



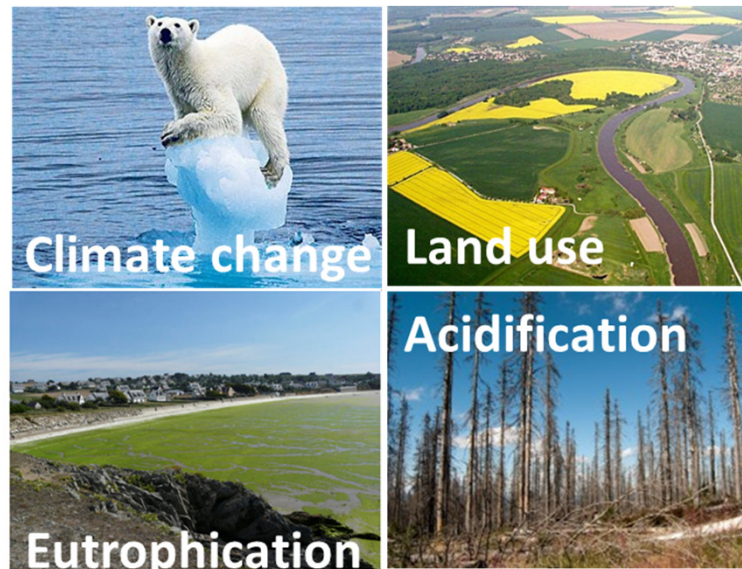
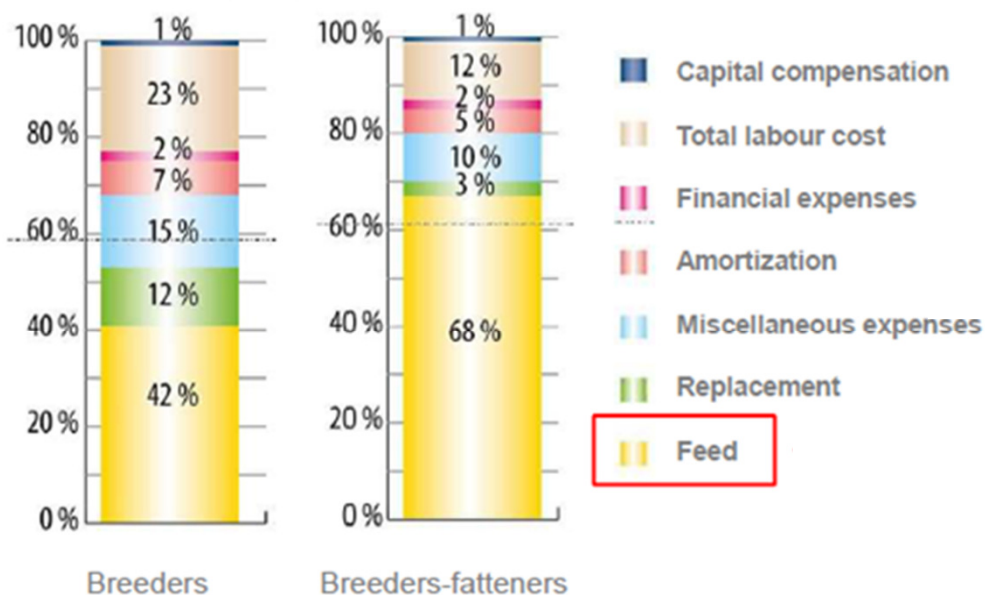
# Economic and environmental optimization of feed sequence plans in pig fattening unit



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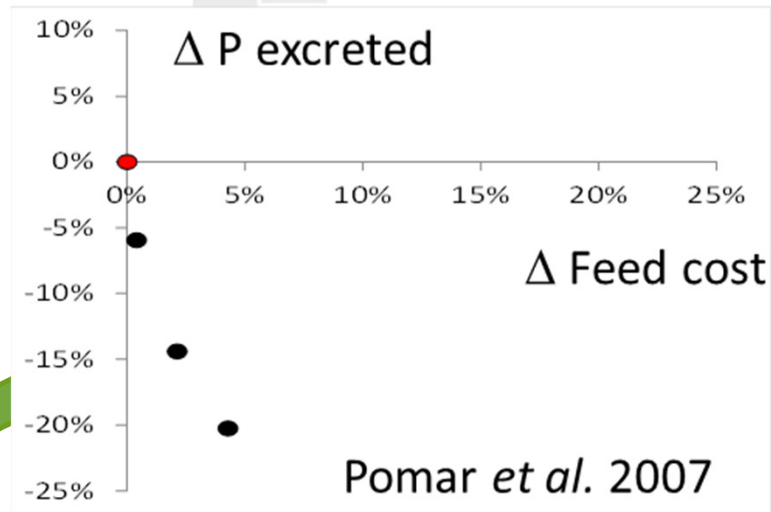




