

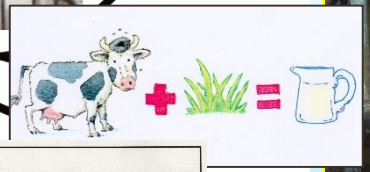
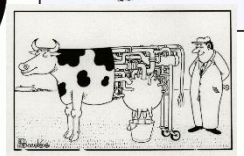
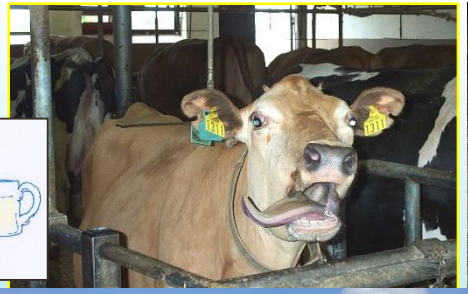
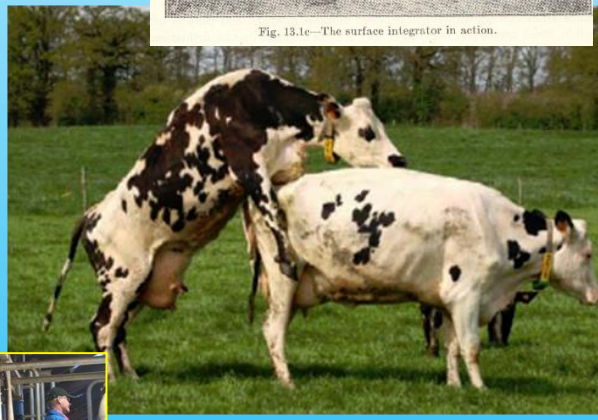






Fig. 13.1e—The surface integrator in action.







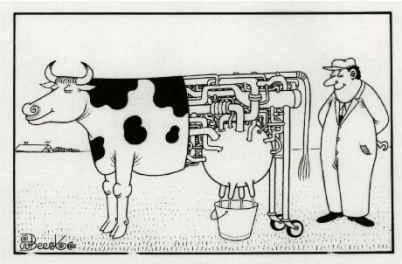
Genomic Management **T**ools to **O**ptimise **R**esilience and **E**fficiency across the Bovine Sector

GenTORE

1st June 2017 – 31st May 2022

GenTORE will develop:

- Innovative genome-enabled selection and management tools to optimise cattle resilience and efficiency in widely varying and changing environments.
- These tools, which will incorporate both genetic and non-genetic variables, will be applicable across the full range of systems (beef, milk and mixed) for increasing system resilience
- Thereby increase the economic, environmental and social sustainability of European cattle meat and milk production systems.



Efficiency

- The ratio energy in the product:energy ingested to achieve that production measured…
- … **over a time period that is relevant to ensure that any efficiency gains are sustainable**.
- The time element is key as efficiencies measured in the short-term do not include the longer term consequences of improving short-term efficiency.
- Thus, selection for growth rate in meat producing breeds has a negative impact on adult resilience, and selection for higher milk yield is associated with decreased productive longevity (in environments that impose limitations).
- This definition does not preclude the measurement of efficiency via residual feed intake type approaches.

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 727213

Resilience

- The capacity to safeguard future ability to contribute genes to the next generation when confronted with environmental perturbations.
- This includes both the ability to survive (or avoid being culled) until the next reproductive opportunity, and the ability to successfully reproduce (adequate numbers of viable offspring).
- Implies abilities to:
  - be able to absorb an environmental challenge through buffering mechanisms, and/or
  - modulate the allocation of available resources to life functions, down prioritizing those that are non-vital and up-prioritizing those that are needed to meet the challenge.
- Significant challenges to phenotype, and to evalue relative to efficiency

Key issues: Resilience and Efficiency

- We need to:
  - Better understand them, and their interplay
  - Be able to phenotype and select for them
  - Optimise R & E according to local production environments

