

# Does integration promote sustainability in organic multi-species livestock farm?

**Marc Benoit**, L. Steinmetz, D. Ulukan, G. Bernes, C. Brock, A. De La Foye, B. Dumont, M. Grillot, M.A. Magne, T. Meischner, M. Moerman, L. Monteiro, B. Oehen, D. Parsons, R. Primi, L. Shanz, P. Veysset, C. Winckler and G. Martin

*INRAE UMR-Herbivores, Clermont-Ferrand, France*

# Background and challenges

- Agrobiodiversity is a core principle of agro-ecology and organic farming
- Not only crop-livestock integration but also between livestock species integration (or type of production)
- Mix-Enable: a Core-Organic project
  - Assessing the benefits of combining several animal species
  - 3 approaches : Farm monitoring, experimental devices, participatory research
  - All farms are in organic production



# Mix-enable



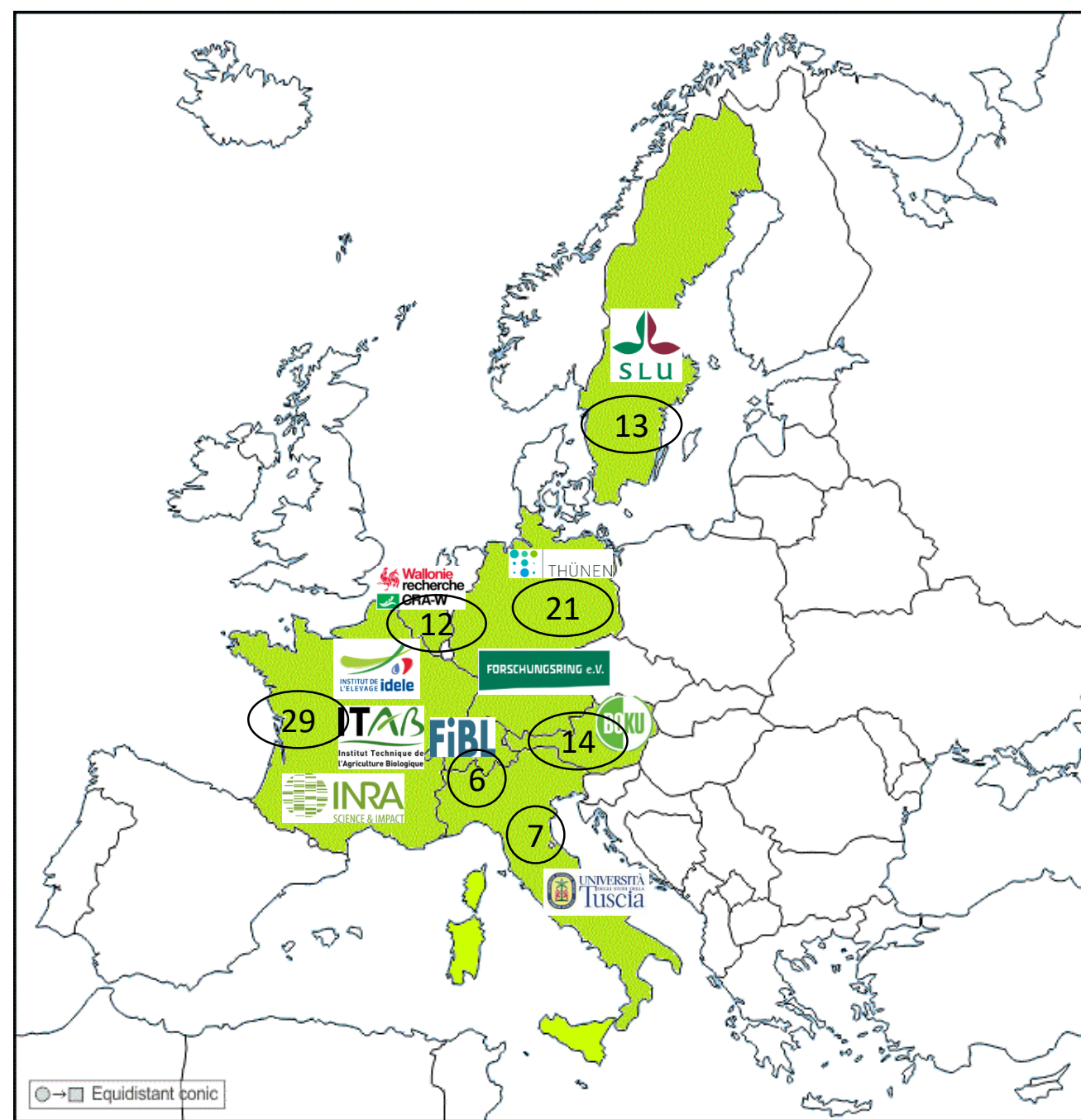
MIX-ENABLE



9 partners from 7 different countries

WP2 (monitoring)

WP3 (indicators and analysis) based on 102 farms



