SmartCow: integrating research infrastructures to foster innovation in the European cattle sector

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SmartCow
an integrated infrastructure for increased research capability and innovation in the European cattle sector

This project has received funding from the European Union's Horizon 2020 research programme under grand agreement N° 730924

Aim of infrastructure projects supported by EU

Bring together, integrate on European scale, and open up key RIs to all European researchers, ensuring their optimal use and joint development

Networking activities

- *Improvement of the cooperation between research infrastructures, scientific communities, industries and other stakeholders*

Joint Research Activities

- *Improvement of the services the infrastructures provide to scientific communities*

Transnational Access

- *Harmonisation, optimisation and improvement of access procedures and interfaces*

Background of SmartCow project

- **Research on farm animals needs to address global issues:** sustainability, food security, climate change, consumer acceptance
- Animal production and research is also **challenged by society** in terms of **ethics** (animal welfare)
- Livestock research infrastructures are **expensive to equip and maintain**
- At the same time **new opportunities** to help the animal sector:
  - Smart technologies (PLF)
  - Rapid analytical methods
  - Digital “revolution”

Phenotyping

Monitoring

Specific challenges for an infrastructure in agricultural (animal) science

- **In comparison with many fields, challenges due to:**
- Scale and cost of the work – but this is also a driver to use facilities more effectively (improve methods and share resources)
- Regional variation across Europe (agro-climatic zones, feeds, animal breeds, speciality products)
- Lack of common terminology (trait ontology)

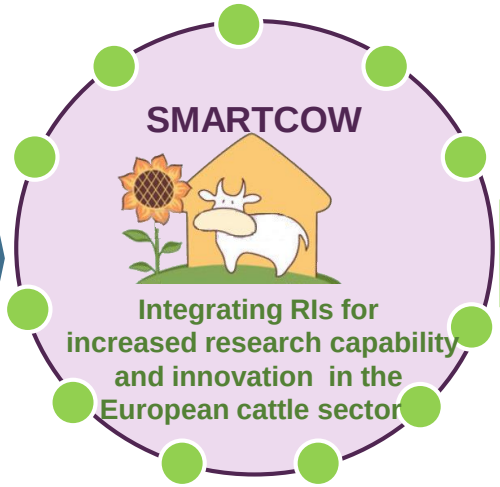
Concept of SmartCow

Strategic aim: Efficiency and innovation by integrating key research infrastructures

Challenges and cross-cutting issues

- Efficient use of biomass – Food security
- Sustainable competitiveness of livestock systems
- Healthy livestock for healthy diets and people