Source : IFIP - GTE - TB

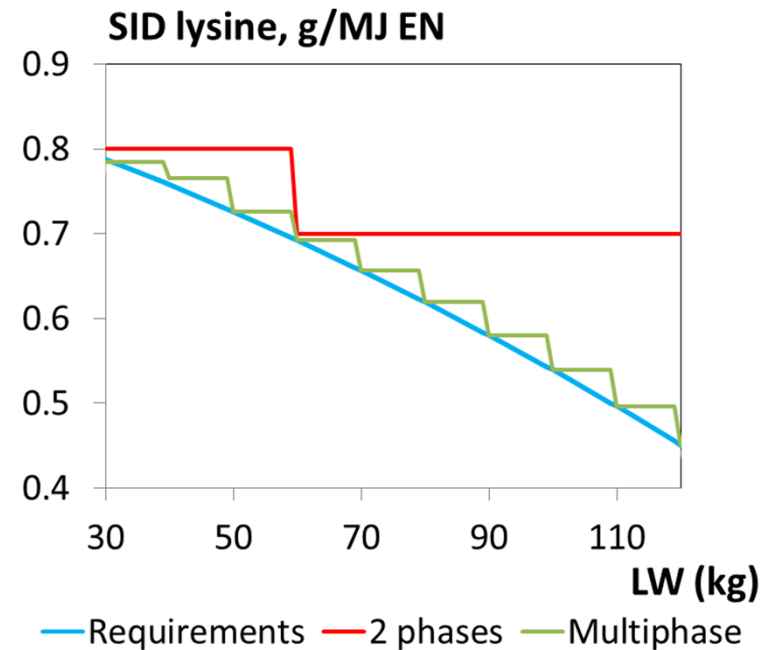
## Major importance/contribution of feed production, and of the fattening unit