# Material and method

- Data monitored
  - Farm structure (area, workers, type of animals and number etc.)
  - Production (kg, Protein, MJ, €, type of marketing)
  - Inputs (Feed and fertilization)
  - Work organization (Who, how, when?)
- Global analysis with both
  - Agronomical approach (i.e. technical organisation and performance)
  - Type of marketing
  - Work organization and farmers satisfaction
  - Efficiency of the production
- 2 steps
  - Data analysis → Main types of farms, their characteristic and performance
  - Search for enterprise combinations (types and thresholds) → Farm Efficiency

# Methodological challenges

## Multi-species and productions (meat, milk...)

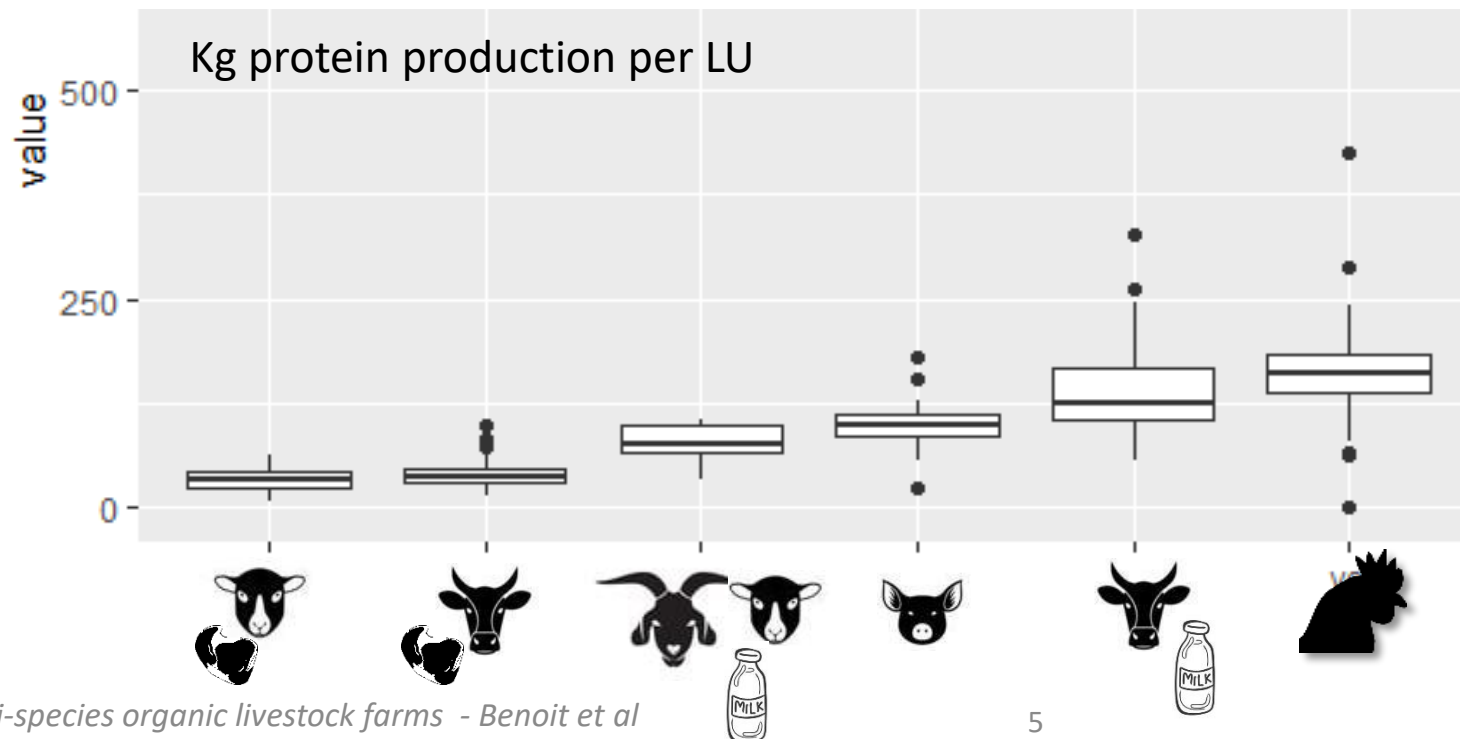
- **Share of each species** → How? New proposal for LU calculation (with net energy from IPCC, for herbivores. See session 67)
- What **efficiency**? → Output/input  
→ Concentrate / Output (from animals)