Improving infrastructure for research and innovation



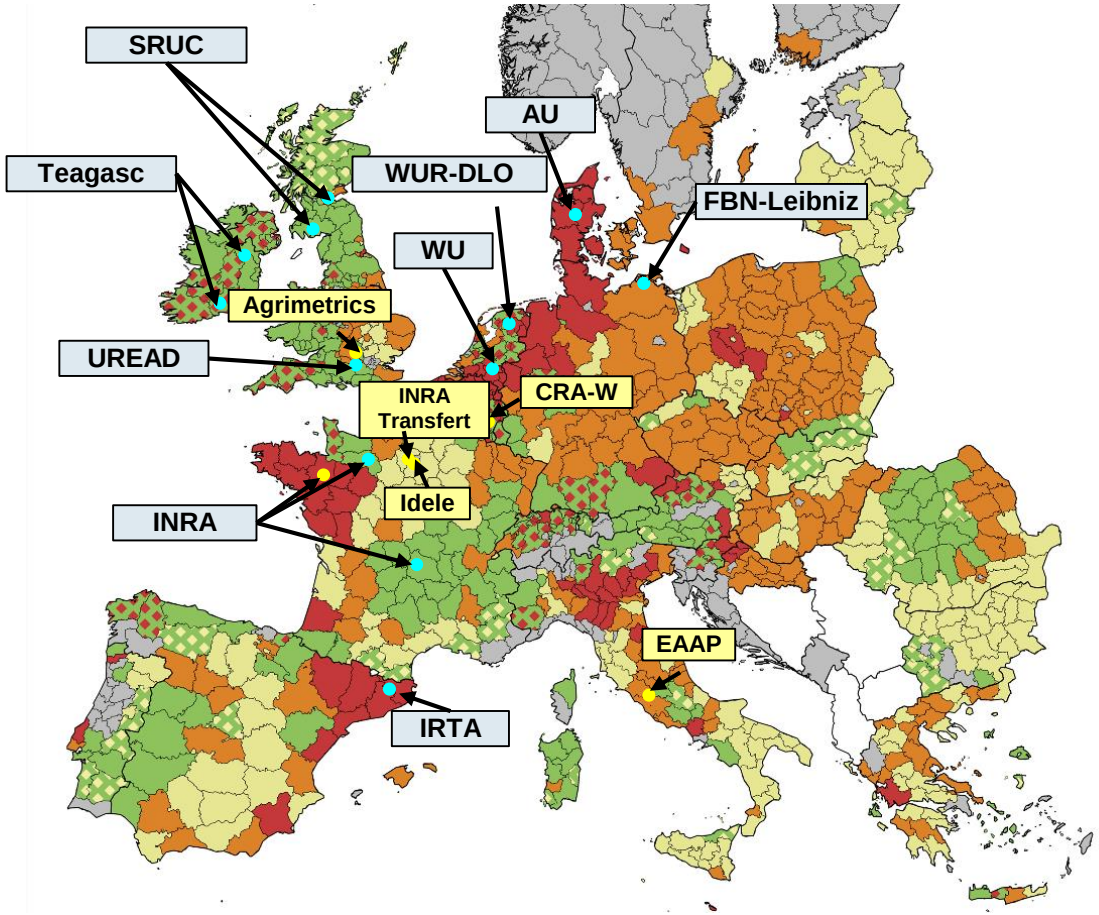
Solutions

- Networking Research Infrastructures to improve research practices
- Improving quality and ethics through new research methods
- Offering wider access to the most advanced research tools

Project partners

N°	Organisation	Country
1	Institut national de la recherche agronomique (INRA)	France
2	SRUC – Scotland's Rural College	United Kingdom
3	WU – Wageningen Universiteit	The Netherlands
4	WUR-DLO - Stichting Wageningen Research	The Netherlands
5	UREAD – The University of Reading	United Kingdom
6	FBN Leibniz – Institut Fur Nutztierbiologie	Germany
7	TEAGASC – The Irish Agriculture and Food Development Authority	Ireland
8	AU - Aarhus Universitet	Denmark
9	IRTA – Institut de Recerca I Tecnologia Agroalimentaries	Spain
10	CRA-W – Centre Wallon de Recherches Agronomiques	Belgium
11	IDELE - Institut de l'Elevage	France
12	EAAP – Federazione Europea di Zootecnica	Italy
13	Agrimetrics – Agrimetrics	United Kingdom
14	IT – INRA Transfert SAS	France

Location of the partners and of the RIs



- **High livestock density areas**
- **Mixed crop and livestock areas**
- **Grass-based livestock areas**
  - *Grass-based with high livestock density*
  - *Grass-based with medium livestock density*
  - *Grass-based with low livestock density*
- Low livestock density
- Not considered

Classification of livestock farming systems areas in EU after Dumont, Dupraz et al (2016) in "Roles, impacts and services provided by livestock in Europe (INRA collective expertise)"

- **Infrastructures open to Transnational Access**

EAAP 2018 – Dubrovnik, Croatia, 27 August 2018

Three types of activity in SmartCow
(Total budget = 5 M€, with 0.5 M€ for management)

Networking activities (≈ 1.5 M€)

- *Harmonizing measurement methods, coordinated data management, joint training activities and stakeholders involvement*

Joint Research Activities (≈ 1.5 M€)

