INRA
SCIENCE & IMPACT

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Economic and environmental optimization of feed sequence plans in pig fattening unit

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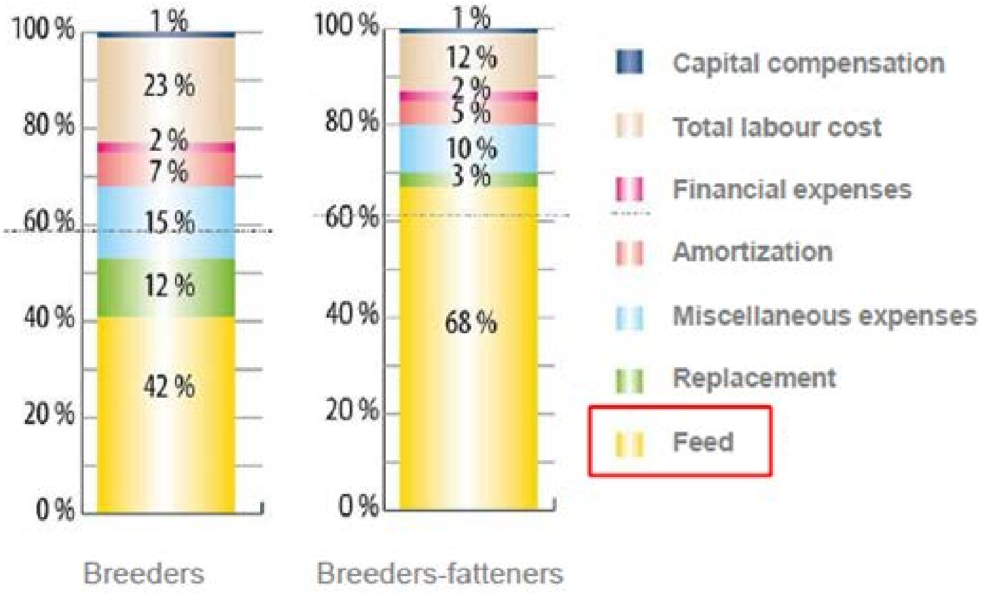
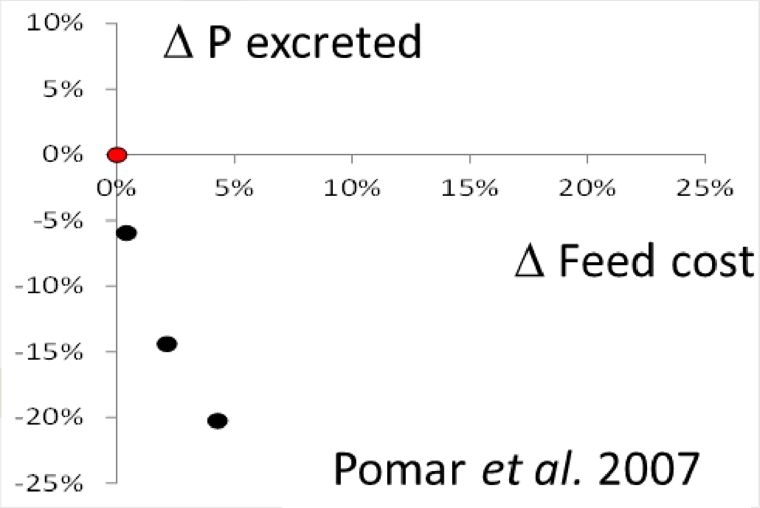


Source : IFIP – GTE - TB

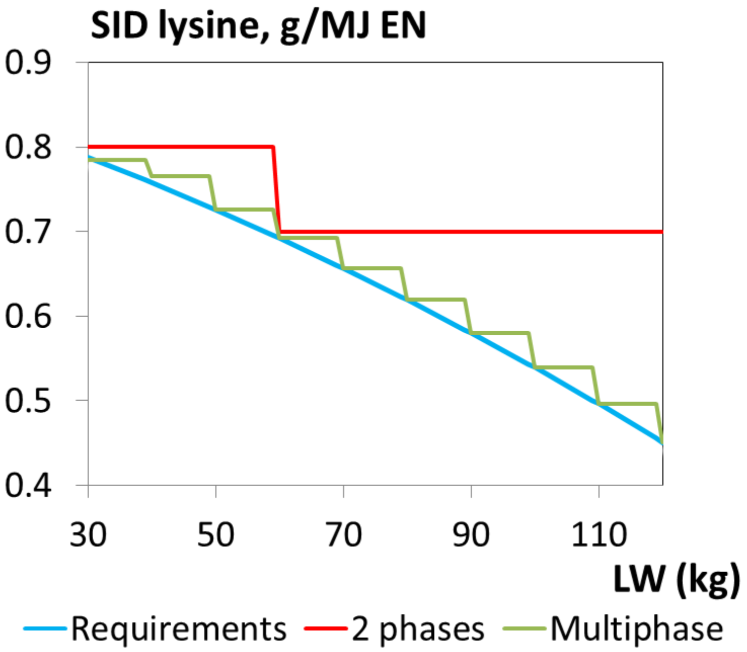
Major importance/contribution of feed production, and of the fattening unit

