Are labour productivity, specialisation and efficiency of livestock production systems compatible?

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Context

- **Productivity**
  - Major source of growth and competitiveness

- **Labour productivity gains and specialisation in agriculture (since 50’s)**
  - Increase in farms’ size and decrease in working population
  - Specialisation, concentration, agglomeration

- **Cattle farms**
  - Labour productivity → heavy workload
  - Animal productivity → milk yield, live-weight
  - Land productivity → Feed self-sufficiency?
  - Practices’ simplification

- **Mixed crop-livestock farming system**
  - Usually seen as ideal, a virtuous farming system → more efficient
Questions and objectives

❖ Productivity of what?
✓ Partial factor productivity
✓ Total factor productivity

❖ Efficiency of what?
✓ Technical, managerial, economic efficiency

→ Definition of these concepts
→ Indicators and evaluation

❖ Evolution and determinants of livestock (with more or less crop) farms productivity and efficiency
✓ Over 36 years (1980-2015) for Charolais suckler beef farms (INRA network) - 87 farms per year on average - Constant sample: 22 over 36 years, 48 over 16 years (2000-2015)
✓ 70 organic livestock farms (cattle, sheep and goat for meat and milk) in French Massif central, for 2014 and 2015
Production factors productivity
= Output quantities / Input quantities

Partial factor productivity
✓ Labour = Output quantities / Number of workers
✓ Land = Output quantities / Ha of agricultural area
✓ Equipment = Output quantities / Equipment quantities
✓ Intermediate inputs = Output quantities / Intermediate inputs quantities
➢ Intermediate inputs + equipment → indicator of technical efficiency
   ▪ Express in € → techno-economic efficiency

Total factor productivity (TFP)
✓ Output quantities / (Labour + Land + Equipment + II) quantities
➢ Indicator of technical and managerial efficiency

Economic value variation between n and n-1

Quantity effect: value variation due to the quantities variations

Economic value variation
Between n and n-1

Price effect: value variation due to the prices variations

Outputs reweighted with their own PPAPI
Inputs reweighted with their own PPMAPI
\[ \Delta \text{ value in constant } € = \Delta \text{ quantity} \]
### Partial and total factor productivity

**Charolais suckler-cattle farms network, Inra**

<table>
<thead>
<tr>
<th></th>
<th>1980-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual growth rate %/year</strong></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>2.03</td>
</tr>
<tr>
<td>Land</td>
<td>0.29</td>
</tr>
<tr>
<td>Intermediate inputs</td>
<td>-0.37</td>
</tr>
<tr>
<td>Equipment</td>
<td>-0.85</td>
</tr>
<tr>
<td><strong>Total Factor Productivity</strong></td>
<td>+0.17</td>
</tr>
</tbody>
</table>

- **Labour**: 2.03%
- **Land**: 0.29%
- **Intermediate inputs**: -0.37%
- **Equipment**: -0.85%
- **Total Factor Productivity**: +0.17%

**Technical efficiency**

*Veysset et al., 2018*
Grass-based suckler-cattle systems (GF) vs mixed crop-livestock systems (MC-L)

Years 2010 and 2011

- Grassland-based farms (n=7)
  ✓ 160ha
  ✓ 100% fodder area
  ✓ 100% grass

- Mixed C-L farms (n=21)
  ✓ 180ha
  ✓ 68% fodder area
  ✓ 9% crops for cattle
  ✓ 23% cash crops

- MC-L less efficient on beef unit
- Crop technical efficiency > beef
- Techno-economic efficiency at the farm level = 

Veysset et al., 2014
Efficiency of organic livestock farming systems

- 70 farms in French Massif central, 2014 and 2015
  - 20 dairy cattle, 16 beef cattle
  - 12 dairy sheep, 13 meat sheep
  - 9 goats

- Variable to be explained
  - techno-economic efficiency
  Gross farm product without aids, € / (Intermediate consumption + equipment depreciation), €

- Explanatory variables
  - 18 structural variables
  - 25 technical variables

- Data analysis on standardized (per production) variables
  - Component analysis, clustering
  - Partial Last Square regression
Determinants of the efficiency
PLS-regression

- Depreciation € / ha UAA
- Concentrates kg / LU
- Intermediate cons. € / ha UAA
- Operating capital € / ha UAA
- Capital € / Worker
- LU / Worker
- Crop diversity
- Ha UAA / Worker
- No. plant species
- Total workers
- Forage self-sufficiency
- Feed self-sufficiency
- Non salaried worker
- Permanent grassland

Regression coefficients

Negative

Regression coefficients

Positive
Patrick VEYSSET / Efficiency Livestock systems

Typology * Determinants → Profiles

Large specialized, self-sufficient grassland farms

Small specialized economical farms, with workforce

Intensive farms, with high land and animal productivity

Large mixed crop-livestock farms, with high land and animal productivity

Farm size

Specialisation

Forage self-sufficiency

Inputs efficient

Labour productivity

Farm income €/worker

EFFICIENCY

Average of 70 farms sample
Discussion, conclusion

- Expansion of farm size with simplification of practices led to lower technical efficiency
  - Lower use of on-farm resources: decrease in self-sufficiency
  - Heavier equipment needs: substitution labour / capital

- Genetic, technical, technological and knowledge progress
  - To increase labour productivity?

- Economies of scale and economies of scope
  - Suckler-cattle farms: NO ECONOMIES OF SCALE!
  - Large conventional and organic livestock farms appear unable to translate a mixed crop-livestock strategy into economies of scope
Discussion, conclusion

❖ Forage self-sufficiency: key factor
  ✓ Herbivore = grass ➔ forage self-sufficiency
  ✓ Productive and economic gain to produce own concentrates??

❖ Enlargement and complex farming systems
  ✓ High labour productivity, heavy workload, combination of skills

➢ Simplification of practices
➢ Incompatible with efficiency and sustainability

❖ Agroecological transition
  ✓ Encouraging “small” specialized farms? Public policies?
  ✓ Encouraging exchanges between farms in a territory?
  ✓ Specialization of the farms and diversification of the territory?
  ✓ Limiting the labour productivity increase?