

➤ Simulating pig multiperformance in contrasted breeding systems using an individual-based model

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Pig production contributes to various environmental impacts



Feed production largely contribute to these impacts

Dourmad et al. (1999) ; McAuliffe et al. (2016) ; Basset-Mens and van der Werf (2005) ; Dourmad et al. (2014) ; Mackenzie et al. (2015)



Feeding strategies to reduce impacts



Feed ingredients with lower environmental impacts and often:
- rich in energy and dig. proteins
+ higher fibre content
+ diversified



Current selected pigs



Energy-rich feed and easy to digest



How do current pigs fed with a diversity of feeds respond?

Objective

Simulate technical, economic and environmental pig performances in contrasted breeding systems with an individual-based model





1586 commercial pigs

Daily recordings of feed intake
And growth performances



InraPorc®



Individual nutritional requirements



Least cost feed formulation method
2 breeding systems



Standard

Conventional system
representative of a
commercial farm in France



Alternative
conventional

- ⊖ Soybean-based ingredients
- ↘ Cereals
- + Coproducts and innovative feed resources



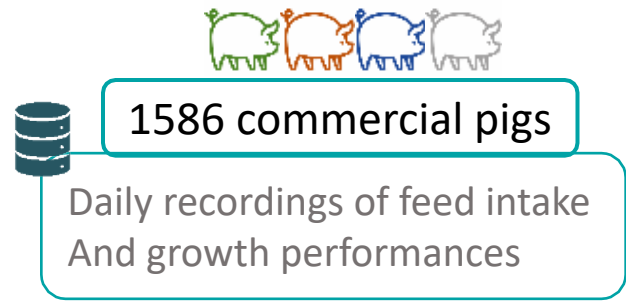
Feed formulation for **each pig in each system**
during fattening



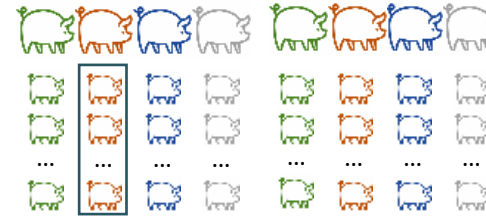
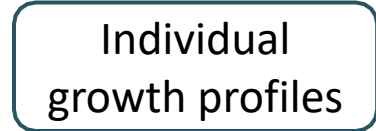
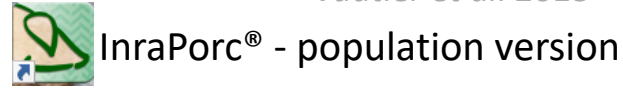
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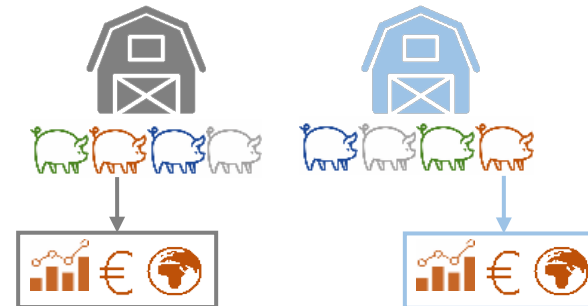
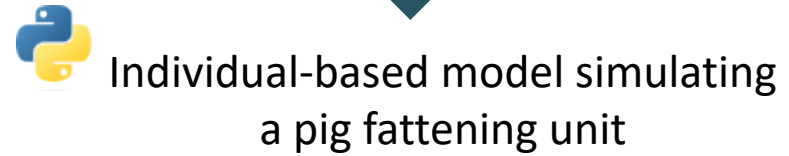
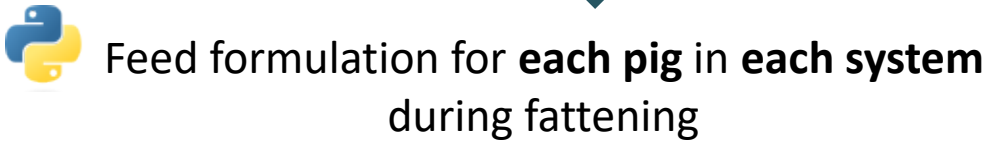
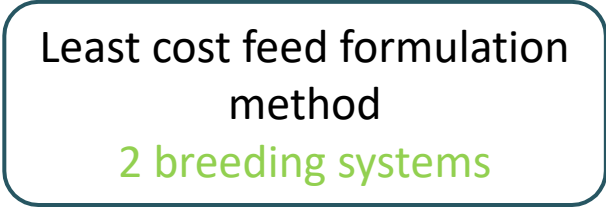
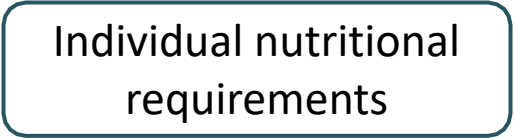
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Vautier et al. 2013



