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Coping with risks by enhancing adaptive capacities of biological components in the system: research strategy in the livestock sector

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HAL Authorization



INTERNATIONAL CONFERENCE/CONFERENCE INTERNATIONALE

Coping with risks in agriculture: What challenges and prospects?

Faire face aux risques en agriculture : Quels enjeux, quelles perspectives ?

Coping with risks by enhancing adaptive capacities of biological components in the system: research strategy in the livestock sector

Stéphane Ingrand, Inra, « Animal physiology and livestock farming system » PHASE Department



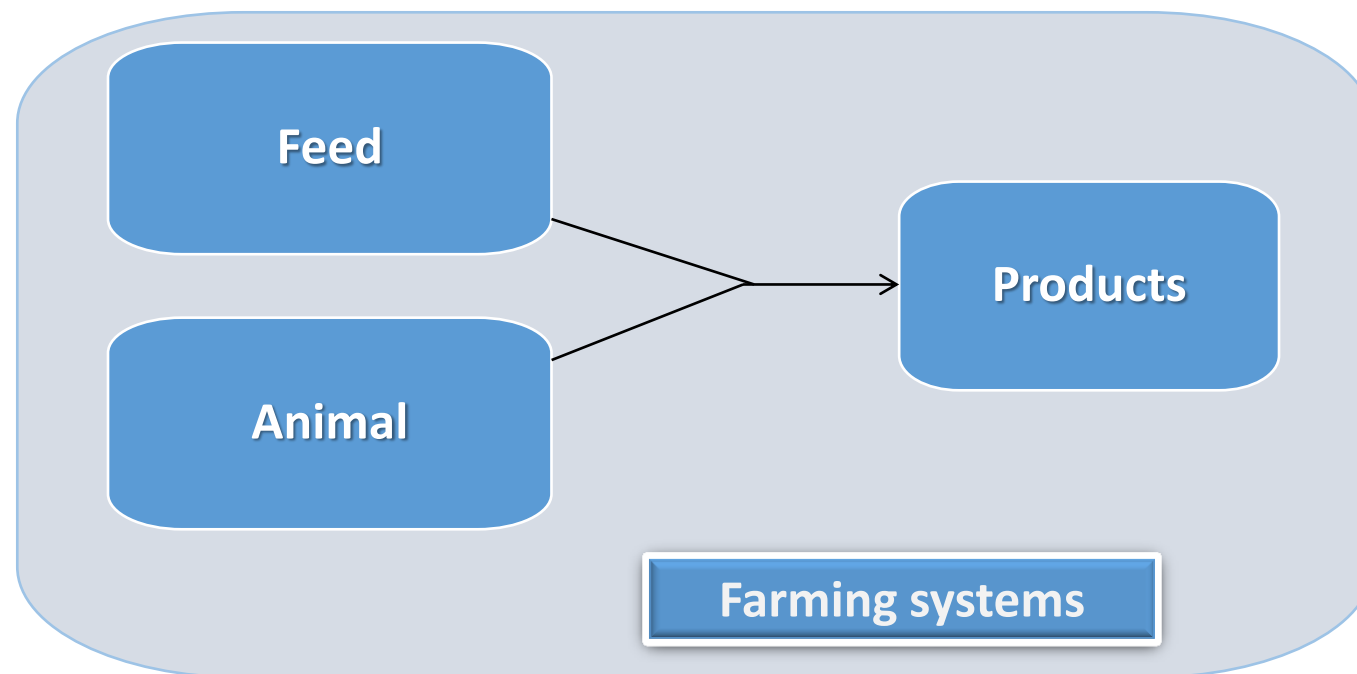
February 22-23 2018 - Collège des Bernardins, Paris

PHASE's strategic plan, 2016-2020

Objective: to contribute to the shift towards multi-effective livestock farming systems, by producing knowledge at different scales and by associating :

- ❖ The principles of **agroecology**: stimulation of natural processes
- ❖ Predictive approaches in biology: models and decision-support tools

4 thematic fields (TF)

