

Using phenotypic distribution models to predict livestock performance

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Acknowledgements



Wondmeneh Esatu
Olivier Hanotte
Fasil Getachew



Indigenous breeds

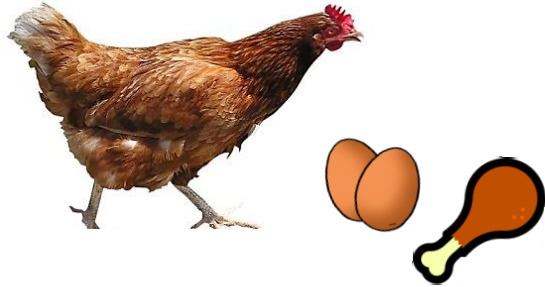


Indigenous breeds

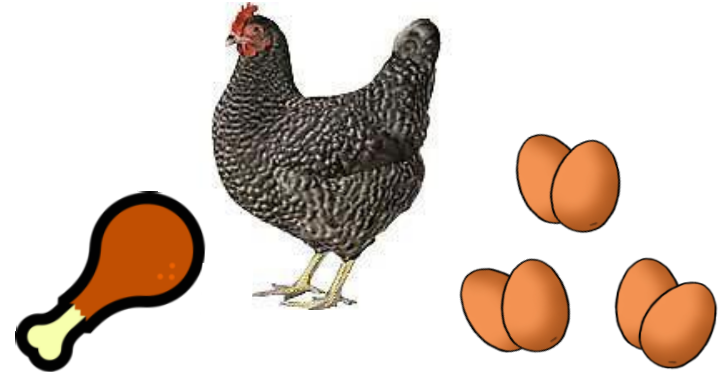
- Natural selection
- Locally adapted



Indigenous breeds vs commercial breeds



Vs.



