RISK ANALYSIS AT BERRY FRUIT FARMS

The 22nd International Farm Management Congress
“Growing Agriculture @ 41 Degrees South”
Launceston, Tasmania, Australia 3. – 8. March 2019

Jaka Zgajnar and Emir Becirovic
In which part of the world was this study done ... BiH
Motivation (1/2)

• There are several reasons why cultivation of berry crops in some developing countries (like BiH) has spread faster than other Ag sectors:
  • If there are favourable growing conditions → such a production generates higher income per unit of production
  • Consequently it enables good economic results also on (very) small farms, which is not the case for most other Ag activities

• Taking into consideration the entire BiH agricultural sector, the most intensive development in the past was in the production of fruit, especially raspberries (MAWF, 2014).

• There is an increasing number of family farms engaged in the production of berry fruits, especially raspberries, strawberries and also blueberries in the last five years.
Motivation (2/2)

• These farms have an increasing importance in BiH - Ag

• They face **different challenges in decision making** and the purpose of this analysis is to observe **how risk can be reduced** on these (mainly) family farms through **diversification** and on the other hand to **assess costs** ...

• Growing **berry fruits** could be characterised as **high-risk production**, especially if we consider that on these farms there is **a lack of diversification** into other agriculture activities;

• This opens up a **number of challenges** ... (i) how to effectively organize those holdings, which activities to select to (ii) reduce risk or (iii) achieve better economic results at a given level of risk (iv) should one focus on extensive, intensive or very intensive production activities v) which are the main characteristics of ...
Modelling tool
Developed modelling-tool

• Problem of **optimal allocation** of production resources - MP

• **Spreadsheet tool** → MS Excel platform & VBA
  • Enables relatively simple integration, complementarity and adjustment of the modelling-tool to (any) analysed berry fruit farm
  • For each „**berry activity**“, a simple simulation model has been developed (generates technological cards and calculates R, VC and GM for different states of nature)

• **Data source:**
  • „Three Hypothetical farms“ – **based on a survey of 90 farms** (2017)
  • experts **calculations** and data from the Agency for **Statistics** of BiH (ASBiH, 2018)
  • **Production** and **price risk** - 10 year data series have been considered

• **RM considered as an issue of** **diversification of production plans**
Scheme of developed „modelling-tool“

Production of strawberry activities

Production of raspberry activities

Production of blueberry activities

\[
\min V(EGM) = \sum_{j=1}^{n} \sum_{k=1}^{n} \sigma_{jk} x_j x_k
\]

s.t.

\[
\sum_{j=1}^{n} GM_j x_j = \lambda EGM_f \quad \lambda \text{ decreased from } 1 \text{ to } p
\]

\[
\sum_{j=1}^{n} x_j a_{ij} \leq b_i
\]

\[ x_j \geq 0; \quad x_k \geq 0 \]
Hypothetical berry farms

- Three different berry farms have been analysed:

<table>
<thead>
<tr>
<th>Resources</th>
<th>Small family farm (Farm1)</th>
<th>Semi-large family farm (Farm2)</th>
<th>Large business farm (Farm3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total arable area (ha)</td>
<td>0.5</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Family labour (h)</td>
<td>8,800</td>
<td>4,400</td>
<td>550</td>
</tr>
<tr>
<td>Hired labour (h)</td>
<td>0</td>
<td>4,474</td>
<td>84,427</td>
</tr>
<tr>
<td>Available working capital (EUR)</td>
<td>5,000</td>
<td>25,000</td>
<td>300,000</td>
</tr>
</tbody>
</table>

Main differences:
- Yield
- \( Q_{\text{labour}} \)
- Working Capital, VC ...

Production activities:
- Intensive
- Extensive
Which is the most efficient combination of production activities for risk averse farmer?

• Small family farm (Farm 1)
• The main assumption was that production was **limited to only two groups of production activities (cultures)** to be included simultaneously into the production plan for each scenario.
  • The first scenario (S11) considers the possibility of producing blueberries and strawberries
  • The second scenario (S12) considers the production of strawberries and raspberries, and
  • The third scenario (S13) considers the production of blueberries and raspberries.
RESULTS
Results (1/3)

SUB-MODULE 2

\[ \max \ EGM_i = \sum_{j=1}^n EGM_j x_j \]

s.t.
\[ \sum_{j=1}^n a_{ij} x_j \leq b_i \quad \text{for all } i = 1 \text{ to } m \]
\[ x_j \geq 0 \]

Economic indicators (EUR)