Consortium

- 21 partners
  - 12 multi-actor
  - 9 academic
- 11 countries
  - Including major beef producing countries
- INRA, Teagasc, SRUC, FiBL, WUR, Aarhus, EFFAB, Allice, CITA, EAAP, FSK, Idele, InterBull, IT, LfL, New Medria, Noldus, RAFT, UDL, UniPadova, Viking
- Multi-disciplinary
- Multi-Actor Stakeholder involvement

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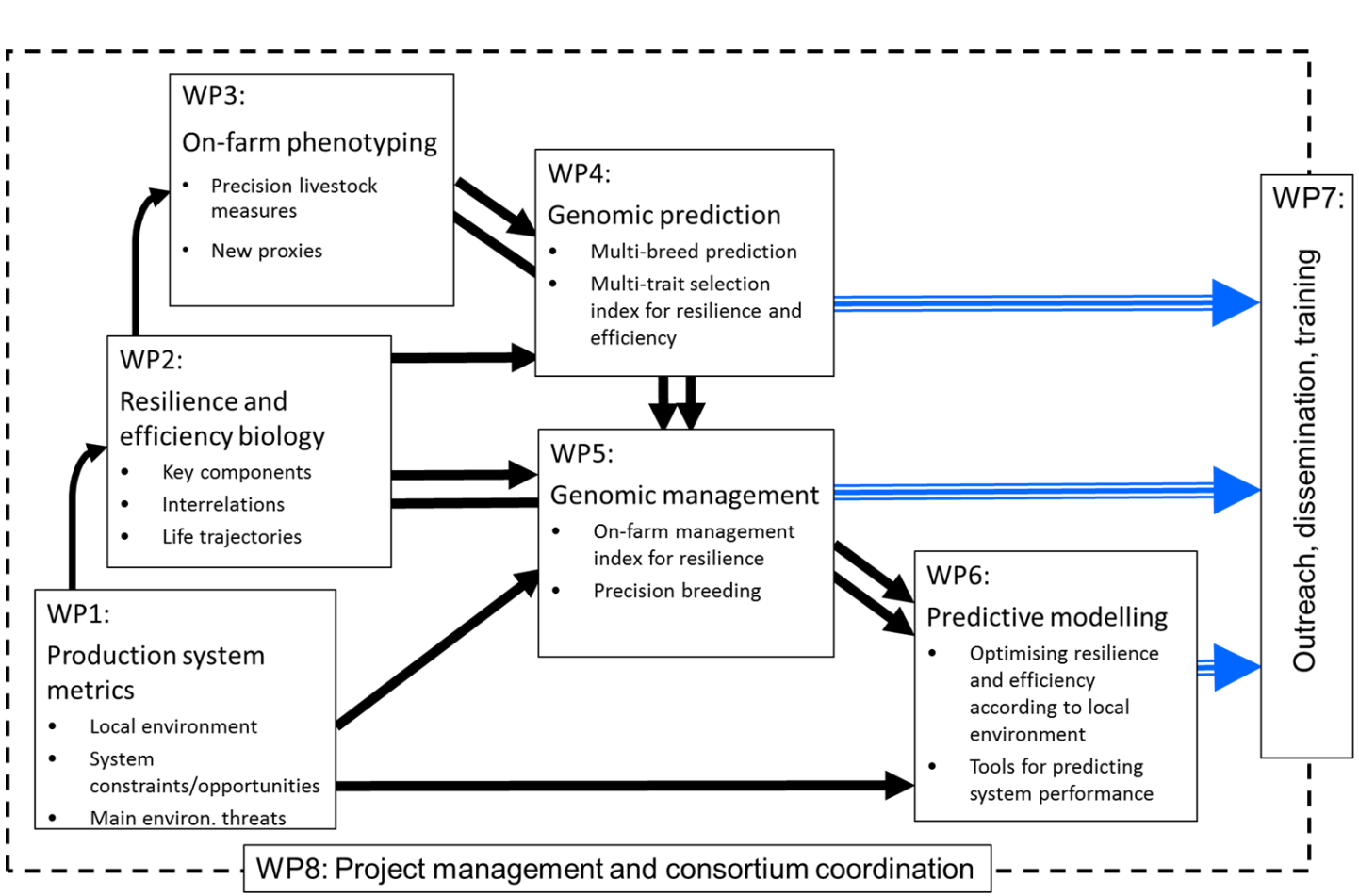
GenTORE Structure