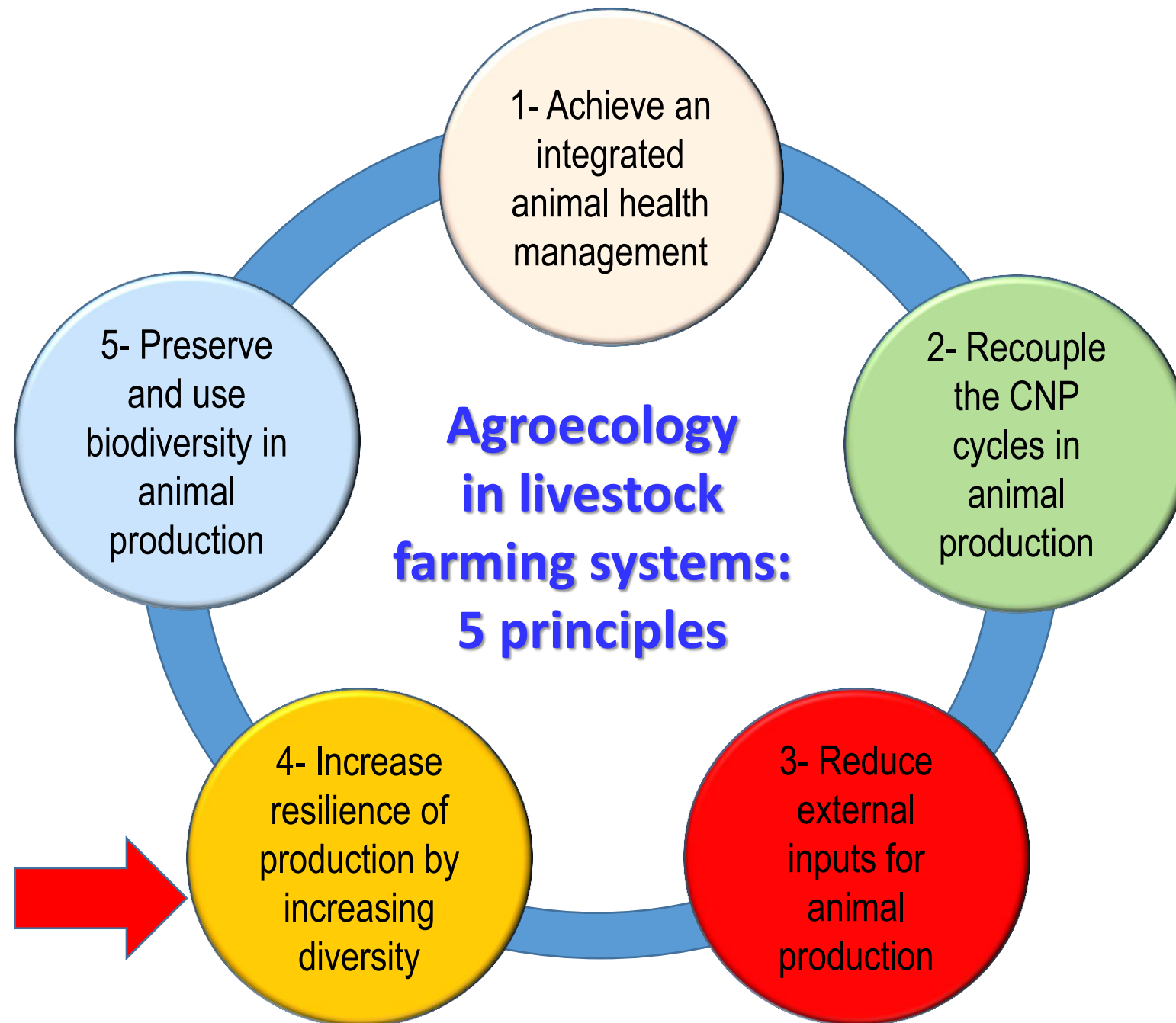


Thematic field: farming systems

Objective: to define combinations of resources, animals and farming practices, taking the environment into account, to conciliate productive, economic and environmental performances, while maximizing animal welfare and health.

