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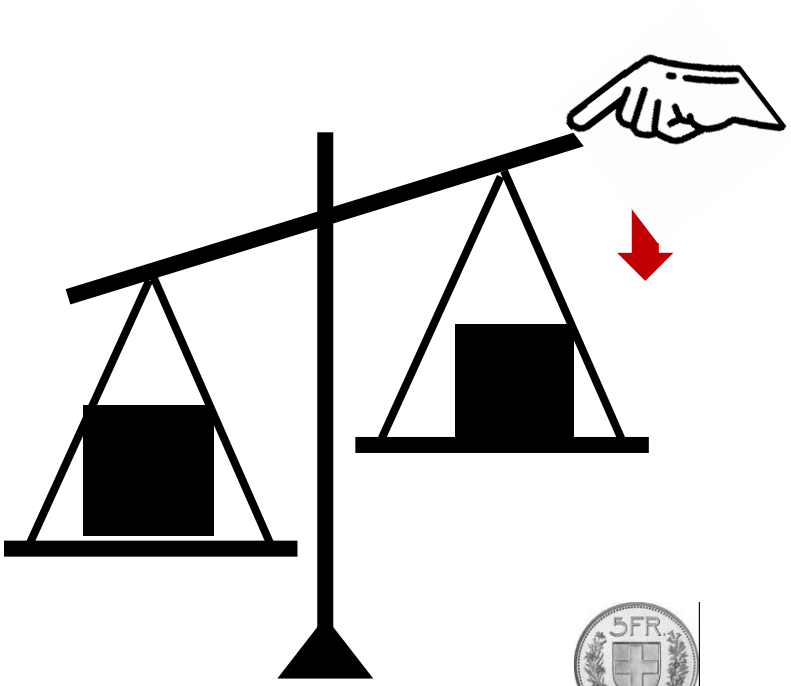
Agroscope

Genetic basis of protein efficiency in pigs

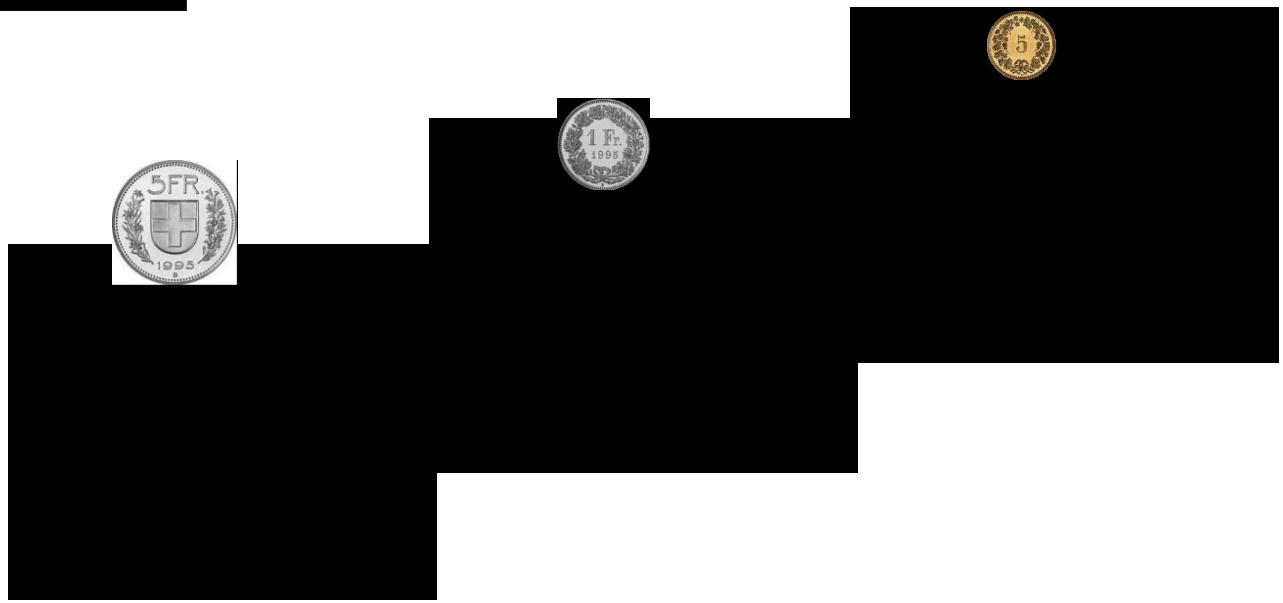
Claudia Kasper
Animal GenoPhenomics Unit
Agroscope

