Adaptation and mitigation in Austrian cattle and milk production - scenarios for 2050

preliminary results

Franz Sinabell (co-ordination)
Karin Heinschink, Mathias Kirchner
Eric Audsley, Andreas Schaumberger, Vojko Danieu, Erwin Schmid, Barbara Amon, Martin Schönhart, Norbert Röder, Petra Salamon, Adrian Williams

Klimatag 7 April 2016
overview

- context and research questions
- methodological structure
- selected results
- interaction with scientific community / stakeholders
- main challenges to tackle
- outlook
context and research questions
sector specific development

Figure 3.4: Greenhouse gas emissions by sector, EU-28, 1990, 2000, 2005 and 2012 (Million tonnes of CO₂ equivalent)

Source: European Environment Agency, Eurostat (online data code: tsdcc210)

-24%
EU climate policy commitment

For the EU, the Paris agreement needs to include a clear long-term emissions reductions goal, robust transparency and accountability rules to lend credibility to countries’ targets, and a dynamic review mechanism to improve countries’ targets over time.

Environment Council 18 Sept 2015:

... the global average temperature needs to be kept below 2°C above the pre-industrial level ...

... global GHG emissions need to ... be reduced by at least by 50% by 2050 compared to 1990 ...

EU „Intended Nationally Determined Contribution“ 6 March 2015:

„ ... BINDING target of at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990 ...“
## Observation and Forecast

### GHG Emission – Total and Agriculture

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mt CO₂ eq</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td><strong>Total GHG emissions</strong></td>
<td>5,680</td>
<td>5,177</td>
<td>5,224</td>
<td>4,786</td>
<td>4,159</td>
<td>3,875</td>
<td>-26</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
<td>569</td>
<td>481</td>
<td>455</td>
<td>442</td>
<td>446</td>
<td>453</td>
<td>0</td>
</tr>
<tr>
<td><strong>Land use, land-use change and forestry</strong></td>
<td>-260</td>
<td>-311</td>
<td>-321</td>
<td>-314</td>
<td>-245</td>
<td>-249</td>
<td>-22</td>
</tr>
<tr>
<td><strong>Share of agriculture in %</strong></td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

forecast for Austria: dairy herd

Source: Sinabell, Schönhart and Schmid, 2015
## mitigation options

<table>
<thead>
<tr>
<th>measures</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in lactation dairy cows</td>
<td>Increases number of lactations per cow; as a consequence reduced demand of heifers for replacement</td>
</tr>
<tr>
<td>Increase in efficiency of livestock</td>
<td>Increases yields of all livestock products except for dairy; assumed to be result of breeding and better (herd) management; no additional feed demand and costs assumed; milk increases are covered by index milk yield per cow</td>
</tr>
<tr>
<td>Increase in quality grassland/silage</td>
<td>Increases protein and energy content of all forage products, i.e. forage from permanent and temporary grasslands and silage maize; assumed to be the result of improved crops, better management; no additional costs assumed</td>
</tr>
<tr>
<td>Feeding efficiency increase</td>
<td>Reduced protein and energy demand of pig production; no changes in costs and manure production assumed</td>
</tr>
<tr>
<td>Reduction of losses manure nutrients</td>
<td>Reduced loss of nitrogen from all livestock manure; assumed to be the result of better management free of additional costs</td>
</tr>
<tr>
<td>Reduction of losses of fertilizer</td>
<td>Reduced loss of nitrogen from all mineral fertilizer; assumed to be the result of better management and spreading equipment free of additional costs</td>
</tr>
<tr>
<td>Additional energy crops</td>
<td>Model is forced to increase area of short rotation forestry</td>
</tr>
<tr>
<td>Tax on mineral fertilizer</td>
<td>Costs of mineral fertilizers are increased</td>
</tr>
</tbody>
</table>
what we know and what might happen

- GHG burden of milk production is relatively low in Austria
- various measures available to reduce it further
  - more efficient cows and more feed concentrates
  - reduction of numbers of cows / cattle
- however, consider
  - incomes will be negatively affected (comparative advantage)
  - consumers not affected ➔ no change of consumption
  - reduction of domestic production might be substituted by less GHG efficient products ➔ leakage
- effect on global GHG emission due to national action
methodological approach
quantitative modeling framework

