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Economic optimization of feeding strategy in pig-fattening units with an individual-based model

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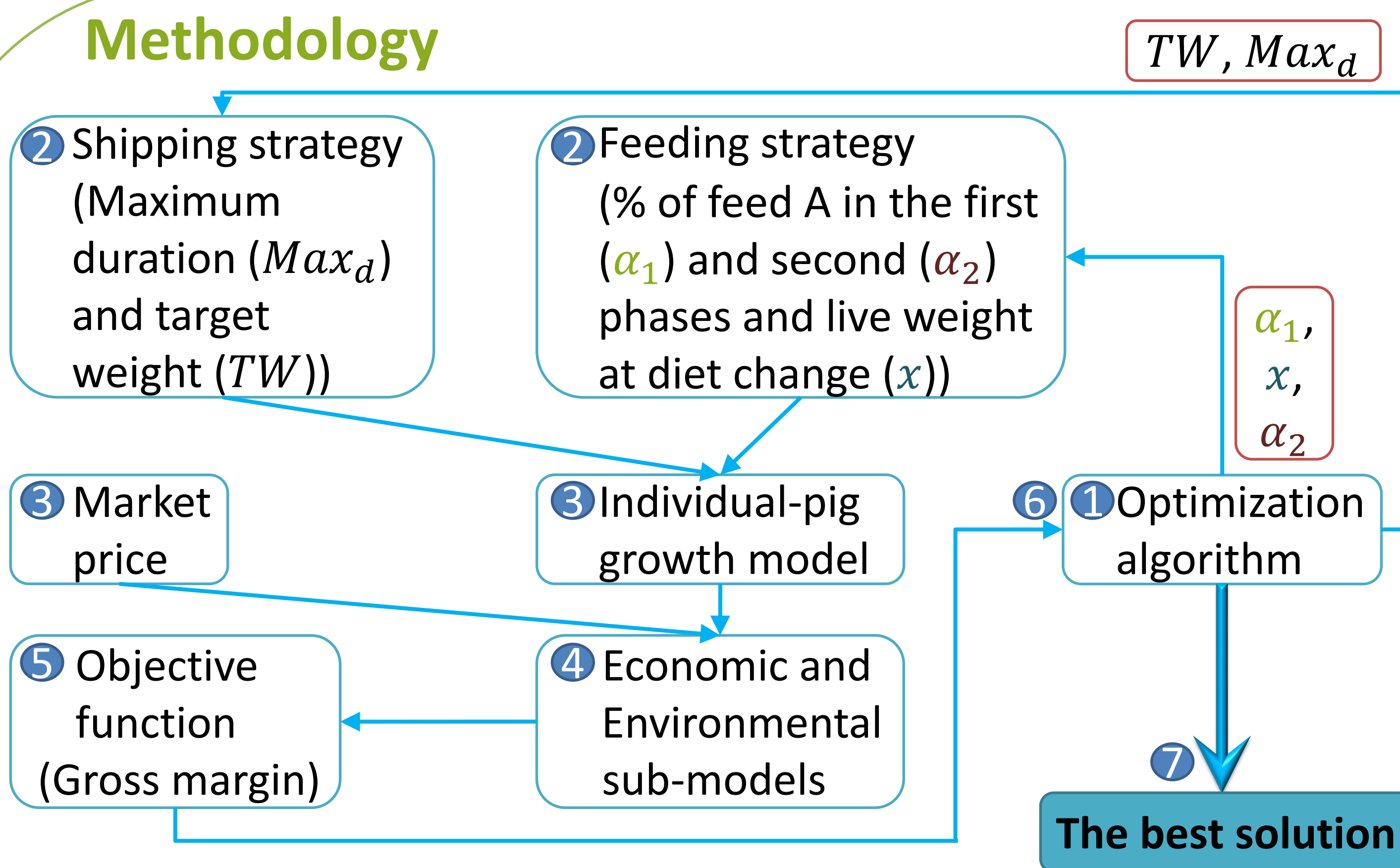
Context

- Economic results of pig farming systems are highly variable and depend on the price of feeds, pig performance, and pork price.
- Shipping strategy affects farm income since lightest pigs that don't reach the target weight at maximal fattening duration result in a lower payment.
- Thus, feeding and shipping strategies are major levers for improvement.

Objectives

- Develop an optimization procedure that finds the best feeding and shipping strategies to maximize the profitability of the pig-fattening unit.
- Illustrate the potential of the model to improve profitability of the pig-fattening unit (**20 batches of 400 pigs**).