Economy | environment



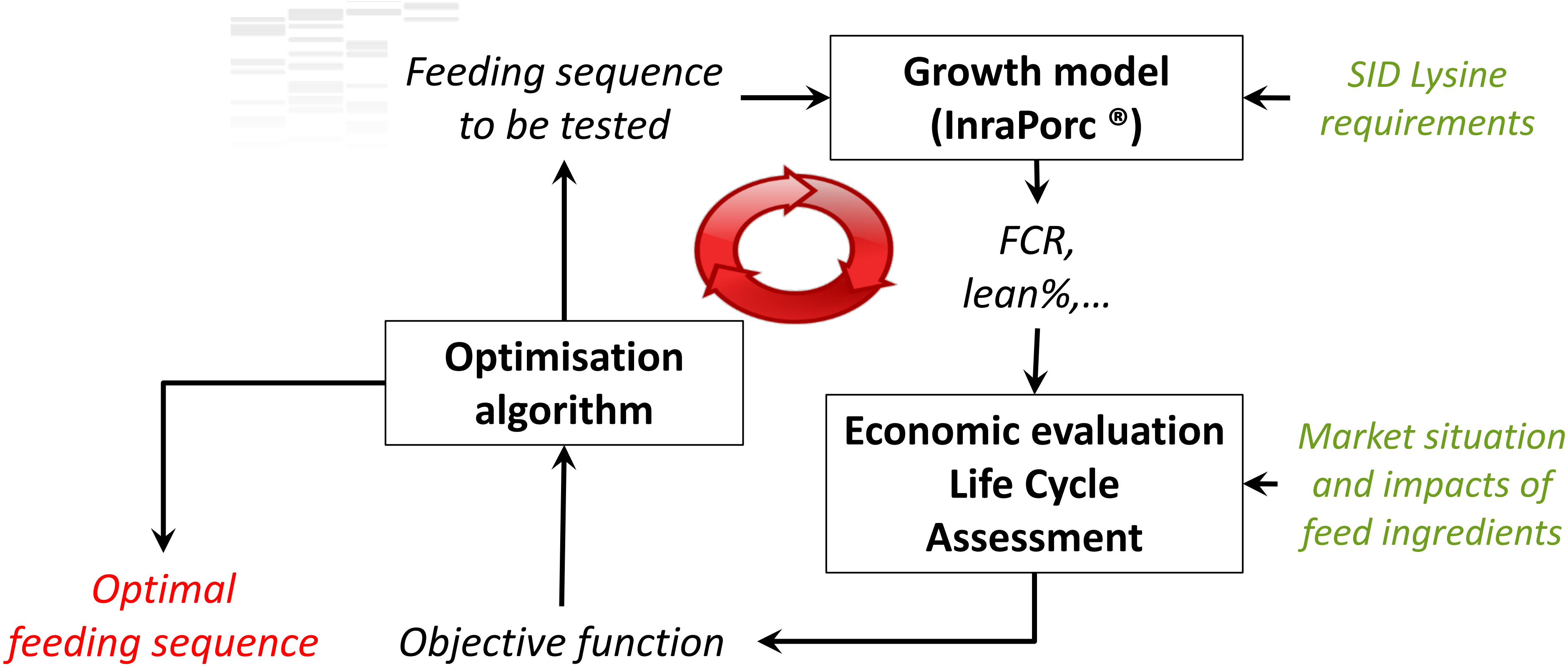
Least-cost formulation of feeds

To adjust quantity and quality of nutrient supply



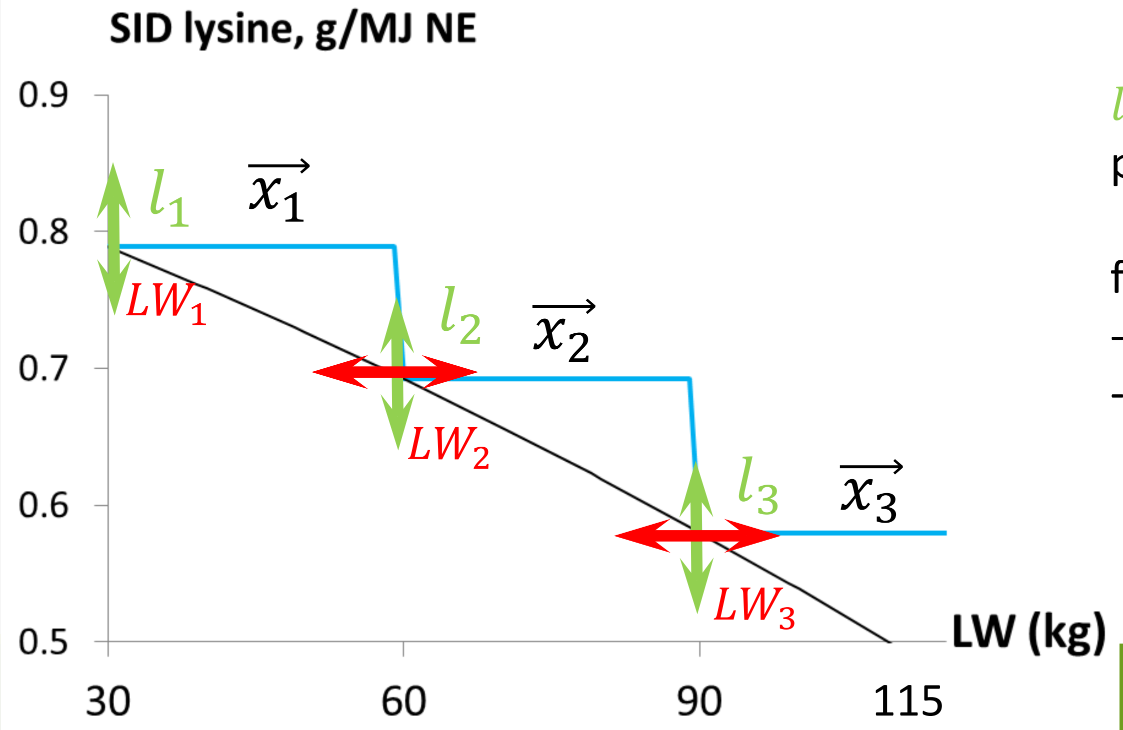
To optimize feeding sequences on economic and environmental criteria

To develop an optimization model : PigOptim



Decision variables : what is optimized ?

$$S = (LW_1, l_1, \overrightarrow{x_1}; \ldots ; LW_n, l_n, \overrightarrow{x_n})$$



l_n from 70% to 130% of the population SID lysine requirement

formulation with :

- min/max for nutrient contents
- min/max for incorporation rates of feed ingredients

