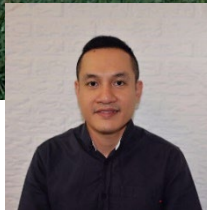


Understanding impacts of scale changes on efficiency gains of pasture-based beef production systems in the Massif Central, France: a modeling approach



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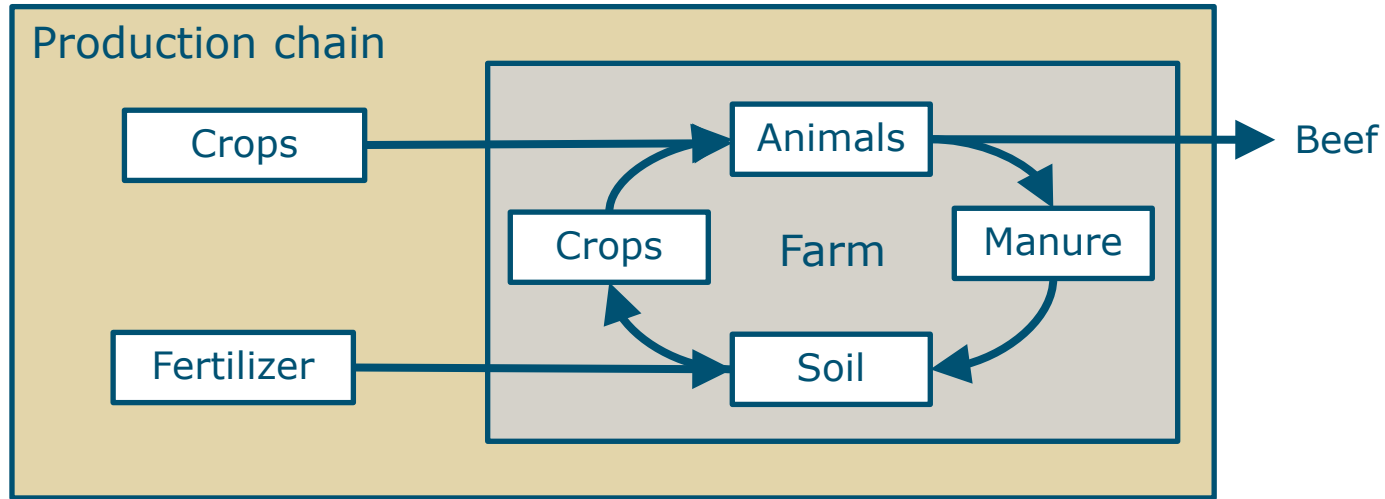
Introduction

- Improving animal efficiency to tackle sustainability problems?
- Trends in the French beef production:
 - Increases in animal liveweight and body size
 - Increases in concentrate feeding
 - Decreasing efficiency of intermediate inputs



Research objective

Understand why efficiency gains at the animal level diminish at the herd, farm and production chain scale



Hypotheses

Why do efficiency gains at the animal scale diminish at higher scales?

Animal: feeding (imported) concentrates 

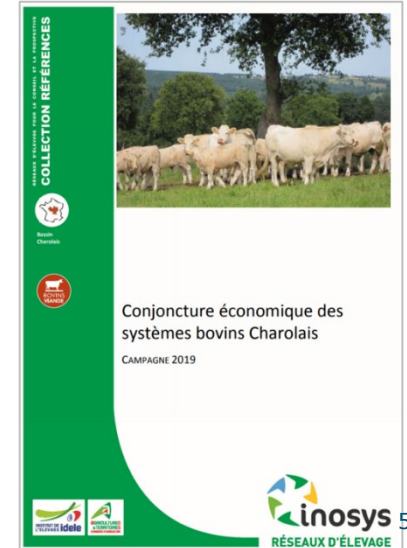
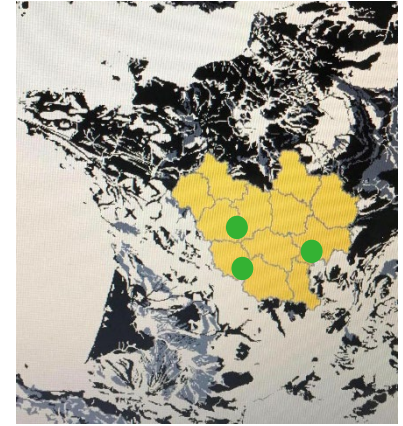
Herd: expansion → calving rate  and calf mortality 
animals fattened 