Posieux, 26 October 2021
Visite Agroscope-Agridea étudiants ACO

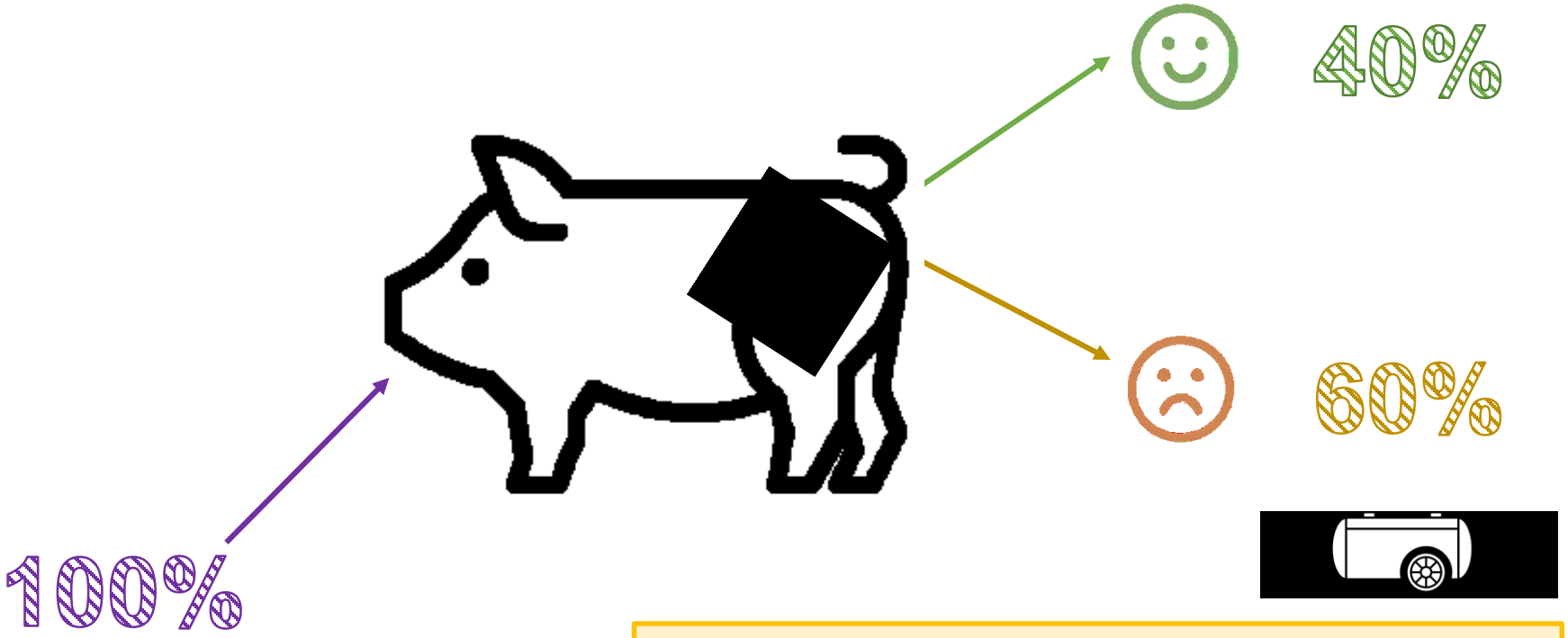
Protein efficiency



Protein efficiency ≠ feed efficiency

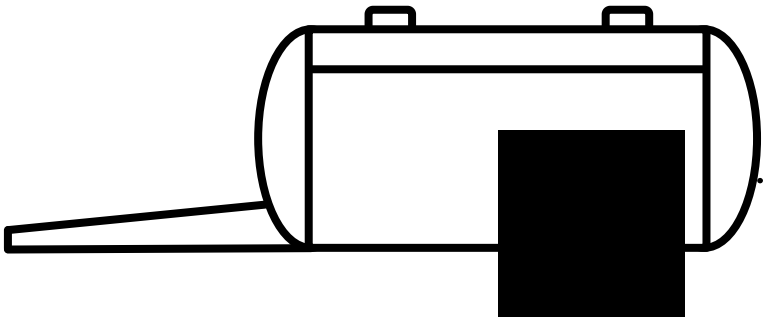


Absorption and excretion of proteins



$$\text{Protein efficiency} = \frac{\text{Fixed protein (muscle mass)}}{\text{Protein ingestion (feed)}}$$

Damage to the environment and human health



Import of protein feed (soy)

Water: Eutrophication (Sea of Marmara), Drinking water pollution

Air: Particulate matter (respiratory problems, cancer)

Greenhouse: Nitrous oxide (N_2O); > 100 Jahre, 298 × CO_2

Ecosystems: Biodiversity losses, leaf damage

Soil: Acidification (forest), biodiversity loss

910.13

Ordonnance sur les paiements directs versés dans l'agriculture

(Ordonnance sur les paiements directs, OPD)

[redacted] (Etat le 1er janvier 2013)