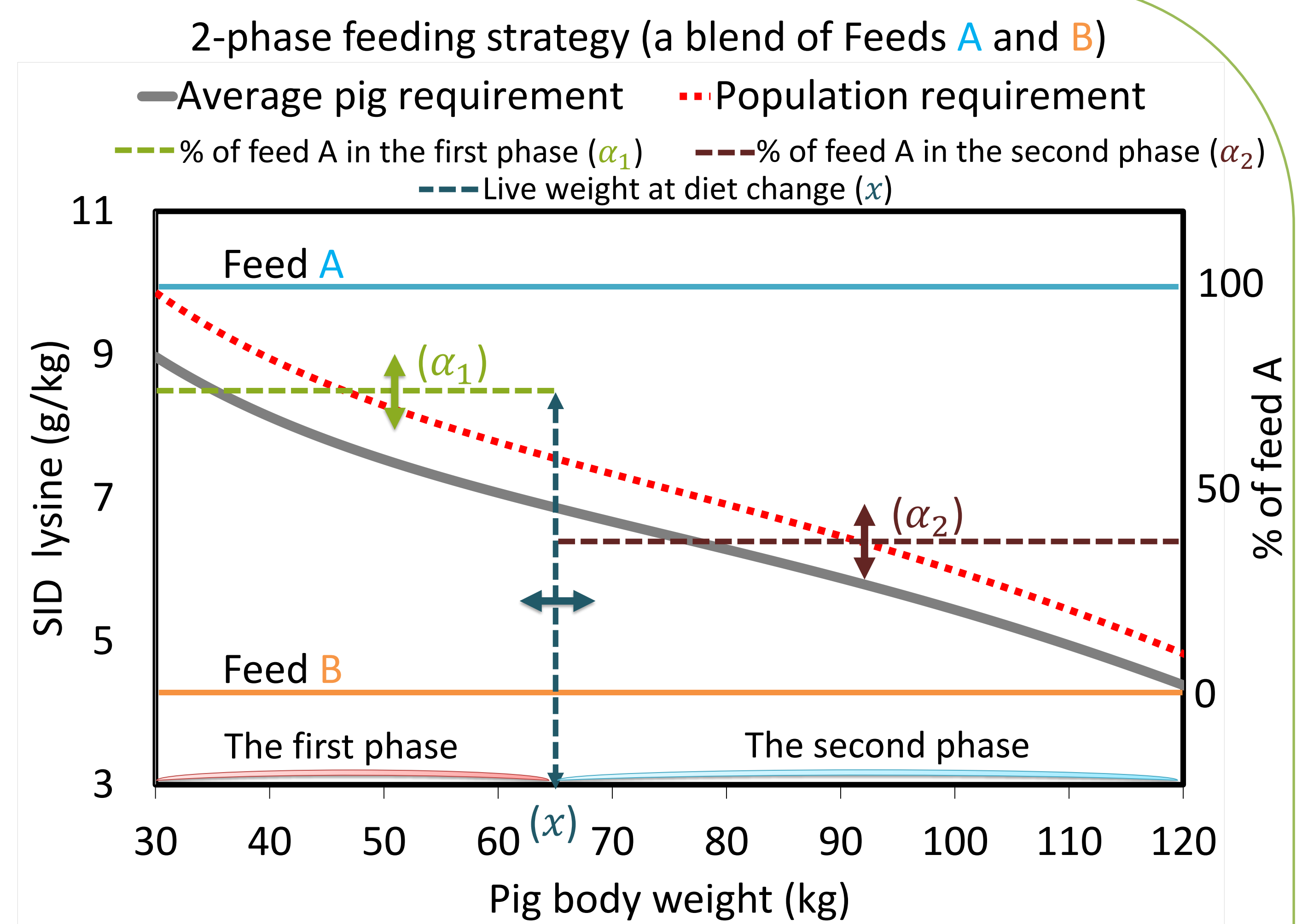
Methodology



The objective is to optimize feeding and shipping strategies in order to maximize the average gross margin per fattened pig.

