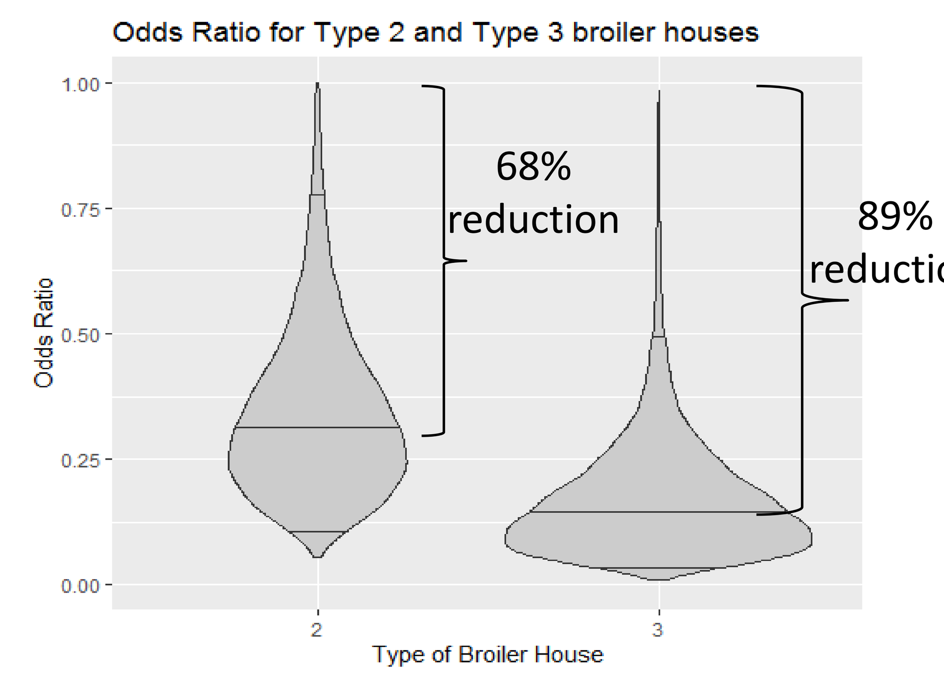
Bayesian hierarchical binomial logistic regression model (Napier et al., 2016): $\ln\left(\frac{\theta_{kt}}{1-\theta_{kt}}\right) = X'_{kt}\,\beta + \varphi_{kt} + \delta_t$,

Where θ_{kt} is the probability of detecting *Salmonella spp* in litter of the *k-th* broiler house at time *t*, X is a vector of p covariates, β are regression coefficients, φ_{kt} and δ_t are spatial and time specific random effects.

Covariates evaluated

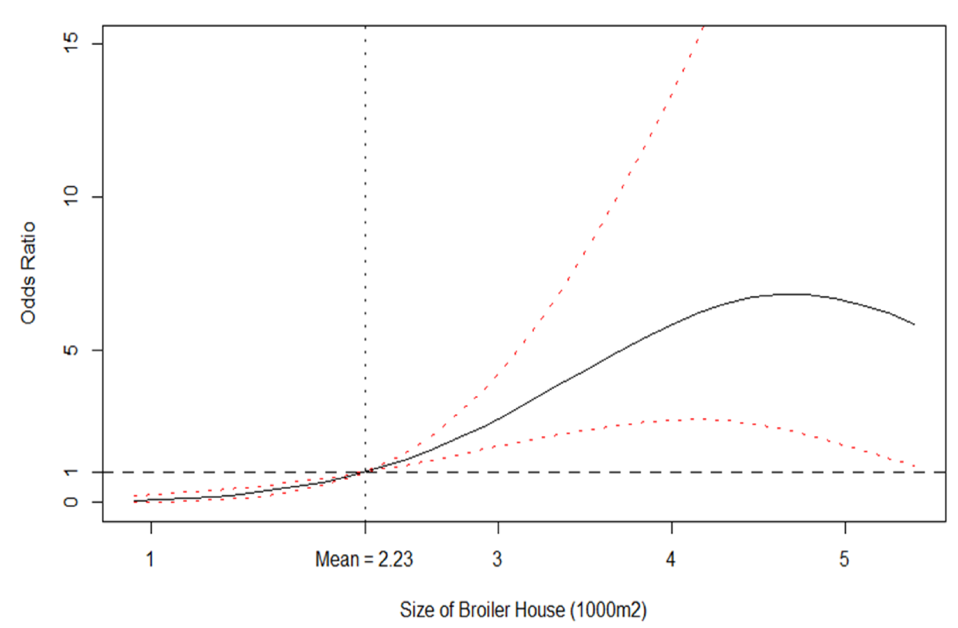
- Size of broiler house ($1000m^2$)
- Type of broiler house: Type 1 → conventional house with curtains, building age > 5 years;
  Type 2→ conventional house with curtains, building age< 5years;
  Type 3→ dark house with climate control.
- Number of litter recycles
- Total housing size/farm, number of houses/farm; presence of livestock, dogs and crops.