Le Conseil fédéral suisse,

vu les art. 70, al. 5 et 6, 73, al. 4 et 5, 74, al. 4 et 5, 75, al. 2, 170, al. 3, et 177 de la loi du 29 avril 1998 sur l'agriculture (LAgr)[1],[2]

arrête:

Art. 6 [redacted]

[1] Les cycles des éléments nutritifs seront aussi fermés que possible et la charge en bétail doit être adaptée à l'emplacement.

[2] Le bilan de fumure doit montrer que les apports en phosphore et en azote ne sont pas excédentaires.

[3] Les apports autorisés en phosphore et en azote sont calculés en fonction des besoins des plantes et du potentiel de production de l'exploitation.

Genetis of protein efficiency in pigs

Project March 2019 – January 2023
PhD Esther Ewaoluwagbemiga

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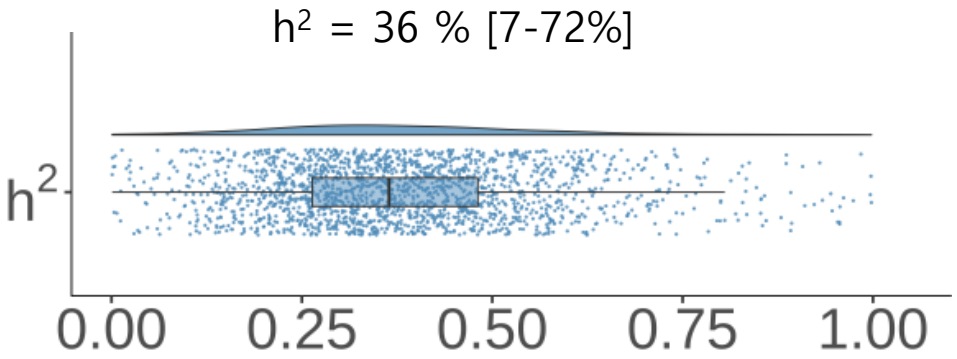
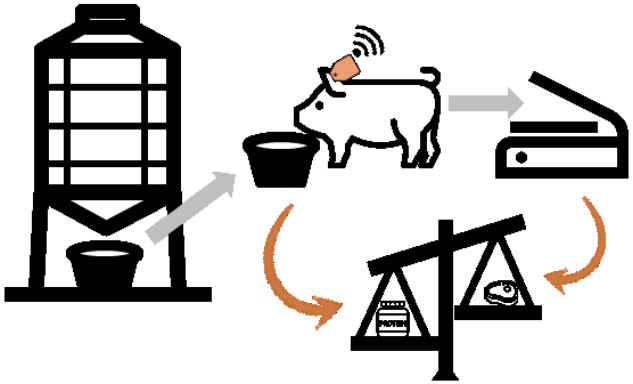
Pilot study (N = 294)



