

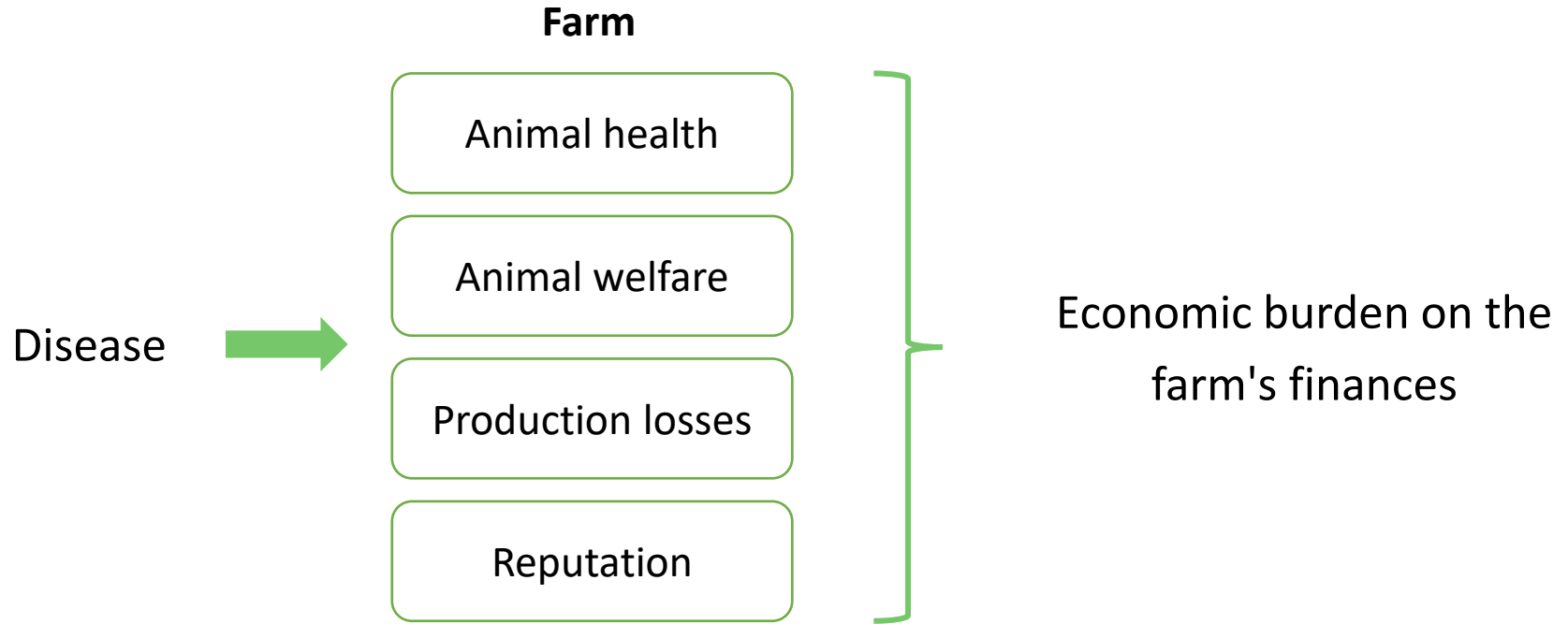
Cost-Effective Biosecurity: Supporting informed decision-making

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Impact of diseases



Motivation to implement biosecurity



Decision-making

Experience

Social
pressure

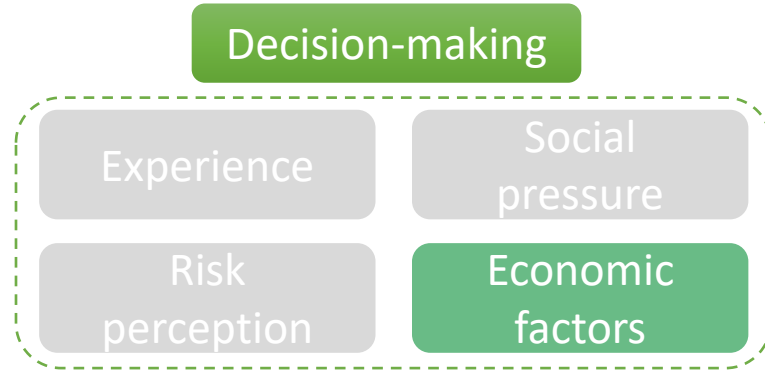
Risk
perception

Economic
factors



Motivation to implement biosecurity

When linked to **benefits**,
biosecurity costs may not be
seen as a barrier.



