Regional impacts of climate change, observations and projections

Finnish Pilot study: North Savo region

Perttu Virkajärvi, Heikki Lehtonen, Kirsi Järvenranta
Natural Resources Institute Finland (Luke)

Based on work of MACSUR team:
Heikki Lehtonen, Reimund Rötter, Taru Palosuo, Xing Liu, Tuomo Purola, Jukka Höhn, Jarkko Niemi, Perttu Virkajärvi, Panu Korhonen, Kirsi Järvenranta, Olli Niskanen, Pellervo Kässi, Pirjo Peltonen-Sainio, Tapio Salo, Fulu Tao

FACCE MACSUR Work shop for policy makess
May 6th 2015, Brussels

www.luke.fi
Firstname.lastname@luke.fi
Total area 20 400 km²
17.5% water bodies
Inhabitants 247 000 (2010)
Agriculture
7.3% agricultural land (150 000 ha)
4 200 farms, av. size 36.2 ha
38 000 dairy cows (10% of the total amount)
Income/cap: 17 000 eur (av. 18 800 eur, 2010)

http://www.pohjois-savo.fi/fi/pohjois-savo/
• In North Savo ca. **70% of income comes from milk**
• 56% of cultivated area is covered by grass
Outline of dairy production in North Savo

- High production per cow: 7900 l/cow/year
- Low number of dairy cows per land area; 0.59 LU/ha
- Average herd size 33 cows/farm (increasing)
- Relatively high grass production potential 9 - 14 tn DM/ha/year,
  - on farms median yield is 5 – 6 tn DM/ha/year
- Rotational ley farming renovation after 3-4 production years

- Important: there is no silage market -> each dairy farm has to succeed each year in silage production
  - Concentrates can be imported
- Challenge: protein source for ruminants
  - No GMO soya
- Short growing season -> Time window for management options is limited
  - risk, cost, D value, soil structure

Dairy cow DM intake

- 46% concentrates
- 48% silage
- 6% grazing
Projected climate change in Finland up to 2100, reference period 1971-2000

Source: Jylhä et al 2009, Ruosteenoja 2013

- Annual average temperature +2 - + 6 °C
  - In summer +1-+5 °C
- Annual precipitation + 12 - 22%
  - In summer + 0 - 20%
- Threat of midsummer drought
- Growing season length +30–45 days
- Temperature sum during growing period:
  - Central Finland 1100 -> 1600 degree days
- Increasing frequency
  - rainy days, heavy rainfalls, dry spells
- Reduced snow cover and soil frost
Climate related problems

• Variability of crop yields
• Feed quality losses (forage, cereals)
• Drought/heat spells more frequent
• Winter time damages
• Soil compaction, wet conditions
• Plant pests becoming more frequent
Yield gaps and their drivers

<table>
<thead>
<tr>
<th>POTENTIAL</th>
<th>ATTAINABLE</th>
<th>ACTUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gap I (20%) – e.g. water limitations due to soil structure, poor drainage – need for farm investments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gap II (10%) -e.g. inadequate liming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gap III (20%) – e.g. inadequate crop protection, fertilisation due to discouraging policies, markets and risks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gaps

I+II +III = 50%

Yield Potential  Water- and/ or nutrient- limited yield  Actual yield
Modeling grassland

• Currently we are able to model DM yield of grassland **BUT** there is clear lack in modelling quality (digestibility) of grass
  – High digestibility is crucial with high yielding cows
  – Heat waves especially together with variable weather condition (exceptionally low and exceptionally high temperatures) leads to lower digestibility (solution: earlier cut leading to decreased yield)

STICS  **Saerheim (NO)**

CATIMO
The cost of managing farm level grass yield risk

- Excess silage grass area (ca. 20%) is kept to hedge against silage deficit
- The mean yield of grass is gradually increasing from the baseline period up to middle-century
- Little change in the variation of grass yields in North Savo
  - The average standard deviation of harvested yield decreases considerably in A1B, as well as the share of years of silage deficit
- => Easier to retain buffer stocks filled in the climate scenario than in the baseline - except under consecutive dry years
- The cost of risk remains significant – farmers need to keep sufficient grassland area and buffer stocks

Source: Kässi, P., Känkänen, H., Niskanen O., Lehtonen, H. & Höglind, M. 2014 Farm level approach to manage grass yield variation under climate change in Finland and North-Western Russia (submitted)
Adaptation solutions, grass

- Increasing the number of cuts
- Earlier cuts
  - To maintain high digestibility
- New grassland species and cultivars
  - More resistant to heat stress and drought
  - Better nutritive value
  - Sufficient winter hardiness
- Adjusted fertilisation levels
  - Proper timing, according to developmental phases
  - According to yield potential of different crops and cultivars
  - Restricted by nitrate directive and agri-environmental legislation
- Prevention of soil compaction
  - Drainage, sufficient
  - Development of machinery/use of machinery
Future rainfed potential yields of barley in North Savo

Water-limited yields simulated with model WOFOST (World Food Studies) using different emission scenario (RCP8.5) / climate model combinations for Kuopio (10 x 10 km grid)

- Current cultivar, Kustaa
- Possible future cultivar, ”F1” (only thermal requirement changed)
Adaptation solutions, cereals

• **New cultivars**
  – Adapted to longer growing season
  – Decrease vulnerability to (early summer) drought
  – More tolerant of heat stress

• **Earlier sowing times**

• **Improved crop protection**
  – Currently no/little fungicide use => can be increased
  – More diverse crop rotations may relieve disease pressure

• **Adjusted fertilisation levels and timing**
  – Split applications according to development phases
  – According to yield potential of different crops and cultivars

• **Improved soil structure, soil pH, drainage**
  => resilience, extra costs…
Issues related to agricultural policy

• Regional adjustment of regulation is important (eg. water protection)
  – Due to expected growing yield potential fertilisation restrictions need adjustment
  – Nitrate directive restricts efficient and sustainable grass production
  – Greening practices have only slight – and partly negative - impact on ruminant production
    (permanent grassland not suitable for northern conditions)

• Inefficient markets for agricultural land cause difficulties for farms that are increasing their production
  – Capitalisation of area payments to land prices + incentives for extensification (e.g. nature management and other set aside schemes under pillar 2) fit better part-time crop farms, not full-time livestock farms
    – they express frustration on weak land supply

• Production based support for suckler cows and (dairy originated) beef production is vital for producers
  – No significant increase in production expected, budgetary limits of coupled supports
Kiitos!
Thank you!

Contact:
Perttu.Virkajarvi@luke.fi
Heikki.Lehtonen@luke.fi

For further information
http://macsur.eu/index.php/regional-case-studies/