Combined use of three whole farm simulation tools for designing innovative production strategies with crop-livestock farmers in Burkina-Faso

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Supporting farmers’ reflections in a constrained context

Increased demographic pressure
  \[\rightarrow\] Land saturation
  \[\rightarrow\] Lower soil fertility

Rainfall uncertainty
  \[\rightarrow\] Unstable crop productivity
  \[\Rightarrow\] Improving crop-livestock integration

- Diversifying incomes
  Cotton, Maize, Milk production, Animal fattening

- Enhancing crop-livestock flows
  (fodder and manure production)

Which future for a given farm?

\[\rightarrow\] Supporting farmers’ prospective reflections by using simulation tools
Three tools used jointly in a one-to-one interaction

1. **OptimCikεda**: Linear programming tool optimizing cropping pattern for maximizing income under resource constraints

   *Optimal compared to current farm pattern and farmer’s project*

   *Redesign of farmer’s project*

2. **Cikεda**: Static simulation tool calculating resource balance (staple food, forage, manure) and income generated by a given farm configuration (yearly time step)

   *Favoured future farm pattern*

3. **Simflex**: Multi-annual rule-based tool assessing the sensitivity of farm income to climatic and economic uncertainty
### Three types of farms studied

<table>
<thead>
<tr>
<th></th>
<th>Crop farmers (3 cases)</th>
<th>Crop-livestock farmers (3 cases)</th>
<th>Livestock farmers (3 cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of the farmers</td>
<td>78</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Total cultivated area</td>
<td>&lt; 5 ha</td>
<td>&gt; 5 ha</td>
<td>&lt; 5 ha</td>
</tr>
<tr>
<td>Family size</td>
<td>&lt; 15</td>
<td>&gt; 25</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Draught cattle</td>
<td>1-2 heads</td>
<td>&gt; 2 heads</td>
<td>&gt; 2 heads</td>
</tr>
<tr>
<td>Breeding cattle</td>
<td>0 heads</td>
<td>&gt; 10 heads</td>
<td>&gt; 20 heads</td>
</tr>
<tr>
<td>Main activities</td>
<td>- Cotton for sale</td>
<td>- Cotton for sale</td>
<td>- Breeding cattle for prestige and sale</td>
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<tr>
<td></td>
<td>- Cereals for sale and self-consumption</td>
<td>- Cereals for sale and self-consumption</td>
<td>- Cereals for self-consumption</td>
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</tbody>
</table>
Example of a crop-livestock farmer (1/3)

Farm characteristics
- Total area: 23.5 ha
- Family workers: 6
- Draught cattle: 6
- Breeding cattle: 60
- Manure (t): 18

Farmer’s initial Project (P0)
- Increasing manure production for improving soil fertility
- Implementing a cattle fattening activity for increasing and diversifying income (objective: 10 heads over 3 months)

Stage 1. Identifying the optimal pattern with Optimcikɛda

Crop by-products

5 fattened cattle

Cotton cake purchase

Project (P1)
- Cotton area: -1 ha
- Maize area: +1 ha
- Sorghum area: -1 ha
- Forage area: +1 ha
- Fattened cattle: 10
Example of a crop-livestock farmer (2/2)

Stage 2. Simulating P1 with Cikeda

Cotton cake purchase

Manure production
Cereale balance
Fodder balance

Total annual income ($)
Stage 3. Assessing the sensitivity of Cikėda scenarios with Simflex

**Decision rules**

- IF Cotton Profit < 170 US$ THEN Cotton is removed
- IF Price NPK > 40 US$ / kg THEN No NPK

A production system which remains sensitive to rainfall and cotton profit variations
Farmers’ evaluation

**OptimCikɛda**
Assessing the gap between farmer’s project and optimal allocation of resources on the farm

⇒ Farmers’ projects are partly changed according to the gap between the optimal solution and their own objectives

**Cikɛda**
Comparing various farmer’s project alternatives

⇒ Tool considered as useful and easy to understand thanks to its focus on technical/physical processes close to farmers’ contexts of action

**Simflex**
Assessing mid-term results of a project: an objective poorly understood by farmers

⇒ Farmers are interested by the yearly sensitivity of their project to climatic/economic variables but not by their sequence over 10 years

**Combination**
OptimCikɛda and Cikɛda viewed as complementary for planning activities
Conclusions

- Designing and simulating whole farm scenarios support farmers’ reflections regarding their projects independently from the kind of tool used.

- Combining three different tools with the same farmer allows to providing him different views on his projects.

- This approach is original but remains a research process which would be difficult to transfer to technicians.
Thanks for attention