Impacts of crop-livestock organization on mixed crop-livestock systems sustainability

A model-based study

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✓ Specialization of territories and farming systems

- Nitrogen losses
- Loss of carbon sequestration
- Loss of biodiversity
- Dependence on inputs markets

(Tichit et al. 2011, Bommarco et al., 2013, Soussana and Lemaire., 2014)

✓ Mixing crop and livestock production is more sustainable

- Ecosystem services
- Face climate change
- Face volatility of input prices

(Bonaudo et al., 2014, Lemaire et al., 2014, Peyraud et al., 2014)

HOWEVER there is no consensus on the benefits of MC-L systems

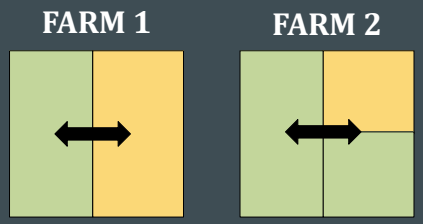
(Perrot et al. 2012, Ryschawy et al., 2012, Veysset et al., 2014)

NEED FOR better understanding mixed crop-livestock systems

(Parsons et al., 2011a, Bell and Moore, 2012)

HYPOTHESES

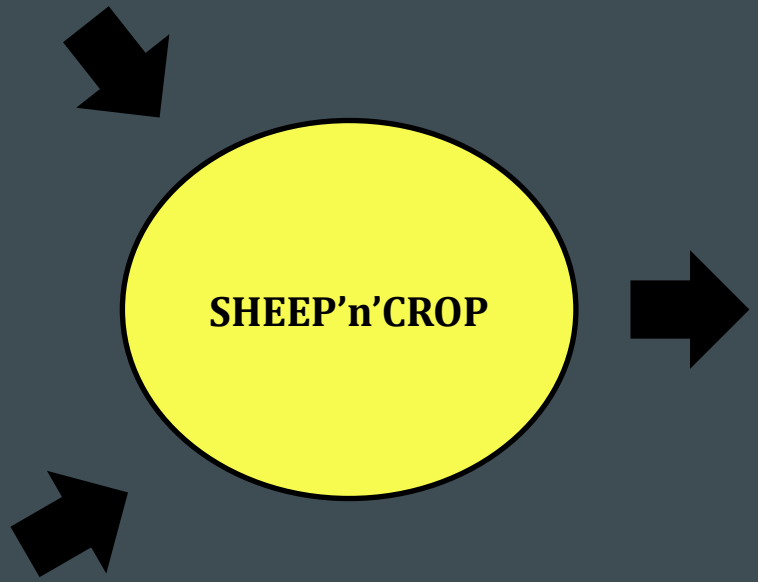
- ✓ Biophysical process levels **VS** farm scale
- ✓ Crop-livestock organization



1. Direct effect : without interactions
2. Indirect effect : with interactions

Crop-livestock organization

- 20% crop – 80% livestock
- 80% crop – 20% livestock



- Income
- Productivity
- MJ consumption
- GHG Emissions
- N balance

Crop-livestock interactions

- Crop self-consumption
- Introduction of pastures in crop rotations
- Introduction of forage intercrops
- Transfer of manure on crops

MAX GROSS MARGIN

Subject to contraints:

FARM

- Number of workers
- Farm size

LIVESTOCK PRODUCTION

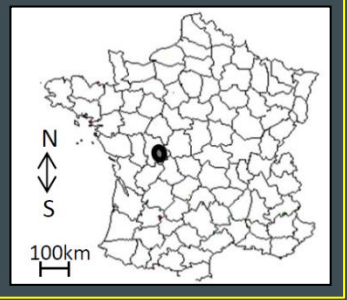
- Demographic structure of the flock
- Fulfill feed needs

VEGETAL PRODUCTION

- Rotations schemes
- Fulfill fertilization needs
- Yields

CROP-LIVESTOCK

- Organization
- Interactions

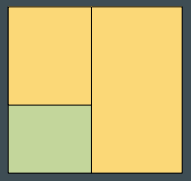


Buildings & materials

Life Cycle Analysis (GHG, MJ)