Motivation to implement biosecurity

- Estimating the **cost-benefit of biosecurity** is of paramount importance
- **Effective communication** by the farm advisor
- Limited research on this area

Aim

Estimate the **most profitable decision to improve biosecurity** to support informed decision making and to encourage farmers and their veterinarians.

Material and methods

Decision analysis at farm-level in dairy cattle:

- 1 Cost of biosecurity
- 2 Cost of disease introduction
- 3 Risk of introduction of diseases

Material and methods

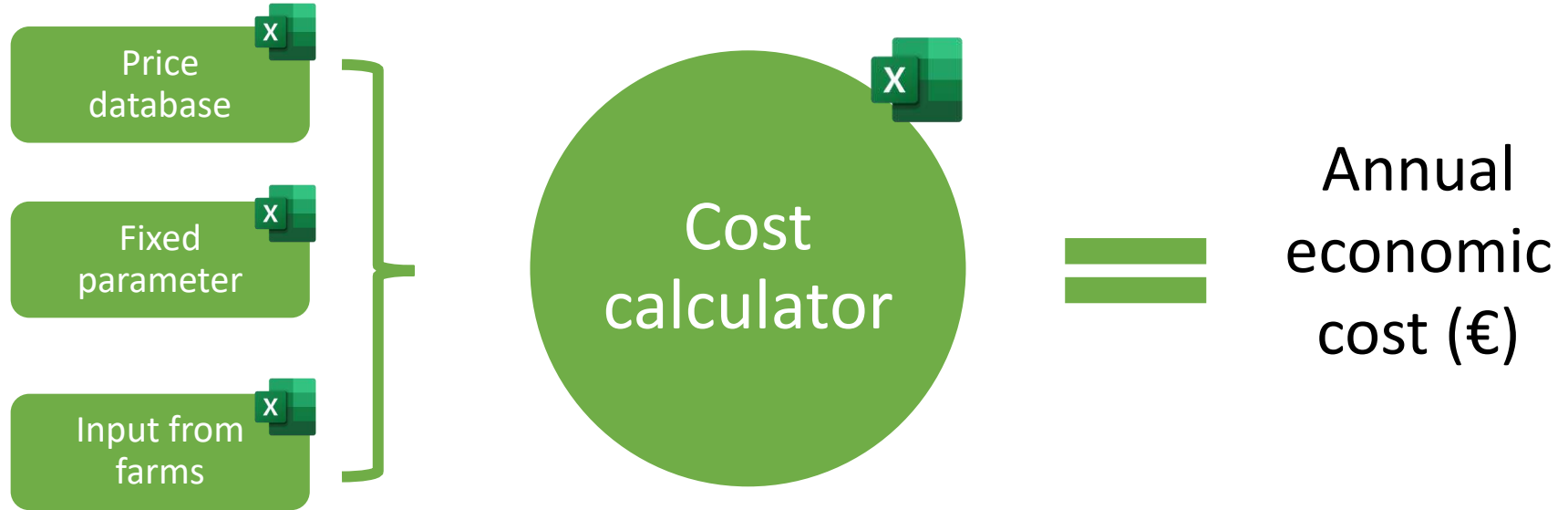
Bovine Viral Diarrhoea (BVD)

- Impact on dairy herd parameters

The image displays five scientific article thumbnails related to Bovine Viral Diarrhoea (BVD):