Farm: expansion + intensive management → resource use efficiency 

Sector: meat from dairy cattle  → meat from beef cattle 

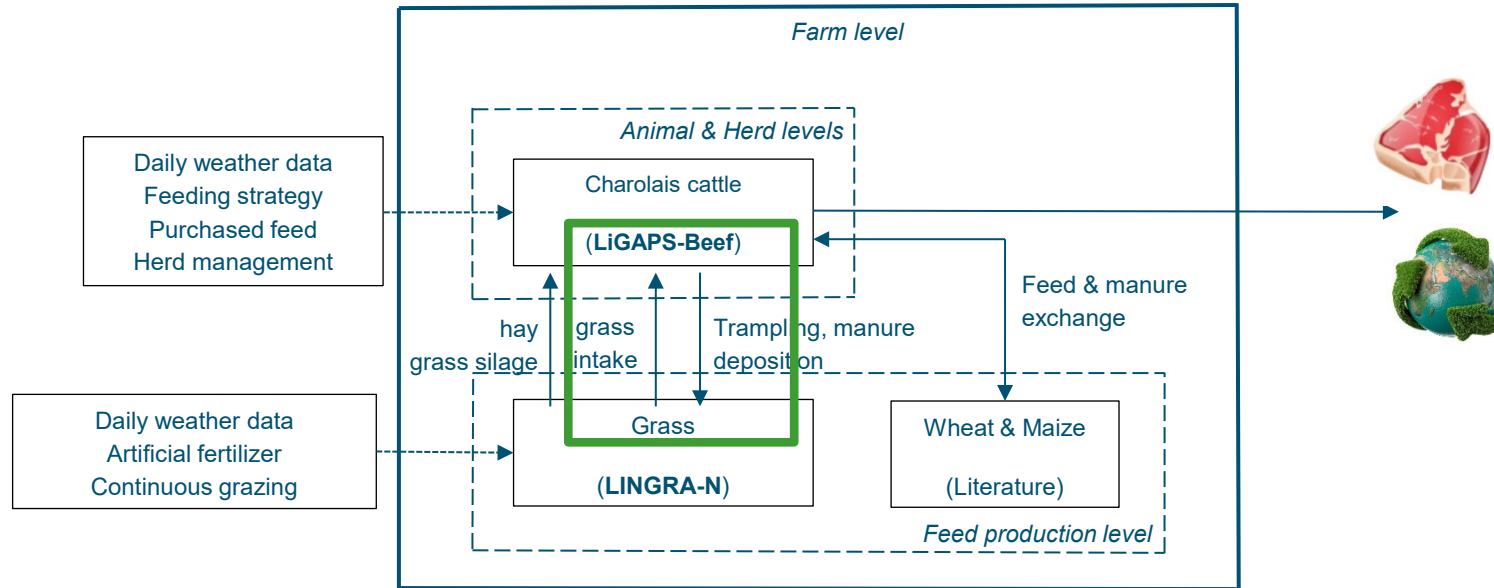
Materials & Methods

- Location: Massif Central, France
- Breed: Charolais
- Cow-calf systems
- 4 farm types selected from INOSYS 2019 report
 - fattened calves vs. without fattened on-farm
- Model inputs:
 - Weather data: Agri4cast, year 2019
 - Soil characteristics: European Soil Data Centre



Materials & Methods

Simulation at 3 scales (Animal – Herd – Farm)



Results

		Without fattening		With fattening	
		Farm 1	Farm 2	Farm 3	Farm 4
Calves	Feed efficiency	225.0	168.9	127.8	124.3
	N use efficiency (%)	31.0	28.7	19.8	18.8

Results

		Without fattening		With fattening	
		Farm 1	Farm 2	Farm 3	Farm 4
Calves	Feed efficiency	225.0	168.9	127.8	124.3
	N use efficiency (%)	31.0	28.7	19.8	18.8
Cow	Feed efficiency	24.1	20.3	26.9	30.1
	N use efficiency (%)	4.2	4.3	4.0	4.2

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	N use efficiency (%)	4.2	4.3	4.0	4.2
Herd	Feed efficiency	33.0	34.2	47.0	48.1
	N use efficiency (%)	6.4	7.7	7.9	7.5

Results

Without fattening

With fattening

		Farm 1	Farm 2	Farm 3	Farm 4
Calves	Feed efficiency	225.0	168.9	127.8	124.3
	N use efficiency (%)	31.0	28.7	19.8	18.8
Cow	Feed efficiency	24.1	20.3	26.9	30.1
	N use efficiency (%)	4.2	4.3	4.0	4.2
Herd	Feed efficiency	33.0	34.2	47.0	48.1
	N use efficiency (%)	6.4	7.7	7.9	7.5
Farm	Beef production (kg/ha/year)	450	335	427	476
	N use efficiency (%)	23.3	20.8	15.8	26.8

Results

Hypothesis: efficiency does not increase due less fattening

- Percentage exported (male) calves: 58% in 1990, 74% in 2012
- Shift from farms with fattening to farms without fattening
- Feed efficiency average herd: -0.26% per year.

Results

Hypothesis: herd expansion → calving rate ↓ and calf mortality ↑

- Calf mortality increased with increasing labour productivity (INOSYS)
- Decrease calf mortality rate by 10%, increase calving rate by 10%

Relative increases

		Farm 1	Farm 2	Farm 3	Farm 4
Herd	Feed efficiency	7.4%	6.3%	5.8%	6.5%
	N use efficiency	11.6%	7.3%	4.3%	8.0%

Discussion

- Relevance of systems approach (scales)
- Results supported hypotheses quantitatively

Next steps:

- Modelling framework → more applications (climate change, stocking density)
- More environmental indicators will be investigated
- Include the production chain(s)

Conclusions

- Efficiencies diminished because of an increased export of calves
- While breeding for efficient animals, increases in labour productivity could offset gains
- Combined mechanistic cattle and grassland model → valuable tool to simulate beef production on European grasslands

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Thank you for your attention!

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