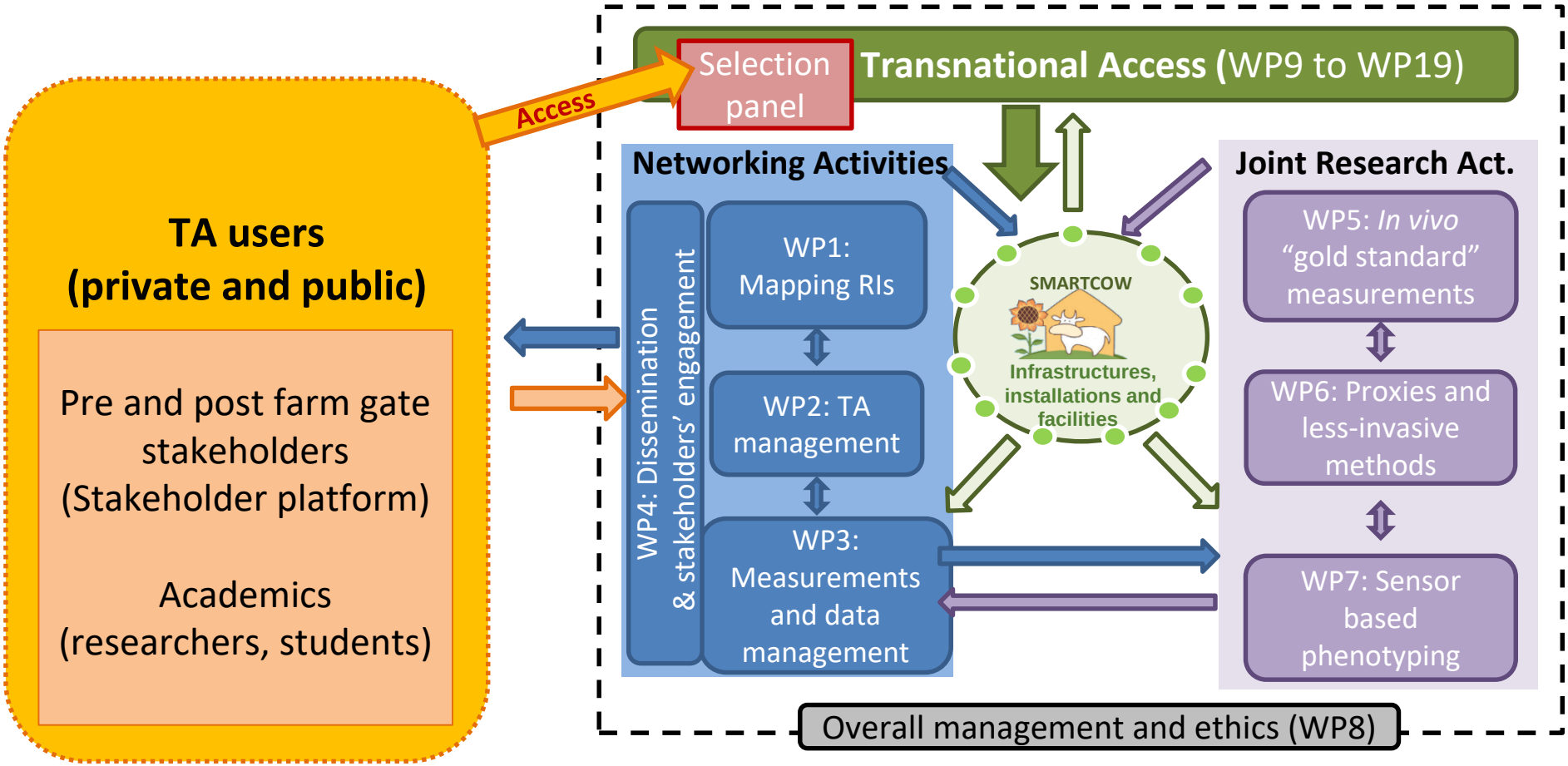
- *Improving measurement methods and ethics, developing new methods, enhancing phenotyping capacity*

Transnational Access (≈ 1.5 M€)

- *Supporting access to key research infrastructures;*

developing a more efficient and attractive European Research Area

SmartCow WPs organisation



Expected results of Networking Activities

- An **interactive map** of national and regional facilities
- **Inventory** of cattle databases and samples banks
- A **cloud-based data platform** to gather and share data
- Publication of **reference protocols** for research and routine data recording (book of methods)
- An improved **trait ontology** (animal and environment)
- Effective **stakeholder engagement**
- Effective ongoing **dissemination and knowledge transfer**
- Developing **co-ordinated training** across the sector