Animal level outcomes, optimise animal resilience and efficiency via:

- Genomic selection for resilience and efficiency across breeds
- Tailored management of breeding and culling

System level outcomes, improve system resilience by:

- Matching genotypes and breeding strategies to local environments
- Evaluating resilience and efficiency outcomes of future scenarios

Develop phenotypic tools as proxies
(Roel Veerkamp)

3.1 Existing (near) marketing sensors

3.2 Big Data cloud / national data

3.3 New technologies (beef cattle)

3.4 Combine, Validate and Calibrate

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Genomic prediction (Mogens Lund)

- Main tasks:
  - Genomic predictions with multiple breeds, crossbreds, and admixed breeds across environments
  - Quantifying the genetic contribution to variance in resilience and efficiency
  - Genomic analysis of traits and environments defined and data collected in WP 1, 2 and 3

- Challenges:
  - Data : Amount, availability, heterogenity, processing, etc

- Key deliverable:
  - Being able to handle multibreed and multi trait models to exploit scarsely measured traits into population scale genomic prediction

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Genome-based management indexes (Donagh Berry)

- Precision ranking tool on expected lifetime female performance and resilience
- Precision genomic matings accounting for non-additive genomic effects
- Precision breeding & reprod management
- Long-term consequences of adopting breeding management indexes

- Challenges: Data availability & format
- Deliverables:
  - Web-based culling tool
  - Potentially superior sire mating advice

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Technological objectives:

- Exploit near-market technologies to allow **low-cost large-scale phenotyping of key R&E traits**, including on-farm evaluation in housed and extensive production environments.
- Develop metrics for **quantifying local production environments in terms of their effect on animal R&E**, and the relative importance of these traits for system sustainability, using readily available farm- and regional-scale information.
- Develop metrics for **quantifying local production environments in terms of the producers' innovation opportunities** and incentives for improvements, using available farm- and regional-scale information.

