How genetic selection can increase resilience and efficiency in sheep and goats across a range of diverse environments

Irish Roundtable Meeting

12th July 2022

WP1 Feed Efficiency

Understand the underlying components of the complex trait "**efficiency of feed resource use**"

1. Generate **novel phenotypes to predict feed efficiency** using automated measures and biomarkers

2. Estimate **genetic parameters and detect genomic regions underlying efficiency** of feed resource

3. Quantify the extent, if any, of **genotype-by-environment (GxE) interactions** for efficiency of feed resource

4. Measure at a larger scale promising resource use efficiency **phenotypes** to assess the impact of their **use in small ruminant breeding programmes**.

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Task 1.1 Experimental populations

Dairy Sheep
- AUTH
  - Multibreed (n =30)
  - Chios (n= 40)
- INRAE
  - Lacaune (n = 54)
- UNILEON
  - Assaf (n =

Meat Sheep
- INRAE
  - Romane (n= 357)
- INIA-UY
  - Merino (n = 854)
  - Corriedale (n =290)
  - Dohne (n= 237)

Dairy Goat
- INRAE (n = 49)

WP2 Phenotypes

1. Develop, test and implement new phenotypes for health, resistance and resilience to endemic disease.

2. Develop novel traits from automated data capture for ante- and post-natal foetus and neonate survival.

3. Quantify new behavioural indicators for adaptation to different farming systems incl. extensive production systems.

4. Identify new traits for lifetime resilience and evaluate their impact in national small ruminant breeding programmes.
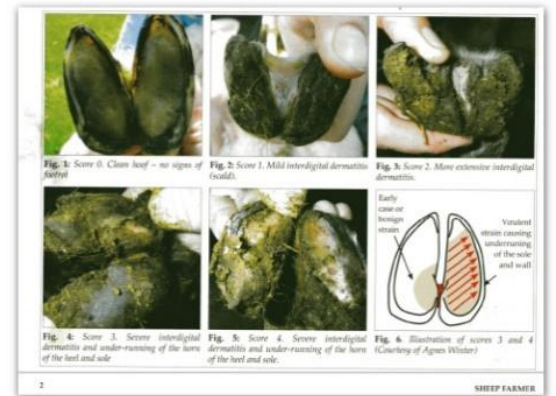
WP3 Trade-offs

The challenge for livestock breeding is to improve resilience traits while simultaneously improving feed efficiency

- To identify trade-offs & synergies under genetic control

- To understand the biological mechanisms underlying those trade-offs & synergies and how they affect resilience and efficiency

- To develop prediction models to manage trade-offs and optimize resilience and efficiency in challenging conditions
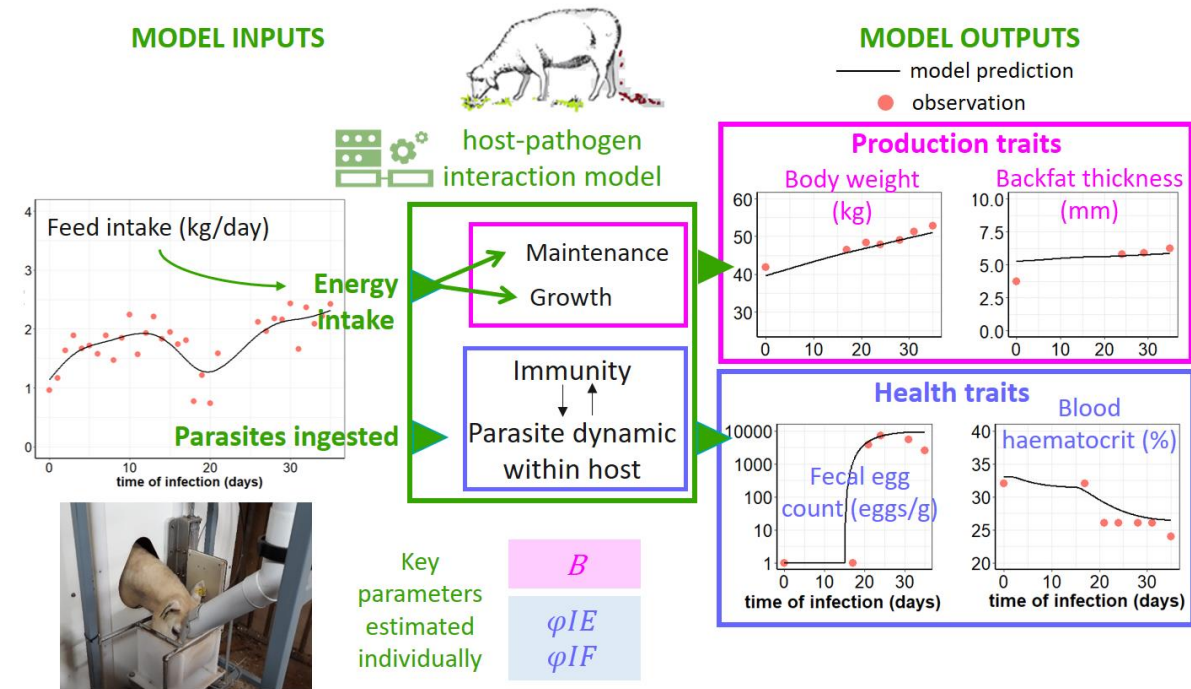
WP4 Hardy breeds

