Complex Adaptive Systems (CAS)

An innovative method to work integrated towards sustainable systems

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Welcome

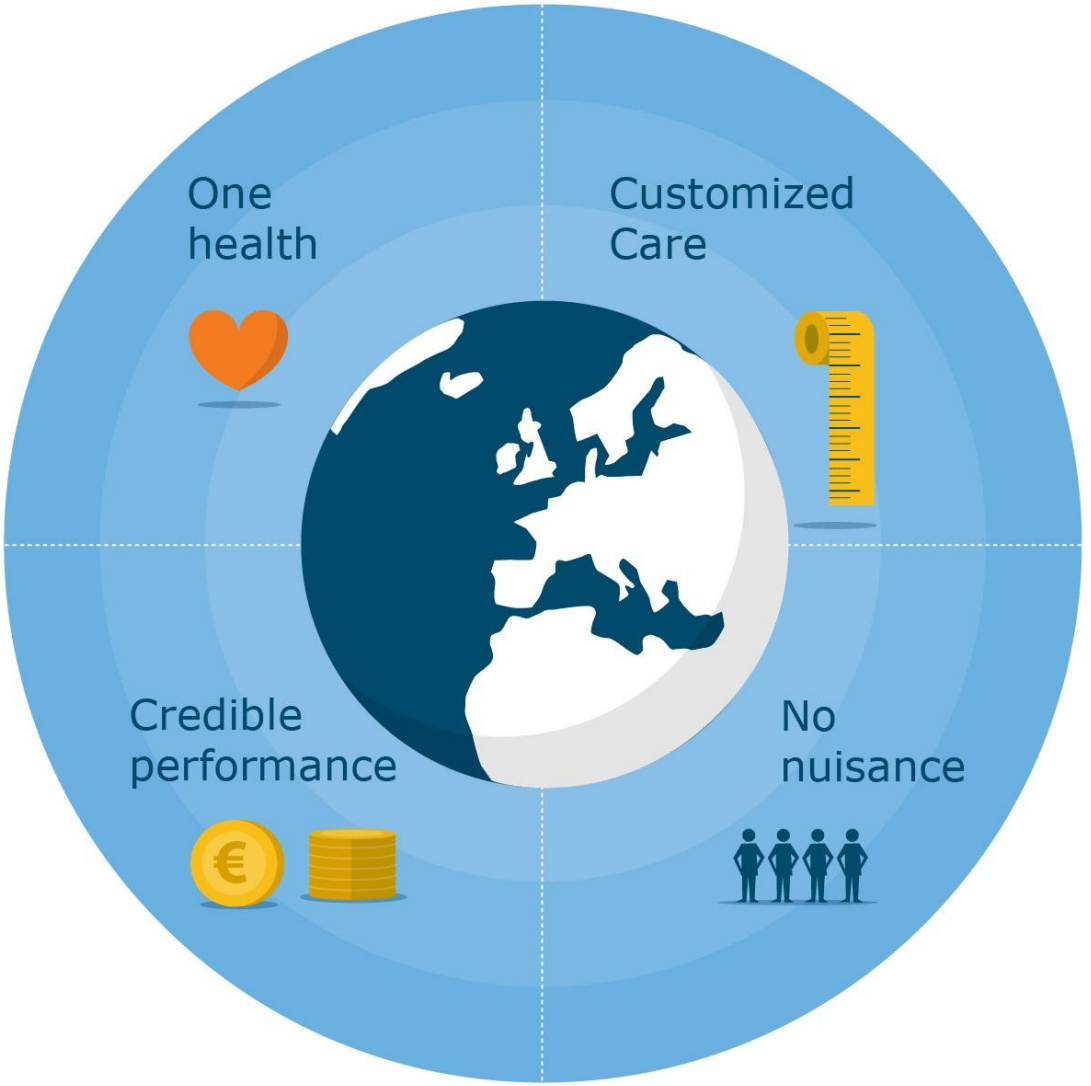
- Introduction
- Why do we want CAS?
- What are the principles of CAS?
- Some examples of what you can do with CAS
    - Udder Health
    - Tail biting pigs
- Conclusion

Why do we want a CAS systems approach?