- Preventive Veterinary Medicine**, Volume 382, September 2020, 105652. Article: **Modelling the economics of bovine viral diarrhoea virus control in pastoral dairy and beef cattle herds**. Authors: Jun-Hyeon Han, Jenny F. Weston, Cori Heuer, M. Carolyn Gales.
- Preventive Veterinary Medicine**, Volume 211, 12 September 2021, Pages 27-33. Article: **A matched case-control study comparing udder health, production and fertility parameters in dairy farms before and after the eradication of Bovine Virus Diarrhoea in Switzerland**. Authors: A. Tschopp, B. Dubs, M. Roten, S. Wanda, S. Thurner, S. Schönbach-Rogala, M. Mosler.
- Journal of Dairy Science**, Volume 104, Issue 2, February 2021, Pages 2059-2066. Article: **The effect of bovine viral diarrhoea virus introduction on milk production of Dutch dairy herds**. Authors: Klaasjan Van, Wilma Steenwerf, Merelien van der Zant, Gerda van Schaik, Johannes C.M. Vermeij, Linde van Duyn, Anouk M.B. Verhulst, Henk Hogeveen.
- Preventive Veterinary Medicine**, Volume 210, January 2020, Pages 123-130. Article: **Influence of new infection with bovine virus diarrhoea virus on udder health in Norwegian dairy cows**. Author: S. Waage.
- Biological**, Volume 13, October 2, June 2003, Pages 137-144. Article: **Economic impact of BVDV infection in dairies**. Author: Hans Houder.

1 Estimating the cost of BSM



1

Cost calculator



Cost
calculator

- 1 Inventory of specific BSM for each pathway of introduction



1

Cost calculator

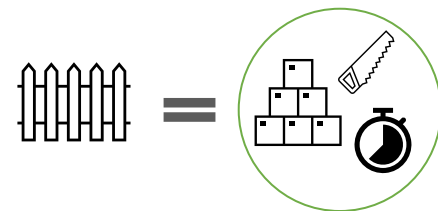


Cost
calculator

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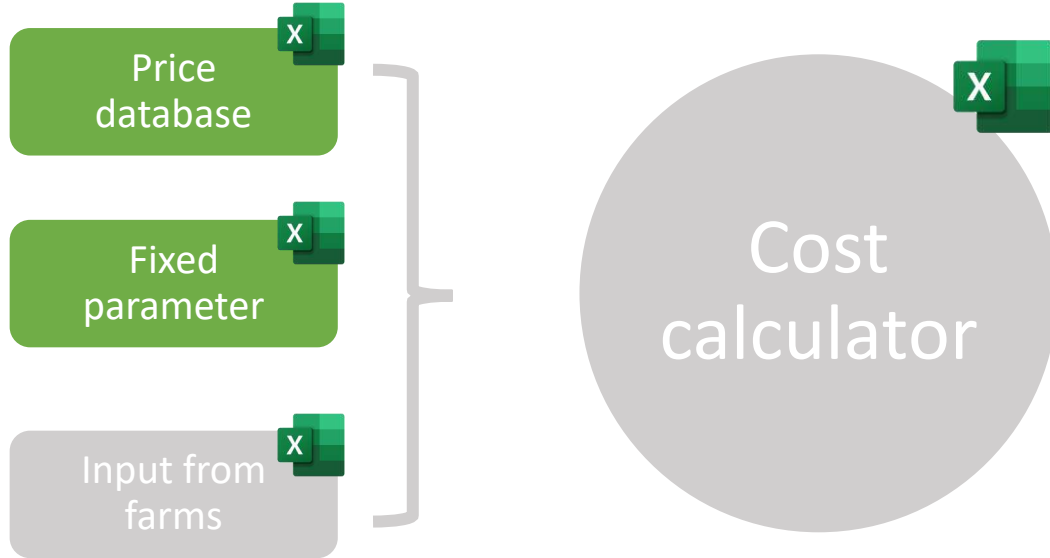