## Economy | environment



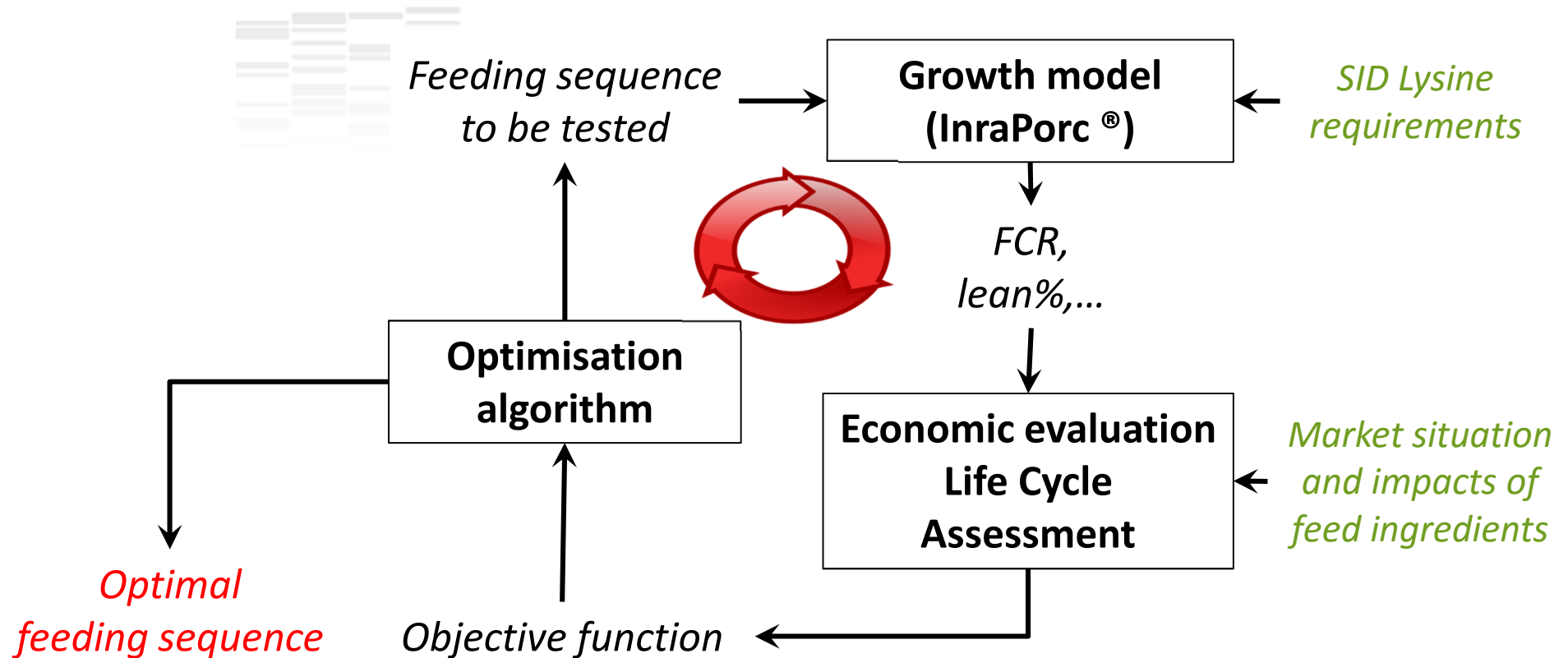
Least-cost formulation of feeds

## To adjust quantity and quality of nutrient supply



To optimize feeding sequences on economic and environmental criteria

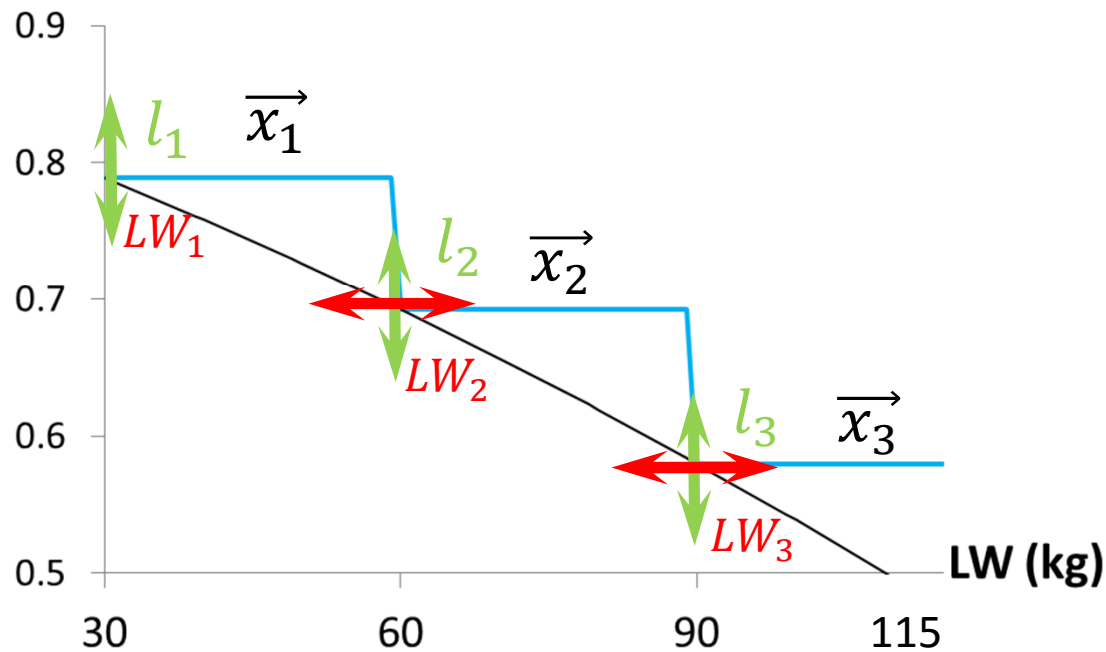
# To develop an optimization model : PigOptim



