The value of precision feeding technologies:
economic, productivity and environmental aspect

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Precision feeding session

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- This presentation mainly focuses on pigs

Introduction

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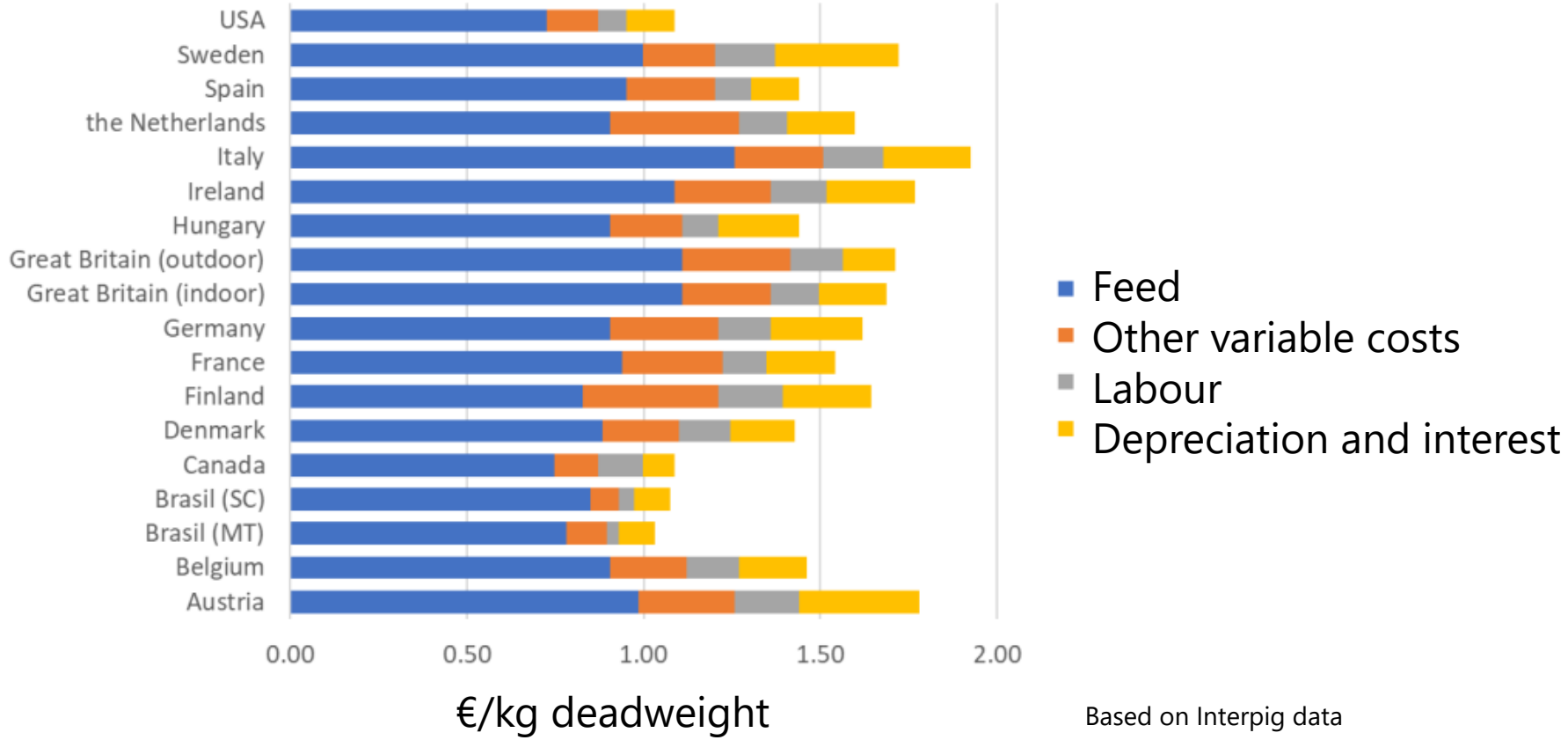