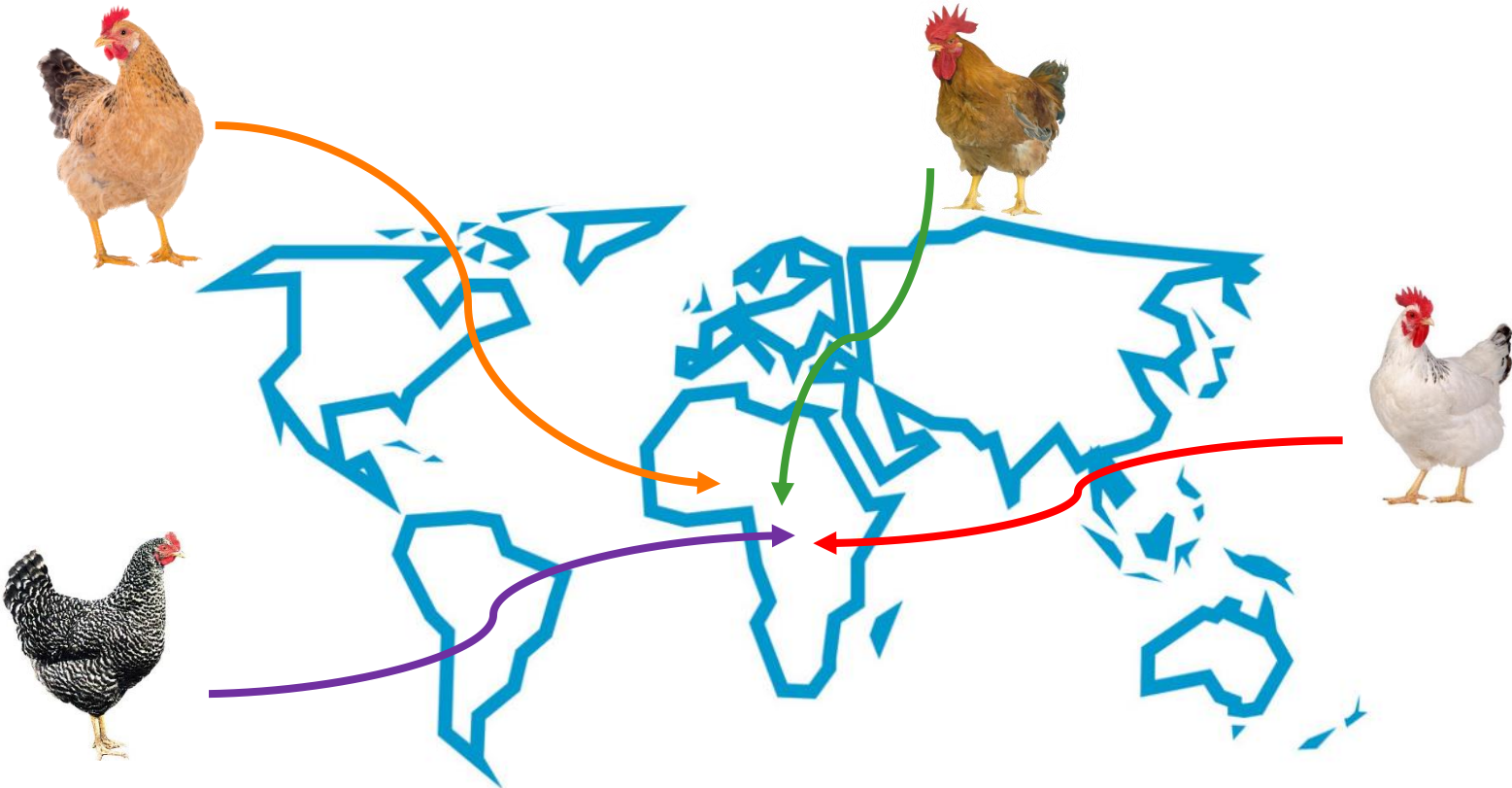
Indigenous breeds

- Natural selection
- Locally adapted

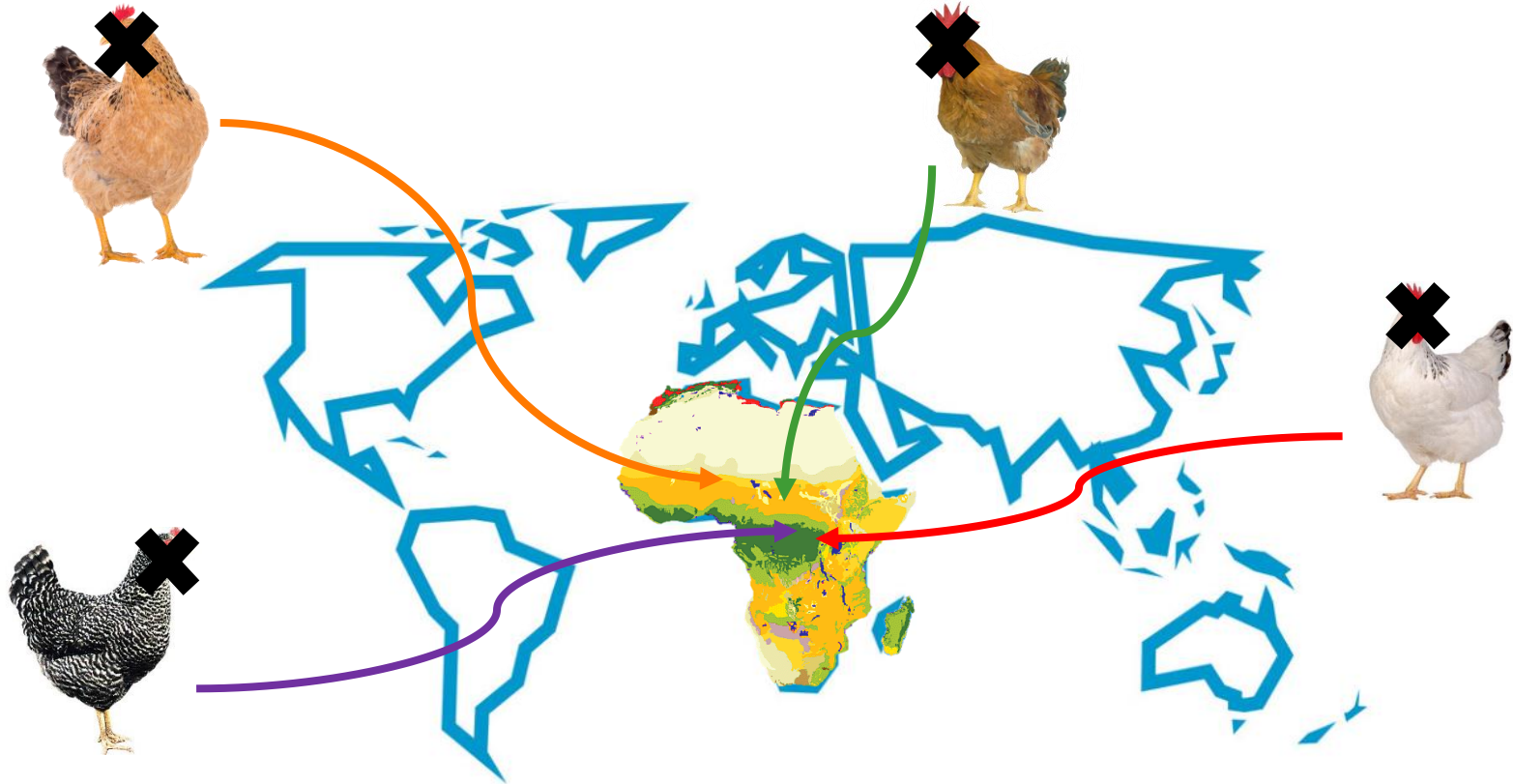
Commercial breeds

- Higher in productivity

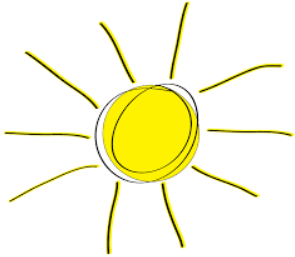
Breed introduction in Africa



Breed introduction in Africa-adaptability



Production systems-poultry



Village systems

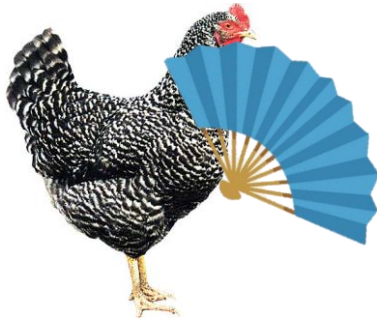
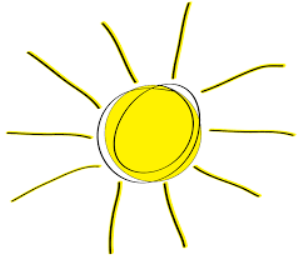
- Scavenging
- Free-range

Resources