Expected results of Joint Research Activities

- **Refining methods** in the field of nutrient efficiency and gas emissions **(WP5)**
- Development of proxies (biomarkers) and **non-invasive methods (WP6)**
- Development of a multivariate approach to phenotype behavioural, health and feed efficiency traits based on **sensor data (WP7)**

→ ***Implementation of 3R principles (Replace, Reduce, Refine)***

WP5
Refining methods in the field of nutrient efficiency and gas emissions

- **To improve the accuracy and precision of measurements**
- **Unify the methods used across SmartCow infrastructures**
  - Develop (or standardize) optimised diet digestion and N balance procedures
  - Perform ‘ring tests’ of respiration chambers and optimise procedures for CH_4 measurements

WP6
Development of proxies (biomarkers) and non-invasive methods

- **To evaluate proxies of feed efficiency and its determinants in cattle (dairy and beef)**

- **To identify their range of applicability across diets and individuals**

  - Increase phenotyping capabilities of RIs for the analysis of feed efficiency in cattle
  - Reduce experimental constraints on animals

WP7
Using sensor data for a multivariate approach to phenotype behavioural traits, health and feed efficiency

- To develop and test uniform **guidelines for validation of outputs from sensors** for the recording of animal behaviour in the SmartCow RIs

- To **develop novel algorithms for phenotyping cows** based on sensors recordings of behaviour

Transnational Access to SmartCow RIs

- **Access to 11 European RIs (18 installations)**
  - Around 2,500 dairy and 1,000 beef cattle
  - Diversity of breeds and environmental conditions
  - High quality measurements (feed efficiency, emissions, digestion, metabolism…)

- **Budget ≈ 1.5 M€ : supporting around 30 experiments**
  - Call for access and project selection run within the project
  - Two types of experiments:
    - Focusing on animal performance and trade-offs between functions
    - Investigating underlying digestive and metabolic processes

Transnational Access Calls

- **In line with SmartCow scientific challenges**
- **In line with the capabilities of SmartCow infrastructures**
- **Taking into account discussions with academics and industry stakeholders**
- **1st Call widely open**
- **Can evolve in the course of the project**

Transnational Access Calls Research Priorities (1/4)

- **Efficient use of feed resources**
  - Utilization of existing non-human-edible feed resources and/or of new by-products and new protein rich feeds

- **Mitigation options to reduce GHG and other emissions**
  - Mitigation options aiming at reducing simultaneously GHGs and other animal based excretions (ammonia, phosphorus, particles…)
  - Trade-off between reducing GHG emissions and animal performances

Transnational Access Calls Research Priorities (2/4)

- **Efficient and robust animals, climate change**
  - Feed efficiency components : intake, fermentative, digestive and metabolic processes
  - Adaptation and resilience of animals to different feeding and management strategies, and environmental changes
  - Integrated studies will be encouraged

- **Animal health and welfare**
  - Improving animal health and welfare through husbandry and feeding management

Transnational Access Calls Research Priorities (3/4)

- **Product quality**
  - Assessing and/or improving the different components of product quality (safety, nutritional and organoleptic) in cattle through nutritional management

- **Precision cattle farming**
  - As a cross-cutting issue, studies focusing on precision nutrition and rearing management of cattle taking advantage of the advanced technologies and the diversity of husbandry situations available in SmartCow RIs will be encouraged

Transnational Access Calls Research Priorities (4/4)

- **Basic science for applied and integrated approaches**

  - Phenotyping and monitoring tools: biomarkers, sensors
    - Studies aimed at developing alternative methods that are easy to implement, less invasive for animals and less costly

  - Comprehensive behavioural, digestive and metabolic physiological studies in cattle
    - Interactions between the diet, the animal (the host) and the microbiome and their consequences on animal behaviour, feed intake and various functions (production, reproduction, immune system, welfare…)

Conclusions

- SmartCow is a first step towards the integration of Research Infrastructures for the European cattle sector
- Integration is necessary to develop more efficient approaches to address global issues and societal concerns, using:
  - A common language, the best standardized techniques and data sharing
  - Improved and new methods to enhance phenotyping of new and more complex animal traits
  - With the full range of genetic (breeds) and environmental diversity across Europe

Thank you for your attention













Further information on: *www.smartcow.eu*