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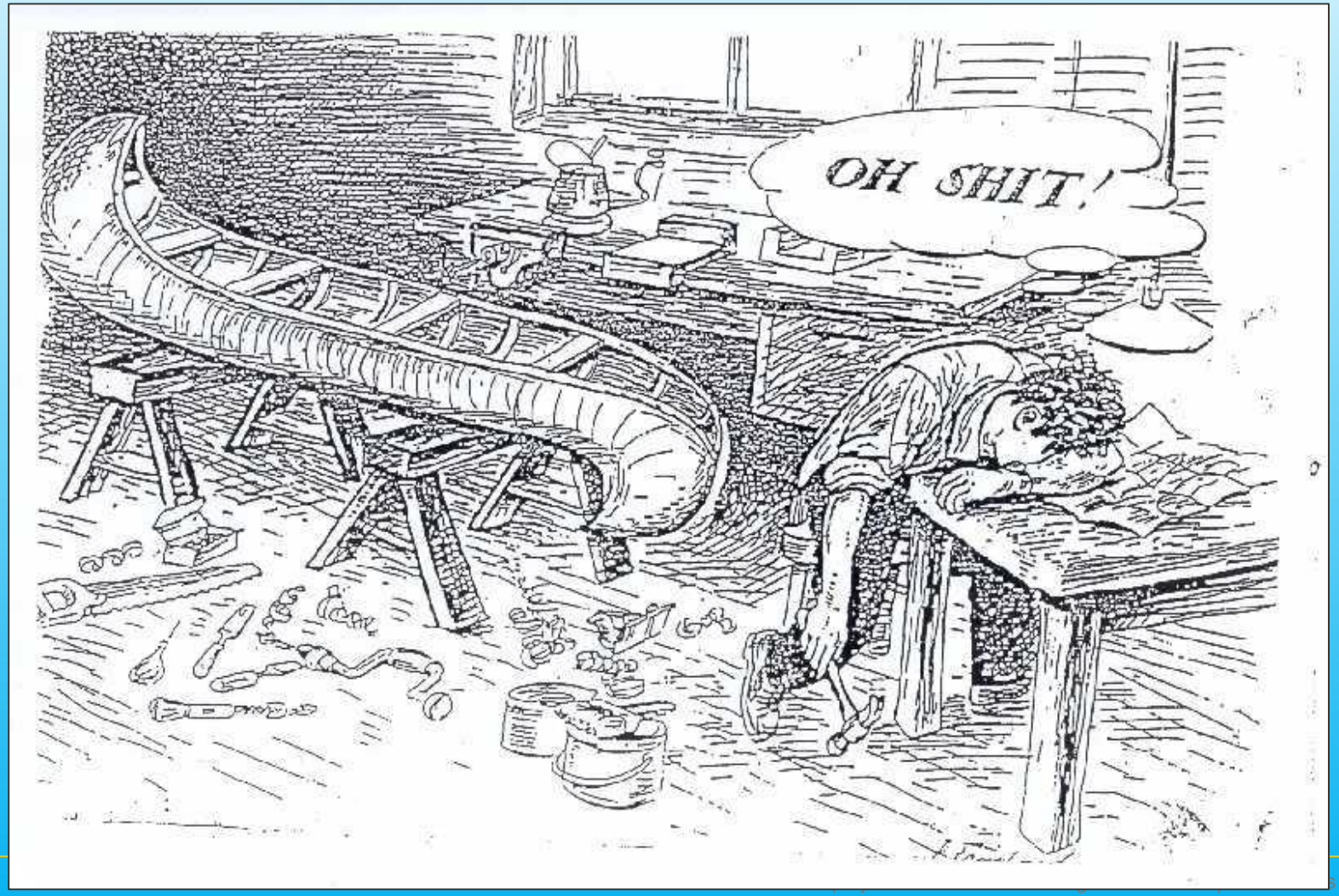
Stakeholder involvement



Horizon 2020 research and innovation program under Grant Agreement No 727213

GenTORE *@GenTORE_H2020*

Genomic management Tools to Optimise Resilience and Efficiency

- A great project
- A great team
- A great opportunity

We just need to…

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Thank you for your attention

www.gentore.eu

GENTORE

Discovery Session at EAAP 2018 on 'Resilience and Efficiency in Cattle'