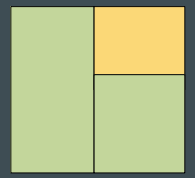
Performances indicators

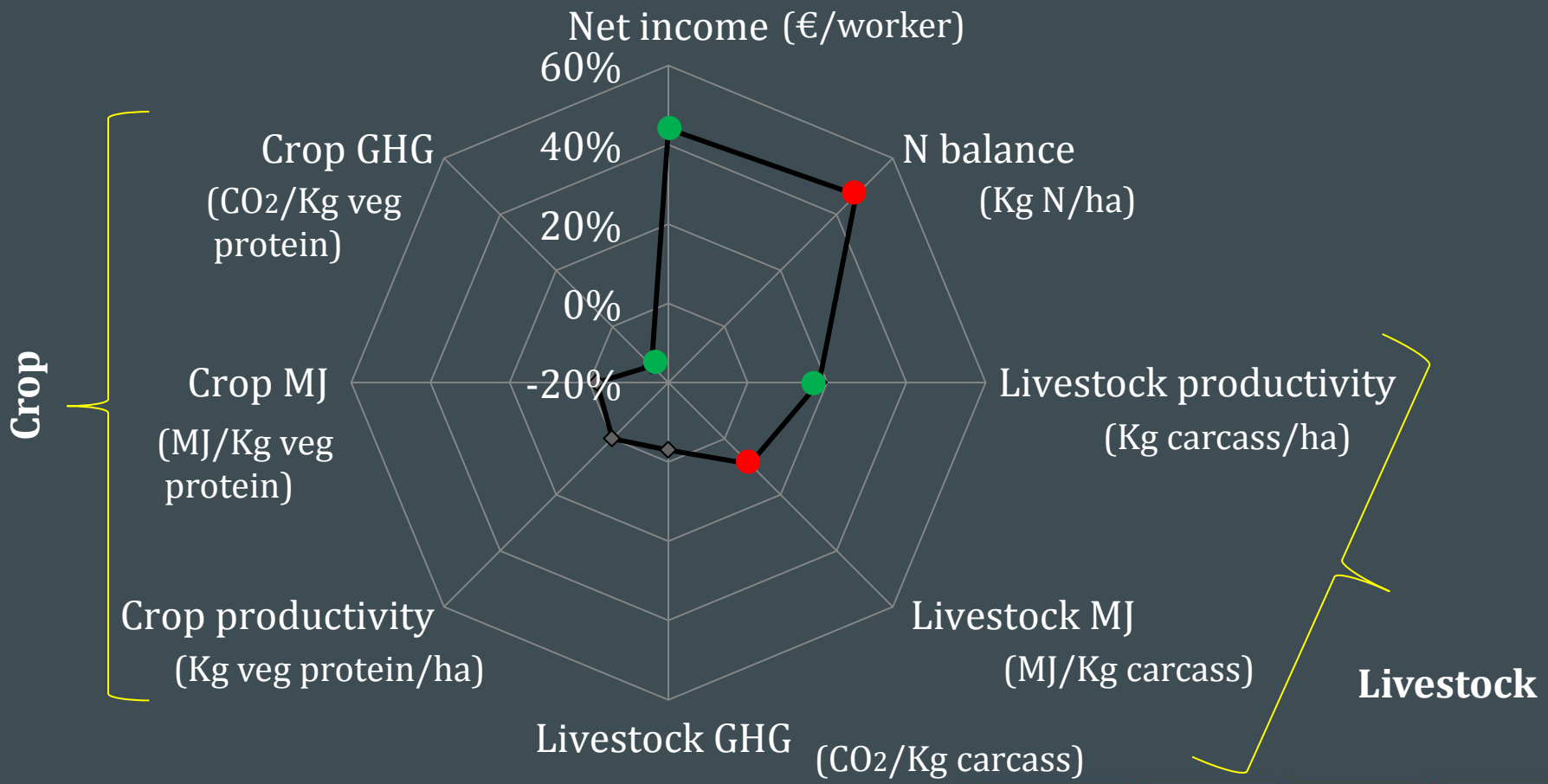
FARM 1



DIRECT IMPACT OF CROP-LIVESTOCK ORGANIZATION
Gains permitted by 80% of crop in comparison with 20% of crop

FARM 2





→ **INCOME :**
Crop production is more profitable than livestock production

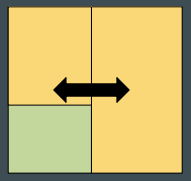
→ **LIVESTOCK PRODUCTIVITY**
Higher livestock intensification

→ **CROP GHG**
N cycle

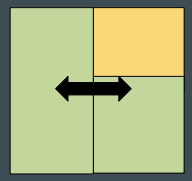
→ **LIVESTOCK MJ :**
Livestock intensification (feeds)

→ **NITROGEN BALANCE :**
Crop-livestock organization
Livestock intensification (feeds)