# Decision variables : what is optimized ?

$$S = (LW_1, l_1, \vec{x}_1; \dots; LW_n, l_n, \vec{x}_n)$$

SID lysine, g/MJ NE



$l_n$  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

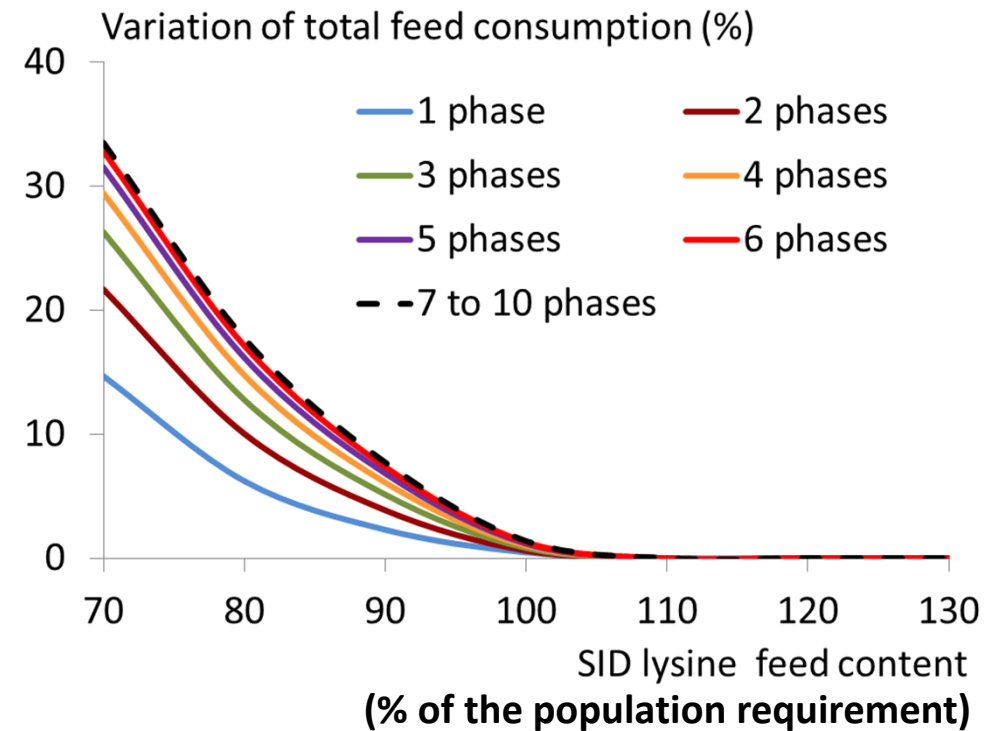
(Brossard et al. 2009)