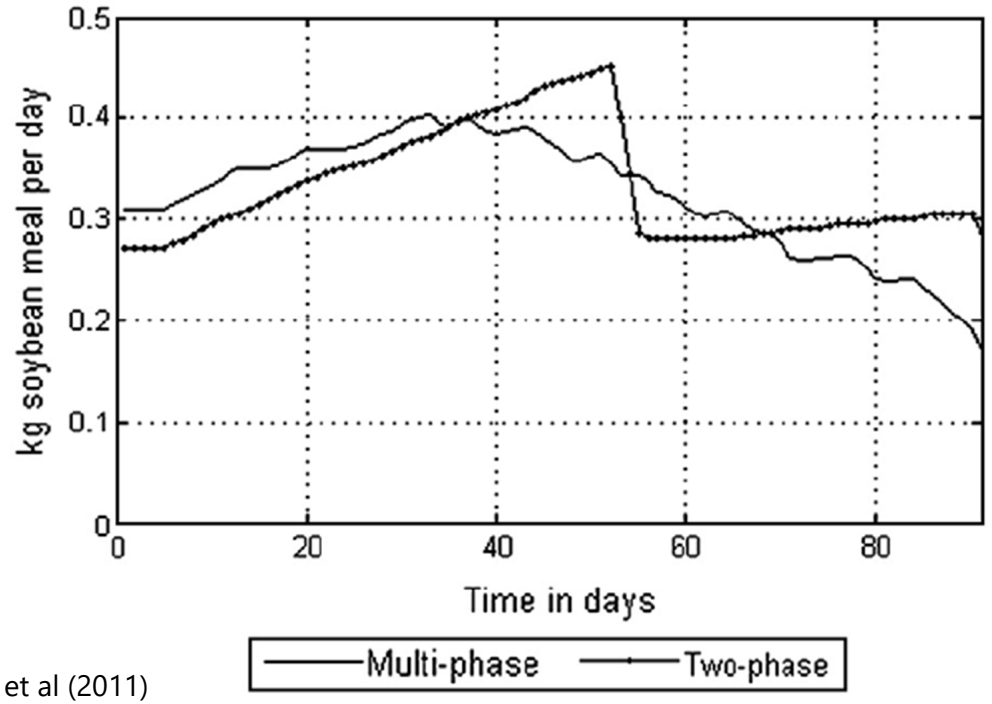
Based on Interpig data

Introduction

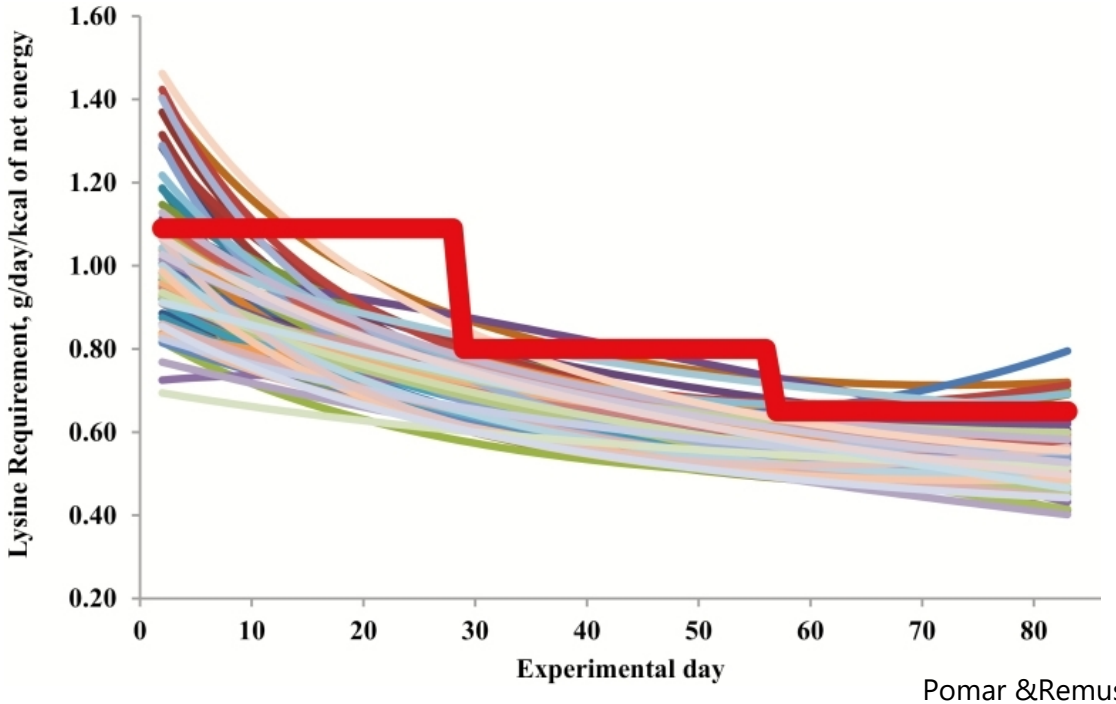
- Livestock farming is facing challenges related to economic viability and environmental sustainability of farming.
- In terms of costs, feed is the most important input especially in pig and poultry farming
- Feeding has a major impact also on production perfomance of animals
- Precision feeding is a concept that relies on the existence of between-animal variation and involves the use of feeding techniques that allow the right amount of feed with the right composition to be provided at the right time to each animal of the herd (Pomar et al., 2011).
- Precision feeding has the potential to improve both economic competitiveness and environmental sustainability of livestock production
- The aim of this presentation is to examine the value of precision feeding technologies from economic, productivity and environmental perspectives