Growth model from InraPorc®

Responses to the level of lysine from simulations of one population of 192 pigs

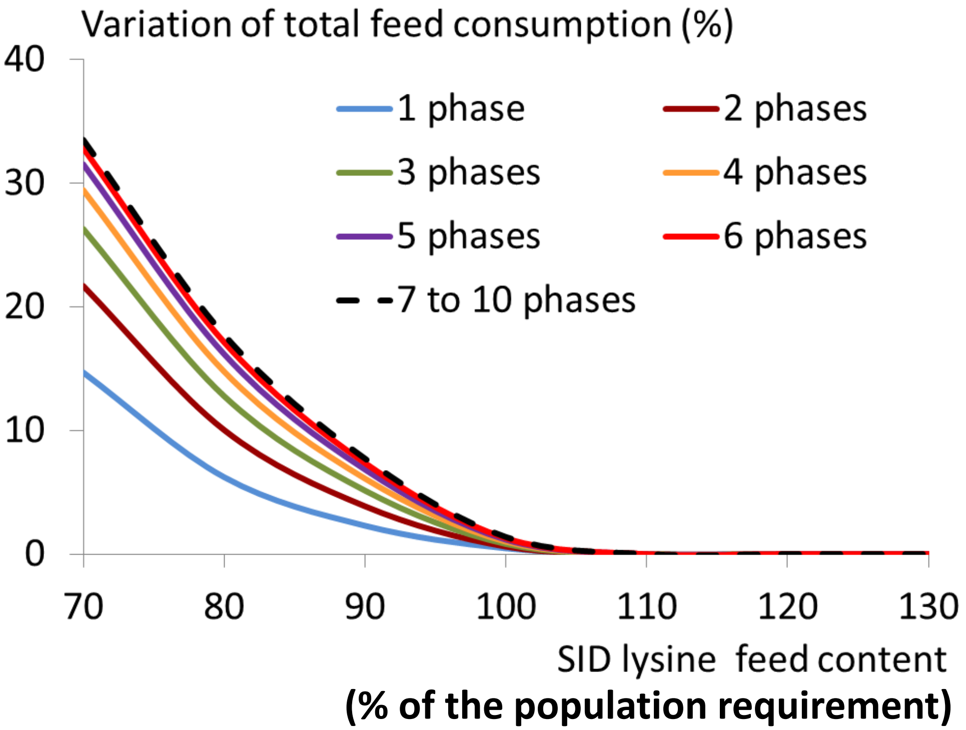
(Brossard et al. 2009)

↓

Total Feed consumption, ADG, Lean %

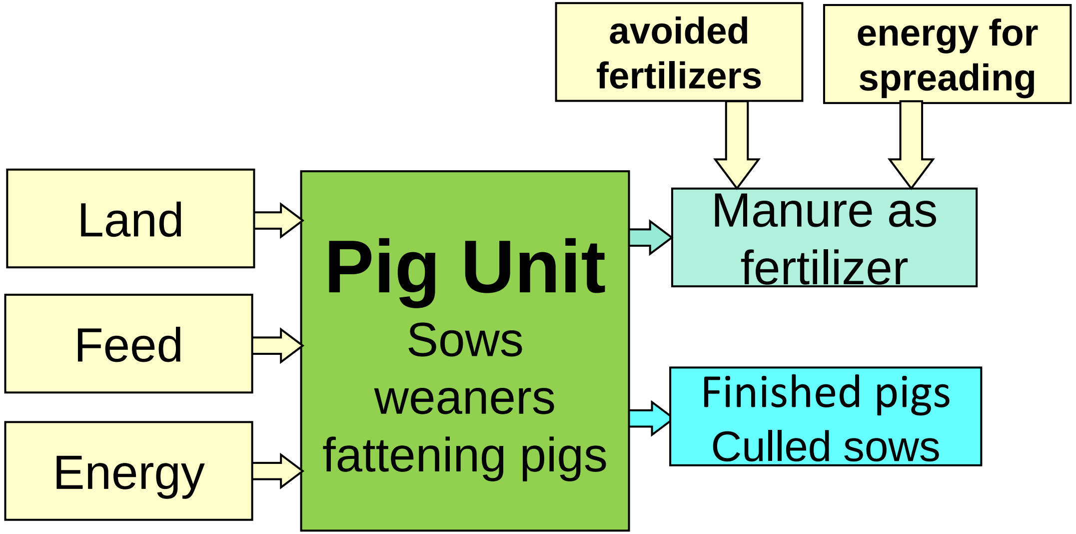
=

f(SID Lys, number of phases)



Economic evaluation and LCA→objective function

$$GrossMargin = (SellingPrice \times CarcassWeight - FeedingCost - CareCost - PigletPrice - LabourCost) \times N_{pigs}$$



(Dourmad et al. 2014; Garcia-Launay et al. 2014)

$$Z = \alpha \times GrossMargin - \beta \times ClimateChangeImpact$$

Behaviour of the model when fixing LYS level (1)

$$Z = \alpha \times GrossMargin - \beta \times ClimateChangeImpact$$

% LYS fixed
(70 → 130% of the population requirement)