**But, productivity (output/LU) depends on species and production**

→ Centered-reduced per enterprise:  $Eff_{CR}$

→ Then global indicator

$$Eff_{farm} = \sum_{entr=1}^n Eff_{CRentr} \cdot \%LU_{entr}$$



# Principal Component Analysis and Agglomerative Hierarchical Clustering

## PCA – AHC

### 96 farms

6 countries

2 or more animal enterprises per farm

Ruminants in all farms

Beef cattle and dairy cattle are the more represented

### 38 variables

n= 14 Farm structure (area, size, production types & importance)

n= 3 Sales type and other activities

n=6 Performance (productivity and efficiency)

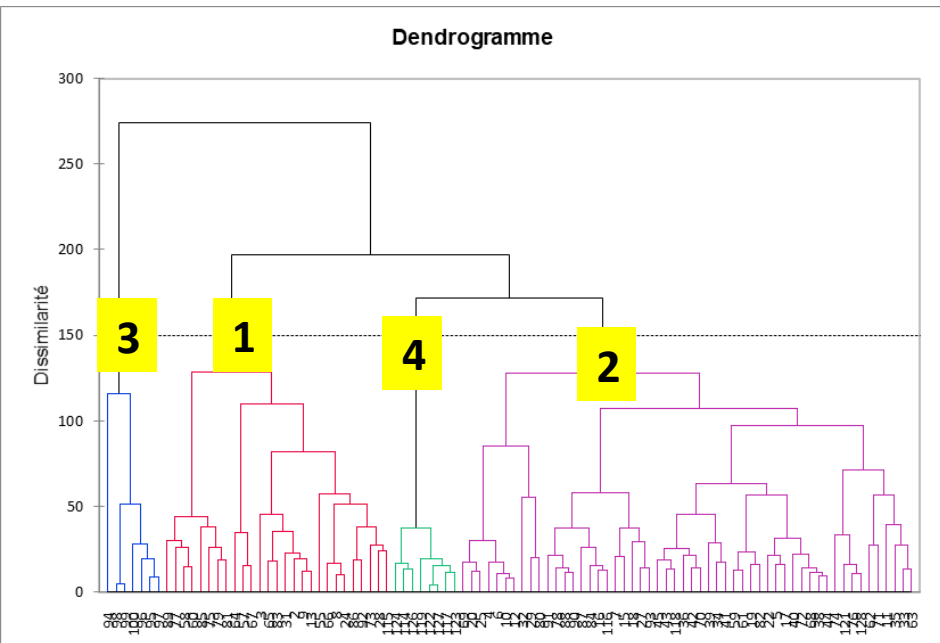
n=15 Social aspects (satisfaction, knowledge, farmers origin etc.)