1 batch of 1000 pigs



Cadéro et al. (2018) and Davoudkhani et al. (2020)

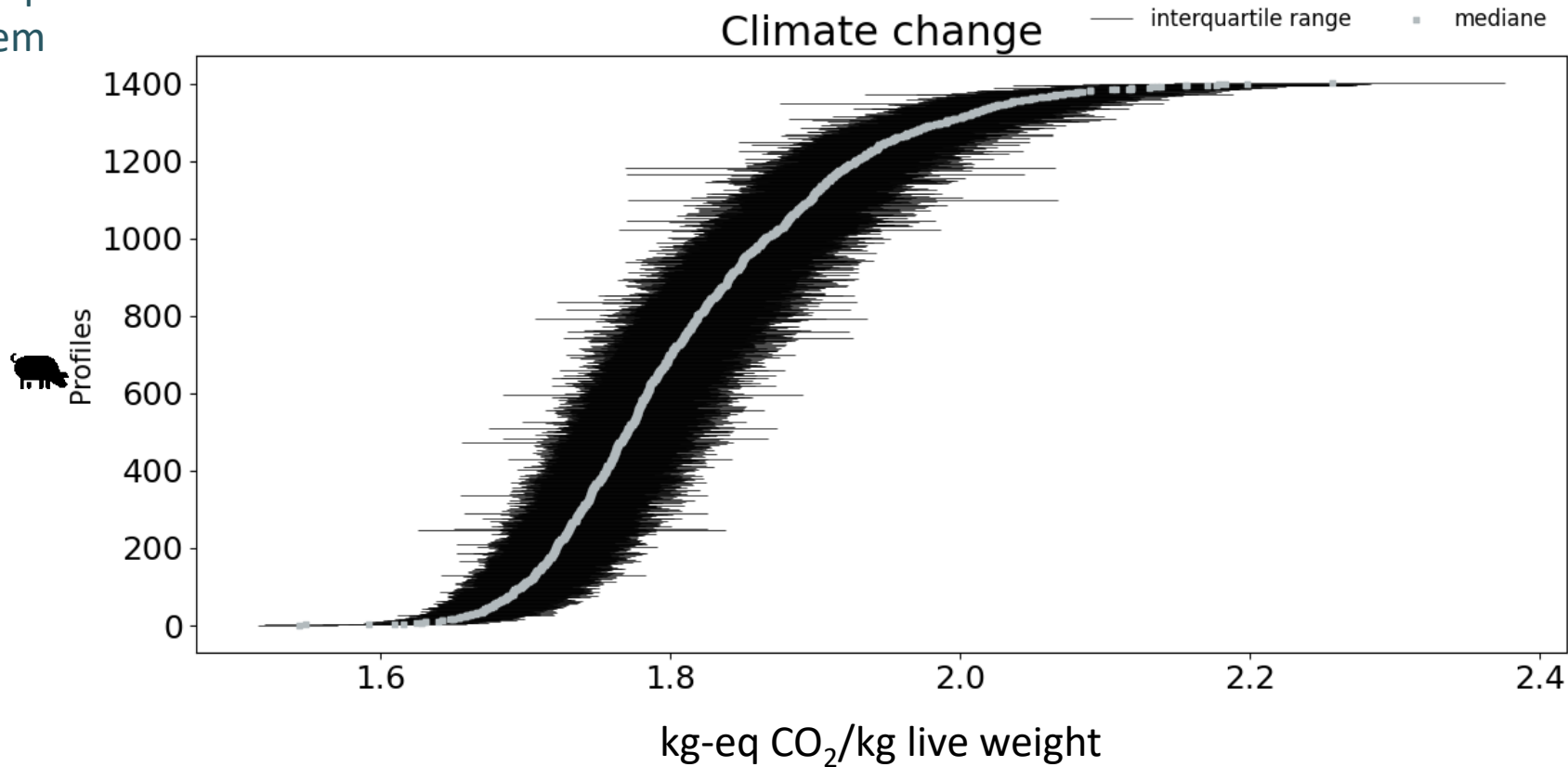


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Environmental performance



Climate change impact
Standard system



What factors explain the differences in environmental performance observed between pig profiles?