$$\text{Max} \frac{1}{I} \sum_{i=1}^I GM^i(\alpha_1, x, \alpha_2, TW, Max_d)$$

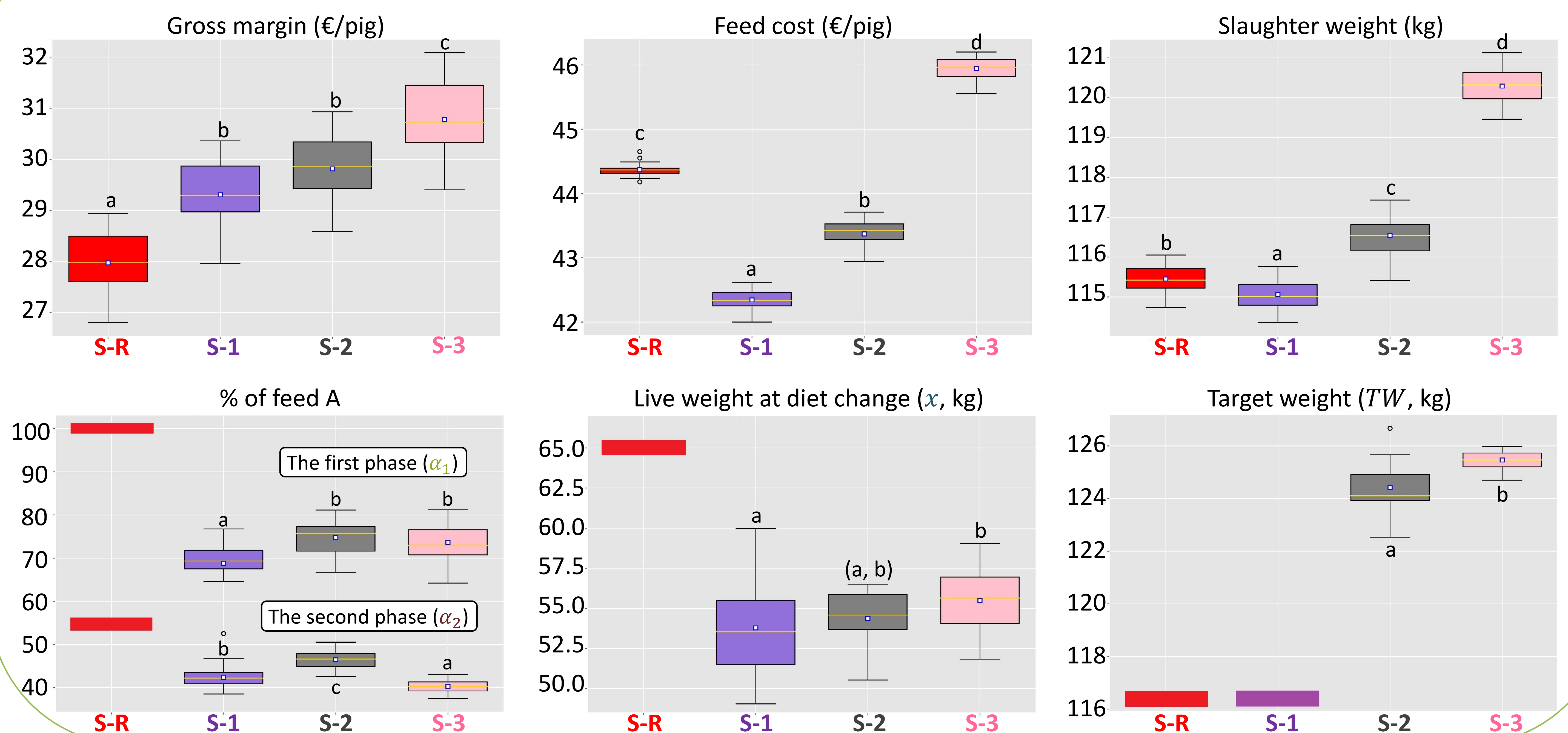
(With I , index of pig)



Decision variable/ *Input parameter	Scenarios				Bounds	
	Simulated	Optimized (using Covariance Matrix Adaptation Evolution Strategy (CMA-ES))			Min	Max
Feeding strategy	S-R (Reference)	S-1	S-2	S-3		
% of feed A (α_1, α_2)	($\alpha_1 = 100^*, \alpha_2 = 55^*$)	✓	✓	✓	0	100
Live weight at diet change (x , kg)	65*	✓	✓	✓	30	120
Shipping strategy	S-R (Reference)	S-1	S-2	S-3		
Target weight (TW , kg)	116.4*	116.4*	✓	✓	110	130
Maximum duration (Max_d , day)	108*	108*	108*	✓	100	125

Results

Means that do not share the same letter are significantly different (according to post-hoc Tukey Honestly Significant Difference (HSD) test at a 5% significance level).



Conclusions

- The optimization procedure is suitable to compare different strategies and improve economic performances of the fattening-unit.
- Accounting for more decision variables (i.e. feeding & shipping strategies) tends to improve profitability.
- Further work will include the feed formulation problem to the whole optimization procedure and investigate : Possible synergies and/or trade-offs between economic and environmental objectives.