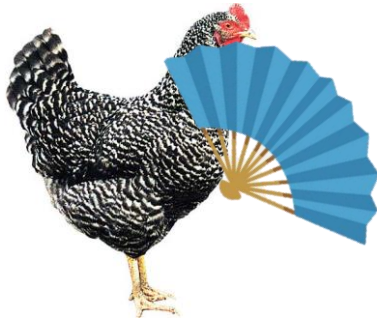
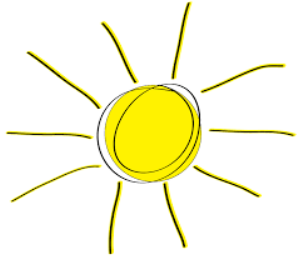
- Dependent on local environment



Commercial breeds-for tropical conditions



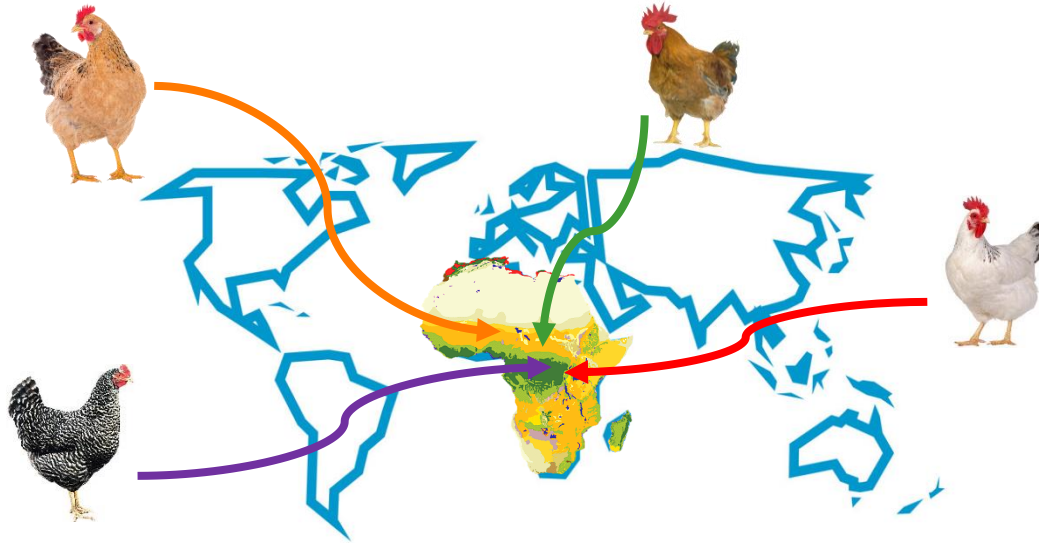
Commercial breeds-for tropical conditions



Understand how these breeds will perform across the wide environmental conditions in Africa.




Which areas can be suitable?



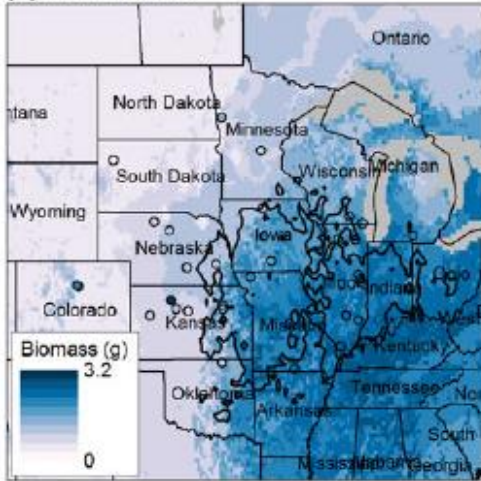
Response of phenotypic traits as a function of the environment.