**Total Feed consumption, ADG, Lean %**

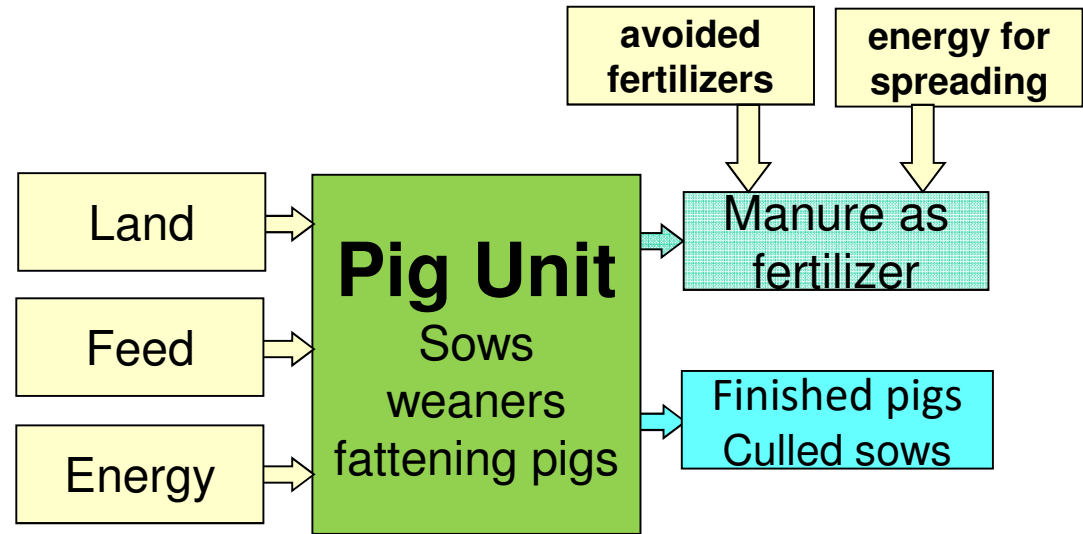
**=**

**f( SID Lys, number of phases)**



# Economic evaluation and LCA → objective function

$$\begin{aligned}
 \text{GrossMargin} = & \\
 & (\text{SellingPrice} \times \text{CarcassWeight} \\
 & \quad - \text{FeedingCost} \\
 & \quad - \text{CareCost} \\
 & \quad - \text{PigletPrice} \\
 & \quad - \text{LabourCost}) \\
 & \times N_{\text{pigs}}
 \end{aligned}$$