Potential benefits of precision feeding

- Over and underfeeding can be avoided, or at least reduced, when anmals are fed according to their genetic and economic potential.
- Increased performance and animals' potential is better exploited.
- Reduced environmental burden of feeding



Niemi et al (2011)



Pomar &Remus (2019)

Challenges

- **Individual** animals in the group must be identified and controlled, which is straightforward in some species and complicated in others
- Monitoring the animals is essential, but how it is implemented technically (e.g. computer vision, weighing) and how the information is used as feedback to feeding
- Precision feeding requires automated data collection and heuristics going to the level of individual animals. However, interactions between individuals also play a role in both economic and biological context
- Benefits that can be obtained are affected by
  - Uncertainty about the quality of feed and genetic potential of animals
  - Accuracy of measurements
  - Lags between the change of feeding and observing changes in the animal (and vice versa)
  - Sluggish processes: to what extent animal's prformance can be altered by changing feeding

Validation

- Studies suggest that farmers require a proof of evidence of the usefulness of new technologies if they are to adopt innovations.
- Preferably, technologies should be validated in local contexts.

Market search

Accelerometers (28%),
load cells (28%),
milk quality (19%),
boluses (11%),
cameras (8%),
others (6%)

Load cells and flow meters (45%),
Cameras (38%),
Microphones (6%),
Accelerometers (5%),
others (7%)

Literature

14% of identified cattle sensors had reported external validation.

5% of identified cattle sensors had reported external validation.

Stygar et al. (2021), Gomez et al. (2021)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 862919

More information = better decisions ?

The value of precision feeding arises from the possibility to exploit the variation between animals
➔ The more variation, the more potential to utilize it

Value of information (in case of expected utility):