Results



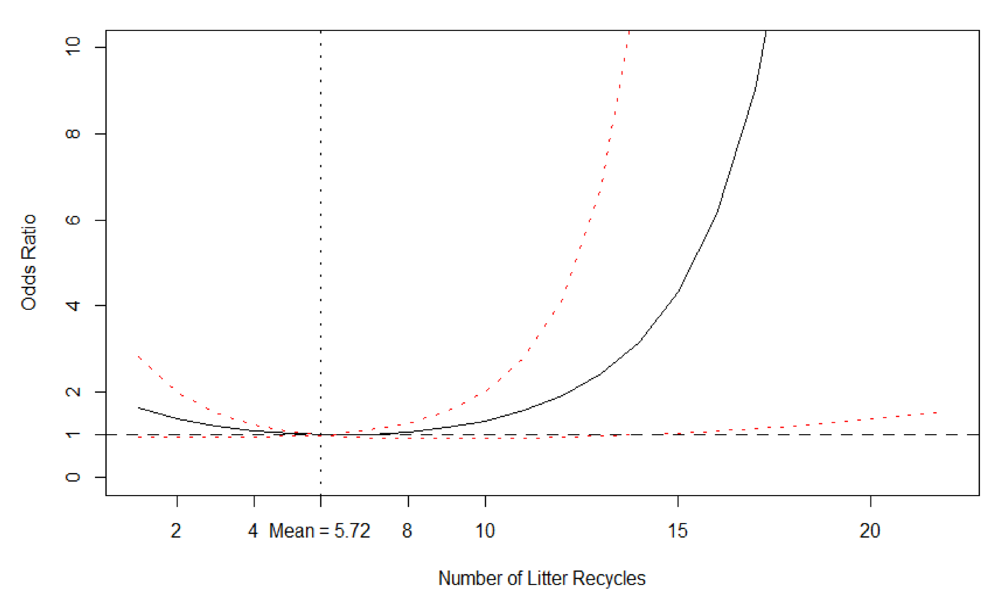
Posterior median and 95% credible intervals marked inside plots

- Violin plots showing the posterior density for calculated odds ratio of isolating *Salmonella spp.* from litter of types 2 and 3 broiler houses with respect to type 1.
- Isolating *Salmonella spp.* from type 2 houses is 68% less likely than from type 1 .
- For type 3 broiler houses, the odds of isolating *Salmonella spp.* is even lower (89% less likely).



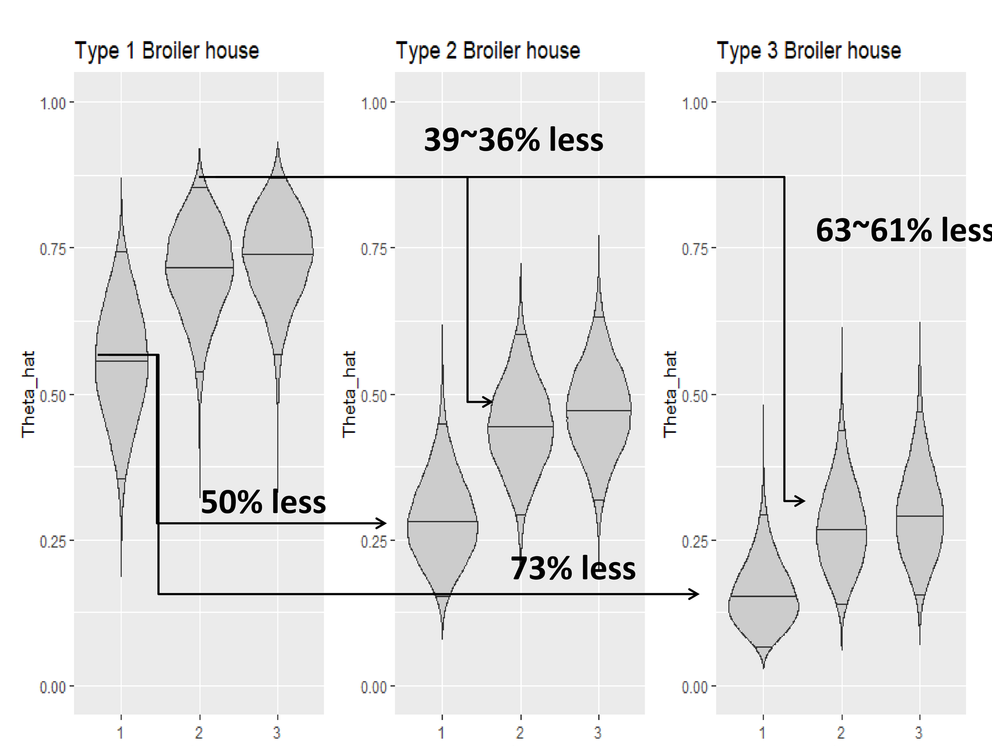
Posterior median (solid lines) and 95% credible intervals (dashed)