FARM 1

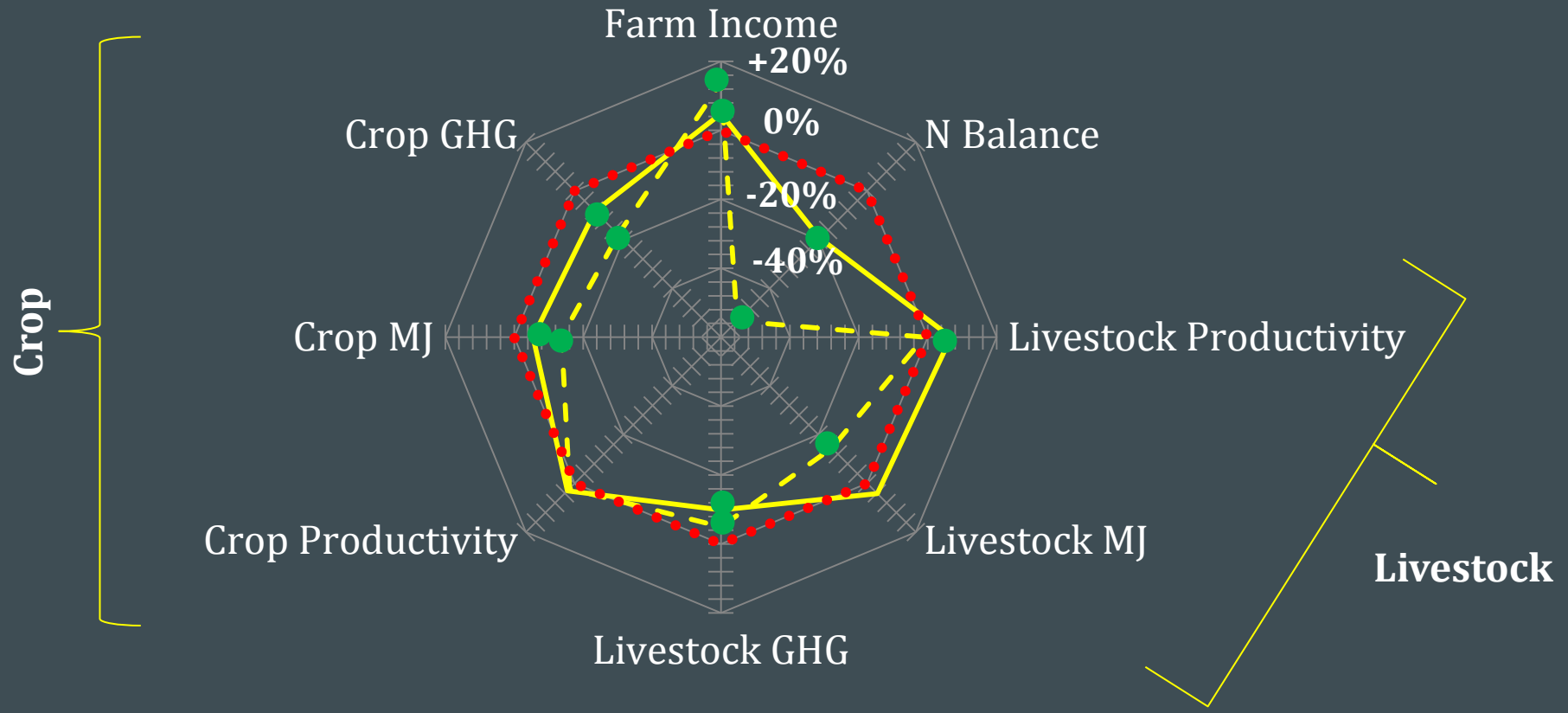


FARM 2



Crop-livestock interactions have beneficial impacts

BUT AN INDIRECT IMPACT OF CROP-LIVESTOCK ORGANIZATION IS OBSERVED



1. **Trade-off : the direct effect of crop-livestock organization**

→ Consistent with scientific literature
(Parsons et al. 2011, Bell and Moore, 2012, Perrot et al., 2012)

→ NOVELTY : crop-livestock organization is a key explaining factor

2. **Crop-livestock interactions are beneficial**

→ some controversial studies
- Production scale
- No consideration of interactions
- Technical or agronomic constraints

→ NOVELTY : significantly affected by crop-livestock organization

3. **Model limits and perspectives**

→ Consideration of the social pillar of sustainability

→ Economic context

- ✓ **Crop-livestock organization is key determinant of performance**

  → **TRADE-OFF**

  → **Ability of a farming system to benefit from crop-livestock interactions**

- ✓ **Trade-off between performances of sustainability**

  → **Need for a compromise analysis**

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THANKS FOR YOUR ATTENTION