Assessment of gradual adaptations of a low input mixed farming system for improved sustainability

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Evolutions of a mixed crop dairy farming system
before 2004
Conventional mixed crop dairy farming system

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from 2004
Organic low input mixed dairy farming system

Livestock
- Grassland
  - Perennial grasslands
  - Temporary grasslands
  - Forage crops
  - 6/8 years rotations
  - Harvested perennial grasslands
  - Harvested temporary grasslands
- Calving season
- Associate crops
  - Cash crops
  - Intercrops
Crops
- Diversity
Manure management
- Milk Animals
- Pasture's management

61 DC, 106 LU
159 ha:
- Crops: 59 ha
- Leys: 47 ha
- Grassland: 53 ha

- Leys, Wheat and sec. Cereals rotations, inc. intercrops
- Grassland
- Hay (no silage)
## System’s evolution

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Crops</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rotations</td>
<td>3 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cereals</td>
<td>49 ha cer. +maize+RS</td>
<td>59 ha local wheat var.</td>
<td>winter barley</td>
<td>mixed varieties</td>
</tr>
<tr>
<td>intercrops</td>
<td>NO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>associated crops</td>
<td>NO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>permanent pastures</td>
<td>105 ha</td>
<td>53 ha</td>
<td>C/H allocation</td>
<td></td>
</tr>
<tr>
<td>leys</td>
<td>5 ha</td>
<td>47 ha Alfalfa/dact</td>
<td></td>
<td>Alf-clov/ dact-Fesc.</td>
</tr>
<tr>
<td>sowing</td>
<td></td>
<td>Aitchinson</td>
<td></td>
<td></td>
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<tr>
<td>tillage</td>
<td></td>
<td>ploughing if necessary</td>
<td></td>
<td></td>
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<tr>
<td><strong>Livestock</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reproduction, calving</td>
<td>Oct-Feb</td>
<td>Aug-Jan</td>
<td></td>
<td>Aug-Nov (improved calvings group)</td>
</tr>
<tr>
<td>genetic diversity</td>
<td>HN-MO</td>
<td>HN-MO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>feeding</td>
<td>inputs</td>
<td>temp mead. / heifers</td>
<td>Alfalfa hay</td>
<td></td>
</tr>
<tr>
<td>alfalfa</td>
<td>NO</td>
<td></td>
<td></td>
<td>Alfalfa past.</td>
</tr>
<tr>
<td>health</td>
<td>drugs</td>
<td></td>
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<tr>
<td><strong>Inputs, Conventional</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Autonomous, Organic</strong></td>
<td></td>
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</tbody>
</table>

### Phasing of improvements (2006-2012)
- Diversification of crops and intercrops
- Simplification of cropping techniques
- Simplification of pastures management and herd feeding

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Questions, approach

• What gains in sustainability provided by a low input organic system?
• What services offered by this system?
• Did step-by-step improvements had positive consequences?

2 approaches:
• Expert assessment
• Multicriteria indicators-based sustainability assessment

Autonomy
- material
- decisional

Biodiversity
Environment
Multi-criteria Assessment of Sustainability
INRA ASTER-Mirecourt

Agro-Environnemental Sustainability

Sustainability

Abiotic Resources

Water pollution

Air pollution

Pesticides in water

NO3 losses

Air pesticides

N2O emissions

CH4 emissions

CO2 emissions

GHG emissions

Chemical quality

Soil quality

Organic matter content

Non-renewable energies

P availability

Energy consumption

Support

Habitats

Soil fertility

Ground worms

Ecological regulation areas

Biotic Resources

Regulation

Biological control

Ground beetles

Birds

Wild vegetal diversity

Wild genetic resources

Domestic genetic resources

Provision

Domestic vegetal diversity

Biotic Sustainability

Societal acceptability

Social Sustainability

Social acceptability

Economical Sustainability

Viability

Indépendancy

Transmissibility

Efficiency

Economical viability

Economical specialization

Financial autonomy

Subsidies dependency

Transmissibility

Efficiency

Economical Sustainability

Societal acceptability

Social Sustainability

Viability

Indépendancy

Transmissibility

Efficiency

Sustainability

McASTER

33 indicators
Expert assessment

8 experts, one-day seminar
- 2 organic farmers
- 2 conventional farmers
- 2 agricultural advisors
- 1 agricultural school
- 1 livestock institute

Support: 4 staff

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Expert assessment

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Crop Autonomy

Livestock Autonomy

Farm autonomy

Crop Production

Livestock Production

Livestock Management

Economics

Supply chain

Social Embeddedness

Work

Agronomy

Environment

Production

Autonomy

Economical

Social

Environmental

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Expert assessment

enhanced

organic

reference
Production and Autonomy

- Production
- Energy
- Nutrients
- Markets
- Feed
- Proteins
- Knowledge
- Energy
- Forage
- Quality
- Traceability
- Flexibility
- Health
Environmental aspects

- Pesticides: ground water, surface water
- Non-renewable energy
- Soil P, OM
- GHG: CO2, CH4, N2O
- P losses
- Ecological areas: regulation, biodiversity, crops, wild vegetation
- Inputs: fossil energy, synthetic inputs, water consumption, animal pressure, landscape diversity
- Soil quality: reduction, crop rotation
- Ecological regulation areas: wild vegetation diversity, cultures diversity, birds, earthworms, ground beetles
Social and societal aspects

- complexity
- consumers relationship
- producers partnership
- employment
- landscape quality
- working time

- products quality
- short supply chain
- landscape management
- buildings management
- provided services
- social autonomy
- work hardness
- hygiene & security
- employment

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Economy

- efficiency
- viability
- transmissibility
- financial autonomy
- specialisation
- subsidies dependency

- income stability
- gross margin
- subsidies
- collect & storage organisms
- local markets
- advisors

Economics Supply chain
Conclusions

• Gains in terms of sustainability provided by a low input organic system
  - Environmental
  - Social
  - Economical
  - Autonomy
  - Productivity

  Inputs, Energy, Biodiversity
  Working conditions, but more complexity
  Efficiency, Viability
  Material, Decisional
  Lower, but…
Conclusions

• Services offered
Conclusions

- Step-by-step improvements
  - Experts assessment:
    - Farm autonomy
    - Agronomic quality
    - Economy
    - Livestock management and production
    - At the expense of workload and crop productivity

- Multi-criteria assessment: a sensitivity analysis is required.

- Complementarity between the different approaches
Thank you for your attention