We want to develop sustainable production systems

Livestock Farming with Care

(Scholten et al. NJAS, 2013)



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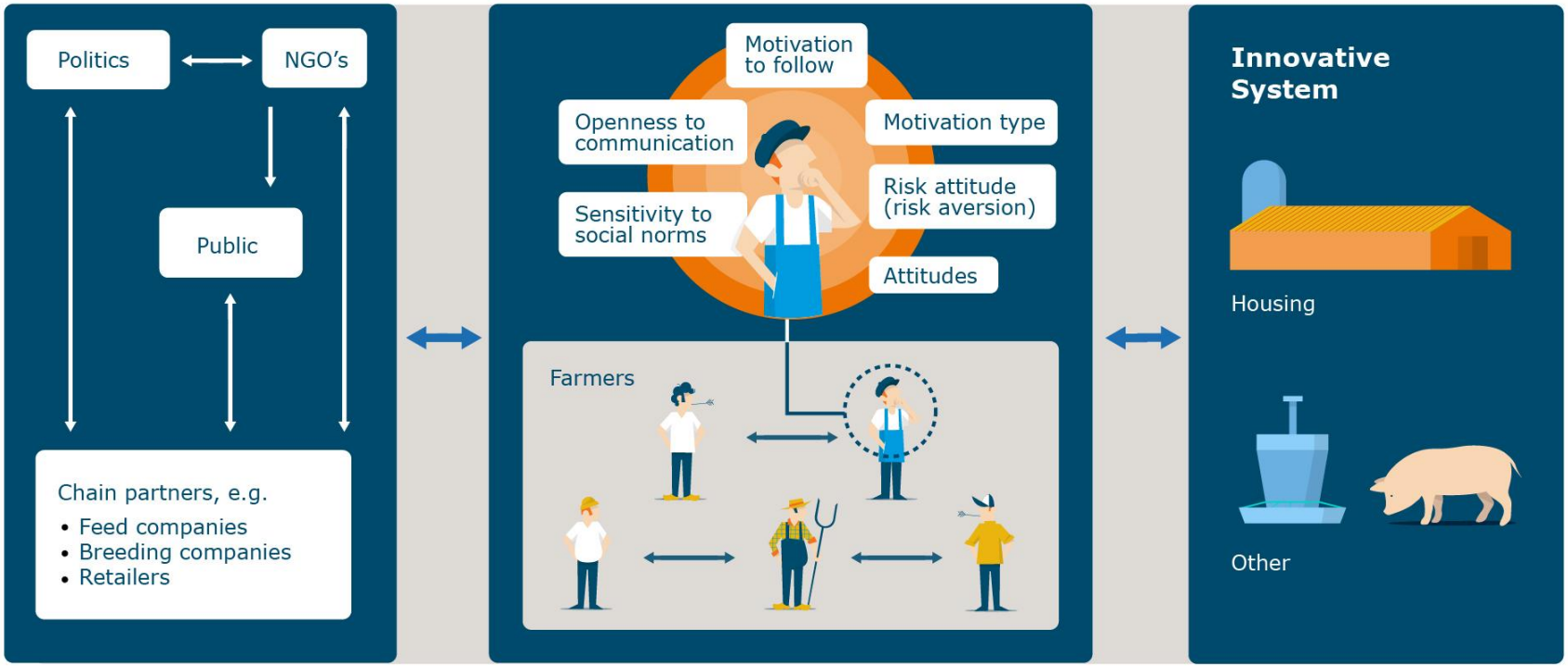
Aggregation levels involved in the development of sustainable systems:

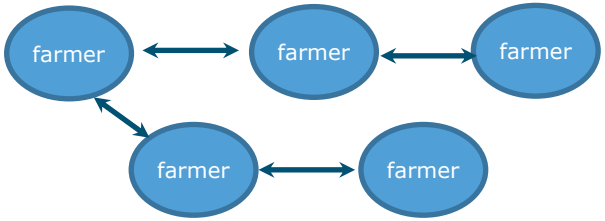


So, systems development is complex

- Heterogeneous stakeholder groups
- Within groups heterogeneous 'agents' with different underlying drivers
- 'Interaction & adaptation' between stakeholders.
- This leads to 'no, partial or total' adaptation for new systems developments.