- Odds Ratio calculated with respect to the mean house size ($2230m^2$)
- Quadratic effect identified.
- High variation after $3000m^2$
- Odds of isolating *Salmonella spp.* is lower for small houses
- Effect may be related to number of birds (not only density).
- Quadratic effect may be influenced by type of broiler house



Posterior median (solid lines) and 95% credible intervals (dashed)

- Odds Ratio calculated with respect to the mean number of recycles (5.72)
- Quadratic effect identified.
- High variation after 10 recycles
- Odds of isolating *Salmonella spp.* increases exponentially after 10 recycles
- Initial reduction may be related to litter microbial colonization



- calculated probability of isolating *Salmonella spp.* from litter of the three types of broiler houses across time, considering mean value of continuous covariates.
- Calculated probability for types 2 and 3 broiler houses on average 50 and 73% lower than type1 in the 1st cycle; 39-36% less for type 2 and 63-61% less for type 3 houses, in 2nd and 3rd cycles.
- Estimated raw prevalence was 32.37%, 53.32% and 55.39% for 1st, 2nd and 3rd cycles, respectively.

Examples of Types 1, 2 and 3 broiler houses

Discussion

Type of broiler house relates directly to the prevention of contamination from external sources (closed houses versus conventional) and to the efficiency of cleaning procedures (old versus new buildings).

Size of broiler house may be related to greater pathogen amplification in the advent of contamination, as bigger houses can accommodate more birds.

Litter recycles is a relevant risk factor: after 10 recycles, the risk of isolating *Salmonella spp.* seems to increase exponentially. It is known that efficiency of litter fermentation decreases with age, but there isn't a clear figure on the optimal number of recycles.

Significant positive time and spatial autocorrelation were observed in this study, underscoring the need to account for those effects to obtain efficient estimates for the covariates.

Salmonella spp. isolation from litter is a risk factor for carcass contamination at the processing plant and allows for specific control measures at that level. This leads to increased costs for the enterprise and translates into an economic problem.

Conclusion

Our findings suggest that an integrator will prefer to contract with farmers with more controlled and newer houses (types 2 and 3) to reduce risk of *Salmonella spp.* isolation in the field and consequent contamination at the processing plant. Integrator will likely prefer farms with more houses rather than few big houses and will also limit the number of litter recycles to not more than 10.

Future applications

The covariates affecting risk of pathogen detection can be used to specify a state space model to allow for simulating the spread of *Salmonella spp.* within the integrated broiler houses.

Estimation of costs of positive flocks, broiler house adequacy and litter replacement can be used to determine optimal number of recycles and proportion of broiler house types for the enterprise.

Acknowledgements

The first author is a grantee of the program Science Without Borders, sponsored by the National Council for Scientific and Technological Development (CNPq), Brazil.

References

OECD-FAO Agricultural Outlook 2018-2027.

Le Bouquin, S., V. Allain, S. Rouxel, I. Petetin, M. Picherot, V. Michel, and M. Chemaly. 2010. "Prevalence and risk factors for Salmonella spp. contamination in French broiler-chicken flocks at the end of the rearing period." *Preventive Veterinary Medicine* 97(3–4):245–251.

Namata, H., S. Welby, M. Aerts, C. Faes, J.C. Abrahantes, H. Imberechts, K. Vermeersch, J. Hooyberghs, E. Méroc, and K. Mintiens. 2009. "Identification of risk factors for the prevalence and persistence of Salmonella in Belgian broiler chicken flocks." *Preventive Veterinary Medicine* 90(3–4):211–222.

