Feed or Food? Development of Indicators for the Quantification of Food Competition of Dairy Farms

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Swiss dairy production

- About 2/3 of the land area is dominated by the Alps
- Arable land is scarce and under competition with alternative uses for settlements or infrastructure
- 80% covered by grassland
- Climatic and topographic constraints
- Production dominated by small scale mixed farms
- Herbage by far the most important forage source
- Low amount of concentrates

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Intensification of dairy production

- Increase of milk yield per cow since 1990 from 5’000 to about 7’500 kg
- Duplication of concentrate feeding to more than 900 kg per cow and year
- 30 % reduction in the number of dairy farms in the last decade, total Milk volume remained constant
Aim of the study

Does the intensification of dairy production lead to feed-food competition of Swiss dairy farms?

1. Development of two indicators allowing to quantify the competition of feed and food production of dairy farms in Switzerland
2. Validate and test the practical applicability as indicators on commercial farms

→ Study initiated and funded by Swiss milk producers association, part of the dairy industry and WWF
Feed or Food?

Feed ration
How much potentially human edible protein does the feed ration contain?

Land use
How much human edible protein could have been produced on the land area used for feed production?

Food competition

Demand of feed and animal products

Land use efficiency
Food Competition Indicator
(Ertl et al. 2015)

Food competition Indicator

\[
\text{Food competition Indicator} = \frac{\text{Potentially human-edible protein in feed}}{\text{Human-edible protein in animal products}}
\]

Value <1: Net production of animal proteins


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Accounting for protein quality - Digestible Indispensable AA Score (DIAAS)

→ No consideration of blending effects on protein quality by combining different protein sources
Indicator for Food Competition - 4 calculation steps

1. Define **feed demand and ration composition** of the dairy herd.

2. Point out the **raw components used** in the feed ration.

3. Definition of **potentially human-edible protein fraction** of components.

4. Analyze competition Ratio of potentially human edible part of feed ration and animal products.
Food Competition Indicator - Estimation of potentially human-edible fraction of feed?

- Scenario “Current”
  - Based on data published by Ertl et al. (2015)
  - Current consumer habits, no diet shifts
  - Use of existing standard processing technologies
  - No consumption of human edible-parts of “downgraded” crops (i.e. low quality potatoes)
  - Assumption, that potentially human-edible feed fractions would be consumed

Land use efficiency Indicator
(van Zanten et al. 2016)

Land use efficiency

\[
\text{Value <1: Net production of animal proteins}
\]

\[
\text{Not edible} \quad \times \quad \text{Protein quality}
\]

\[
\frac{\text{Human-edible protein in crops}}{\text{Human-edible protein in animal products}}
\]

Land use efficiency – Four calculation steps

1. Determination of (internal and external) land area used for feed production.

2. Proportion of arable land adapted for crops (Soil, Climate, Topography)

3. Definition of protein yield potential (crop rotation with maximal protein production potential).

**Land use efficiency Indicator**

**Definition of protein yield potential**

- Classification of land used for feed production into nine categories according to
  - Soil productivity
    - Soil maps, farmer interviews
  - Climate
    - Climate maps

- Two different crop rotations to maximize protein production potential

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Applicability-test on 25 commercial farms

<table>
<thead>
<tr>
<th>Category</th>
<th>Commercial farms (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional/Organic Production</td>
<td>21/4</td>
</tr>
<tr>
<td>Valley-/Hill-/Mountainzone</td>
<td>14/7/4</td>
</tr>
<tr>
<td>Mixed/specialized farms</td>
<td>14/11</td>
</tr>
<tr>
<td>Milk yield «high» (&gt;8’000 kg ECM/cow&amp;year)</td>
<td>11</td>
</tr>
<tr>
<td>Milk yield «low» (&lt;8’000 kg ECM/cow&amp;year)</td>
<td>14</td>
</tr>
<tr>
<td>Average concentrate utilization (g DM/kg ECM)</td>
<td>108 +/- 73</td>
</tr>
</tbody>
</table>

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Results

Food competition Indicator

VZ, HZ, MZ=Valley-, Hill-, Mountain-Zone; MY-=<8’000 kg ECM, MY+=>8’000 kg ECM
Results

Land use efficiency Indicator

VZ, HZ, MZ=Valley-, Hill-, Mountain-Zone; MY-=<8’000 kg ECM, MY+=>8‘000 kg ECM
Results

Comparison of both indicators

- No correlation – indicators are complementary
Results

Important drivers for competition

- **Food competition**
  - Concentrate feeding
  - \( R^2 = 0.70 \)

- **Milk yield**
  - \( R^2 = 0.51 \)

- **Land use efficiency**
  - Proportion of arable land
  - \( R^2 = 0.82 \)

- **Feed conversion**
  - \( R^2 = 0.29 \)

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Conclusions

- Complementary indicators for sustainability evaluation of dairy farms
- Identified options to reduce food competition of Swiss dairy farms
  - Direct
    - Increase the use of by-products
    - Reduce the proportion of arable land used for feeding (i.e. shift dairy production primarily in regions with permanent grassland)
  - Indirect
    - Improve feed conversion (i.e. better forage quality, reduced losses) and use of less feed (lower replacement rates)
- Tool for standardized calculations available
  - On farm use, policy making decisions
  - Extension to other animal categories in progress
Thank you for your attention!