Priorities

- ❖ **Identification of bottle-necks** to design innovative systems to cope with climatic hazards (milk/agroforestry), water quality (aquapony), economic volatility (hitech organic pig), health status (zero antibio), animal welfare (fat liver without forced feeding, no castration in pigs).
- ❖ **Identifying some indicators for robustness, resilience and efficiency (animal, group, system)**
- ❖ **Understanding synergies/antagonisms between elements within the system**
- ❖ **Producing methods for multicriteria assessment of new systems**



3 scientific + 1 « societal » challenges

- ① **Early levers to drive phenotypes and products and favour coadaptation between animals and the environment**
- ② **Models and biomarkers to anticipate and drive processes**
 - Model the dynamic interactions between levels of organization and between functions
 - Produce validated biomarkers of efficiency, robustness, product quality
 - To improve high-throughput phenotyping, precision livestock farming
- ③ **Diversity to enhance efficiency, robustness et resilience**

Assuming that "diversity of items (resources, animal, products) within a system increases its capacity to face unpredictable events »

→ Propose rules for managing farming systems, which are based on the diversification of biotechnical elements.
- ④ **Perception of livestock farming systems and research involving animals**

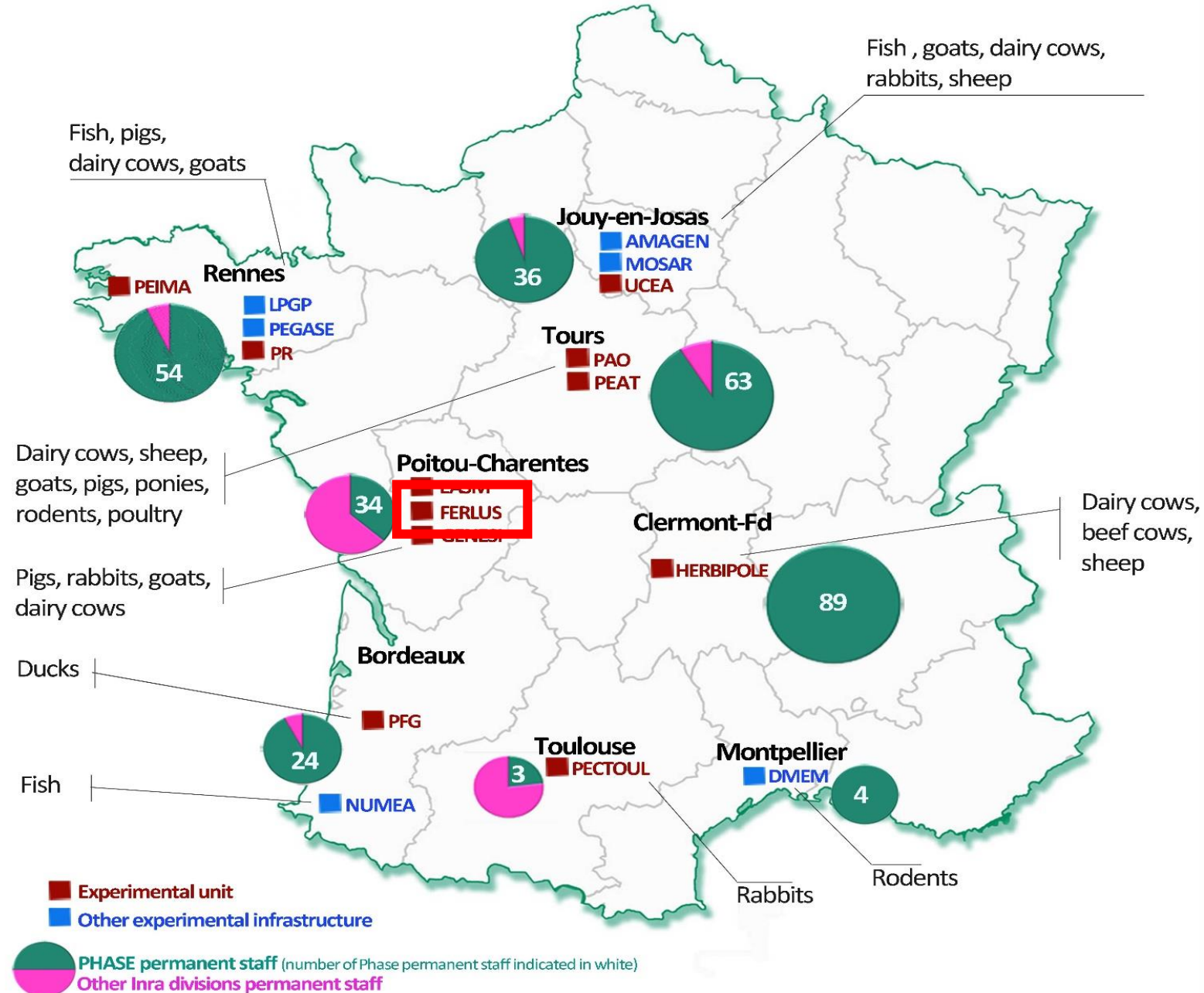


Example n° 1: A long-term experiment

**OasYs : a dairy system designed
to have a low sensitivity to
climatic hazards**



Experimental facilities of PHASE Department



The main innovations in the « OasYs » system

Diversification

Species, mixed crops



Breed, calving period



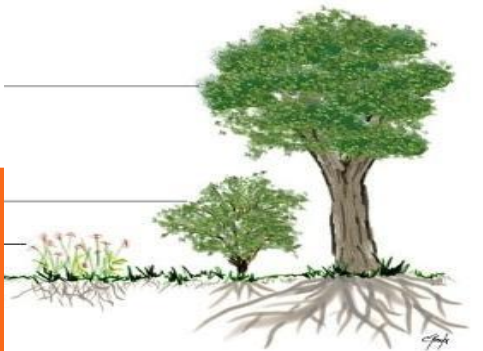
Functions



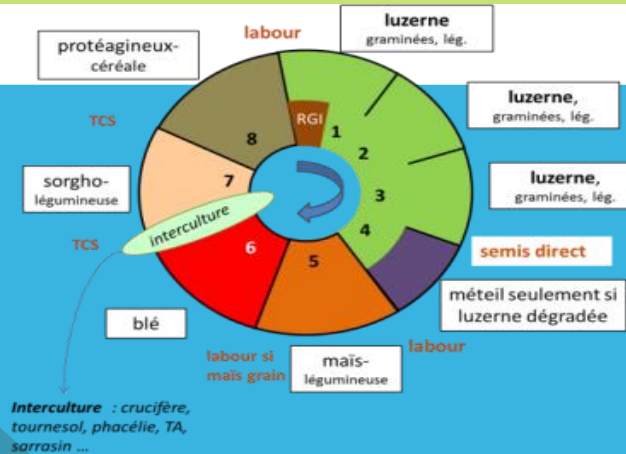
Valorisation in all dimensions

Time 4D

verticale 3D



Crops succession



Lactation duration









Fodder trees: future pollards to be browsed

pollarded to increase the foliar biomass



Alnus cordata

italian alder



Ulmus minor

field elm



Morus alba

white mulberry



Fraxinus excelsior

ash



Quercus ilex

Objectives: to be browsed during periods of low grassland production (summer and autumn).

Objective: to provide shade

Example n°2: a PhD thesis

Assessing robustness of dairy cows

Emilie Ollion (2015)

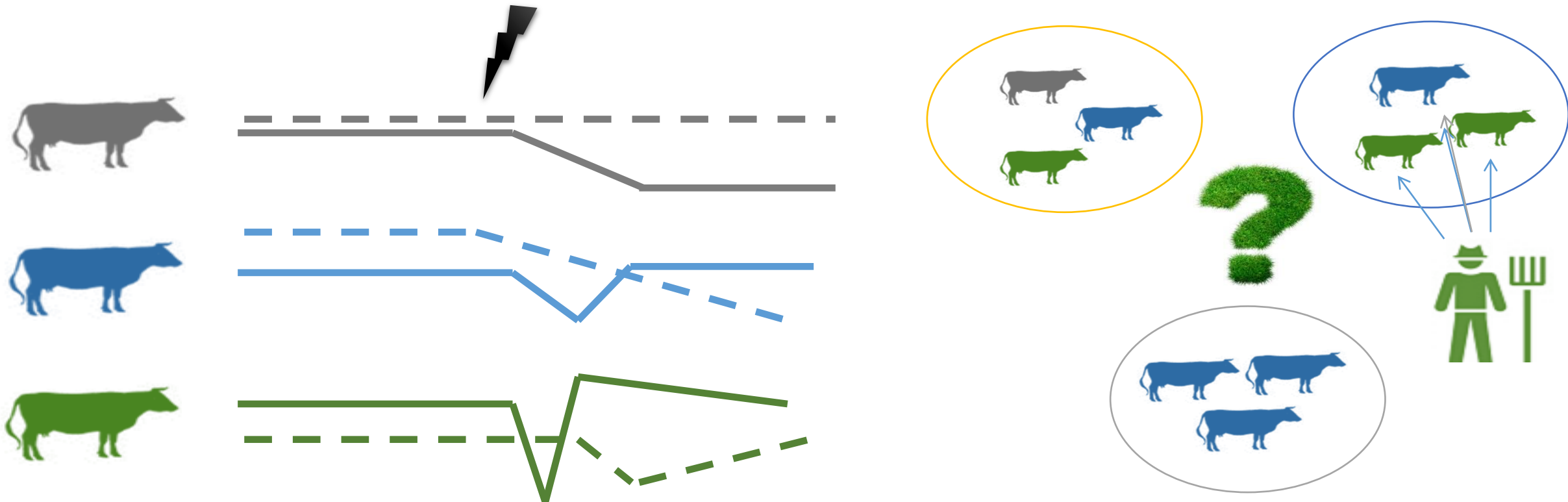
Fabienne Blanc & Stéphane Ingrand, supervisors