Kasper C., Ruiz-Ascacibar I., Stoll P. & Bee G. 2020. Journal of Animal Breeding and Genetics

Experiment

Phenotyping



fondation sur la croix
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682, ♀ & ♂

80% protein content, soy free

~100 kg live weight

Genotyping

~ 1000 pigs

HD genotyped and low-pass (1X) sequenced

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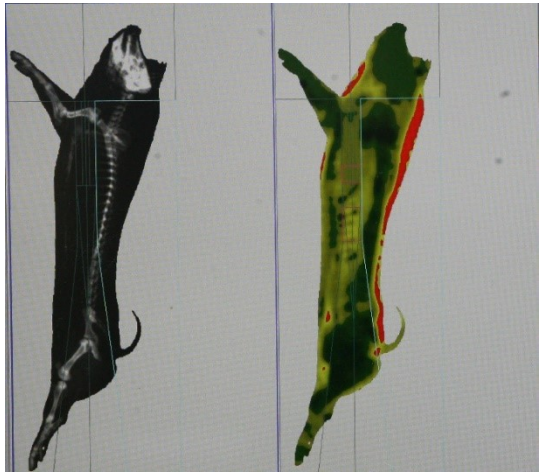
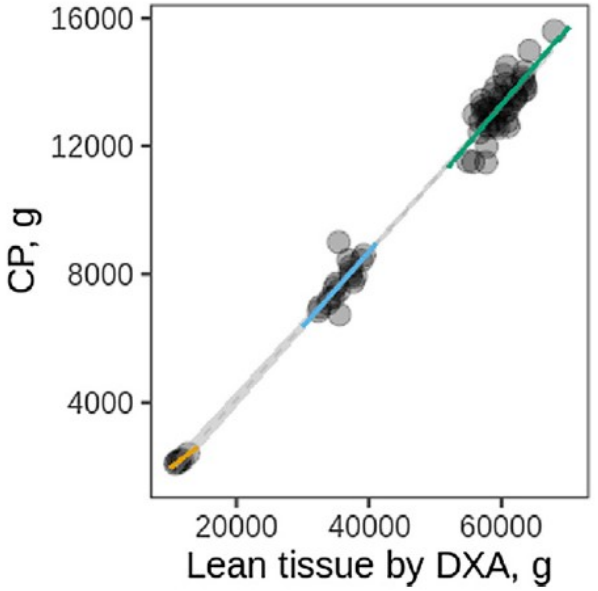
Muscle mass in the carcass

Dual-energy X-ray absorptiometry (DXA)



Dual-energy X-ray absorptiometry DXA

- Calibration study: lean meat content *DXA* vs. protein/N content *chemical analyses*
- High accuracy (R^2=0.98) and precision (rCV=4.4%)
- Bone mineral content (P) and fat content
- Carcass halves but also live scans (light anaesthesia)
- Continuous improvement of method – H2020 Pigweb



PIGWEB

Kasper C., Schlegel P., Ruiz-Ascacibar I., Stoll P. & Bee G. 2021. Animal

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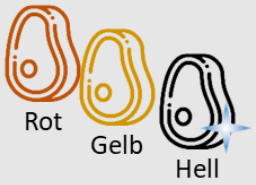
Additional traits

(N = 510)

Fleischfarbe



Intramuskuläres Fett

Tropfsaftverlust

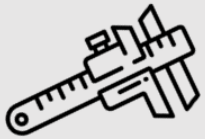
Kochsaftverlust

Sensorik

Scherkraft

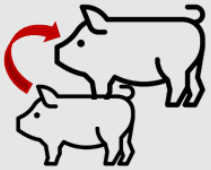
LMC

Rückenspeck-dicke

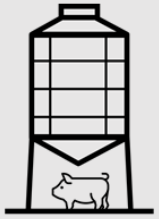


Ø Futteraufnahme

Ø Mastzuwachs



FCR



Phosphor-effizienz

Heritability of protein efficiency

(N = 682)