Phenotypic distribution models (PDMs)

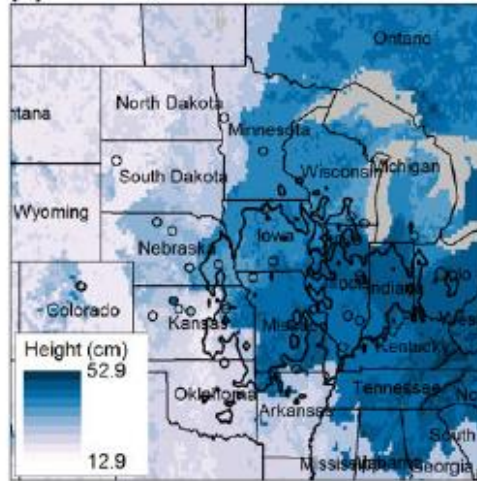
Phenotypic distribution models corroborate species distribution models: A shift in the role and prevalence of a dominant prairie grass in response to climate change

Adam B. Smith¹  | Jacob Alsdurf² | Mary Knapp³ | Sara G. Baer⁴ | Loretta C. Johnson²

(a) PDM: Biomass

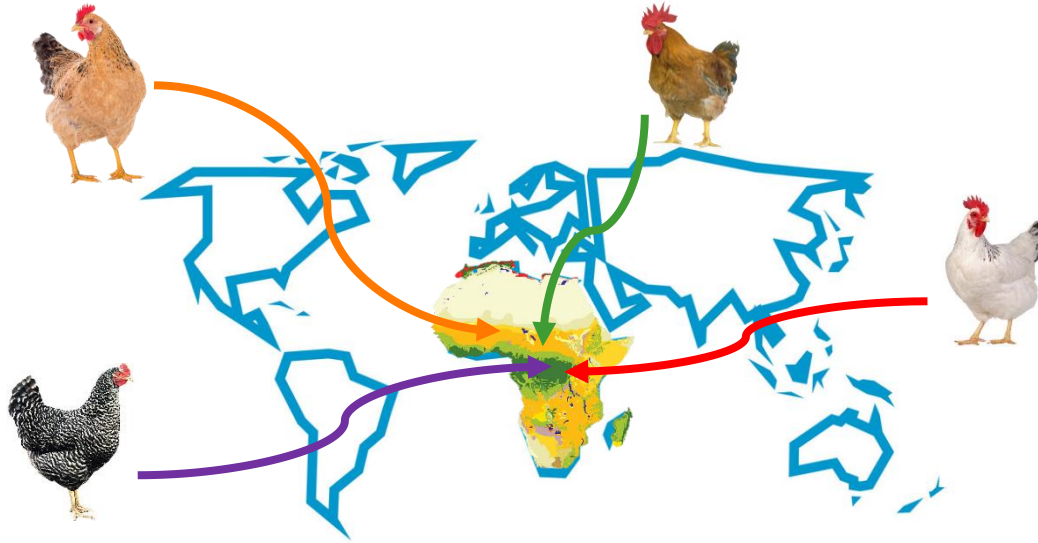


(d) PDM: Height



Response of phenotypic traits as a function of the environment.

Phenotypic distribution models (PDMs)



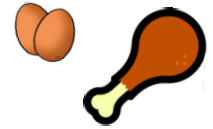
Which areas can be suitable?

As the **environment** plays an important role in **scavenging systems**, this model could be used to **predict** the productivity (phenotype) in a specific region.

African Chicken Genetic Gains (ACGG)



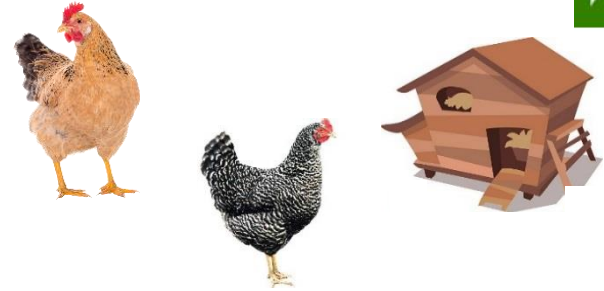
Project that tested the performance of different commercial and indigenous chicken breeds in smallholders' households.



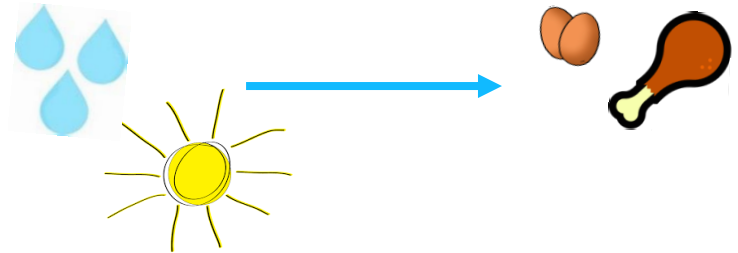
African Chicken Genetic Gains (ACGG)



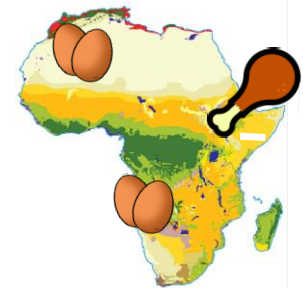
Project that tested the performance of **different commercial and indigenous chicken breeds** in smallholders' households.