‘Agent based modelling’ as model tool in CAS

- Heterogeneous stakeholders is modelled as an ‘agent’ with distinct drivers (‘identity’)



- In time ‘agents’ influence each other so they are adaptive

- In time this leads to new developments (emergence)

An example

Udder health management improvement

- Processors and governments are interested in motivating farmers to improve udder health
  - Tools: penalty system based on BMSCC, communication campaign

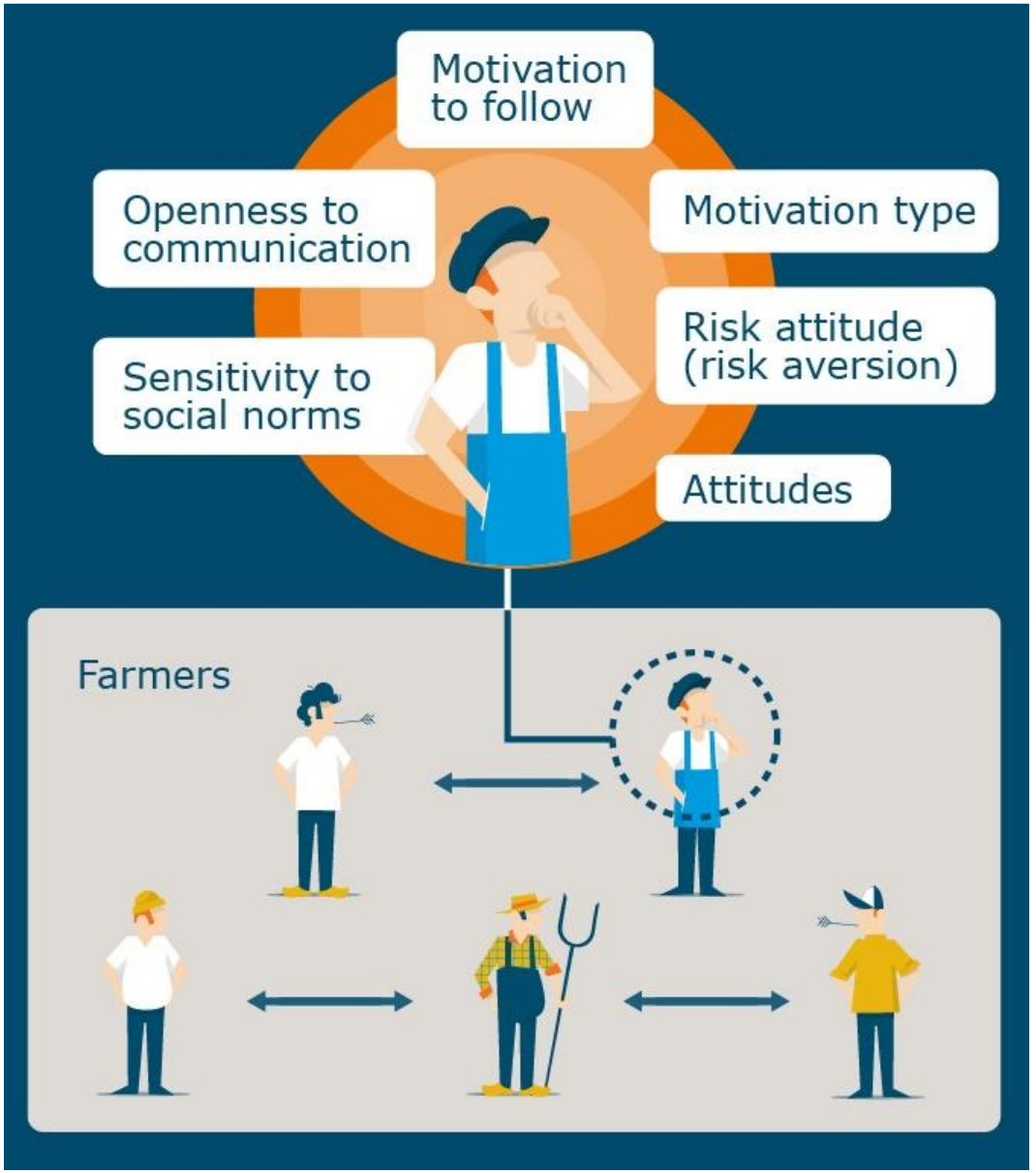
- Implementation of various measures on the farm
  - E.g. using gloves, milking mastitis cows last