2 Breakdown of biosecurity measures into items



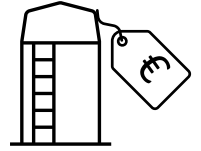
1

Inputs for the cost calculator



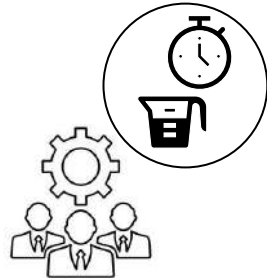
Market price

- Public suppliers
- Useful life



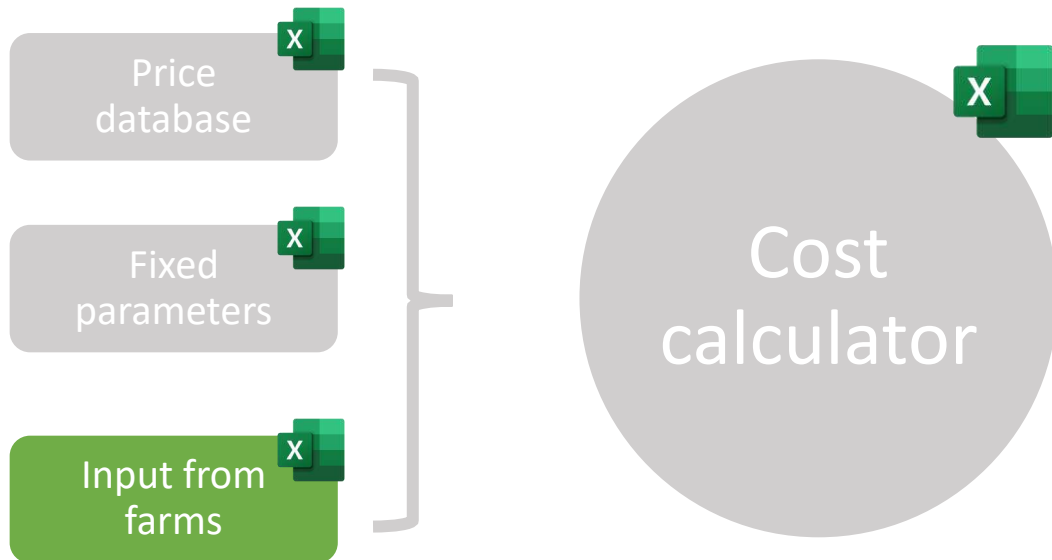
Fixed parameters

- Literature
- Experts





1 Inputs for the cost calculator



Questionnaire

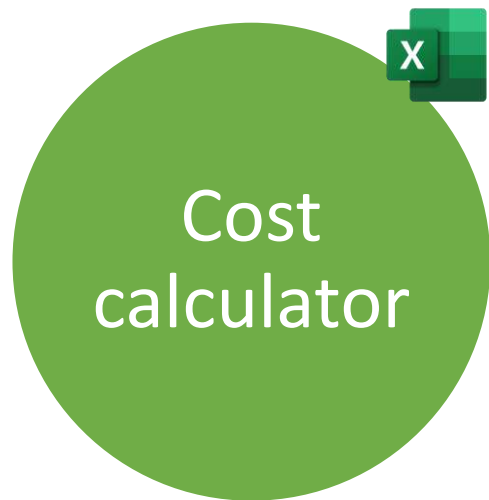
- Addressed to farmers and veterinarians
- General farm information
- Relevant data on the four introduction pathways

1

Cost calculator

Pathway of introduction	Biosecurity measure
Animal introduction	Quarantine
	Transport of incoming animals
	Diagnostic testing for incoming animals
Farm access by visitors and vehicles	Farm perimeter fencing
	Visitor control
	Transport of outgoing animals
	Mortality management
	Worker hygiene protocols
Feed storage and water treatment	Feed storage
	Drinking water treatment
Pest control	Rodent control
	Flying and crawling insect control

1 Estimating the cost of BSM



Outputs

- Total cost (amortized)
- Cost breakdown by section (amortized)
- Cost per cow (amortized)

2

Estimating the impact of BVD

Model developed by SimHerd

- Mechanistic, dynamic, and stochastic
- Estimates consequences of parameter changes



<https://simherd.com/>

2

Estimating the impact of BVD

Cost of BVD outbreak:

Difference in gross margin (GM) → (first 5 years of simulation)

- Farm under current conditions

2

Estimating the impact of BVD

Cost of BVD outbreak:

Difference in gross margin (GM) → (first 5 years of simulation)

- Farm under current conditions
- **Scenario** with modified parameters

Estimating the impact of BVD

Parameter	Change in parameter	Reference
Mastitis incidence	7% (+)	(Waage, 2000)
Conception rate	30% (-)	(Han et al., 2020; Houe et al., 1993)
Milk yield	2% (-)	(Tschopp et al., 2017 ; Yue et al., 2021)

^a Mean value of the parameter reduction reported in literature.