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Environmental performance

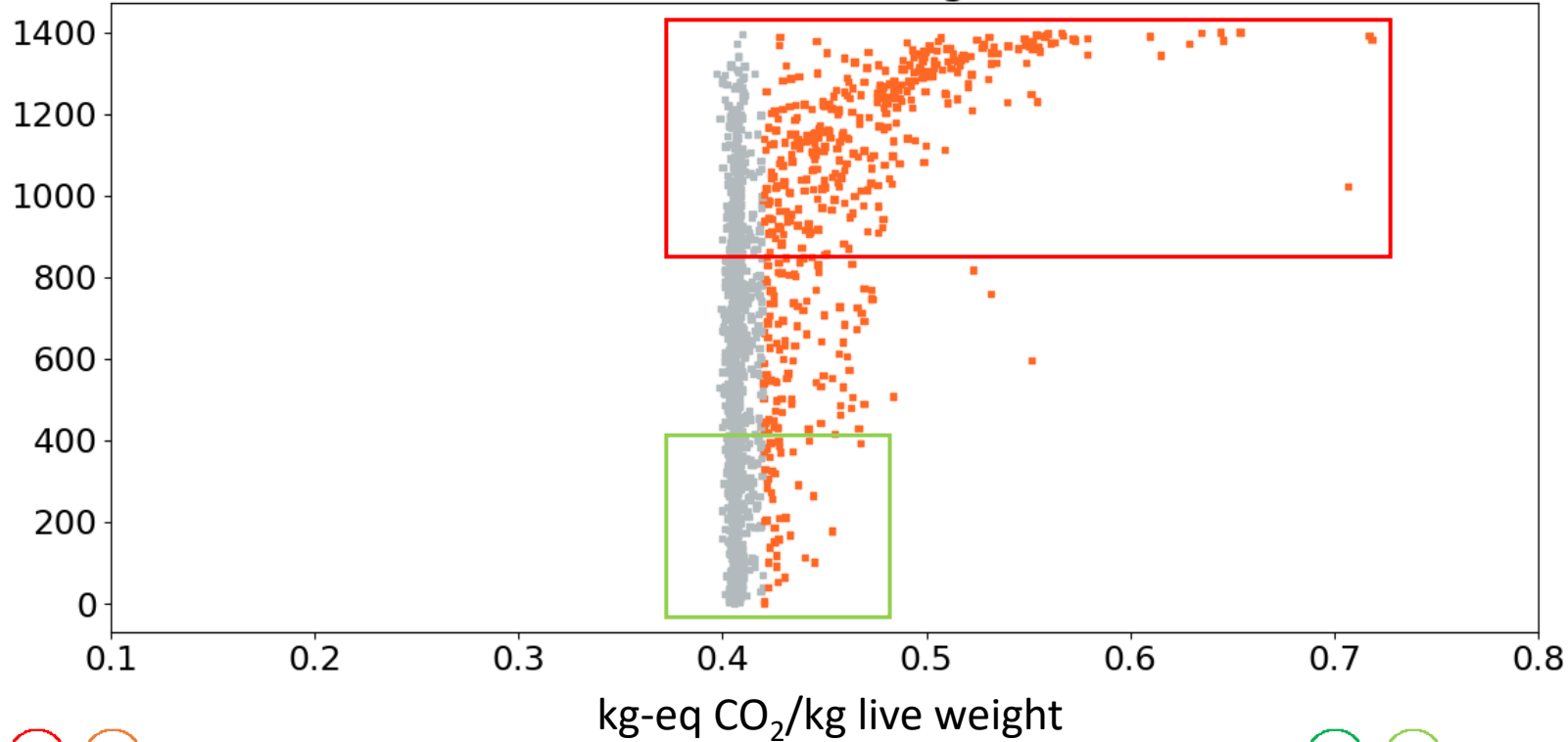


Standard

Climate change impact
Standard system



Profiles



■ CC feed > 0.42
 kg-eq CO₂/kg feed
■ CC feed < 0.42
 kg-eq CO₂/kg feed



Feeds with the highest CC impacts correspond to the pigs with the highest global CC impacts

Pigs with the lowest global CC impacts were fed with the lowest CC impact feeds

Some pigs with highest global CC impact were fed with low CC impact feeds



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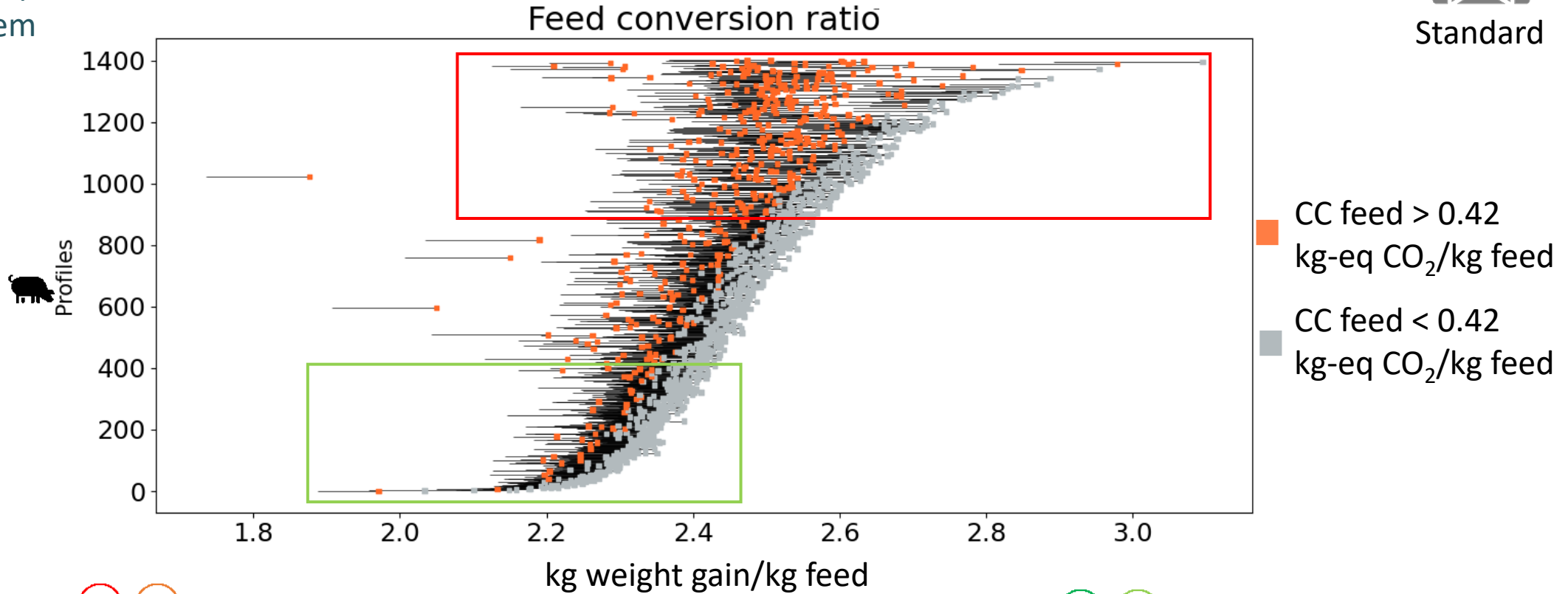
Animal performance



Standard

Climate change impact

Standard system



Among pigs fed with the highest CC impact feeds, some had intermediate feed conversion ratios



Pigs with the lowest global CC impact had the lowest feed conversion ratios



Pigs fed with the lowest CC impact feeds had high feed conversion ratios

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Environmental performance

Climate change impact



Worst pigs with highest environmental performance in the standard system explained by **high environmental impact of feeds** **or** **poor feed conversion ratios**



Environmental performance

Climate change impact



Best pigs with lowest environmental impacts in the standard system explained by the combination of **low impacts of feeds** **and** **low feed conversion ratios**



Alternative conventional

- ⊖ Soybean-based ingredients
- ↘ Cereals
- + Coproducts and innovative feed resources

What are these pig responses when simulated for an alternative conventional system?



