Economic Assessment of crop protection strategies in apple production

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Aim of the economic study

1. To provide a method for the economic assessment of crop protection strategies, which can be adapted to specific regional conditions.

2. To provide economic estimations for sustainability assessments of crop protection strategies, which at the end allow elucidating the optimal conditions for the implementation of innovative and durable cropping systems.

3. To assess potentially innovative and futuristic methods of crop protection, which are needed towards identifying the driving forces of innovative crop protection systems.
Economic criteria for the assessment

• Crop profitability

- Crop profitability is meant to evaluate the economic efficiency of the orchard system in securing grower’s incomes.

Attributes

- Total production cost per kilogramme 1st class apple
- Family income per labour hour
- Net profit per hectare
**Full cost calculation**

**Total production cost** = Direct cost + Structural cost

**Direct cost** = Fertilisers + Pesticides + Irrigation + Contribution to grower’s cooperative + Orchard depreciation + fruit packing

**Structural cost** = Cost for buildings + Operation of machinery + Irrigation operations + Interest on capital + Labour cost (family and non-family labour)

Tool of Agroscope Switzerland (Arbocost) available on the internet
Expected changes of total production cost

- **From baseline to advanced systems**
  - Cost for synthetic chemicals including machinery cost for application decrease
  - Cost for alternative plant protection measures (e.g. non-chemical mechanisms and innovative products) increase
  - Cost for protective measures increase (more hail nets)
  - Labour cost (e.g. pheromons, time for plant protection monitoring) increase
Expected changes of total production cost

- From advanced to innovative systems
  - No additional cost for or non-chemical mechanisms and innovative products are assumed
  - No additional costs for protective measures (hail nets) are assumed
Expected changes of revenues

- From baseline to advanced systems
  - Yields
    - No change: ES, D, CH, F
    - Increase: NL
  - Quality
    - No change: D, CH
    - Increase: NL, ES, F

- From advanced to innovative systems
  - Yields increase (D, CH, NL)
  - Quality increase (NL, ES, CH)

Expert estimations
Prices assumptions for all systems are equal
How are production costs per kg affected?

![Bar chart showing total production cost per kg class-1 apple (Euro/kg) for different systems: Baseline, Advanced 1, Advanced 2, and Innovative. The x-axis represents the system, and the y-axis represents the percentage of the baseline cost. The chart includes data for CH, DE, FR, NL, and ES.]
Farm autonomy criteria

• Measurement of the economic viability in the long-run

**Attributes**

- Invested capital per hectare = cash flow at the end of the 3rd year
  
  (establishment costs + \( \sum (\text{net profit})_{1-3\text{ year}} \))

- Return on investment = 
  
  (net profit + interest on capital) / invested capital

  - Interest on capital = interest rate \times invested capital
Return on Investment

Return on investment (EURO/ha)
Baseline = 100 %

Baseline | Advanced 1 | Advanced 2 | Innovative
--- | --- | --- | ---
CH | DE | FR | NL | ES

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Income risk criterium

– The risk related to income variability is defined by the potential costs or benefits that the instability in crop production and in fruit quality may cause.

– Attributes

  • Family income variability per hectare
  • Probability of dramatic yield loss in 10 years
Expected changes of variability

- **From baseline to advanced systems**
  - **Yield variability**
    - No change (ES)
    - Increase (D, CH, NL)
  - **Fruit quality variability**
    - No change (NL, D, CH, ES)

- **From advanced to innovative systems**
  - **Yield variability**
    - No change (D)
    - Decrease (ES, CH, NL)
  - **Fruit quality variability**
    - No change (ES, D, NL)
    - Decrease (CH)
## Risk calculation

<table>
<thead>
<tr>
<th>Family labour income</th>
<th>Name</th>
<th>Units</th>
<th>Baseline (BS)</th>
<th>Advanced (AS1)</th>
<th>Advanced (AS2)</th>
<th>Innovative (IS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family labour income</td>
<td>FI</td>
<td>EUR/ha</td>
<td>Arbokost</td>
<td>Arbokost</td>
<td>Arbokost</td>
<td>Arbokost</td>
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<tr>
<td>Upside variation</td>
<td>U</td>
<td>EUR/ha</td>
<td>↑Y, ↑S</td>
<td>↑Y, ↑S</td>
<td>↑Y, ↑S</td>
<td>↑Y, ↑S</td>
</tr>
<tr>
<td>Downside variation</td>
<td>D</td>
<td>EUR/ha</td>
<td>↓Y, ↓S</td>
<td>↓Y, ↓S</td>
<td>↓Y, ↓S</td>
<td>↓Y, ↓S</td>
</tr>
<tr>
<td>Potential variation</td>
<td>VI</td>
<td>EUR/ha</td>
<td>BS (U – D)</td>
<td>AS (U – D)</td>
<td>IS1 (U – D)</td>
<td>IS2 (U – D)</td>
</tr>
<tr>
<td>Risk related to variation (baseline 100%)</td>
<td>%</td>
<td></td>
<td>BS (VI) / BS(VI)</td>
<td>AS (VI) / BS(VI)</td>
<td>IS1 (VI) / BS(VI)</td>
<td>IS2 (VI) / BS(VI)</td>
</tr>
</tbody>
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