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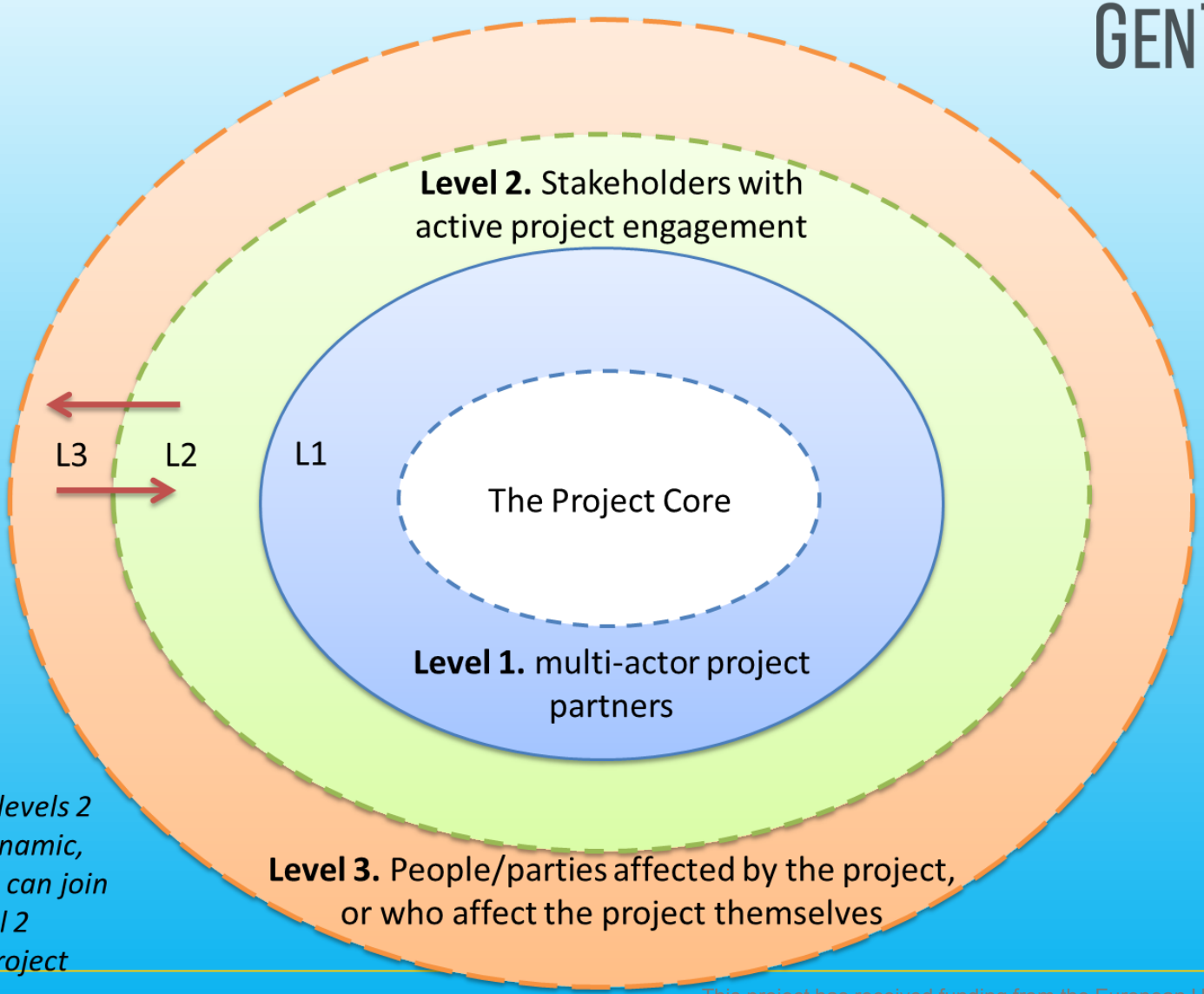
Stakeholder levels in GenTORE



Stakeholder levels 2 and 3 are dynamic, stakeholders can join or leave level 2 during the project

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Scientific objectives:

- Characterise and quantify the **interrelations between animal resilience and production efficiency** across different life stages for meat and milk producing animals, using multi-site pooled data in a systemic modelling framework.
- Quantify the **relative importance of the component traits of R&E in different production environments**, using innovative statistical approaches and new proxy measures.
- Advance genomic selection methodology to improve the accuracy of evaluations in large and medium-size breeds (beef and milk), especially through **multi-breed and cross-breed genomic evaluation for key R&E traits**, taking genome x environment interactions into account and exploiting genomic information on over 1 million cattle.
- Develop **prediction models** capable of evaluating the consequence of future selection strategies on herd- and population level R&E under varying environments.

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- 2.1 improved statistical models to quantify efficiency
- 2.2 improved statistical models to quantify the importance of different resilience proxies on productive longevity
- 2.3 data to strengthen RFI and resilience work, and evaluation of automated technology proxies, from contrasting local production environments
- 2.4 Improved definitions of efficiency that include resilience to provide more durable efficiency selection goals
- 3.1 data extraction algorithms from automated technology for efficiency and resilience components, validated on several sites across Europe
- 3.2 improved statistical models using national level farm records to provide herd-level metrics for performance and health components of efficiency and resilience
- 3.3 proof-of-principle for use of new technologies to monitor cattle in extensive conditions, tested on an independent site
- 3.4 Statistical and computational methodology for combining proxies from automated data with herd level metrics in real-time elaborated

