Modelling European Agriculture with Climate Change for Food Security

How to achieve higher yield levels in North Savo – means and challenges indicated by farmers

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Projected climate change in Finland up to 2100, reference period 1971-2000:

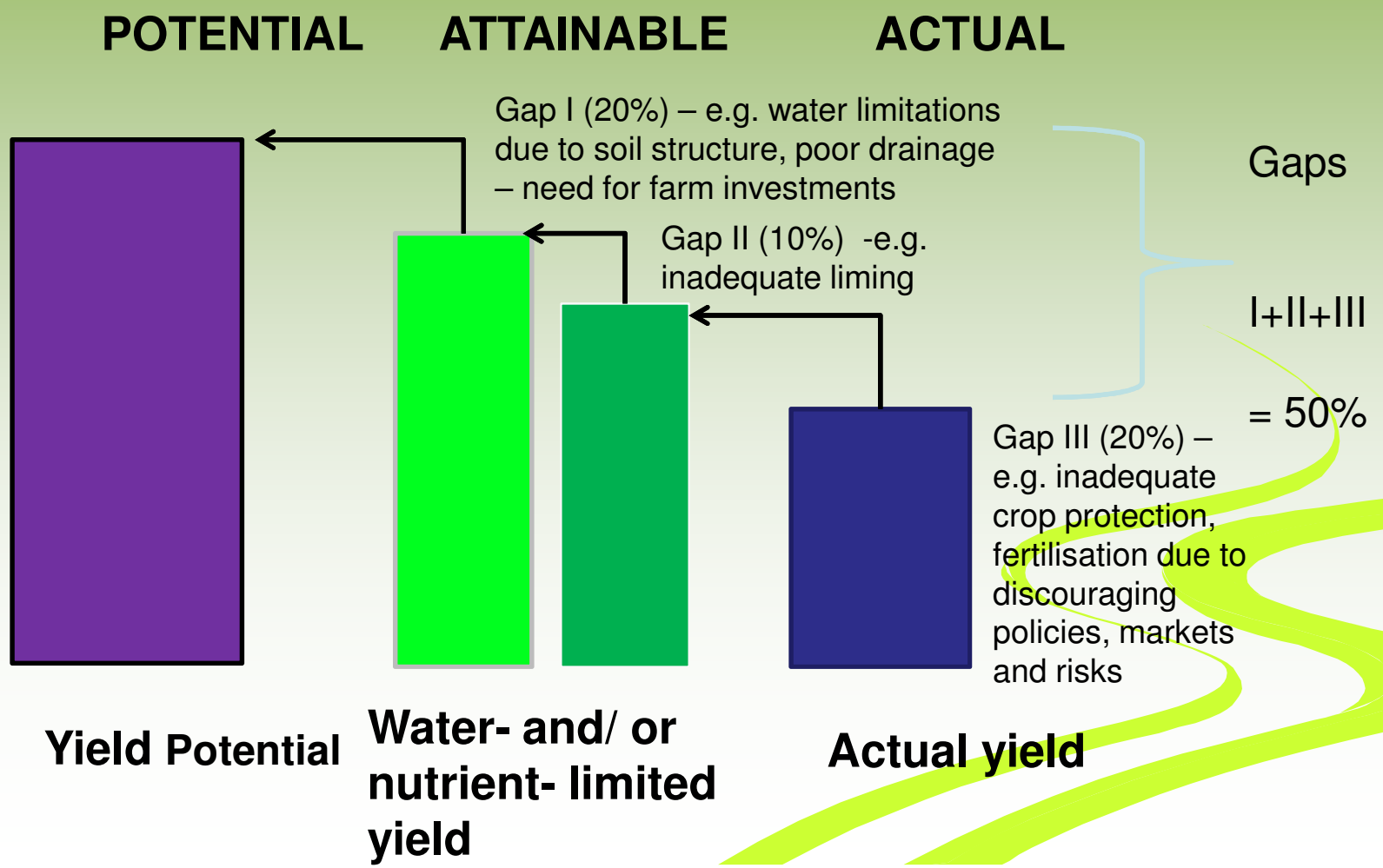
Source: Jylhä et al 2009, Ruosteenoja 2013

- **Annual average temperature** +2 - + 6 ° C: In winter +3-+9 ° C; In summer +1-+5 ° C
- Annual precipitation + 12 - + 22%: In winter +10 - +40%; **In summer +0- +20%**
- **Increased evapotranspiration during the growing period - increasing risk of water deficit, threat of worsening early summer drought**
- Growing season length +30–45 days until 2100
  - **Middle Finland 1100 -> 1600 degree days**
  - Southern Finland 1300 -> 1900 degree days
  - Northern Finland 900 -> 1200 degree days
- Increasing frequency: rainy days, heavy rainfalls, dry spells
- **Decreased length of thermal winter => Higher risk of N, P leaching**
- **Reduced snow cover and permafrost => Overwintering risks of winter crops, forages**

Introduction

- Researchers have identified some possibilities for higher yields at northern latitudes under climate change and implied longer growing seasons
  - New cultivars (Rötter et al. 2013 Ecology and evolution); yields of forage crops (Höglind et al. 2013 Agric. &Forest Meteorology)
- However there are certain challenges to be solved
  - Pest&disease pressure (Hakala et al. 2011 http://www.mtt.fi/afs/pdf/mtt-afs-v20n1p3.pdf), increased precipitation (winter), droughts (summer), drainage and water retention (Trnka et al. 2014, http://dx.doi.org/10.1038/nclimate2242.)
- Are farmers / close stakeholders prioritising the same /different challenges / opportunities?