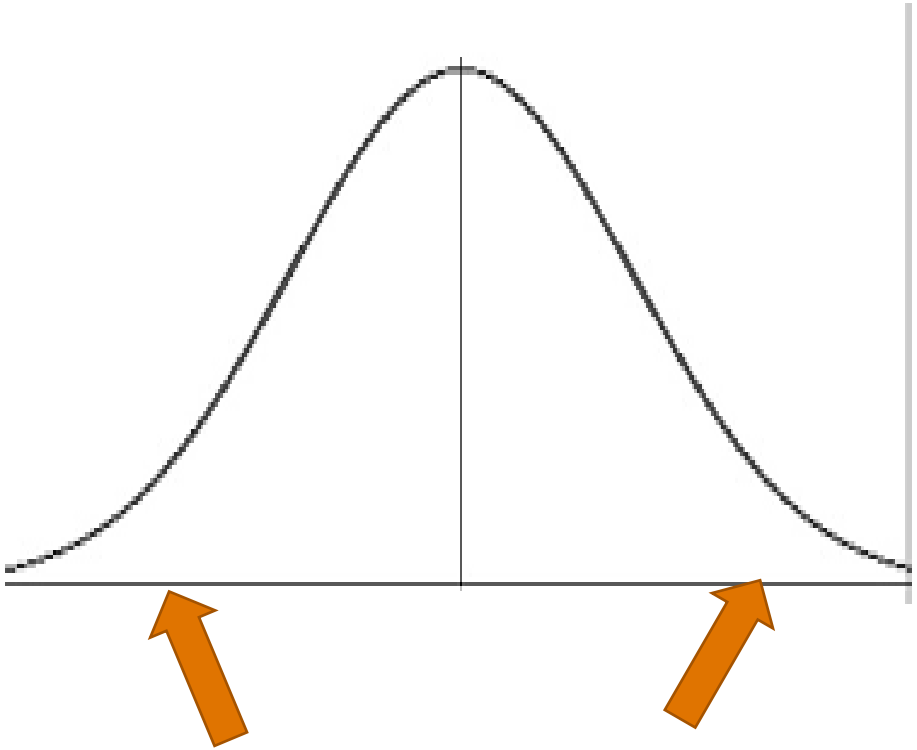
+Expected utility *with* information

–Expected utility *without* information

=Value of information

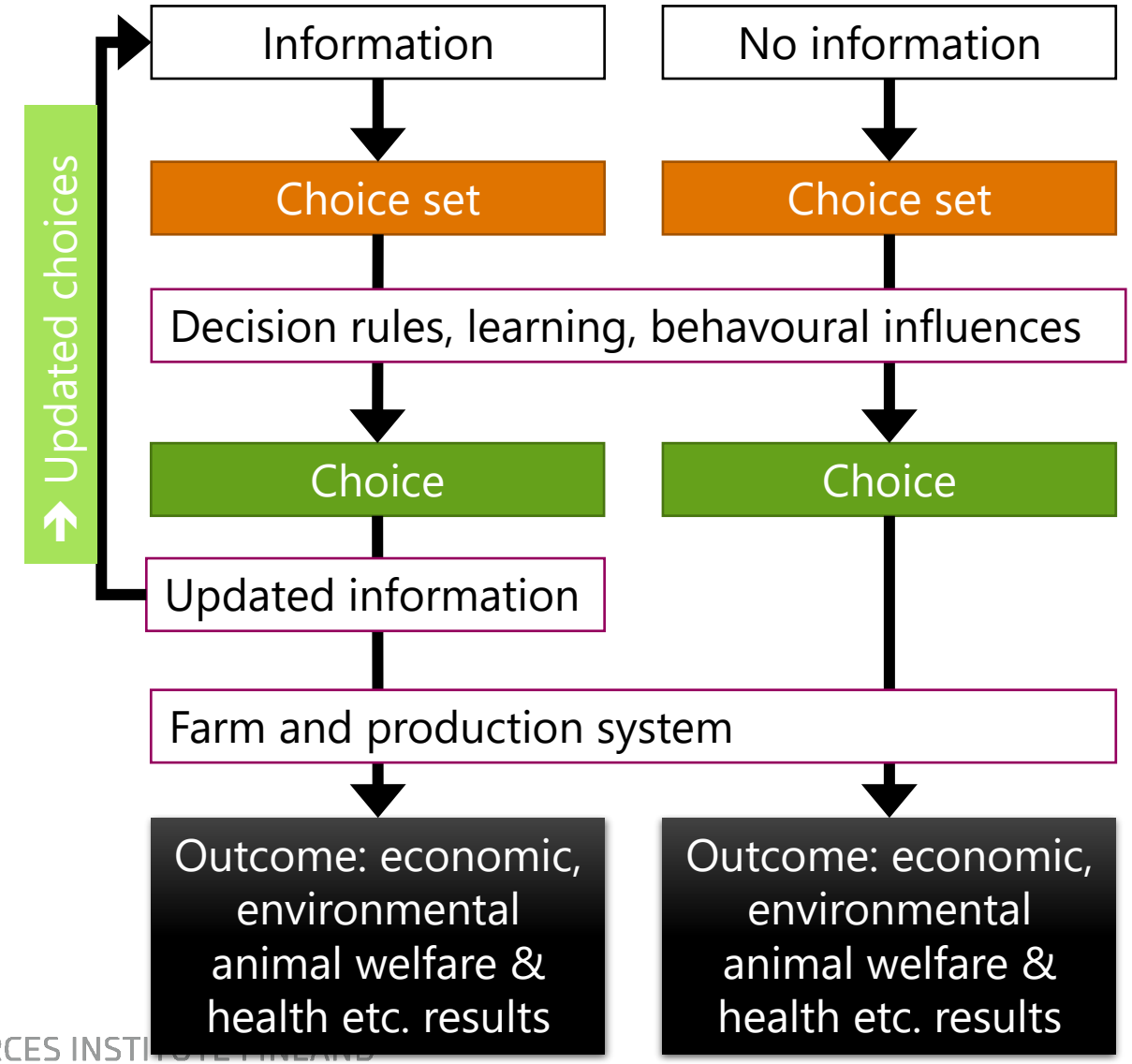
Information enables us to make better decisions!

- More accurate information may change our (best) decisions!
- The value of information likely shows diminishing marginal returns.