Knowledge how the **environmental conditions** have an effect on productivity.

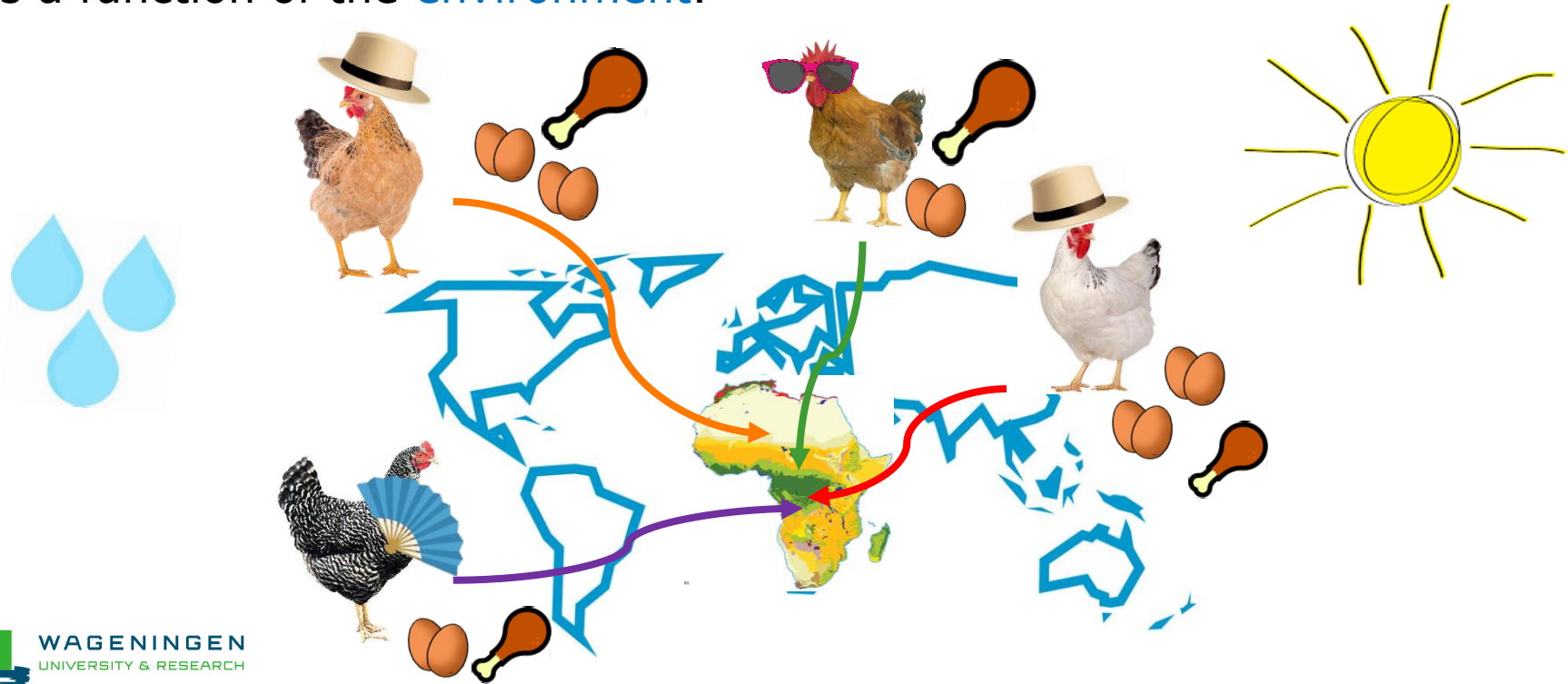


Predictions on how these breeds respond to different agro-ecologies.



Objective-Use PDMs

Predict the response of productivity traits of different introduced breeds as a function of the environment.



Why?

- Improve the design of animal breeding programs (breed introduction).
- Help to better understand which factors cause differences in breed productivity in different environments.

How?

Live body weight (phenotypes)
(5 breeds Ethiopia; males 14-20 weeks)

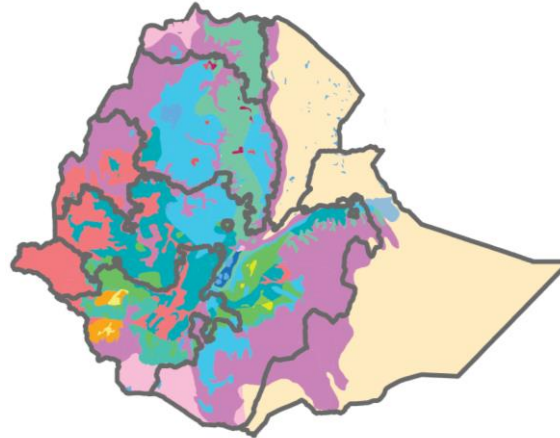
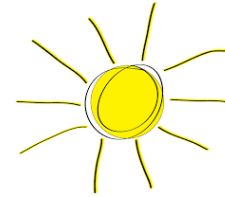


How?