Scientific context

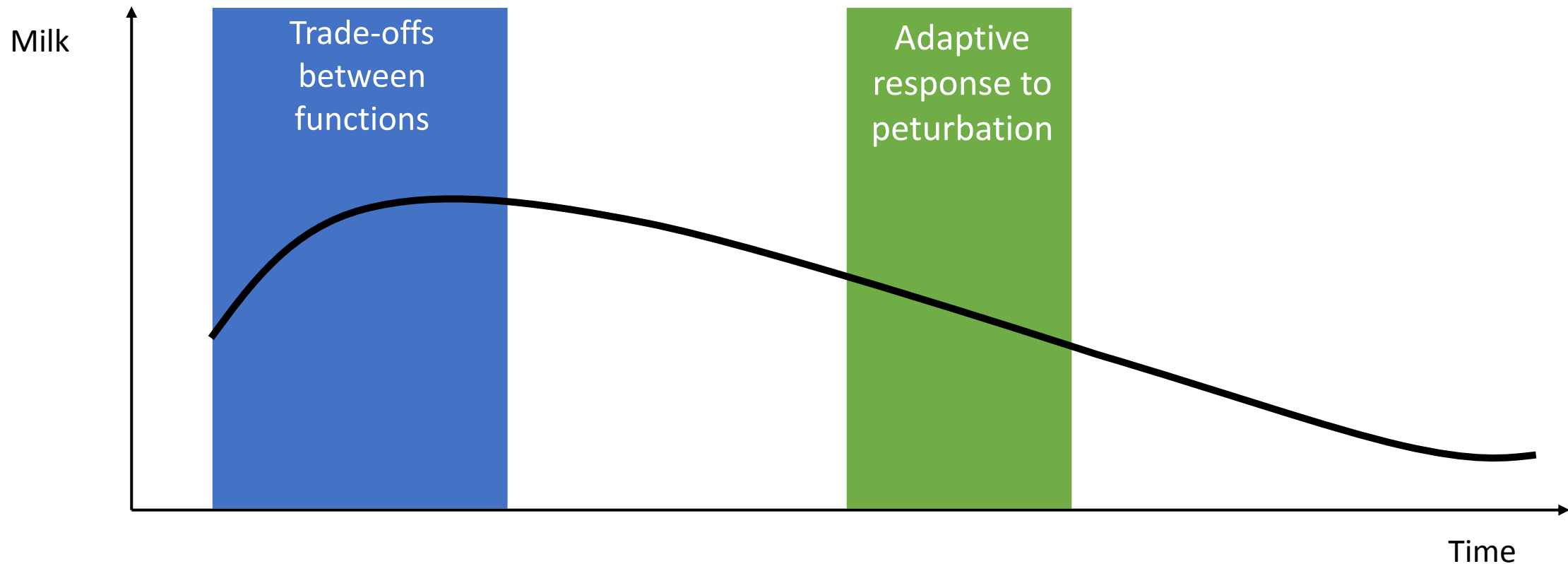
- Herd scale

➔ Individual diversity + accurate practices: stabilisation of production and revenue
(Puillet et al. 2011, Cournut et al. 2012, Blanc et al. 2013)