Economic optimization

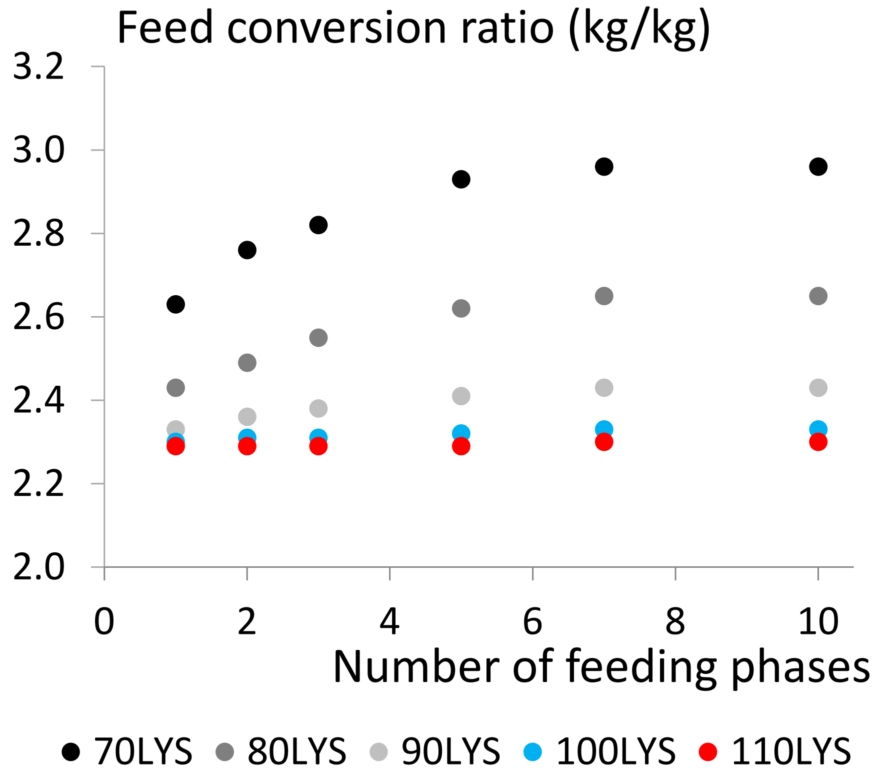
↓

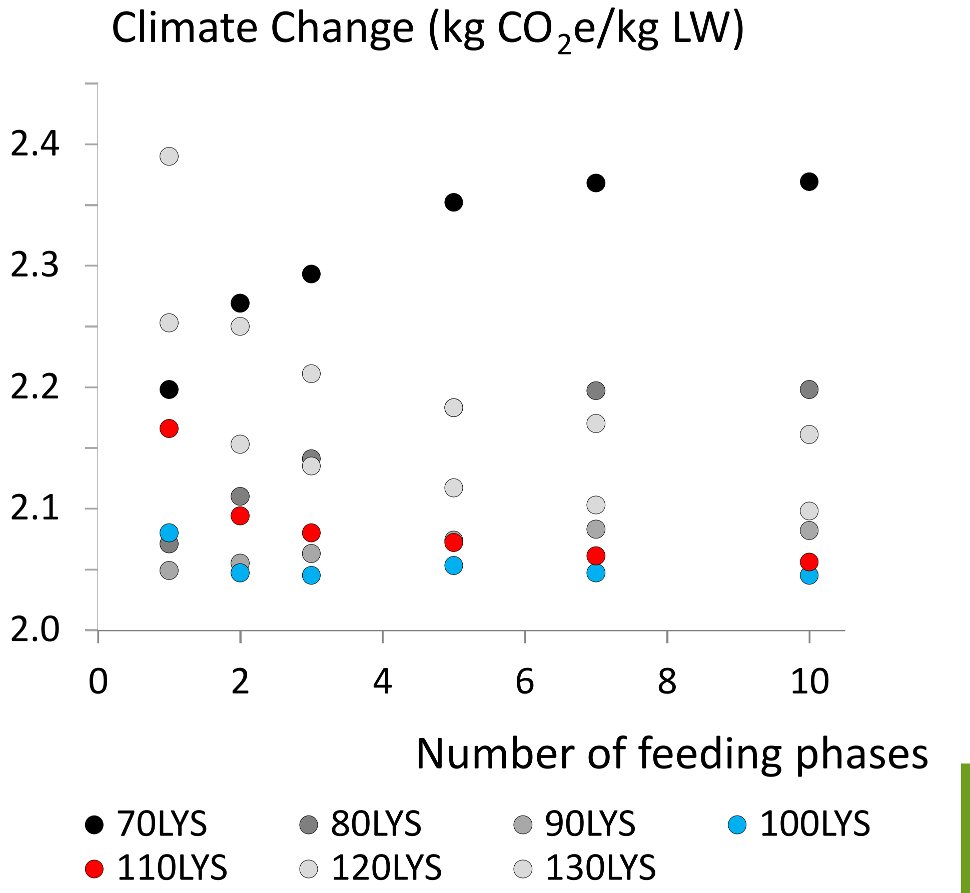
$$\alpha = 1 \,;\, \beta = 0$$

↓

70LYS … 130LYS

Behaviour of the model when fixing LYS level (2)