Genomic characterisation of hardy or under-utilised breeds and their environmental adaptation

1. Produce new genetic data and consolidate with already available datasets

2. Exploit these data to characterise the genetic diversity and demography of sheep and goat breeds

3. Contribute to understanding the genetic basis of adaptation of small ruminants
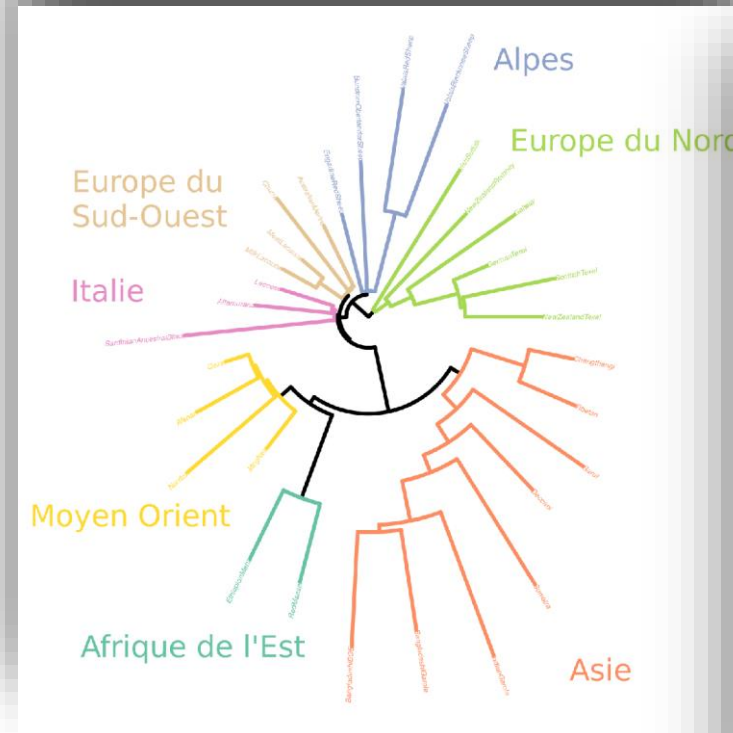

Sheep HapMap
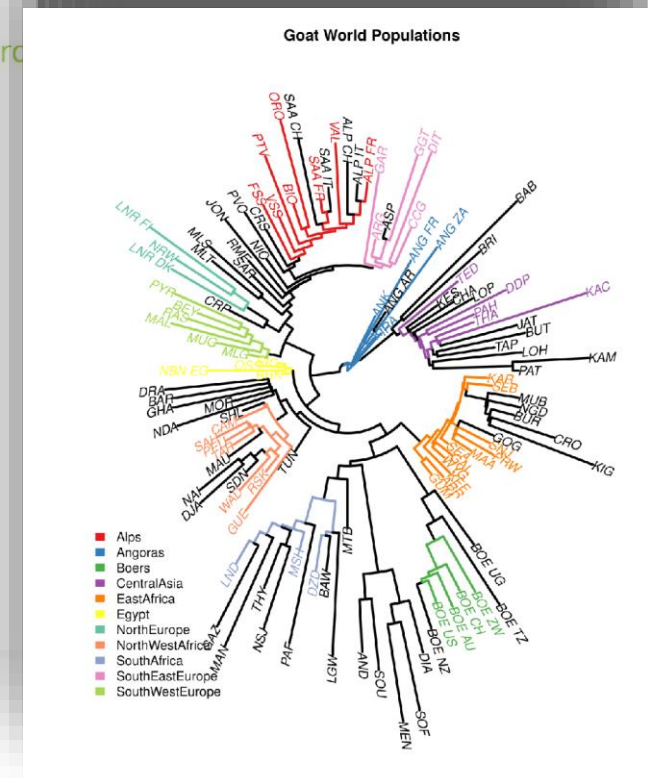
Goat AdaptMap

WP5 Genomic selection

Quite often it is said that genomic selection "works" in dairy cattle and "does not work" in small ruminant . Yet it is not true.