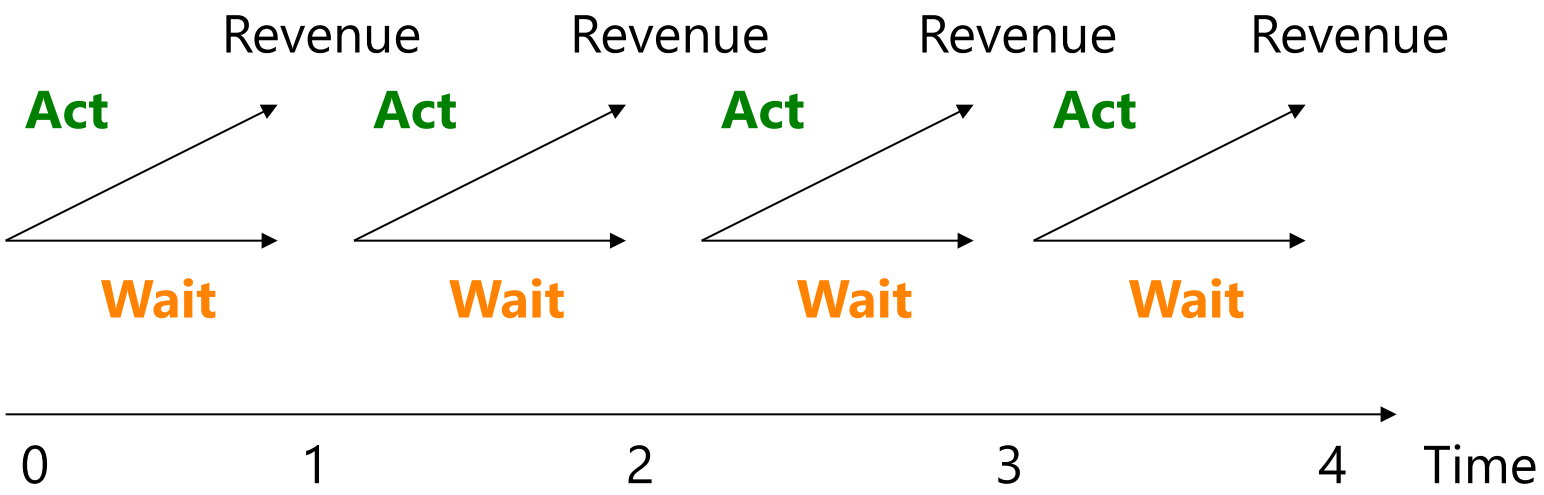


Make more use of the tails of a distibution

The value of information depends on how we can use it!