- vTI global trade model
- INCAP gross margins
- CRANFIELD LCA - model
- PASMA
- HBLFA grassland model

Impact indicators assuming no change in consumption patterns:
- Gross value added
- Employment
- CO₂equ-emission
- Nutrient balances

methods, models, preliminary results

PASMA
Ex-Post-Evaluierung PASMAgrid

**Input:** prices, production costs, policy payments, yields, nutrient and feed requirements, regional endowments, observed land use activities …

**Model Equations**

**Objective function**
max regional producer surplus [for each NUTS3]

**Model constraints**
Endowments (e.g. land, livestock housing)
Feed balances (e.g. concentrated feed, fodder)
Fertilizer balances (e.g. manure, nutrient needs)
Product balances (e.g. imports, sales, intra-regional trade)

Mixes for observed:
- land use types [spatial HRU level]
- crop and livestock activities [NUTS3 level]

**Model Activities**

**Land use [spatial HRU level]**
- Land use type (e.g. cropland, grassland)
- Cultivar (e.g. wheat, corn, alfalfa)
- Management intensity (e.g. high, moderate, low, organic)
- Soil management (e.g. conventional tillage, reduced tillage, winter cover crops)

**Imports**
- (e.g. mineral fertilizer)

**Intra-regional trade**
- (e.g. fodder crops)

**Livestock [NUTS3 level]**
- Livestock type (e.g. dairy cattle, fattening pigs)
- Management intensity (i.e. conventional, organic)
- Housing system (e.g. loose housing, deep litter)

**Sales**
- (e.g. cash crops, meat, milk)

**Output:** Comparative static scenario analysis of land use development indicators (e.g. regional producer surplus, fertilization intensity, emissions)
input parameters: cost data (example wheat in Gänserndorf)

Gross margins (€/ha) for quality wheat, yield for Lower Austria, conventional farming, standard tillage, own+hired labor, dry climate, medium plant protection intensity, excl. tax

- Insurance
- Machinery
- Plant protection
- Fertiliser
- Fertiliser
- Seeds

Revenue

0 10 20 30 40 50 60

Euro/ha


Yield (100 kg/ha)

100 kg/ha

Grassland Yield of 2-, 3- and 4-Cut Management (Ø 2031 - 2040)

Based on drought sensitive model Spatial GRAM, applied on total area (Schaumberger, 2011)

Climate Scenario (Strauss, 2012):
Temperature: +1.5 °C up to 2040; Precipitation: -20% up to 2040

Yield in t DM ha⁻¹
- <= 4.0
- > 4.0 - 5.0
- > 5.0 - 6.0
- > 6.0 - 6.6
- > 6.5 - 7.0
- > 7.0 - 7.5
- > 7.5 - 8.0
- > 8.0

Input parameters: yield of grassland
policy experiment with PASMAgrid
effect agri-environmental measures

Impact of RDP on N balance at 1km²

Change in N balance in kg/ha
- < -20kg/ha
- -20 bis -10
- -10 bis -1
- -1 bis 1
- 1 bis 10
- 10 bis 20
- > +20kg/ha

0 25 50 100 150 200
Kilometers

interaction with scientific community and stakeholders
ways and methods of interaction

- presentation of preliminary results and interaction with stakeholders
- course on LCA in Vienna for scientific community (participants from 5 countries)
- strengthening of co-operation within Austrian research teams (ÖGA) and extension services (chamber of agriculture)
- integration in international networks (MACSUR)
main challenges
still to tackle
challenges still to tackle

- expectation – stakeholders
  - projections into longer future – how to communicate
  - how costly is mitigation – still information needs
  - what are really useful recommendations
  - how to disseminate the data and results
  - it is necessary to overcome sectoral views (e.g. land use change and agricultural production)

- scientific output
  - most impact likely with a methodological detail
selected research output so far …

expected research outputs for the coming months …