- Genomic evaluations in dairy Lacaune are as precise other dairy cattle or beef breeds
- French dairy sheep have been running an « up to date » genomic evaluation since 2012
- Barriers for a more efficient (genomic) selection in sheep and goats:
    - small population size in « small » breeds
    - assessment of efficacy of genomic selection quite complicated
    - details, technical yet important, (missing pedigree, computation of reliability...)
    - management of diversity and inbreeding
- We are looking at removing the barriers...
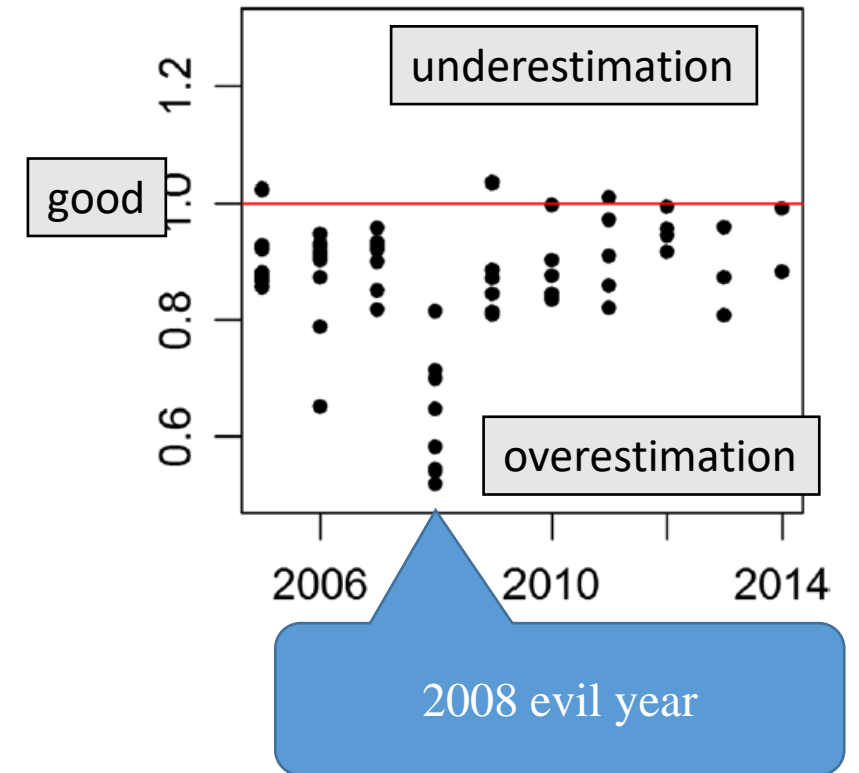
WP6 International GE

International cooperation :

1. Formal international recommendations, for recording on-farm phenotypes, genotypes and international pedigree

2. Generating across-country genetic evaluations by pooling genomic data

3. Facilitate, encourage and motivate cooperation in international evaluations in small ruminants.

4. Estimating the cost-benefit of international genetic/genomic evaluations and cooperation

5. Improve mating management, genetic diversity and breeding of selected and under-utilised populations

WP7 Breeding Goal Design

- Design balanced breeding goals for resilience and efficiency:
  - Agro-ecological impact modelling of breeding for R&E traits at farm level
  - Structured interviews to establish breeder & farmer preferences
  - Economic, environmental and social value modelling of traits to inform index weightings
  - Selection index theory (breeding program simulation) to assess the long-term impact of breeding

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Major achievements – 7.3 Choice modelling

- Preliminary analysis of Manech Tete Rousse trait preferences
- A diversity of preference profiles (3 clusters)
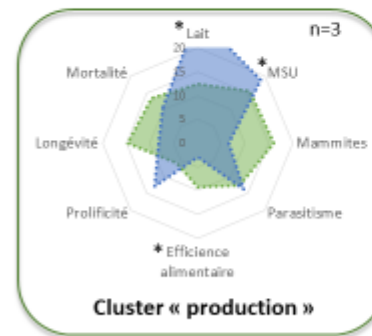
Cluster « production »
Radar of preference group 1 utility values (blue) compared to average utility values (green) for each trait
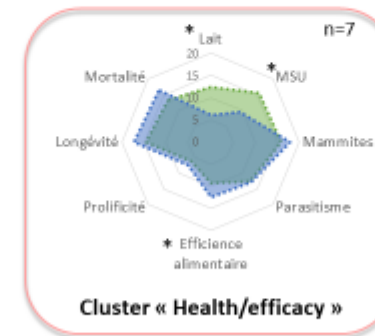
Cluster « Health/efficacy »
Radar of preference group 4 utility values (blue) compared to average utility values (green) for each trait
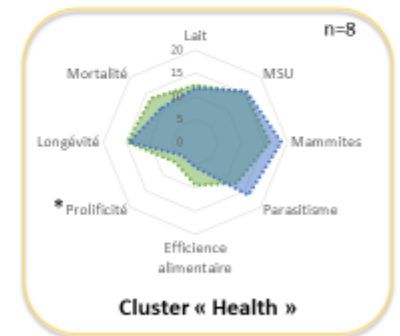
Cluster « Health »
Radar of preference group 2 utility values (blue) compared to average utility values (green) for each trait

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Thank you for your attention

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