Live body weight (phenotypes)
(5 breeds Ethiopia; males 14-20 weeks)



Environmental variables-Ethiopia
(21 variables: precipitation, temperature and land cover)

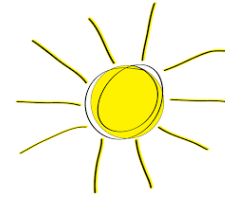


How?

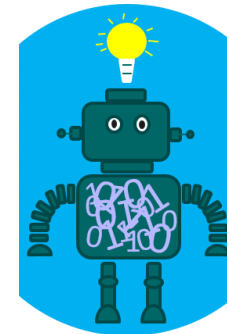
Live body weight (phenotypes)
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Environmental variables-Ethiopia
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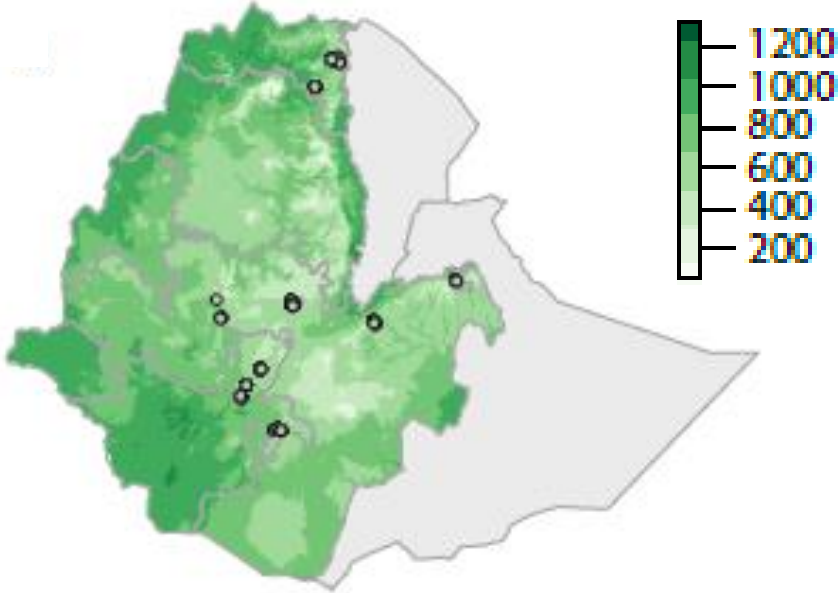
Model the relationship between
environmental variables and phenotypes-
Heat map
(predict body weight; machine learning: boosting)



Results-predicted body weight

Horro

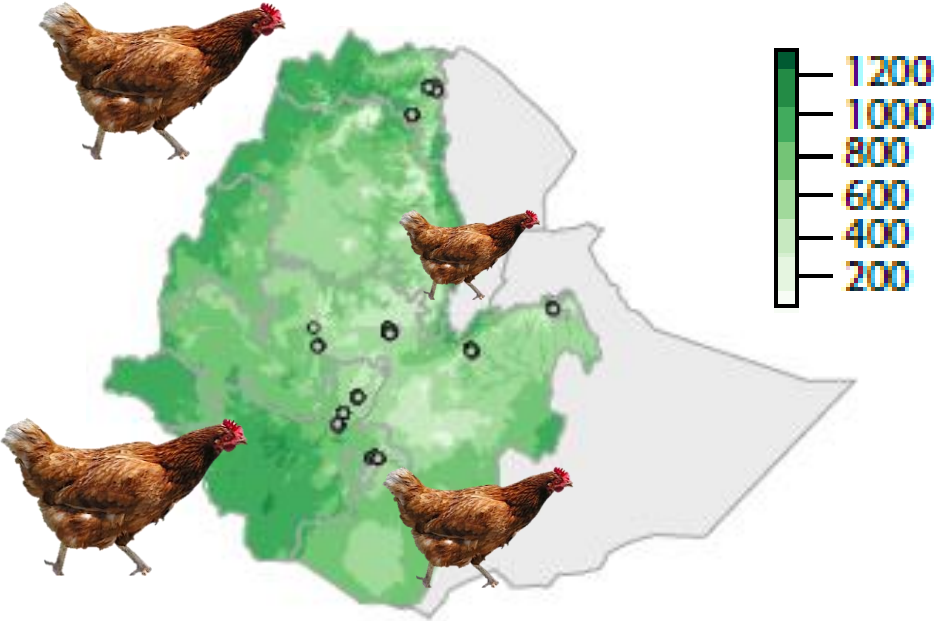
Body weight (g)