Environmental performance



Standard

$\rho = 0.25$

Spearman correlation

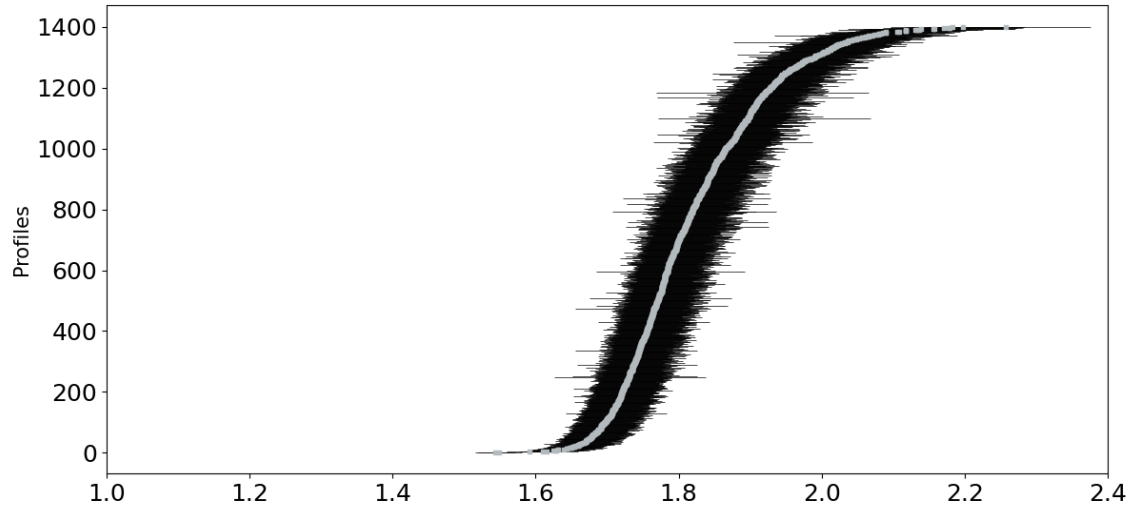


Alternative

Climate change impact
Standard system

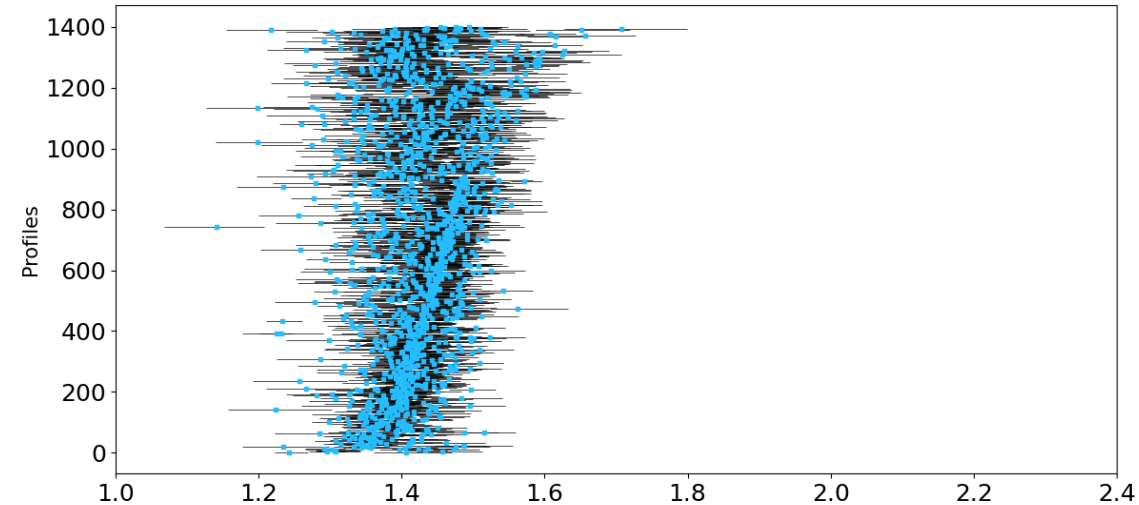


Climate change



kg-eq CO₂/kg live weight

Climate change



kg-eq CO₂/kg live weight



Re-ranking



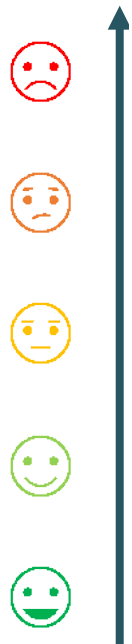
Do the same factors explain the environmental performances of pigs in this new system?