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

$$\mathbf{Z} = \alpha \times \text{GrossMargin} - \beta \times \text{ClimateChangeImpact}$$

# Behaviour of the model when fixing LYS level (1)

$$Z = \alpha \times \text{GrossMargin} - \beta \times \text{ClimateChangeImpact}$$

  
% LYS fixed

(70 → 130% of the population requirement)

Economic optimization

↓

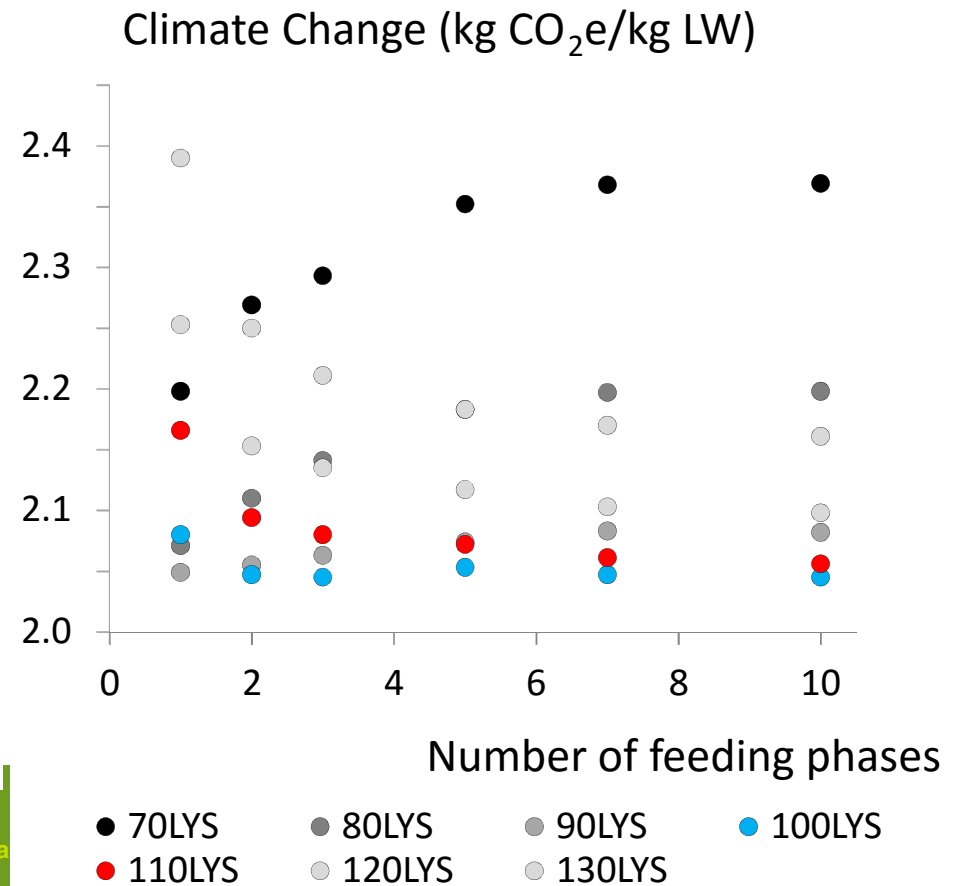
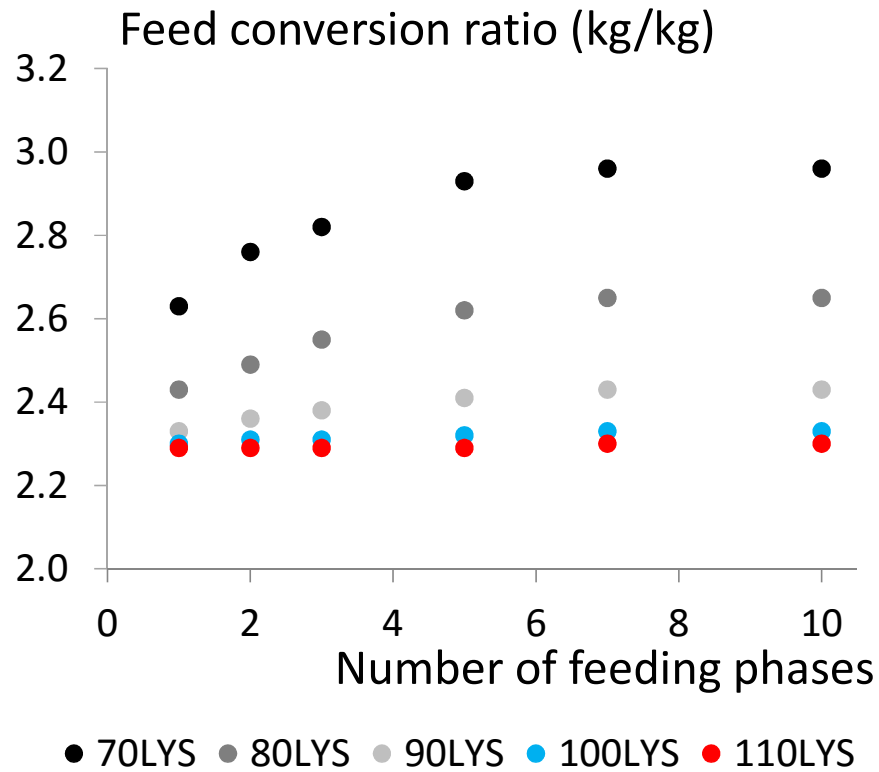
$$\alpha = 1 ; \beta = 0$$