3

Estimating the probability of BVD introduction

- Quantitative risk analysis model
- Prioritization of biosecurity measures based on their impact

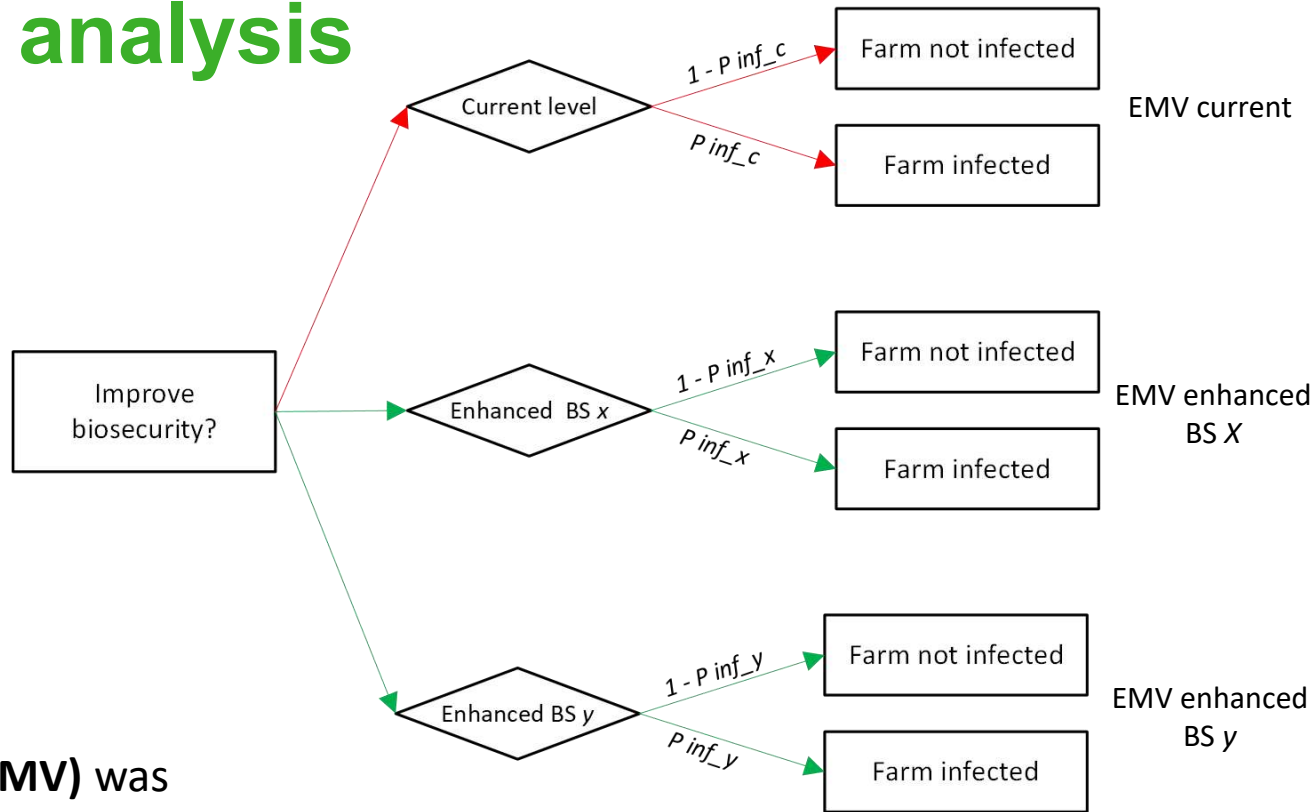


FARMR!SK

Ciria et al., 2024

Decision Tree analysis

- Potential cost of each node 1 2
- Probability of occurrence 3



Expected monetary value (EMV) was calculated for each branch

$$EMV_{(i)} = P_{inf_{(i)}} * [Cost_{EBS_{(i)}} + Cost_{outbreak}] + (1 - P_{inf_{(i)}}) * Cost_{EBS_{(i)}}$$

Data collection

3 farms visited:

BVD (-)

Variable	Farm A	Farm B	Farm C
Number of cows	724	247	79
Kg ECM per cow-year	13,141	13,602	9,567