# AHC

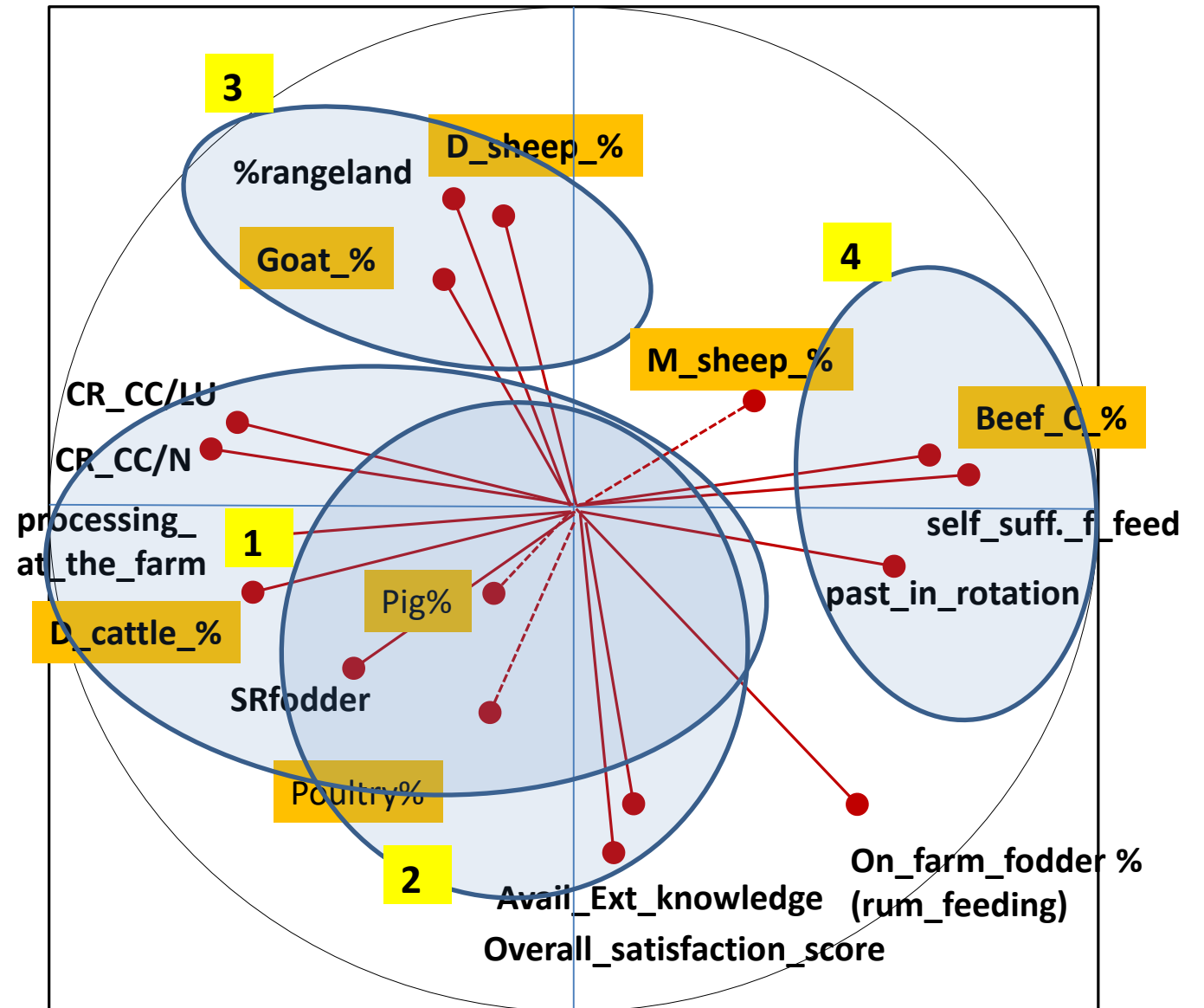
4 groups of farms

Number of farms:

<b>1</b>	27
<b>2</b>	54
<b>3</b>	7
<b>4</b>	8



PCA + Clustering  
(Factors 1 & 2 = 20%)



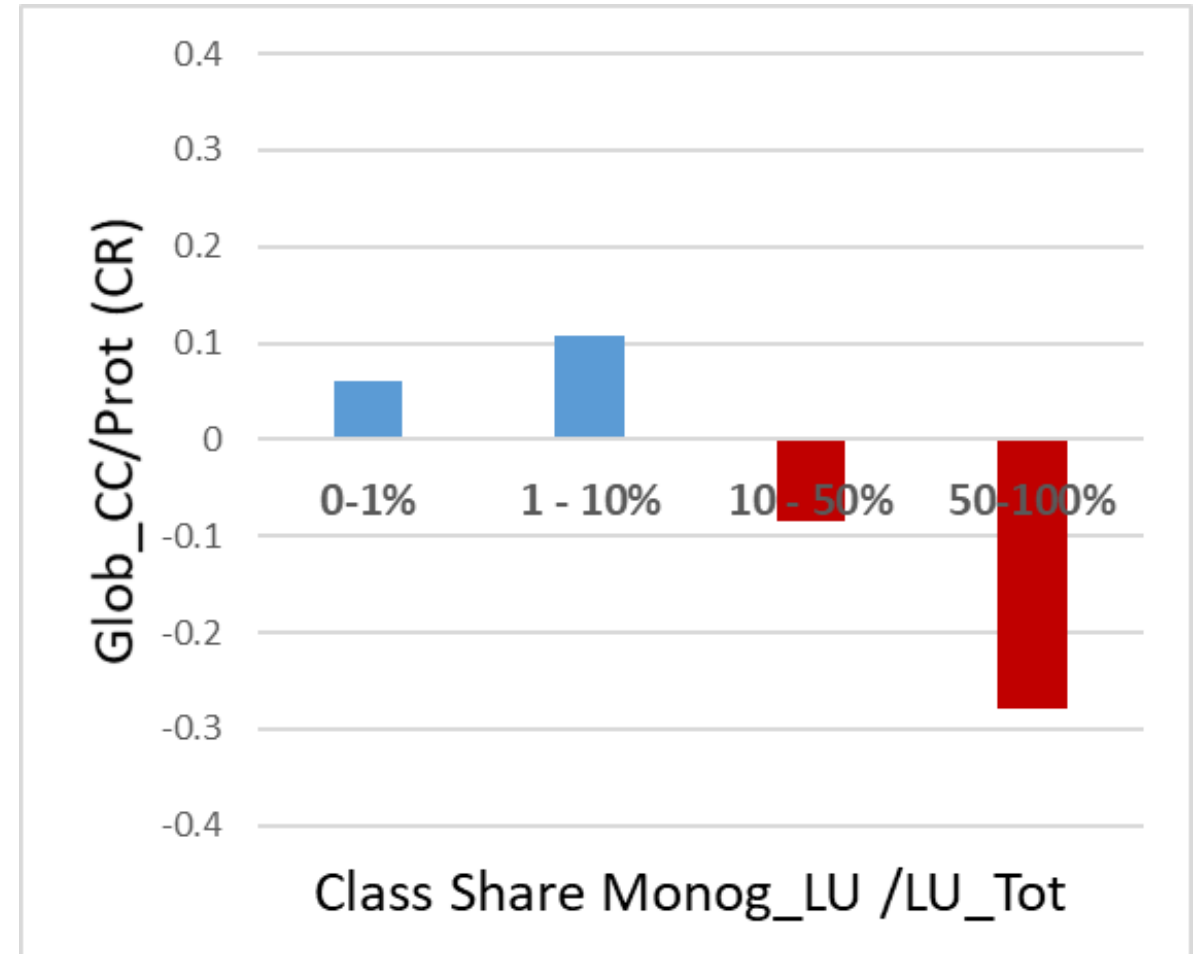
# Main features of the farms (4 groups)