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- 4.1 Genomic tool that makes it possible to rank animals across breeds for eg resilience and efficiency
- 4.2 Genomic tools that makes it possible to rank animals for eg resilience and efficiency across environments
- 4.3 Genomic ranking of animals based on improved definition of efficiency
- 4.4 Genomic ranking of animals based on improved definition of resilience
- 5.1 Index to predict expected lifetime performance from genomic information and the cows own phenotypic information about resilience
- 5.2 Quantification of the importance of factors other than additive genetics on breeding values for efficiency and resilience
- 5.3 prototype of a decision support tool to aid farmers in real-time in their breeding management
- 5.4 Demonstration of the potential for precision breeding management to improve/change the genetic make-up of the herd

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- 1.1 Indicators defined for assessing the current degree of resilience and future challenges facing typical European beef and dairy cattle systems across a range of pedo-climatic zones under changing climatic conditions.
- 1.2 Refined regional information through stakeholder consultation (Delphi questionnaires and focus discussion groups)
- 1.3 Evaluation of models in 1.1 via on-farm assessment in regional focus areas
- 1.4 Models at regional level to predict the climate change related risk factors that need to be accounted for in future breeding strategies
- 6.2 Models to predict life trajectories of beef and dairy cattle genotypes in different nutritional environments
- 6.3 Model of weather effects on growth trajectories of beef cattle under extensive conditions
- 6.4 Models integrating information from 1.4, 6.2, 6.3 to allow prediction of system-level resilience and efficiency
- 6.5 Assessment of farm vulnerability to climate change

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GENTORE

Genomic Management to Optimise Resilience and Efficiency across the Bovine Sector

SFS-15-2016-2017: Breeding livestock for resilience and efficiency

Scope A:

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Call text

- Expected Impact: Projects should generate tools able to accurately link genomics data from farm animals to efficiency- and resilience-related traits in order to help exploit the full potential of the growing amount of recently generated genomics data. They will translate genomic information to facilitate predictive biology of efficiency- and resilience-related traits and test the new concepts in genomic selection. They will promote diversity-rich livestock breeding. More generally and in the longer term, outputs and results will help increase resilience of livestock production, including organic production, to more variable environments, while securing productivity.

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- Scope: The research will focus on breeding terrestrial livestock for improved resilience and efficiency. It will target efficiency and resilience related traits and possible links between them (synergies, trade-offs) to address balanced breeding goals in an agro-ecological way. Research activities should assess and exploit the potential of underutilised genetic resources (other breeds, traditional breeds and crossbreeds). The projects should address the wide genetic variation among bovine breeds linking beef cattle over dual-purposed cattle to more specialized dairy cattle and link with other EU initiatives in the cattle dairy sector (scope A, 2016) or small ruminants and/or monogastrics (scope B, 2017). Activities will further develop tools/systems/statistical methods to measure phenotypes and assess the feasibility of schemes for improving targeted livestock. Coverage of both conventional and organic sectors is expected. **Proposals should fall under the concept of the 'multi-actor approach'.** Projects should ensure appropriate dissemination to the breeding sector and other relevant stakeholders to facilitate the uptake of results.

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- Specific Challenge: While increasing focus is placed on the efficiency of animal production, animal production systems also need to be resilient, at both animal and system level. For animals, this resilience needs to apply to their welfare, as well as their health. Systems may make use of local, multipurpose breeds and/or highly productive breeds and the genetic variation within breeds could be used more effectively. Enhancing animals' ability to overcome endemic and emerging diseases and nutritional, reproductive or environmental challenges will help them stay healthy and productive, i.e. increase their resilience, as a result of being better suited to their living conditions. Progress here will be key to improving resilience traits and other traits that are important for a sustainable livestock sector. The challenge for livestock breeding is to address the need for efficiency and the need for resilience, and to manage trade-offs. To accelerate progress on these issues, it is important to develop improved tools to identify, exploit and measure important genomic and phenotypic characteristics of resilience and efficiency.

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