Environmental performance

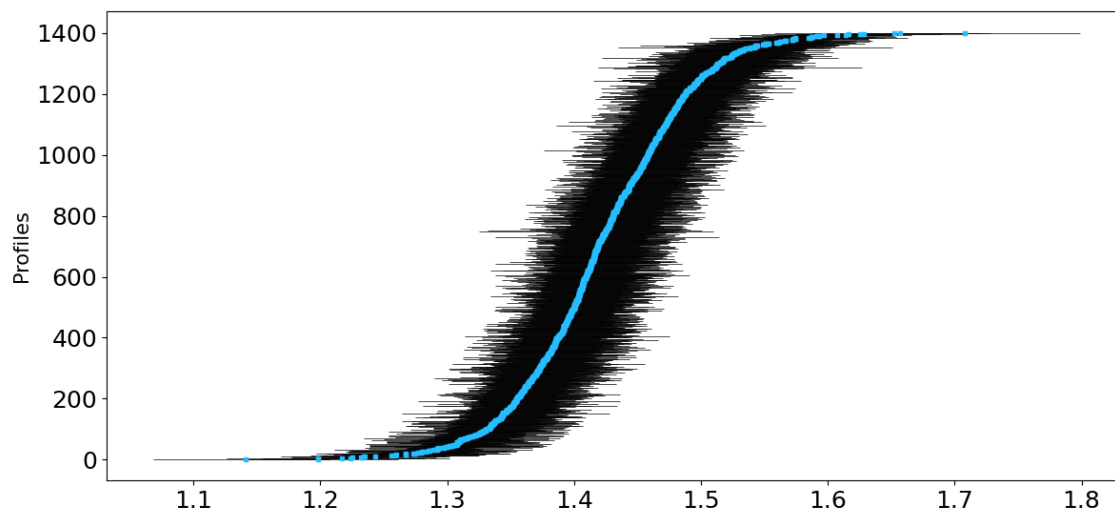


Alternative

Climate change impact
Alternative system

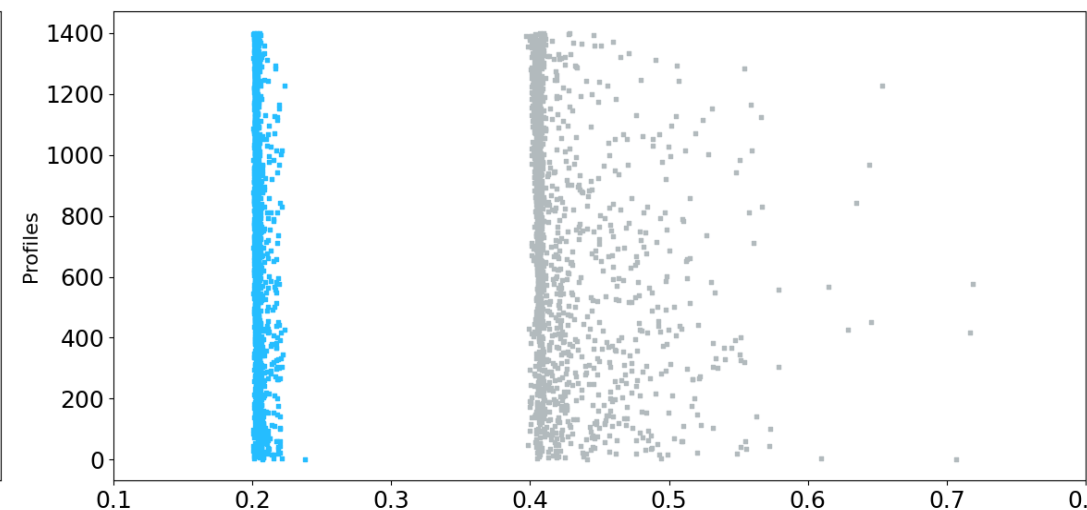


Climate change



kg-eq CO₂/kg live weight

Climate change



kg-eq CO₂/kg feed

- Climate change impact of feeds varies little between pig profiles