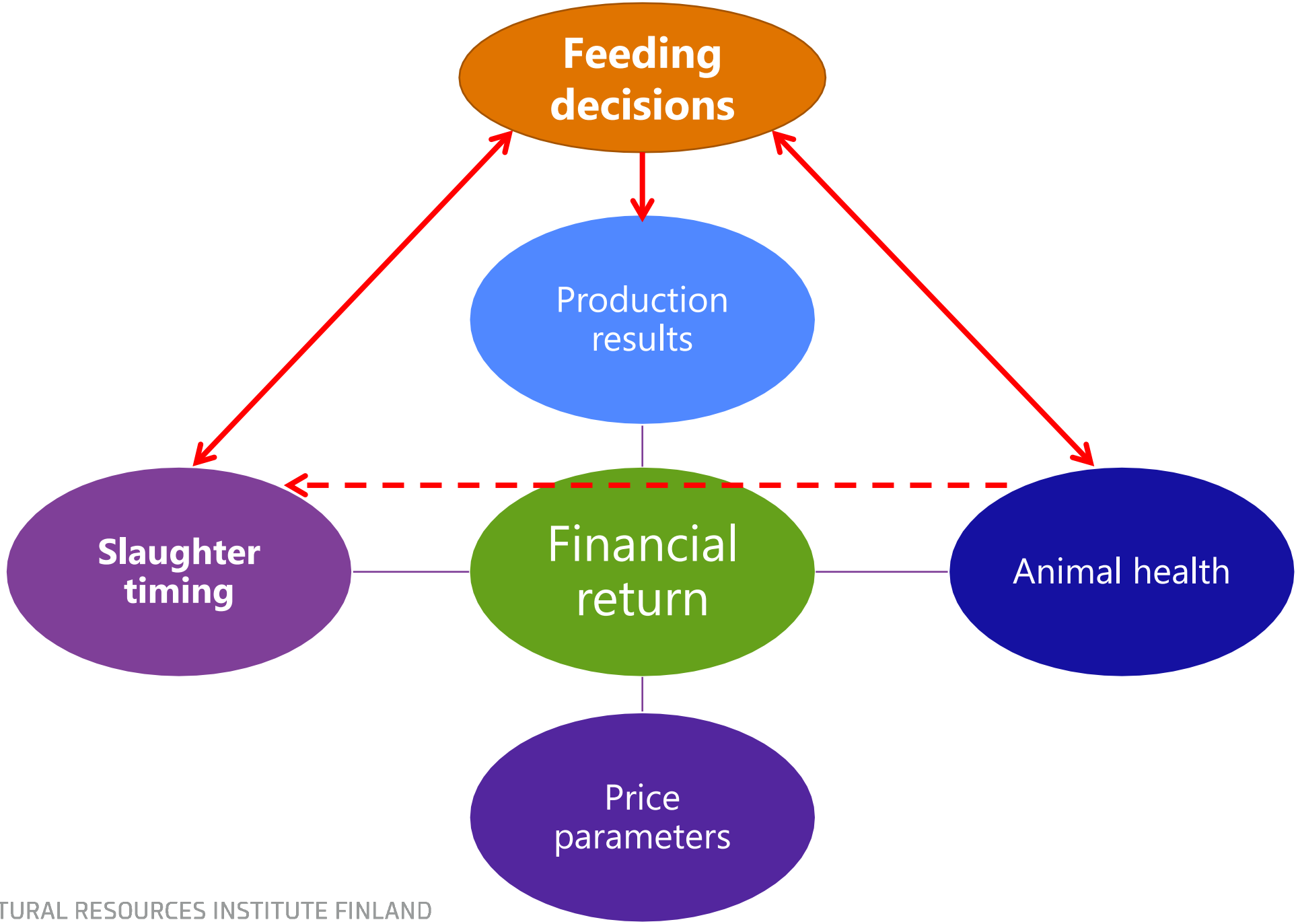


Real options are one of the approached to value information



- Probability of each outcome?
- Time lags?
- Decisions can be updated when new information arrives

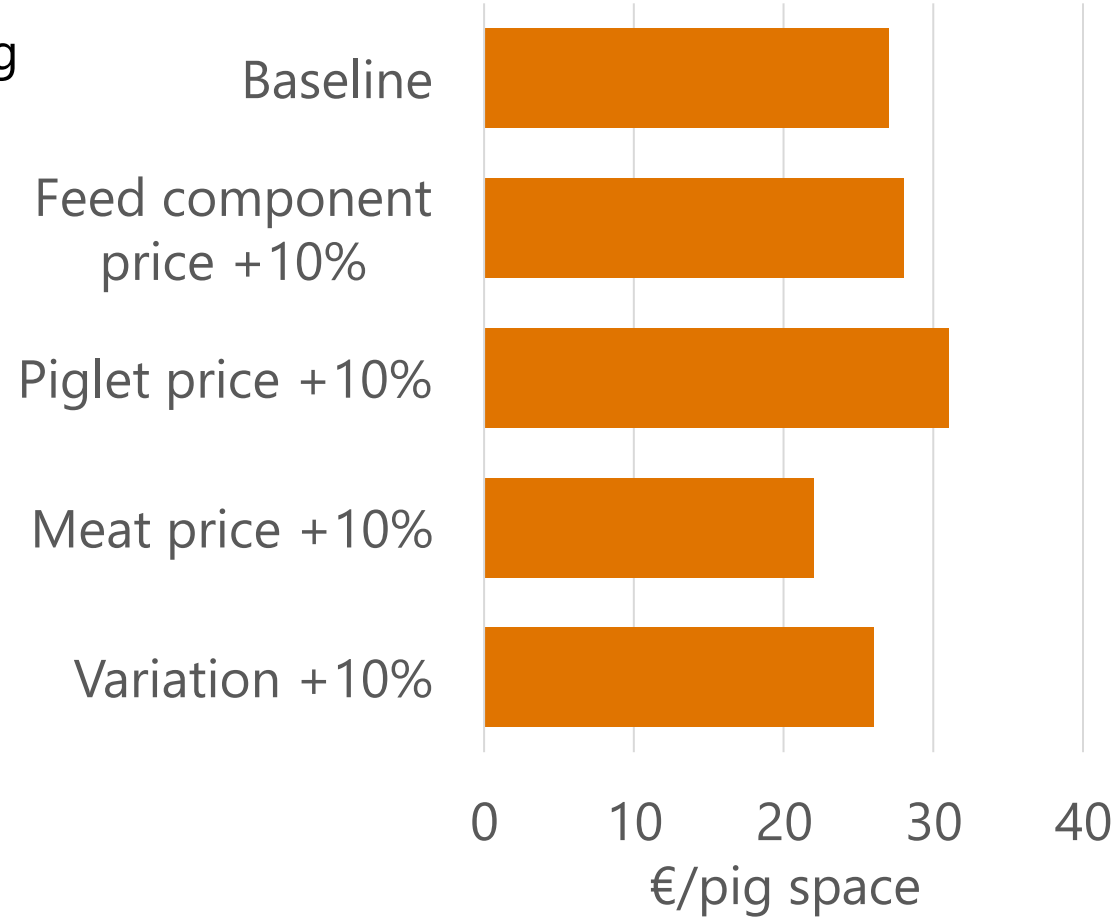
➔ The quality and amount of information, learning



Benefit from multi-phase feeding in pigs

(in comparison with two-phase feeding)