Results-predicted body weight

Horro

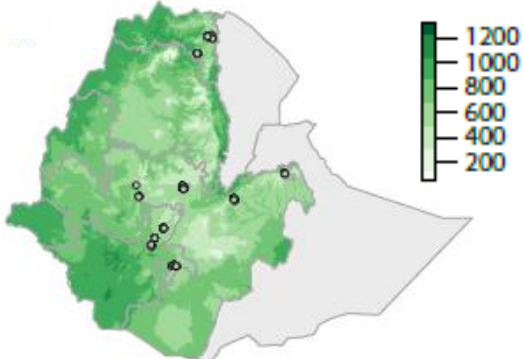
Body weight (g)



Results-predicted body weight

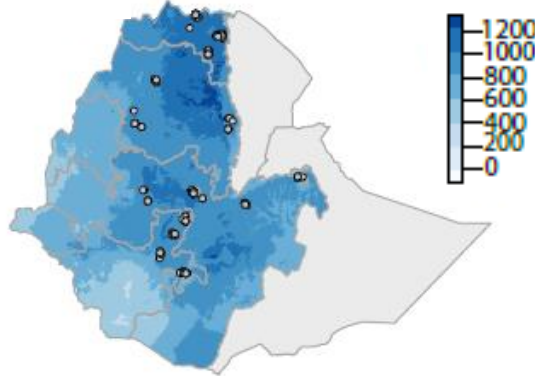
Horro

Body weight (g)



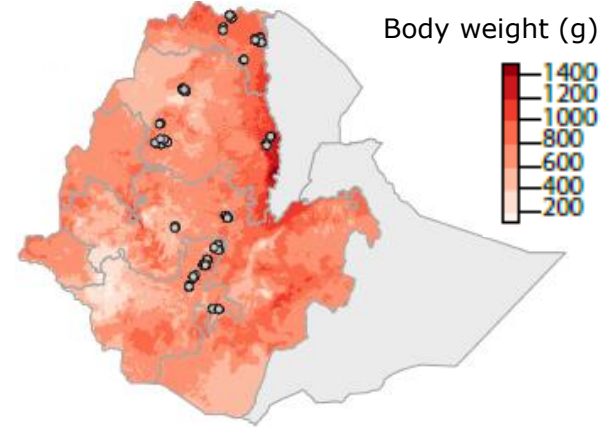
Koekoek

Body weight (g)



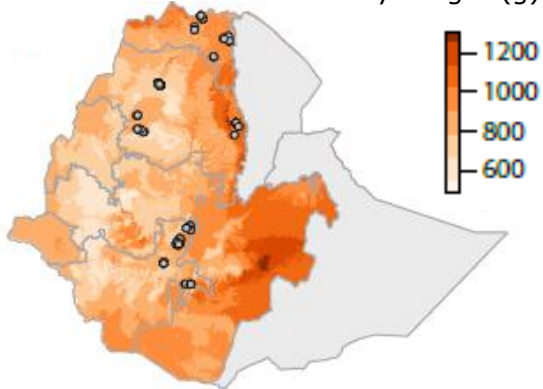
Sasso-RIR

Body weight (g)



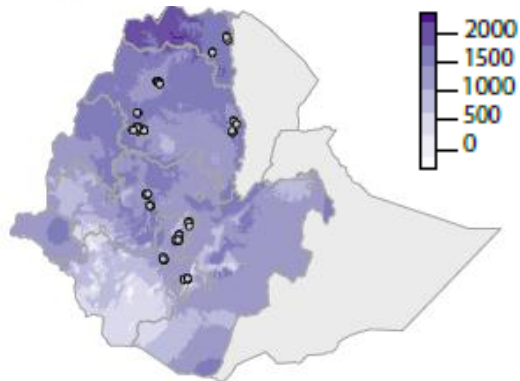
Kuroiler

Body weight (g)



Sasso

Body weight (g)

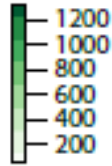


Variation within and between breeds.

Results- variable of influence

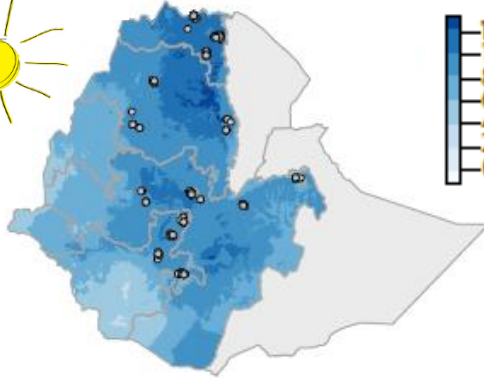
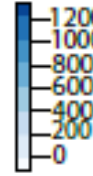
Horro

Body weight (g)