Trade-off between economy and environment (1)

$$Z = \alpha \times GrossMargin - \beta \times ClimateChangeImpact$$

% LYS optimized
(70 → 130% of the population requirement)

Economic or both environmental and economic optimization

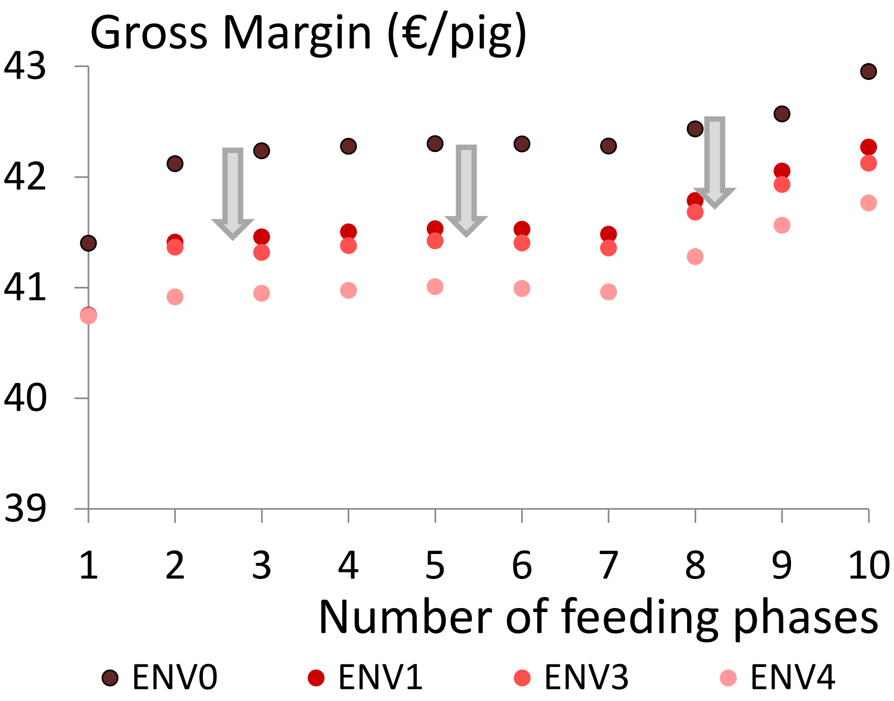
↓

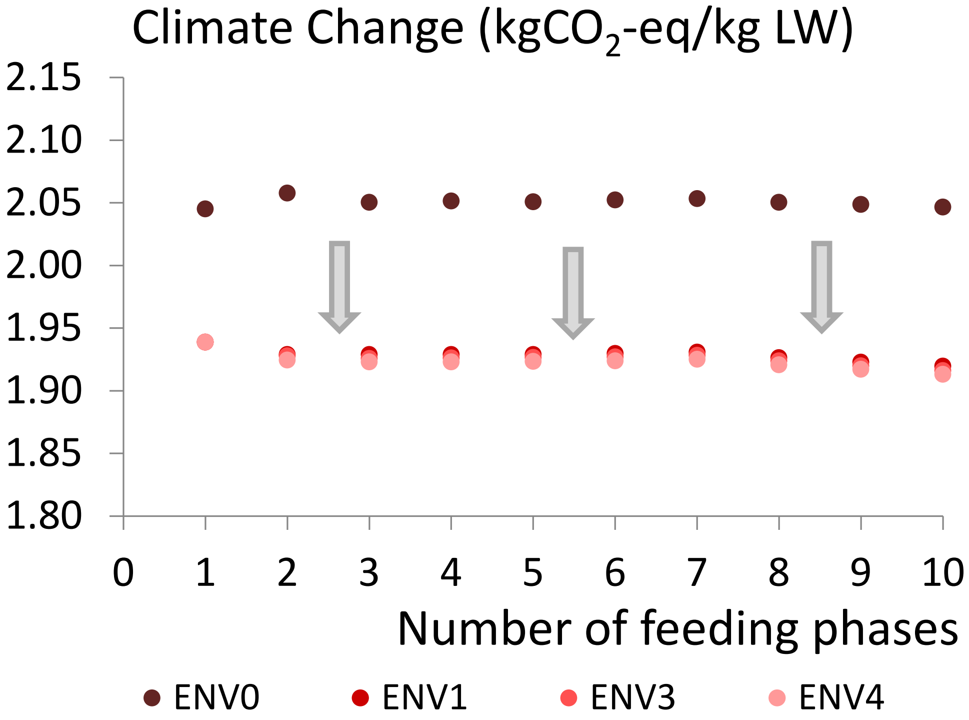
$$\alpha = 1 \, ; \beta = 0, 1, \ldots 4$$