↓

70LYS ... 130LYS



# Behaviour of the model when fixing LYS level (2)



# Trade-off between economy and environment (1)

$$Z = \alpha \times \text{GrossMargin} - \beta \times \text{ClimateChangeImpact}$$



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

Economic or both environmental and economic optimization

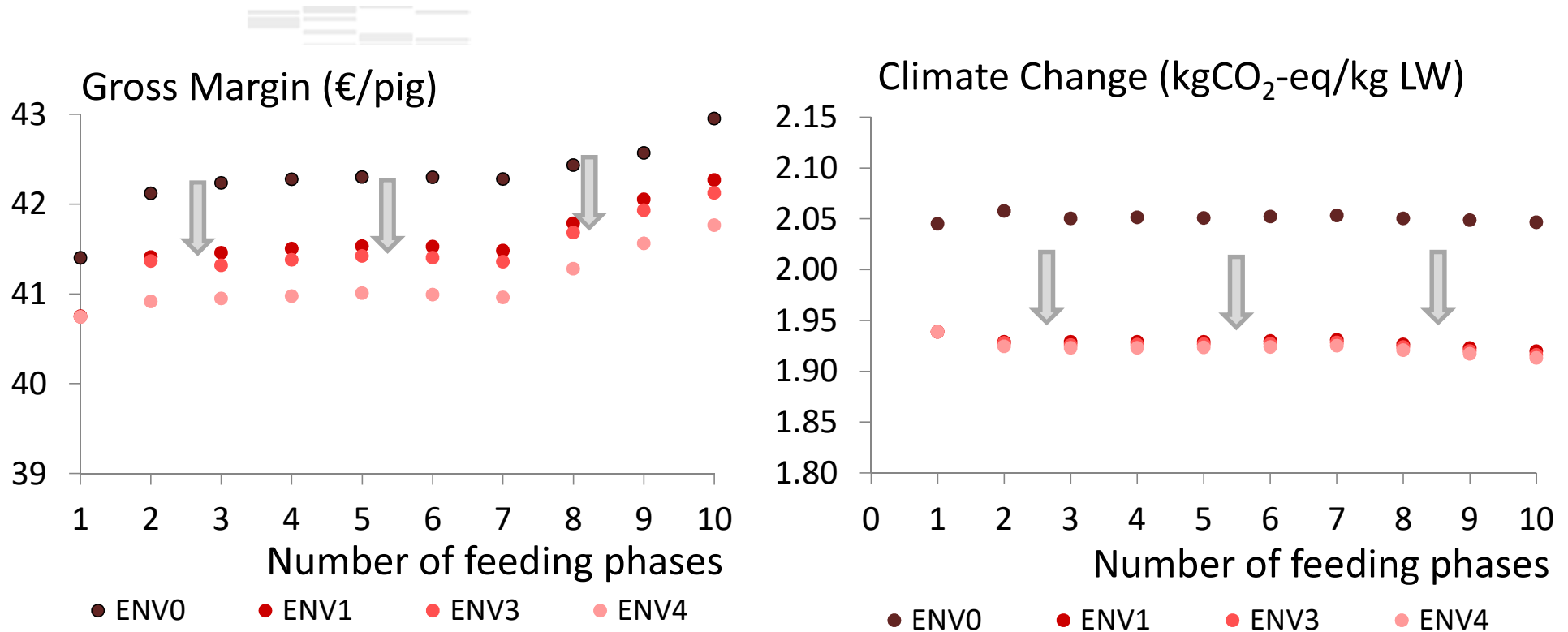


$$\alpha = 1 ; \beta = 0, 1, \dots, 4$$



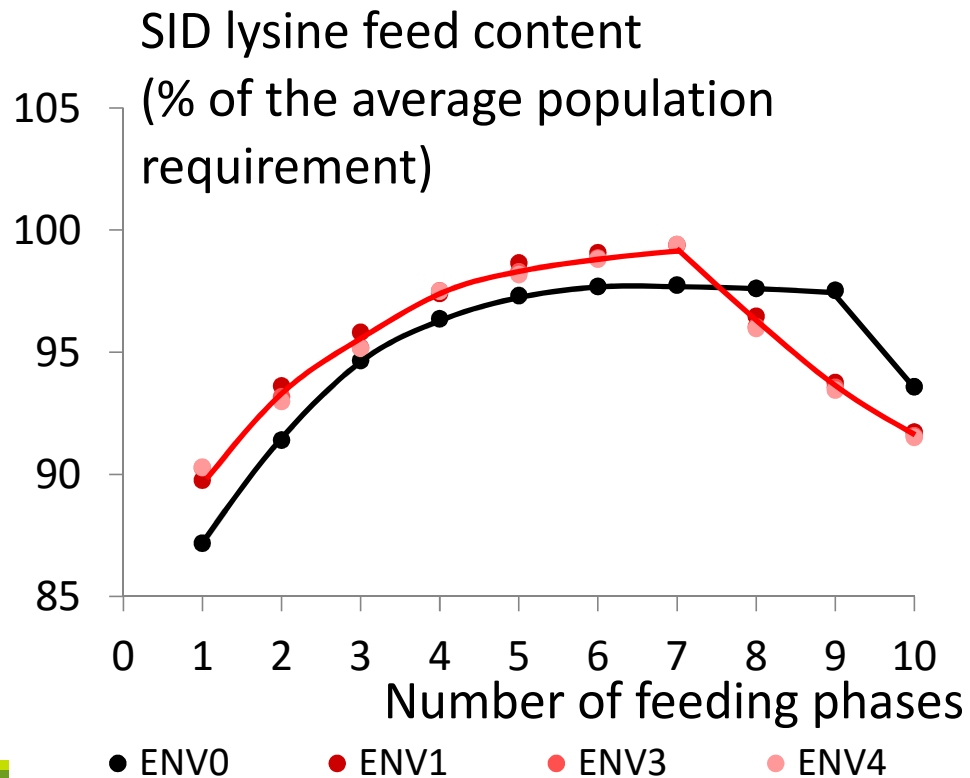
ENV0, ENV1, ...ENV4

# 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  $\nearrow$  when number of phases  $\nearrow$  to compensate for restriction in LYS at the beginning of each phase

optimal LYS  $\searrow$  when number of phases  $\nearrow$   
 $\rightarrow$  No more impact of low LYS supply (70%) for the 8<sup>th</sup> to 10<sup>th</sup> 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  $\neq$  Economic optimum  $\neq$  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 !**



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