Valeeva and Verwaart., ICUHC, 2011

Objective

- To explore the extent of adoption of desirable measures over time and the influence of drivers of farmers' decision making and external tools on this process

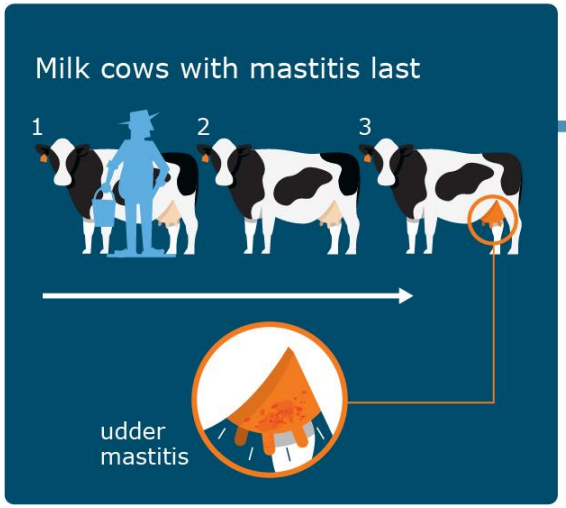
Farmers are modelled to be diverse



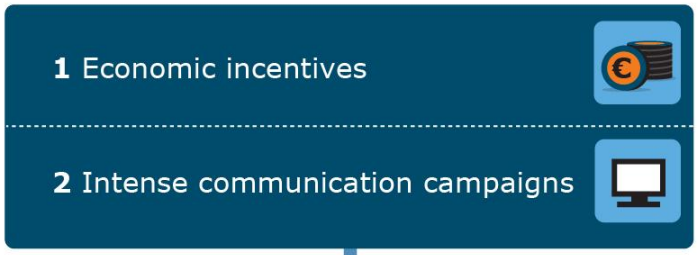
Udder Health

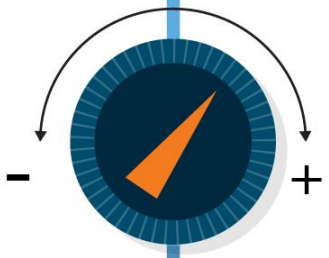
Problem:

Measures:

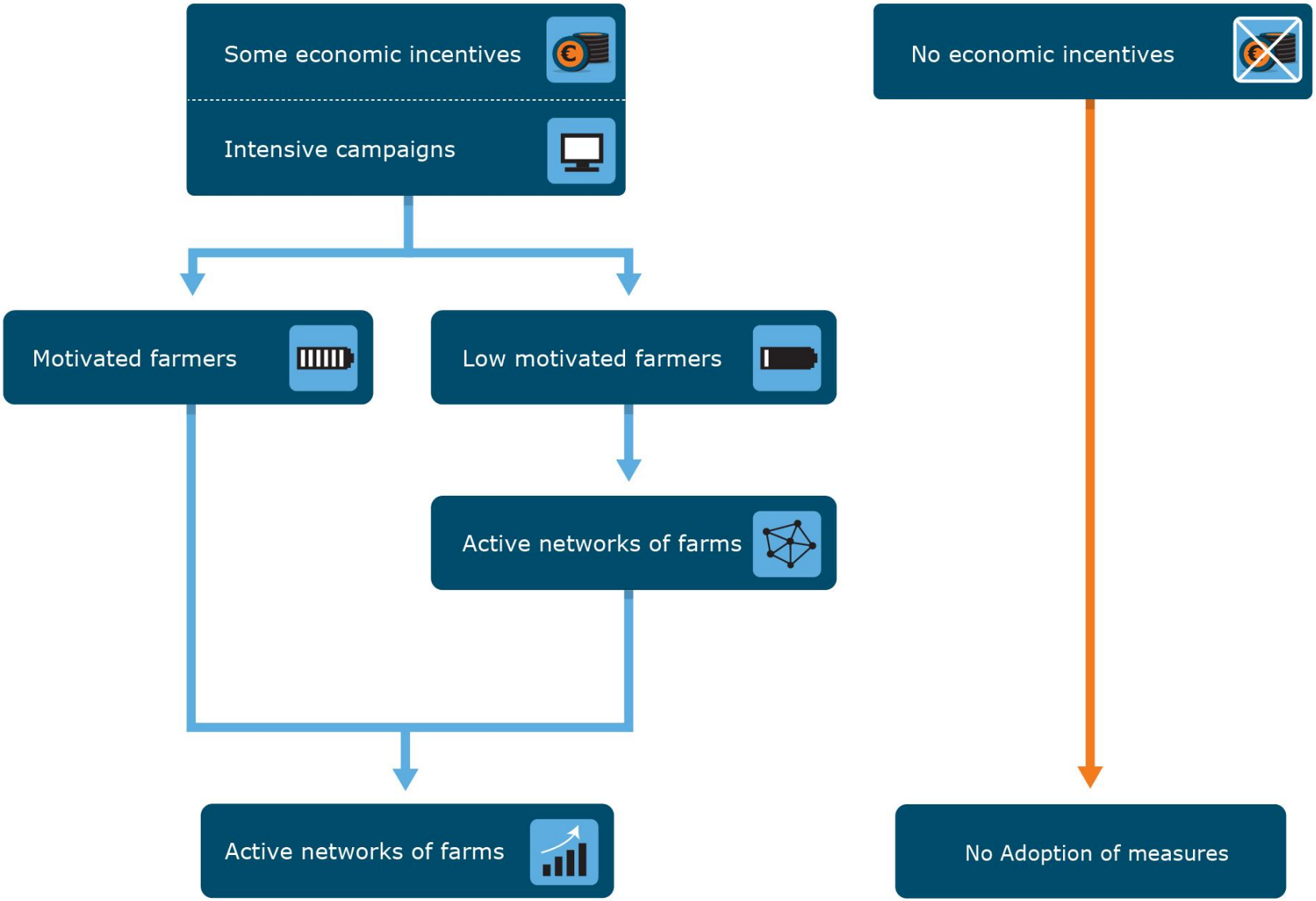


Adoption of measures by farmers through:





Conclusions



Conclusions

To get adoption of measures to decrease mastitis you need:

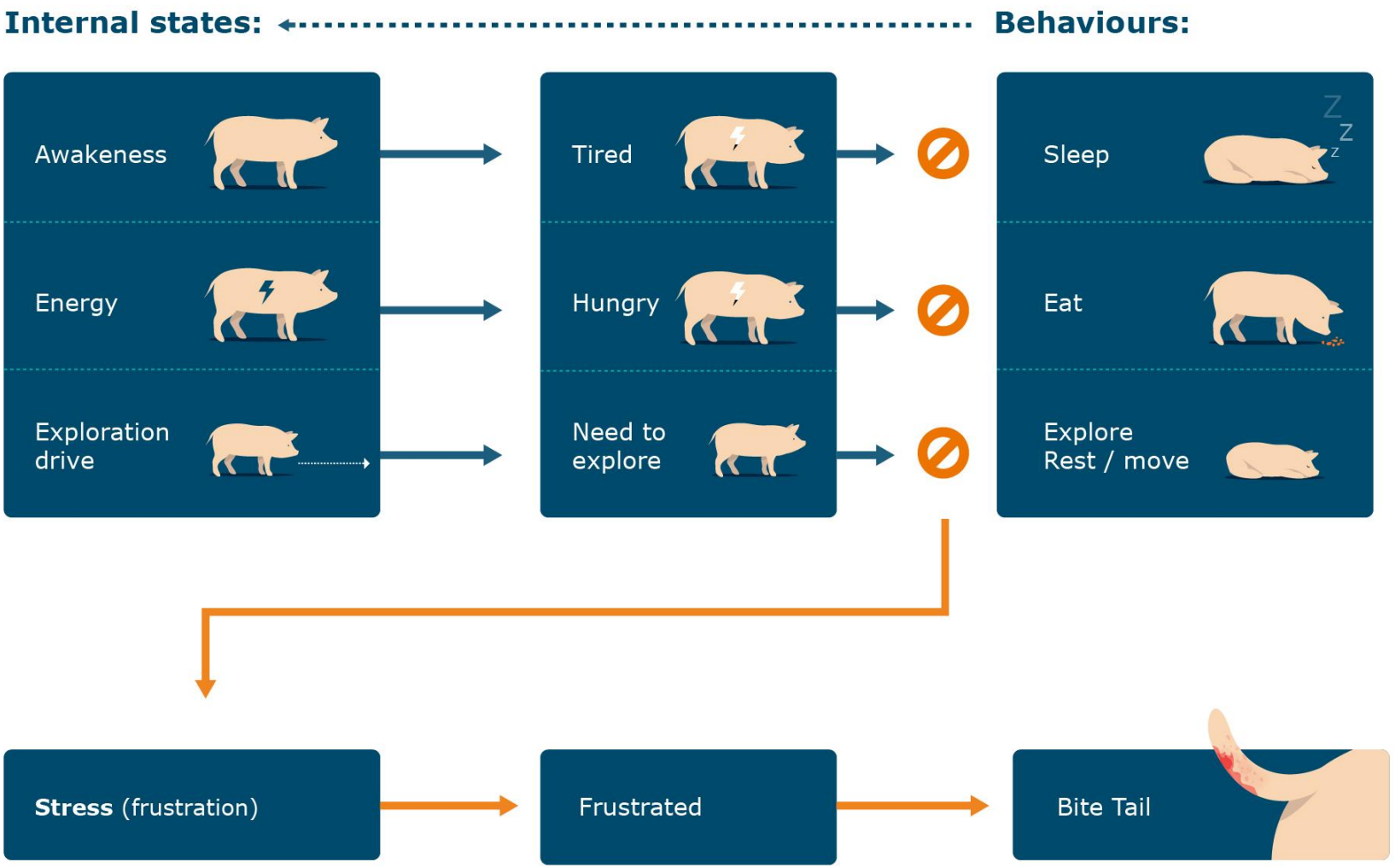
- Economic incentives
- Active networks of farms for low motivated farmers
- At low economic incentive levels intense communication campaigns