<table>
<thead>
<tr>
<th>Description</th>
<th>Small family farm (Farm 1)</th>
<th>Semi-large family farm (Farm 2)</th>
<th>Large business farm (Farm 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>15,414</td>
<td>55,911</td>
<td>547,464</td>
</tr>
<tr>
<td>Variable costs (VC)</td>
<td>5,000</td>
<td>25,000</td>
<td>300,000</td>
</tr>
<tr>
<td>EGM</td>
<td>10,414</td>
<td>30,911</td>
<td>247,464</td>
</tr>
<tr>
<td>SD of EGM</td>
<td>3,344</td>
<td>11,622</td>
<td>112,214</td>
</tr>
<tr>
<td>EGM/ha</td>
<td>20,828</td>
<td>15,455</td>
<td>12,373</td>
</tr>
<tr>
<td>EGM/h*</td>
<td>4.77</td>
<td>4.76</td>
<td>4.65</td>
</tr>
<tr>
<td>Share of SD in EGM (%)</td>
<td>32</td>
<td>38</td>
<td>45</td>
</tr>
</tbody>
</table>

Land Area

Production activities included in the production plan

<table>
<thead>
<tr>
<th>Activity</th>
<th>Small family farm (Farm 1)</th>
<th>Semi-large family farm (Farm 2)</th>
<th>Large business farm (Farm 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueberry Duke (ha)</td>
<td>0.19</td>
<td>0.00</td>
<td>13.84</td>
</tr>
<tr>
<td>Blueberry Bluecrop (ha)</td>
<td>0.00</td>
<td>1.02</td>
<td>0.00</td>
</tr>
<tr>
<td>Strawberry Clery (ha)</td>
<td>0.31</td>
<td>0.98</td>
<td>6.16</td>
</tr>
</tbody>
</table>

Labour input

<table>
<thead>
<tr>
<th>Labour input</th>
<th>Small family farm (Farm 1)</th>
<th>Semi-large family farm (Farm 2)</th>
<th>Large business farm (Farm 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family labour (h)</td>
<td>2,182</td>
<td>3,722</td>
<td>550</td>
</tr>
<tr>
<td>Hired labour (h)</td>
<td>0</td>
<td>4,657</td>
<td>88,651</td>
</tr>
<tr>
<td>Total labour (h)</td>
<td>2,182</td>
<td>8,379</td>
<td>89,201</td>
</tr>
<tr>
<td>Utilized family labour (%)</td>
<td>24.80</td>
<td>84.59</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Post optimal analysis

Reduced costs (EUR)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Small family farm (Farm 1)</th>
<th>Semi-large family farm (Farm 2)</th>
<th>Large business farm (Farm 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raspberry Willamette</td>
<td>-5,670</td>
<td>-3,660</td>
<td>-5,490</td>
</tr>
<tr>
<td>Blueberry Duke</td>
<td>0</td>
<td>-700</td>
<td>0</td>
</tr>
<tr>
<td>Blueberry Bluecrop</td>
<td>-1,570</td>
<td>0</td>
<td>-620</td>
</tr>
<tr>
<td>Strawberry Maja</td>
<td>-5,470</td>
<td>-6,980</td>
<td>-5,670</td>
</tr>
</tbody>
</table>

Shadow prices (EUR)

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Arable land</td>
<td>19,520</td>
<td>0</td>
<td>933</td>
</tr>
<tr>
<td>Hired labour (VI month)</td>
<td>0</td>
<td>4.6</td>
<td>0</td>
</tr>
<tr>
<td>Working capital</td>
<td>0.13</td>
<td>0.42</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Results (2/3)

Efficiency of risk reduction through diversification on different farm types...

- Decrease in EGM (%)
- Decrease in SD (%)

Farm 1
Farm 2
Farm 3

RGV

F1 > F2 > F3
F1 < F2 ~ F3
F1 > F2 < F3

>87 %
87 % < 42%
<42 %
Which is the most efficient combination of production activities for risk averse farmers? A small family farm.

Expected GM (EUR)

SD (EUR)

Attractive for risk averse farmers...

E-V efficient frontiers for different scenarios on small family farm (FARM 1)
Conclusions
Conclusions

• Based on the results of this research we can conclude:

• Berry crop production could be interesting for farms that have favourable production conditions and available market

• A combination of raspberries and blueberries could be promising production plan for a risk-averse farmer;
  • less intensive productions varieties are selected - in terms of capital and labour
  • optimal (LP) solution (max EGM) - NO raspberry production - has relatively high reduced costs on all three farms

<table>
<thead>
<tr>
<th>Reduced costs (EUR)</th>
<th>Raspberry</th>
<th>Williamette</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-5.670</td>
<td>-3.660</td>
</tr>
</tbody>
</table>

• Diversification as RM strategy is the most efficient on the small family farm
  • with up to a 42% decrease (give up 20% EGM);

• Decreasing risk (RGV) by one EUR on small family farms costs 3.06 EUR, for semi-large farms it is almost the same, while for large business farms it is the most expensive.

• Important challenge on berry farms (if they have a market) is the seasonality of work
Thank you for your attention!

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