	1	2	3	4
Main (second)	Dairy Cattle (+pig)	Beef Cattle (+poultry)	Dairy Sheep (+ goat)	Beef Cattle ( + Meat sh)
LU	64	<b>101</b>	<b>112</b>	44
LU/AWU	14	<b>47</b>	18	<b>34</b>
AWU	4.4	2.2	<b>6.1</b>	1.3
Worker Paid/Unpaid	<b>36%</b> - 7%	18% - 12%	<b>46% - 31%</b>	14% - 0%
Process/Short ch (€)	<b>82%</b> - 64%	39% - 44%	<b>71%</b> - 82%	0% - 53%
% farm fodder in R.feed	81%	<b>84%</b>	<b>46%</b>	<b>98%</b>
Conversion to OF	1995	2001	<b>2011</b>	2004
farmer_1_off_roots	<b>56%</b>	17%	<b>0%</b>	12%
Eff: CC / Prod (CR)	<b>- 0.14</b>	<b>+ 0.04</b>	<b>+ 0.49</b>	<b>- 0.62</b>



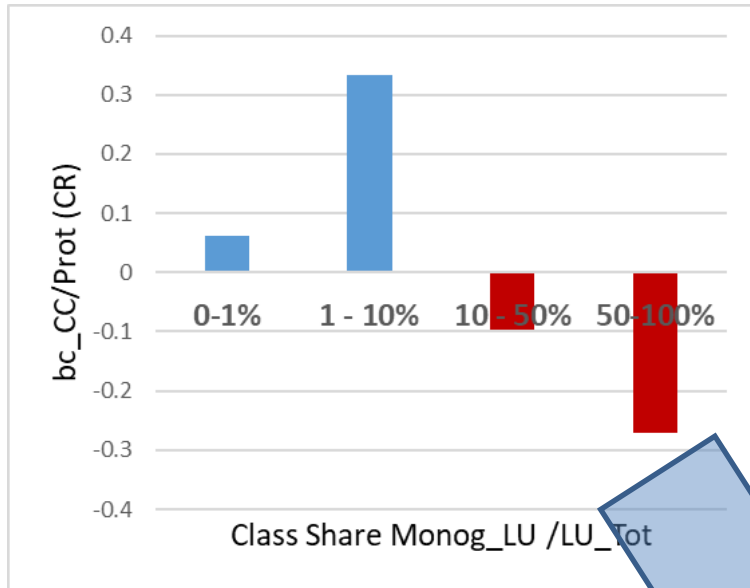
# What combination for a good efficiency?

- CC/Prot (CR): seen as non-efficiency indic.
  - **Negative is good**
- Beef cattle and Sheep (meat): **-0.62**
  - See poster no 36.21 from Vazeille et al*
- Role of monogastrics ?
  - The more monogastric, the best global efficiency
  - **Why / How?**