Method

To develop a method for characterising adaptive responses to perturbations based on the identification of trade-offs between biological functions in early lactation



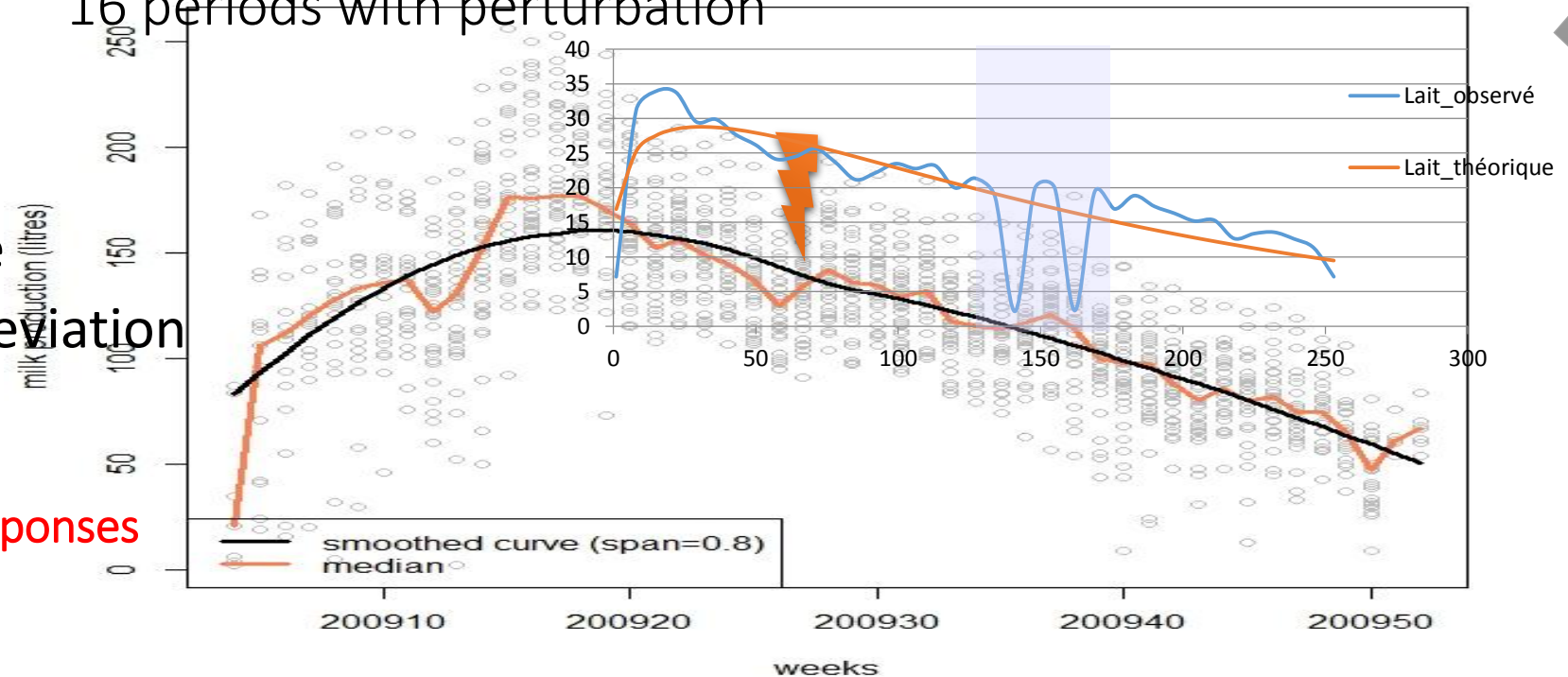
Characterisation of adaptive responses

- Detection of perturbations at herd's scale:

- At animal scale:
 - Reference curve
 - Indicateurs of deviation

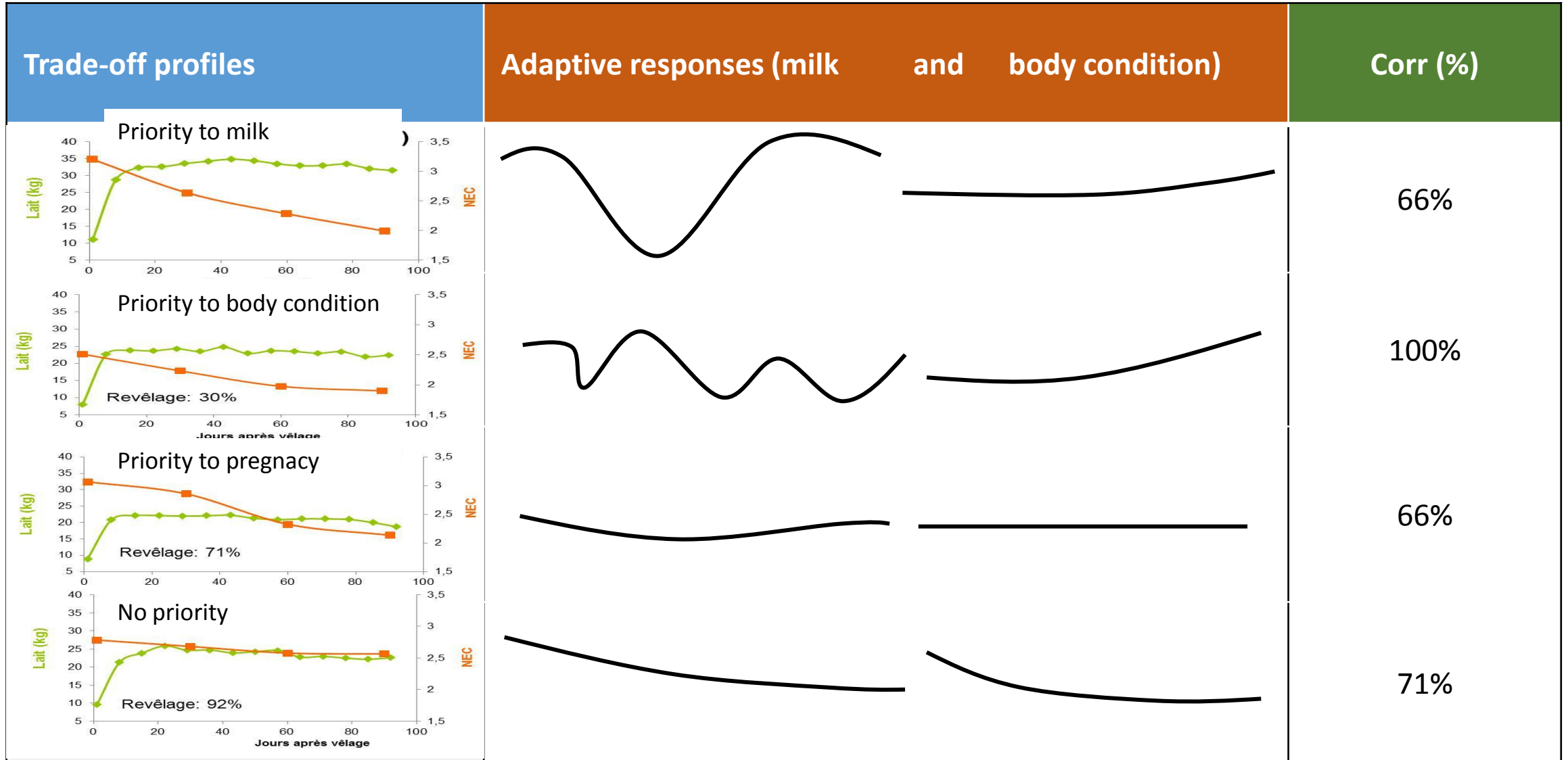
→ 4 profiles of adaptive responses

16 periods with perturbation



Données Inra Mirecourt, 2009

Relationships between adaptive responses to perturbation and trade-off between functions



Concluding remarks...

Need to monitor systems in hazardous environment

→ precision farming as a tool for agroecological transition

Diversity as a lever to cope with risks:

→ what are the conditions?

- « position paper » in progress

 - (another paradigm for researchers in animal science)

- a PhD thesis concerning crossbreeding in dairy herds