An example

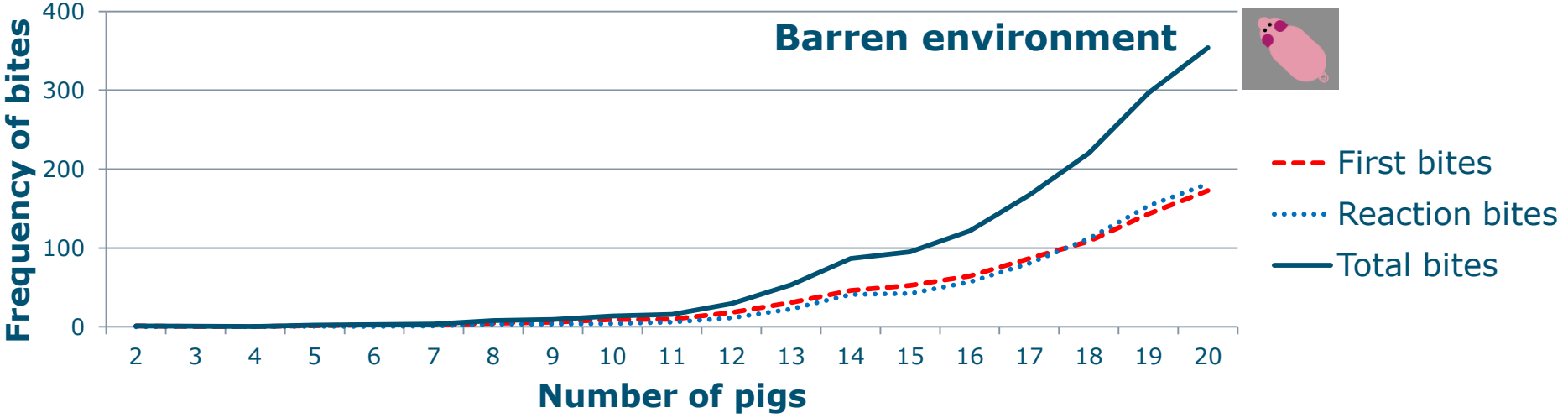
Modelling tail biting behaviour in pigs

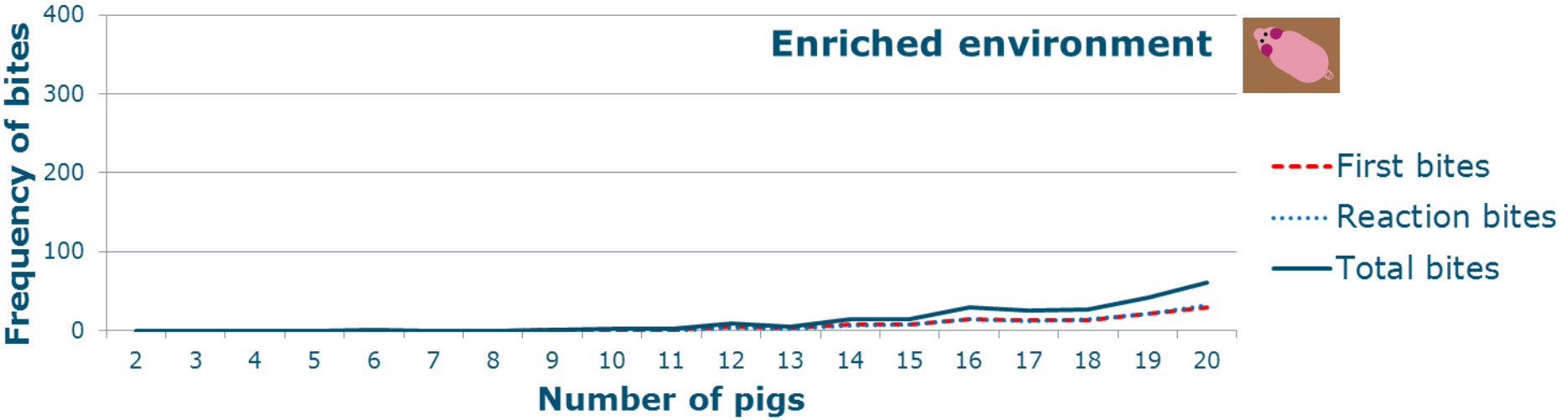
- Fattening pigs & tail biting behaviour
- Complex interplay housing-pig-farmer
- No existing models for analysis of pig behaviour and related welfare & production issues

Model description



Results: effect of density on tail biting behaviour





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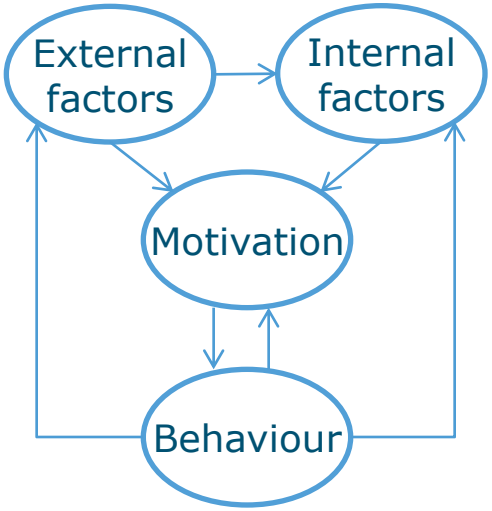
Each variation simulated in 10 runs, every run 2000 time steps

Tail biting outbreaks in pigs:

- Can be explained by underlying drivers that lead to frustration
- Farmers can learn what factors are involved in frustration(e.g. stocking rates)



So systems are complex and many agents with different drivers influencing the development of sustainable systems

With CAS (using ABM) we:

- Learn how heterogeneity in agents lead-to or hamper emergence of sustainability
- Learn which underlying drivers support or hamper emergence (virtual lab)
- Can connect the different aggregation levels (instrumentation of integration social and technical domain)
- Can be more successful in introducing sustainable system innovations