fondation sur la croix
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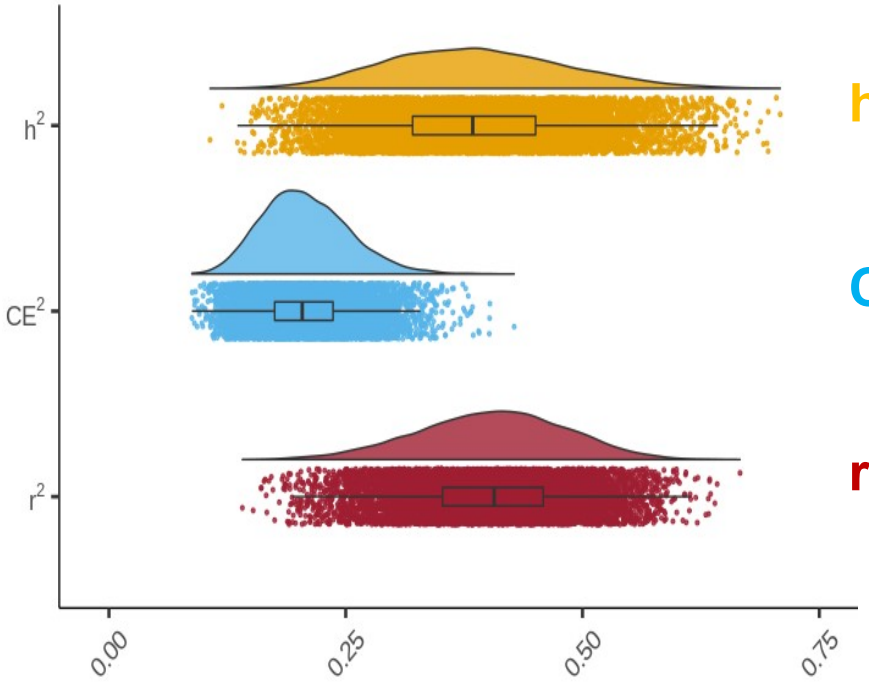

h^2 = 0.39 (0.22, 0.58)

CE^2 = 0.20 (0.12, 0.30)

r^2 = 0.40 (0.24, 0.25)