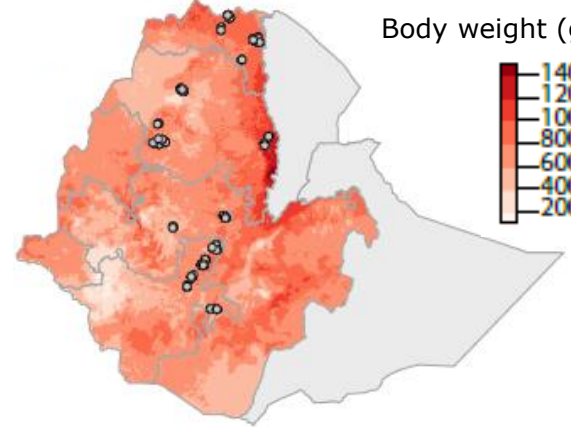
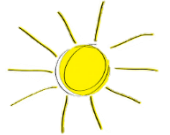
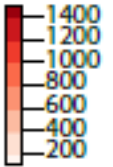
Koekoek

Body weight (g)



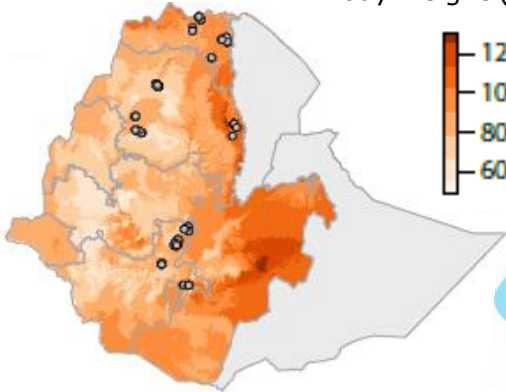
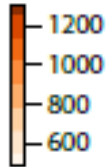
Sasso-RIR

Body weight (g)



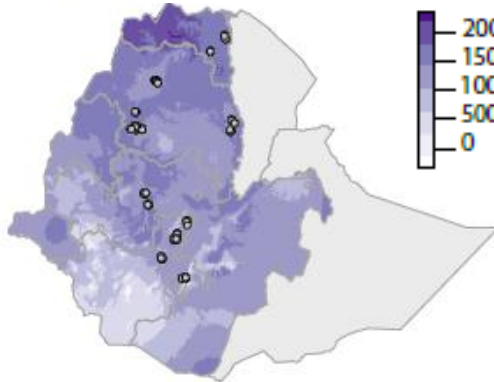
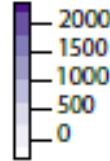
Kuroiler

Body weight (g)



Sasso

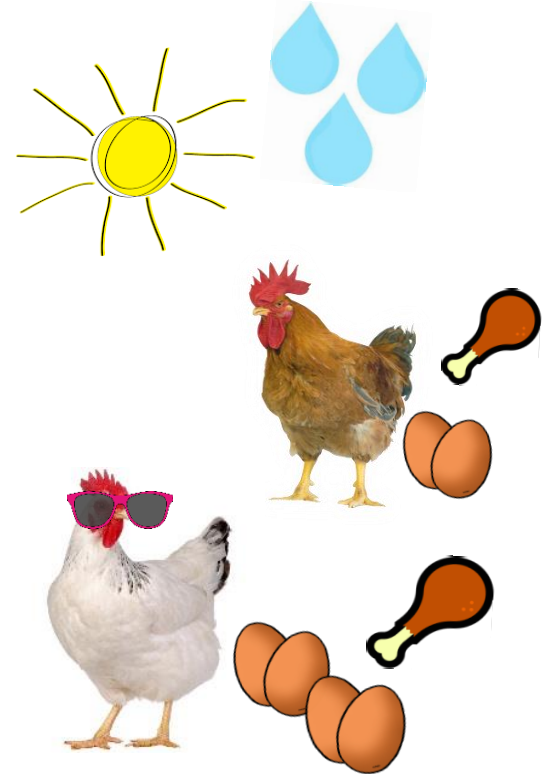
Body weight (g)



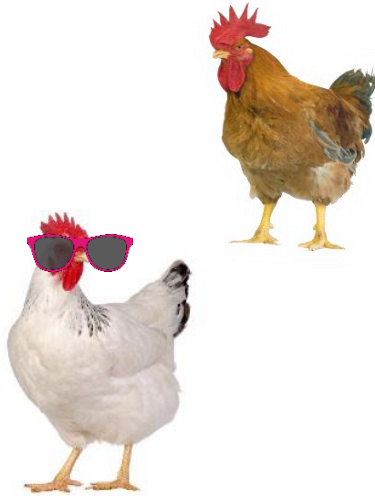
Origin of the breed seems to play a role in the local adaptation and performance.

Take home messages

- Different breeds respond differently to the same environmental conditions (origin).
- Importance of taking environmental variables into account in breeding programs.
- Use PDMs allow to understand the agro-ecological diversity.
- Apply PDMs to different livestock breeds.



Thank you for your attention



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