Thanks for your attention

Complex Adaptive Systems

An innovative method to work integrated towards sustainable systems

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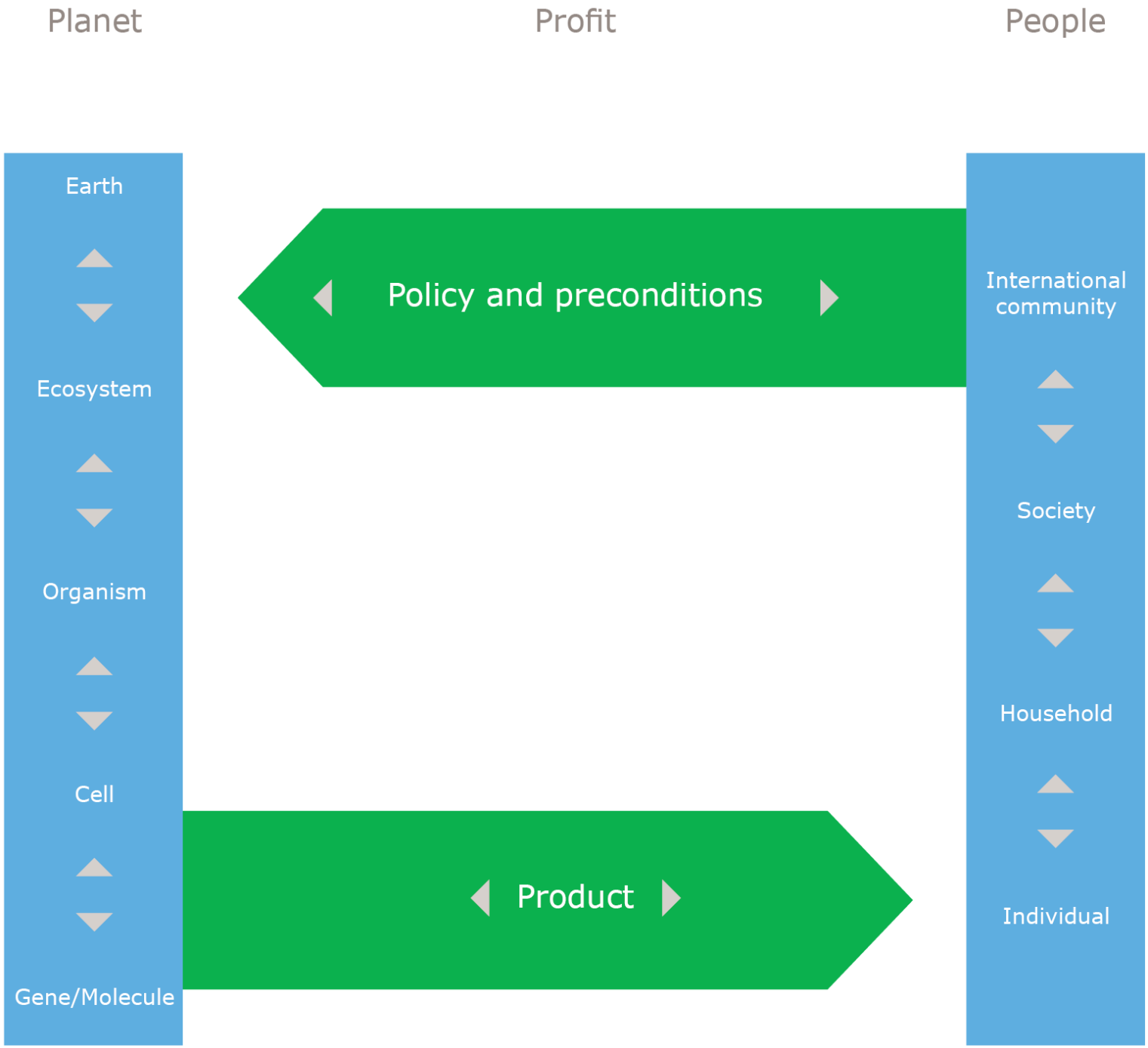
Planet
Profit
People
Earth
Ecosystem
Organism
Cell
Gene/Molecule
Policy and preconditions
Product
International community
Society
Household
Individual