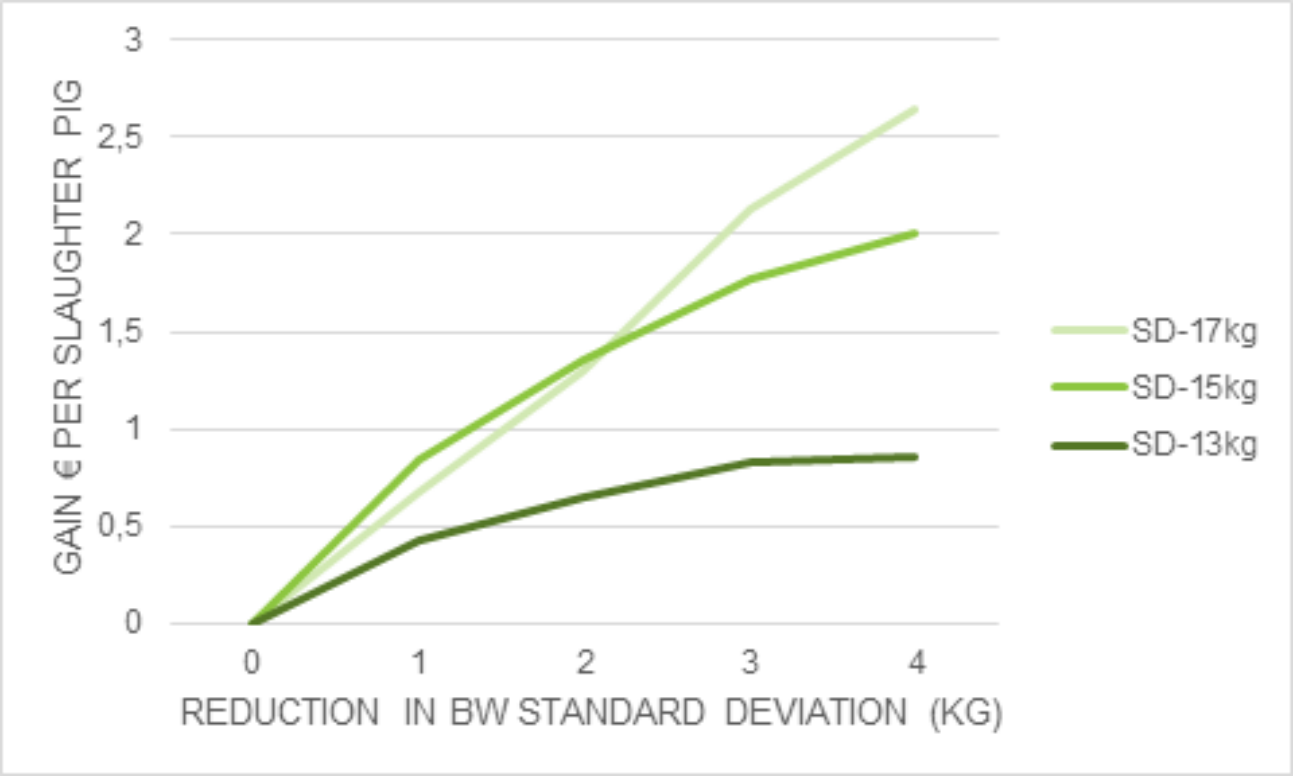
- The figure (➔) illustrates a case study on how much the farmer could pay for a precision feeding investment
- The value of technology was estimated by using stochastic dynamic programming model, that included a mechanistic pig growth model.
- If no investment needed, the baseline corresponds to 4.5% change in return on investment.
- Pomar et al. (2018) noted that profitability can be increased by nearly 10% when using precision feeding.
- Remus et al. (2019) found production costs to decrease by >8% and Pomar et al. (2011) feed costs by 10.5%



Based on Niemi et al. (2011)

Sensor technologies

- Sensors are essential in order to monitor animals
- A camera-based system estimating BW and RFID system monitoring number of visits to the feeder were examined.
- The costs of sensors systems varied from €0.35 to €1.75 per slaughter pig.
- The application of even relatively expensive camera technologies could be profitable, when there is substantial change in body weight variation.