- Climate change impact of feeds does not explain differences in global climate change impact



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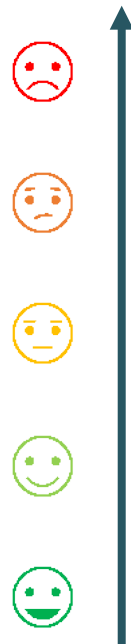
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Environmental performance



Alternative

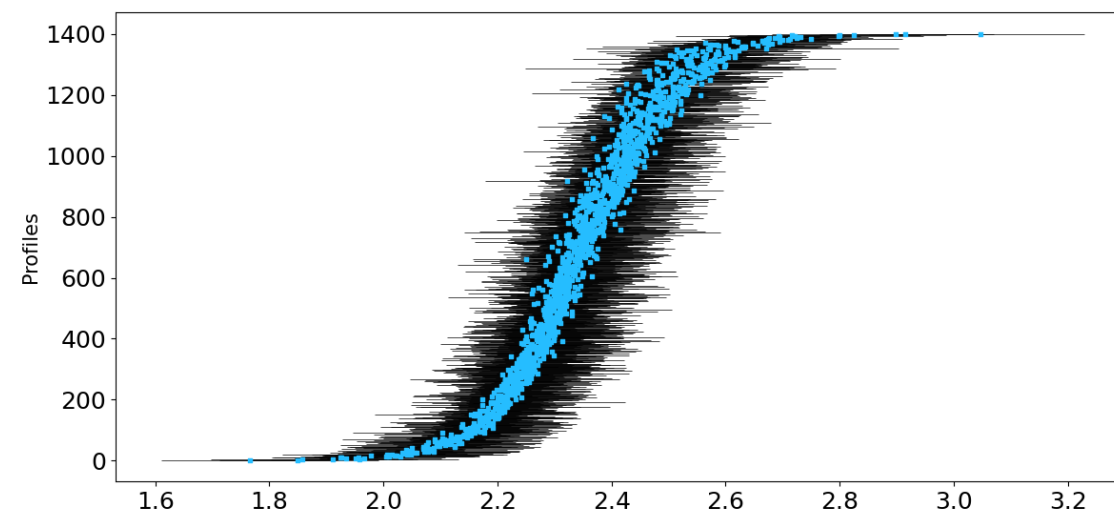
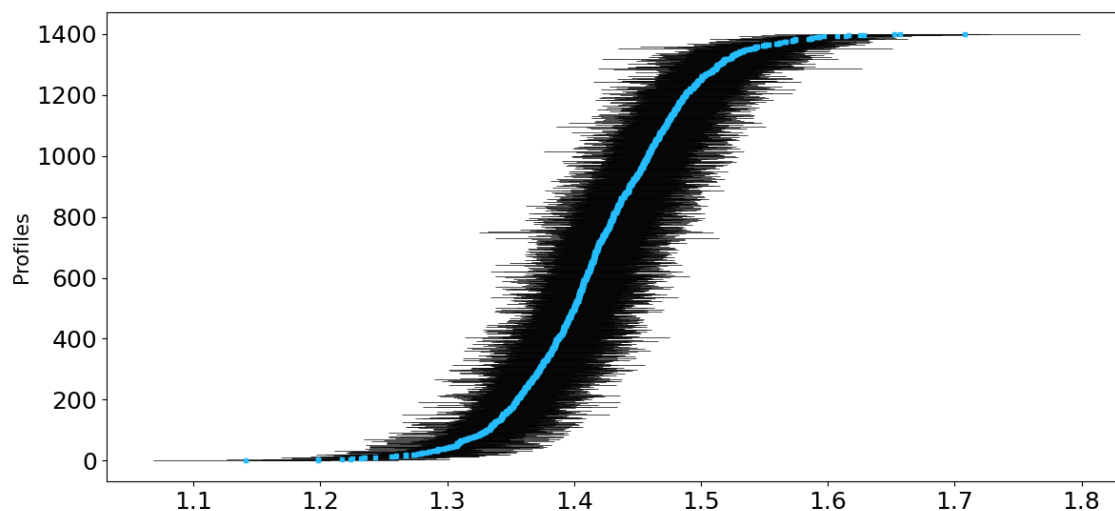
Climate change impact
Alternative system