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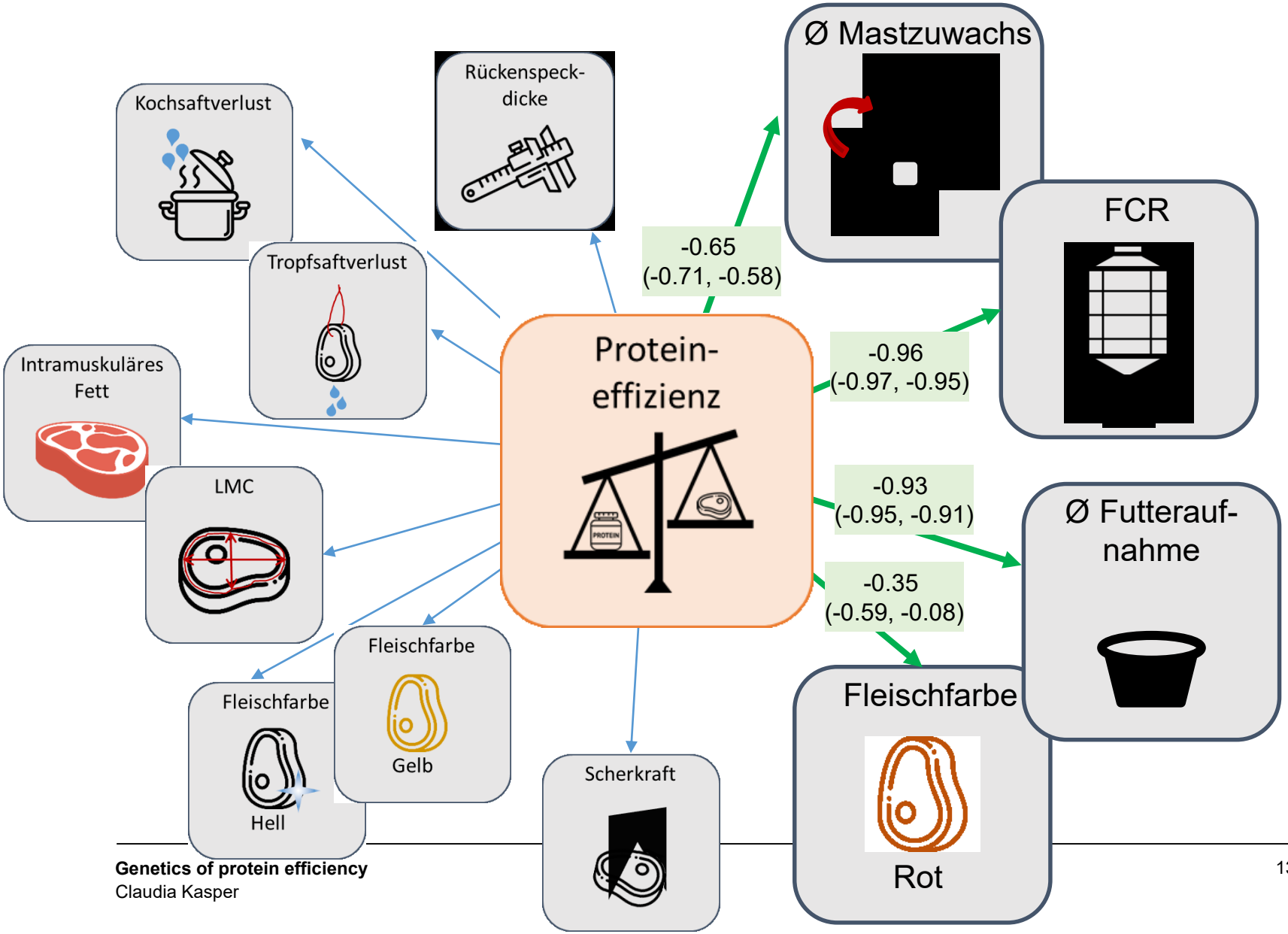
Genetic correlations



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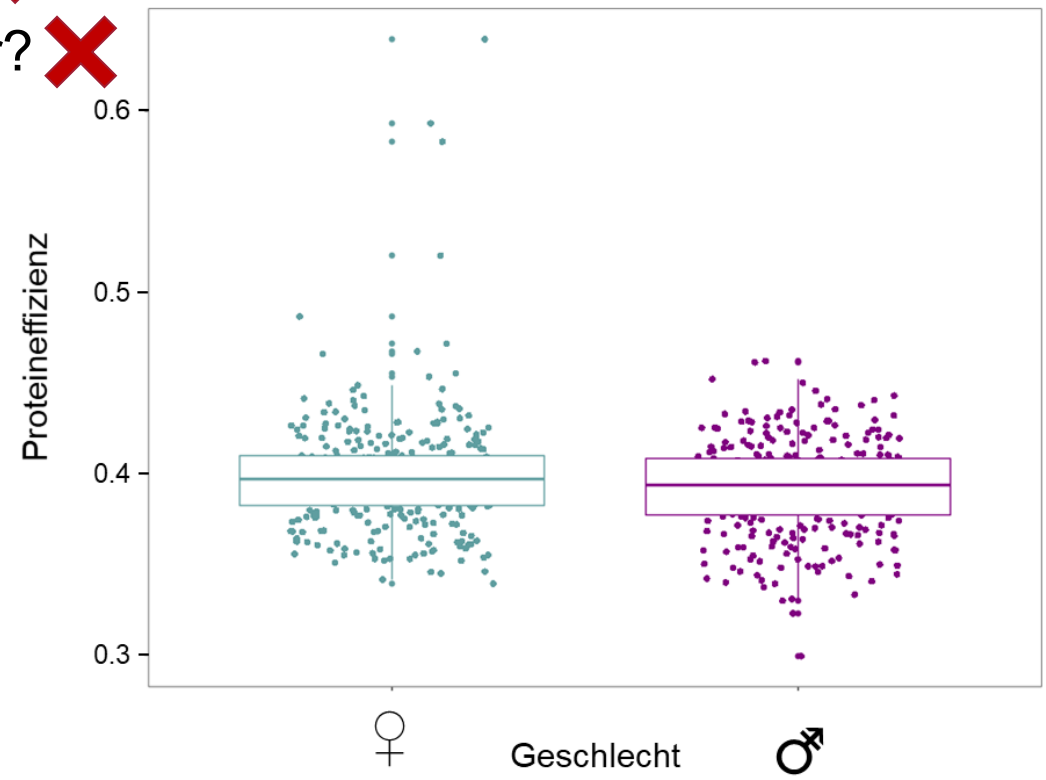
How do you recognise protein-efficient pigs?