↓

ENV0, ENV1, …ENV4

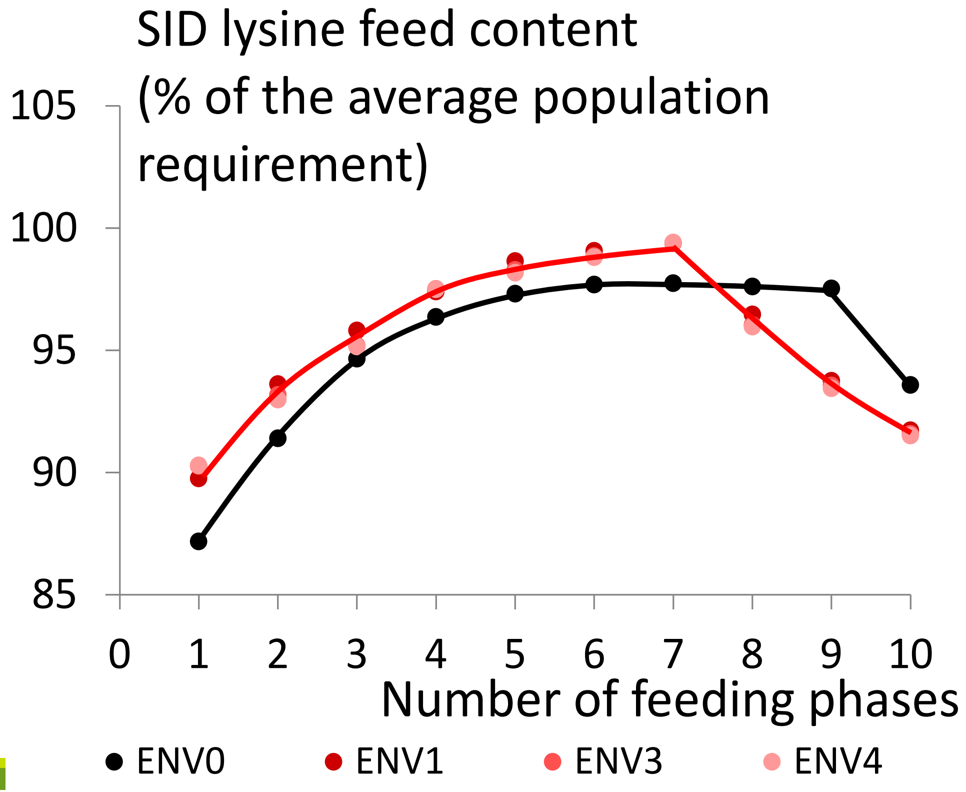
Trade-off between economy and environment (2)





Climate change and energy demand reduced but eutrophication and land occupation increased

Trade-off between economy and environment (3)



optimal LYS ↗ when number of phases ↗ to compensate for restriction in LYS at the beginning of each phase

optimal LYS ↘ when number of phases ↗
→ No more impact of low LYS supply (70%) for the 8th to 10th phase.

Optimized LYS varies according to number of phases

Conclusions

- First attempt of an optimization model
  → appropriate behaviour | level of SID lysine

- Interaction between SID lysine level and number of feeding phases → performance, impacts, gross margin

- Technical optimum ≠ Economic optimum ≠ Environment optimum

Perspectives

- First attempt of an optimization model | next steps
  - → link with InraPorc® to simulate the behaviour of any population
  - → optimizing the number of feeding phases
  - → optimizing feed restriction

- To include various impacts in the objective function

- Necessary to test sensitivity to market situation

Thank you for your attention !