Yield gaps and their drivers (typical case in Finland)



Key questions

- What are the obstacles for achieving higher yields?
  - Key solutions?
- What would you recommend for farmers who aim for higher crop yields?
  - What needs to be improved?

Seminars/workshops for farmers and their close stakeholders in November 2014, 2016

- November 2014
  - Full day interactive seminar in Kuopio, North Savo
  - 35 participants, almost all were farmers, some individuals from agricultural extention, food industry
  - Specific theme: Adaptation to climate change in North Savo agriculture

- November 2016
  - Full day interactive seminar in Iisalmi, North Savo
  - 64 participants: 30 farmers, several representatives from each of the following: food industry, input suppliers, extension, administration
  - Specific theme: how to increase yields under climate change

What can we find from stakeholder responses?

- Identify farmers' and other stakeholders' views on the challenges and opportunities concerning crop yields
- Can we see any changed views / priorities / focus, 2014-2016?
  - Climate change has been a topic under intensive discussion in research since many years, and increasingly in farming community since 5-10 years

What are the obstacles for achieving higher yields ? - Responses 2014

- Agricultural and agri-environmental policy provide incentives not compatible with higher yields – nutrient limitations with risk free payments
- Grasslands are clearly more extensive because of policy incentives (CAP pillar 1, 2), than they would be otherwise
- Both policy incentives AND drought risk management leads to extensive grasslands, low yields and high costs
  - Large harvested area leads to high timeliness and other costs
- Uncertain land tenure and short land rent contracts, often due to agricultural policy, lead to reduced liming and drainage investments on rented land

What would you recommend for farmers who aim for higher crop yields? (2014)

- Increase grassland (seed) density
- Increase the use of weed control chemicals
  - Or mechanical control, e.g. early harrowing of forages in spring
- Increase the use of certified seed
- Improve soil fertility - organic matter, liming, drainage
  - Cooperate with other farmers, focus on high yielding field parcels, or parcels with high yield potential
- Manure fractioning – use N and P rich fractions according to the plant needs
  - Optimise, avoid overdozing nutrients

What are the obstacles for achieving higher yields ? - Responses 2016

- Soil quality, soil compaction
- Attitudes: lack of interest, old habits
- Policy promotes extensive production, especially agri-environmental support scheme, limits for P fertilisation, nitrate directive
- Lack of know-how, lack of observations of crop growth, few measurements of field parcel specific crop yieds: lack of resources
- Weakened economic situation does not allow investing in necessary equipment / cultivation practices for higher yields; low-cost alternatives penalise yields
- Low profitability => reduced external workers => reduced actions
- Field parcel structure, logistic costs inhibit monitoring and actions
- Unfavourable growing conditions: Drought /too wet conditions cause harvesting losses and quality losses
- Non-optimal forage seed mixes, non-optimal techniques in sowing

Solutions for higher yields - 2016

- Improved drainage: earlier sowing, timely harvest more likely
- Liming, soil structure improvements, crop rotation, avoid soil compaction
- Optimise forage seed mixes per field parcel
- Sufficient seed use and grass density; right deepness in sowing
- More diverse crop rotations, crops according to soil type
- Renew high yielding forage graslands as well, do not wait low yields
- Improve your knowledge: participate in ”forage grassland groups” to share experiences and knowledge; participate seminars; networking
- ”Showing concrete results on improvements will change attitudes”
- Crop protection, harrowing forage grasslands in spring
- Fertilisation: right amount and timing per field parcel; optimisation
- Increased protein crop production in the region; more rotation - oilseeds, faba beans ? Mixed experiences

Means for attaining higher crop yields

Farmers

- Quality and quantity of seed
- Optimised seed mixes
- Drainage and liming
- New cultivars
- Knowledge sharing
- Seeding techniques
- Crop protection / weed control /harrowing
- Policy incentives!
- Low profitability, weak economic situation

Others (input suppliers, food industry, extension, research, administration…)

- Quality and quantity of seed
- Optimised seed mixes
- Drainage and liming
- New cultivars
- Knowledge sharing
- Crop rotations (more crops)
- Yield measurements, monitoring

NOT MENTIONED:
Irrigation, expansion of horticulture, fruit trees etc, large scale shift in main products

Summary of the main topics for climate change adaptation and yield improvements:

- **Soil structure, fertility and hydrology**, as well as needed actions for improvements
- **Agricultural and agri-environmental policies** (particularly 2014, also 2016)
- **Farmers' attitudes, skills and knowledge** as basic conditions for farm profitability (particularly 2016)
  - E.g. increase monitoring and measurement of field parcel specific yields, share experiences, good practices
- The meaning and role of higher yields for farm economy, importance of using **core inputs** affecting the yields - clearly expressed in 2016
  - Use **inputs with good payoffs**: seed quality/quantity, optimised seed mixes, new cultivars, crop protection, (drainage, liming)

Conclusion

- Farmers agree on the importance of new cultivars, drainage, soil improvements, crop rotations, knowledge gaps, in promoting yields under climate change, suggested by research/ extension/ input suppliers
- Farmers also find some individual practices at the farm level as key improvements (”low-hanging fruits”)
- Farmers: ”Policies and weak markets /farm economy do not support increased resource use for higher yields, especially under increased (climate, market) risks”
- 2014-2016: Some focus shift from policy problems to knowledge gaps, solutions, knowledge sharing, cooperation

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