- sex? ✗
- Age at slaughter? ✗
- Weight at slaughter? ✗
- ADG? ✗



How do you recognise protein-efficient pigs?

- sex? ✗
- Age at slaughter? ✗
- Weight at slaughter? ✗
- ADG? ✗

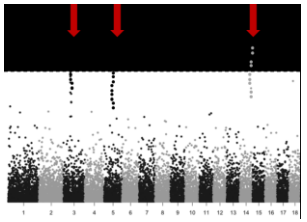
Wanted: prediction method!

- Feeding patterns?
  - R^2=0.33
  - RMSE=0.02

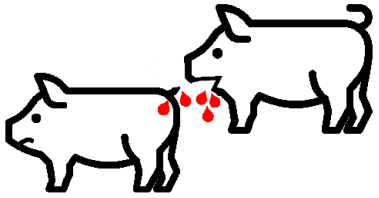
Ewaoluwagbemiga E.O., Bee G. & Kasper C., 2021. Animal

Outlook

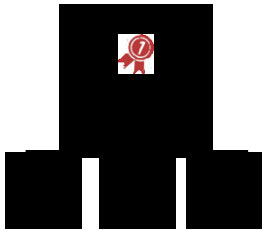
- **Genome wide association study** – in progress



- **Animal welfare** – in progress
  - Tail biting
  - «problematic behaviours»

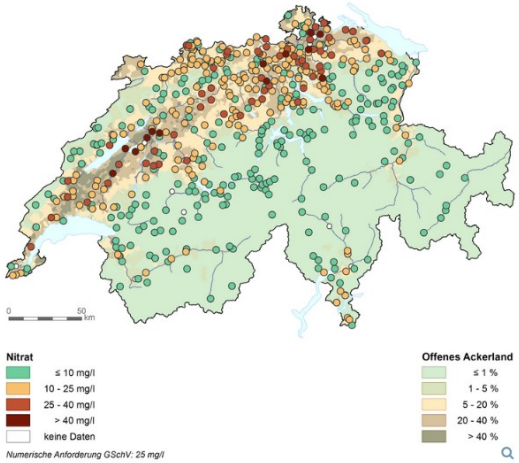


- **Selection lines** – logistics very difficult
  - fertility
  - health
  - Stress resilience
  - …