Napier, G., D. Lee, C. Robertson, A. Lawson, K.G. Pollock, A.B. Lawson, and Y. MacNab. 2016. "A model to estimate the impact of changes in MMR vaccine uptake on inequalities in measles susceptibility in Scotland." In *Statistical Methods in Medical Research*. pp. 1185–1200.

Vandeplas, S., R.D. Dauphin, Y. Beckers, P. Thonart, and A. Théwis. 2010. "Salmonella in Chicken: Current and Developing Strategies To Reduce Contamination at Farm Level." *Journal of Food Protection* 73(4):774–785.

Volkova, V. V., R.H. Bailey, M.L. Rybolt, K. Dazo-Galarneau, S.A. Hubbard, D. Magee, J.A. Byrd, and R.W. Wills. 2010. "Inter-relationships of Salmonella Status of Flock and Grow-Out Environment at Sequential Segments in Broiler Production and Processing." *Zoonoses and Public Health* 57(7–8):463–475.

Measurement of disease burden : the use of economic meta-analyses

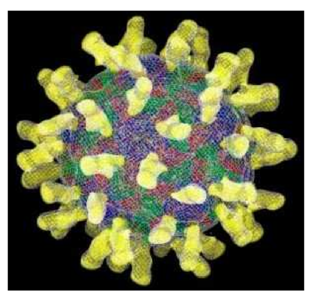
D. Raboisson , A. Ferchiou, JJ. Minviel, S. Garcia, T. Gautier, B. Pinior
INRA, UMR IHAP, Ecole Nationale Vétérinaire de Toulouse (ENVT), France
Institute for Veterinary Public Health, University of Veterinary Medicine Vienna, Veterinärplatz 1, 1210 Vienna, Austria

d.raboisson@envt.fr

Introduction

What is the economic impact of burden of diseases ? → How meta-analyses could help to assess ? → Can meta-analyses identify the contributors of the cost & how mean cost is influenced ?

Materials and methods



3 meta-analyses

BVD production losses	Change in BVD production losses after new practices	**Clinical mastitis** total cost
19 publications 83 observations	6 publications 87 observations	9 publications 82 observations

Results

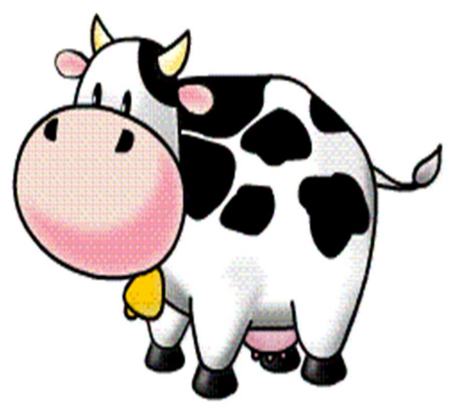
See Pinior et al. 2019. Transboundary & Emerging Diseases. Accepted

BVD production losses per cow and per year were :
- €42 on average
- €73 in cases of
  - high BVD introduction risk
  - low initial seroprevalence
  - high virus circulation intensity
  - high duration of circulation

Decrease in BVD production losses was :
- 8-13 % in cases of vaccination
- 29-30 % if high biosecurity
- Most of the decrease is yet lost in cases of biosecurity break

Costs per case of clinical mastitis were estimated at :
- €457 for Gram -
- €101 for Gram +
- €428 for *Escherichia coli*
- €74 for *Staphylococcus aureus*

- All failed to clearly highlight the link between the production losses and whether all the contributors of the losses were included in the raw data
- The mean monetary values of the different contributors of the production losses cannot be defined (for instance, the values of the contributors of €474 for G- mastitis)
- The economic input parameters of the raw data (input of published models) did not influence the mean production losses obtained in the meta-analyses.



Conclusions

The meta-analyses help to overview the economic value of the burden of diseases

The contributors of the average cost/losses cannot be overviewed by meta-analyses
(for the diseases studied here)
The raw data (input parameters) do not seem to influence the mean value of cost/losses

The extrapolation of the present results out of the context of the initial studies is consequently limited

We call for a **standardisation on how economic assessments are done and presented**

Center for Outcomes Research & Epidemiology

CORE

KANSAS STATE UNIVERSITY

USDA

United States Department of Agriculture
National Institute of Food and Agriculture