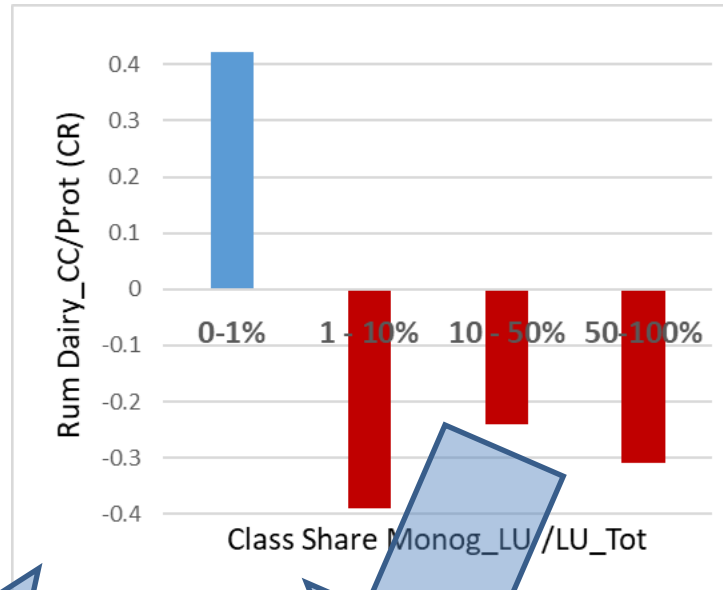


# Relation between share of LU-Monogastric and animal efficiency

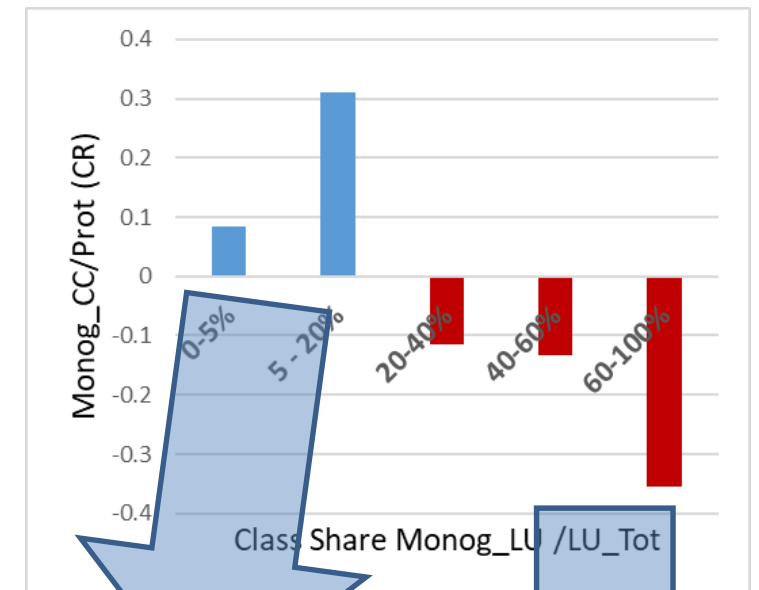
**Beef cattle efficiency**



**Dairy efficiency**



**Monogastric efficiency**



Hyp:  
Significant and positive impact of feed importation (monogastric) on pasture fertility and on ruminants feed self-suffic.

Hyp:  
More importance on short channel marketing?  
€: marketing > tech. efficiency

Hyp:  
Large enterprises are more rationalised /efficient



# Take-home messages

- **Big-Small ruminants association (beef cattle / meat sheep)**
    - Interesting complementarity? (feeding, parasitism management)
    - Low added value on meat (compared to conventional F) → profitability depends to a large extent on technical performance
  - **Ruminants-monogastrics association**
    - Global efficiency ↗ when share of monogastrics ↗
    - Hypothesis
      - Significant fertility transfer (*Steinmetz et al 2021*)
      - When lower share of Monogastrics → Technical management is less important for farmers and more investment is made on processing / marketing (to be checked)
  - **Dairy sheep and goat**
    - Very frequent in Italy, with
      - Low agronomic potential (rangelands)
      - 82% short channel marketing
- ➔
- Low Animal Efficiency (output/input)

# Conclusion

- **A wide range of data** (technical, marketing, work), on 100 farms, 6 countries, 6 types of production. Huge data verification work. Lack of overall economic results
- Studying complex (diversified) farming systems leads to several methodological issues (calculation of LUs, comparison of performance, input allocation,...)
- Interesting first results
- Additional analyses should be carried out, e.g. effects of the level of integration between enterprises and the role of work organization on farm efficiency and farmers' satisfaction
- There is a huge diversity in the sample (farm size, type of sales, type of combinations etc.) → for more refined analyses, it would be necessary to re-sample within-combination

# Thank you for your attention

marc-p.benoit@inrae.fr



We acknowledge the financial support for the MIX-ENABLE project provided by transnational funding bodies, being partners of the H2020 ERA-Net project, CORE Organic Cofund, and the cofund from the European Commission