Climate change

$\rho = 0.98$
Spearman correlation

Feed conversion ratio



kg-eq CO₂/kg live weight

kg weight gain/kg feed

Pigs with the **lowest global CC impacts** also had the **lowest feed conversion ratios**

Pigs with the **highest global CC impacts** also had the **highest feed conversion ratios**

➤ Conclusion & Perspectives



Best pigs for environmental impacts in a standard system may not be the best in another system



Differences observed in a **standard system** between pig profiles on **climate change** impact can be explained either by differences in **feed conversion ratios** **or** by differences in **environmental impacts of feeds**



Differences observed in the **alternative conventional system** between pig profiles on **climate change** impact can be explained by differences in **feed conversion ratios** in a context where feed impacts vary much less

➤ Conclusion & Perspectives

 Feed formulas



Pig responses in other **breeding systems**



Local



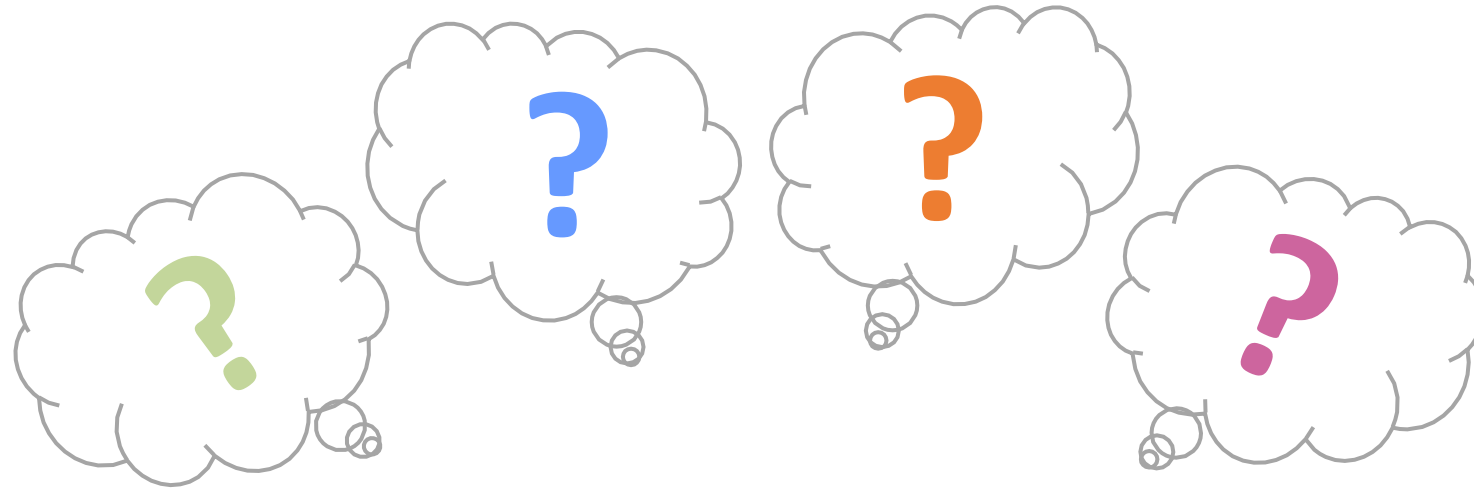
Organic



Pig responses with **feeds formulated to minimize environmental impacts**



Thank you for your attention



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