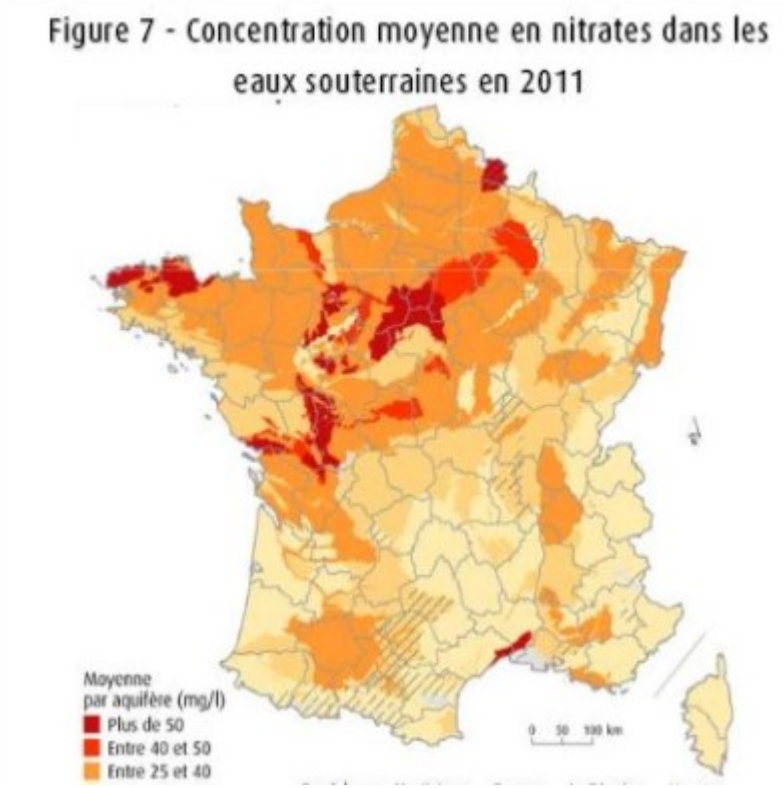
How realistic is breeding for increased protein efficiency?

- Important?
- Measurable?
- Heritable?



Nitrat im Grundwasser (2019) sowie offenes Ackerland. Maximalwert pro NAQUA-Messstelle.

© BAFU



Quelle: BAFU (CH), Umweltbundesamt (DE)

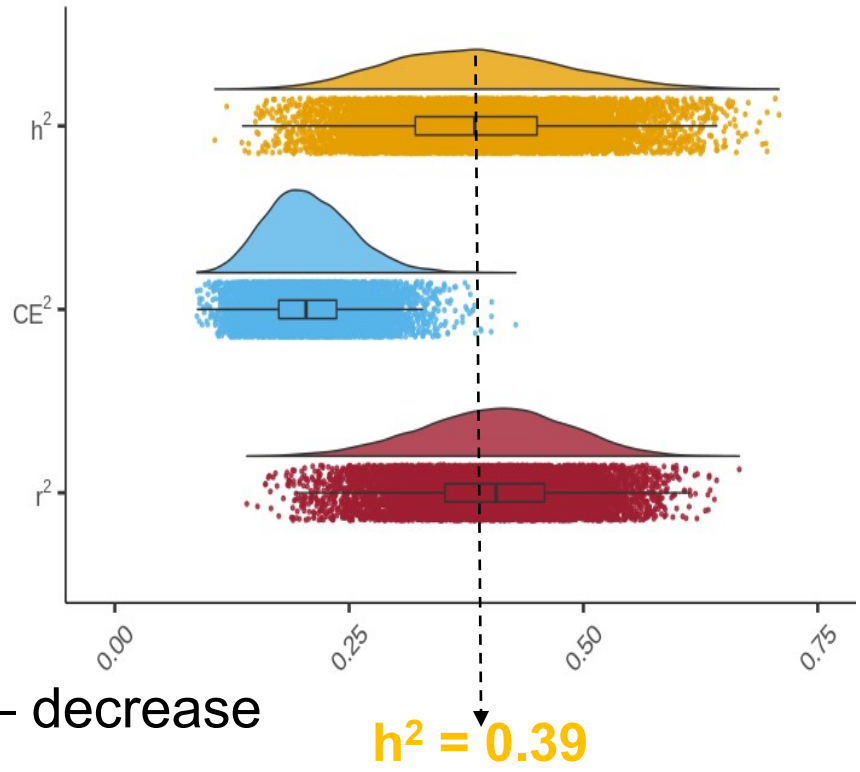
How realistic is breeding for increased protein efficiency?

- Important? ■
- Measurable? ■
- Heritable? □

but…

How realistic is breeding for increased protein efficiency?

- Important?
- Measurable?
- Heritable?



- Attain environmental goals – decrease N emissions?
- Breeding is no magic bullet

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Acknowledgements

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Thank you for your attention!

Claudia Kasper
claudia.kasper@agroscope.admin.ch

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www.agroscope.admin.ch








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