1 Results – Farm biosecurity cost

	Farm A	Farm B	Farm C
Current biosecurity cost			
Total cost	74,679.51 €	25,237.68 €	42,480.99 €
Amortized cost	19,968.59 €	11,014.85 €	5,696.79 €
Amortized cost per cow	27.58 €	44.59 €	72.11 €

1 Results – Farm biosecurity cost

	Farm A	Farm B	Farm C
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2 Results – Cost of BVD outbreak

Outbreak scenario reduced the average GM (first 5yrs):

Farm	BVD outbreak cost at farm level	Reduction in the average GM
Farm A	-153,871 €	-6.0%
Farm B	-46,386 €	-5.7%
Farm C	-8,977 €	-5.9%



3 Results – Risk of BVD introduction

Risk of BVD introduction (current situation):

Farm A: 2.66% (95% CI: 0.99–5.67)

Farm B: 15.70% (95% CI: 10.1–21.5)

Farm C: 0.36% (95% CI: 0.15–0.73)

FARMRISK

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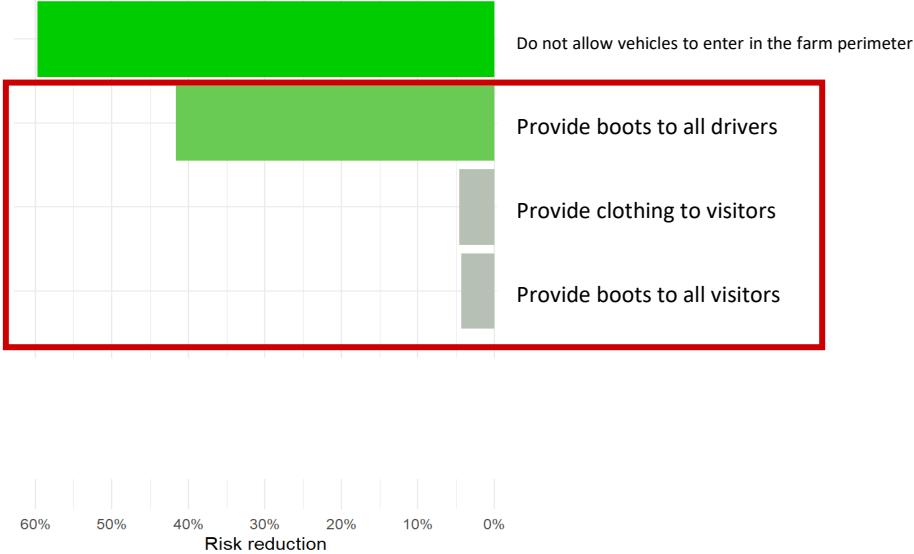
FARMRISK

HR
pathways:

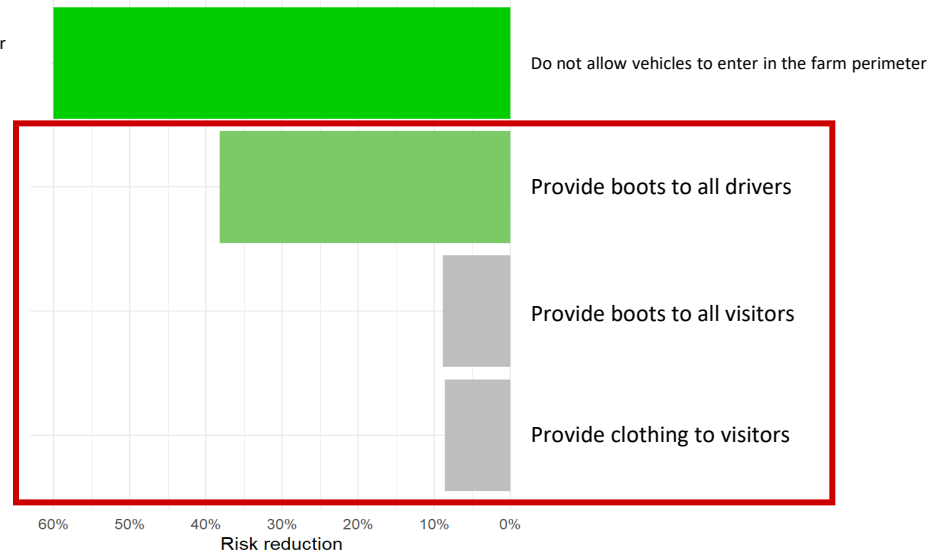


3 Results – Risk of BVD introduction

Farm A

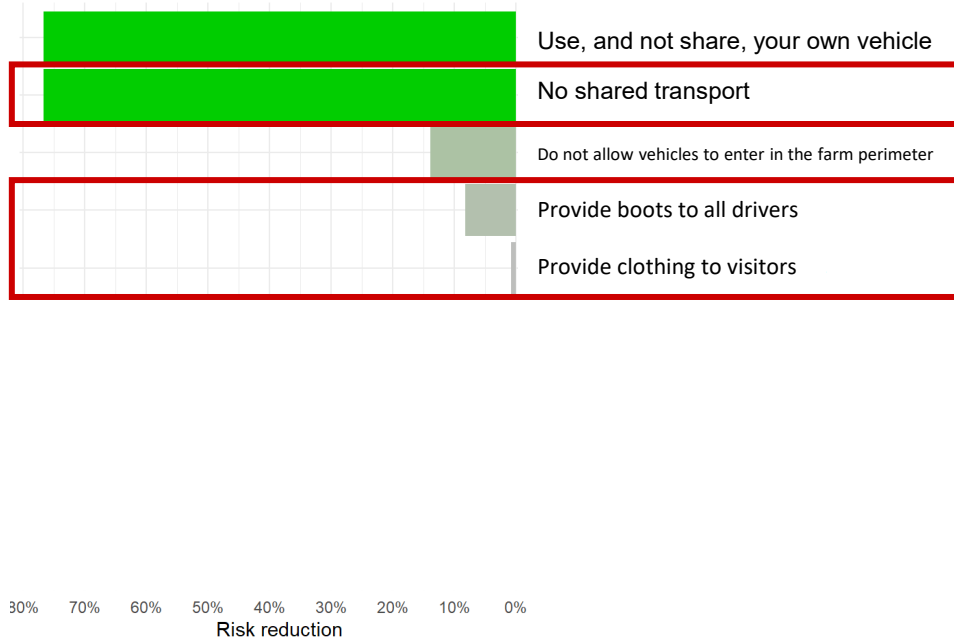


Farm C



3 Results – Risk of BVD introduction

Farm B



Results – Decision analysis

Farm A → Current risk **2.66%**

Biosecurity scenarios:		Final risk		EMV dif. ^a
Provide boots to all drivers	➔	1.55%	==	1,680 € (+7.0%)
Provide clothing to visitors	➔	2.54%	==	162 € (+0.7%)
Provide boots to all visitors	➔	2.55%	==	152 € (+0.6%)

^a Differences in EMV relative to the current biosecurity level (€)

Results – Decision analysis

Farm B → Current risk **15.7%**

Biosecurity scenarios:		Final risk		EMV dif. ^a
No shared transport	→	3.67%	=	381 € (+2.1%)
Provide boots to all drivers	→	14.40%	=	576 € (+3.1%)
Provide clothing to visitors	→	15.57%	=	33 € (+0.2%)

^a Differences in EMV relative to the current biosecurity level (€)

Results – Decision analysis

Farm C → Current risk **0.36%**

Biosecurity scenarios:		Final risk		EMV dif. ^a
Provide boots to all drivers	→	0.22%	=	0 € (0%)
Provide boots to all visitors	→	0.33%	=	-22 € (-0.4%)
Provide clothing to visitors	→	0.33%	=	-24 € (-0.4%)

^a Differences in EMV relative to the current biosecurity level (€)

Discussion and Conclusions

- The methodology identified the most cost-effective **biosecurity measure** for each farm based on its specific risk context
- **Lower-cost measures** (e.g. farm-specific boots/clothing) proved most cost-effective outcomes
- The smallest farm showed the **highest biosecurity cost per cow** → Explore support mechanisms
- **Economic impact of a BVD outbreak**: €114 - €213 per cow/year:
 - ✓ BSM also help prevent other endemic and exotic diseases → Benefits observed could be even greater

Special thanks to:

Farmers and veterinarians

Co-authors of the study:

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B. Højlund, J. Ettema & G. Ciaravino.

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Thank you for your attention



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