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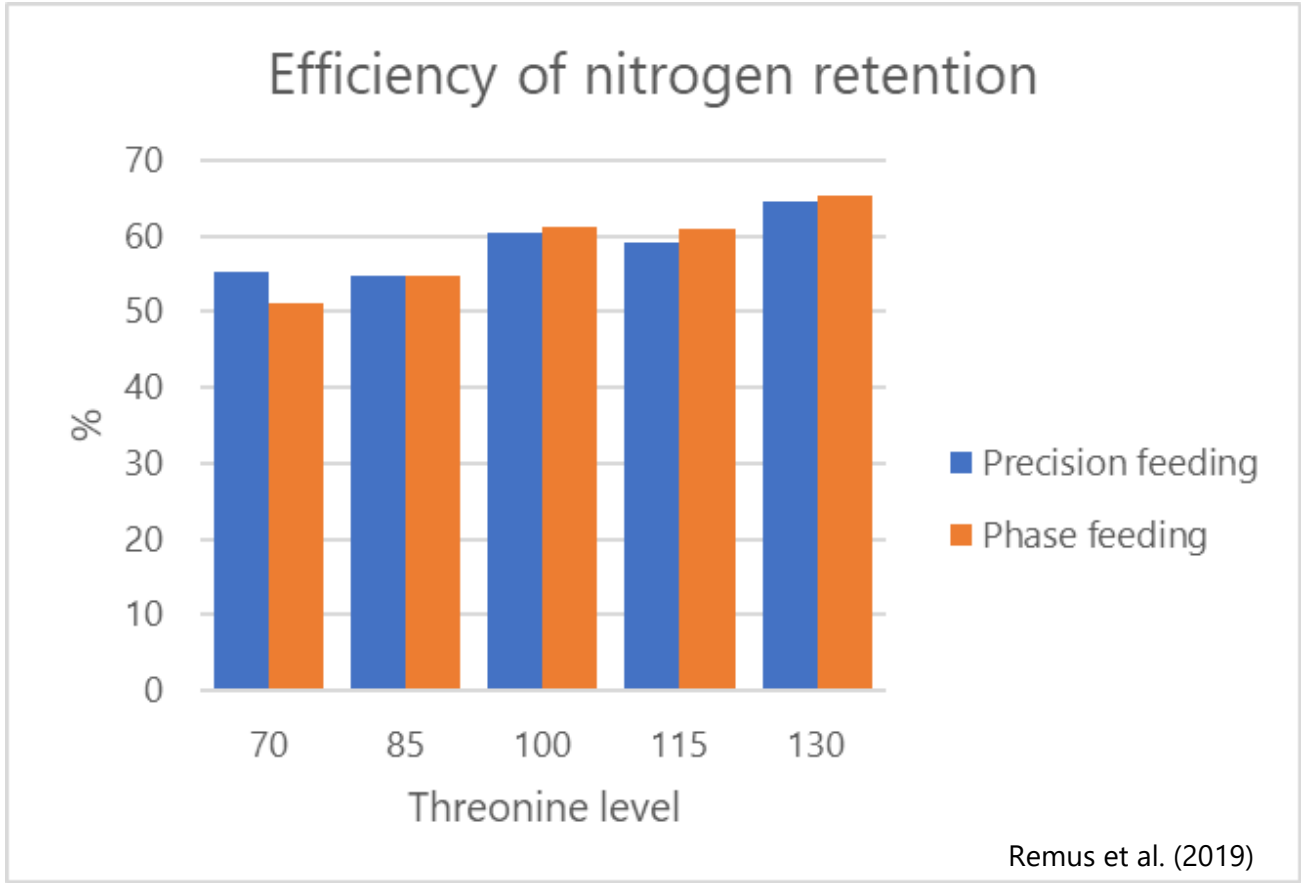
Environmental benefits

- By increasing individual nutrient efficiency, the use of precision feeding in growing pig operations can significantly reduce… (Pomar & Remus, 2019).
- protein and phosphorous intake (25%)
- N & P excretion into the environment (40%)
- Greenhouse gas emissions (6%)

- Different levels of protein and amino acids

  May be both feasible and needed.

  The figure (➔) illustrates a study in piglets.



Remus et al. (2019)

An example of the economic significance of precision feeding in dairy (Barrientos-Blanco et al., 2020)

- Diet cost and predicted nitrogen supply with nutritionally grouped dairy cows (NG) decreased for low-nutritional-requirement groups and increased for high-nutritional-requirement groups compared with current farm groups.
    - The average N supply -15.14 g/cow per day
    - The average diet cost -1% (-31 USD per cow)

Concluding remarks

- Precision feeding aims to match the nutrient supply by unique features and status of individual animals.
- Precision feeding makes use of variation between animals
- Significant economic benefits are available through better exploitation of nutrients and the potential of animals.
- It holds the potential to mitigate environmental emissions and to improve economic viability of livestock farming
- In group-housed animals, such as broilers, a paradigm shift from group to individual management, and new technologies (e.g. sensor development) is needed.
- Uncertainty about the status of animal and lags in observing changes may reduce the benefits

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