Regional Impacts of Climate Change and Trade Policies

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Agriculture and climate change

- Higher temperatures
  - Longer vegetation and growth period
  - Higher evapotranspiration rates

- CO_2 fertilization effect

- Changes in precipitation pattern (extreme events) → Crucial in arid and semi-arid areas (e.g. Marchfeld), but difficult to predict
  - Water balance
  - Soil erosion

Sources: Olesen et al. (2011); Strauss et al. (2012); Thaler et al. (2012) …

Agriculture and trade

- 1990ies → NAFTA, URAA
- Production shifts from North to South

- Generally expected impacts:
  - 'North' (e.g. Austria) (p↓)
    - Extensification and land abandonment in marginal areas
    - Intensification in productive areas
  - 'South' (p↑)
    - Expansion of agricultural land → deforestation (GHG emissions, loss of biodiversity)

Sources: Verburg et al. (2009); Schmitz et al. (2012); Briner et al. (2012) …

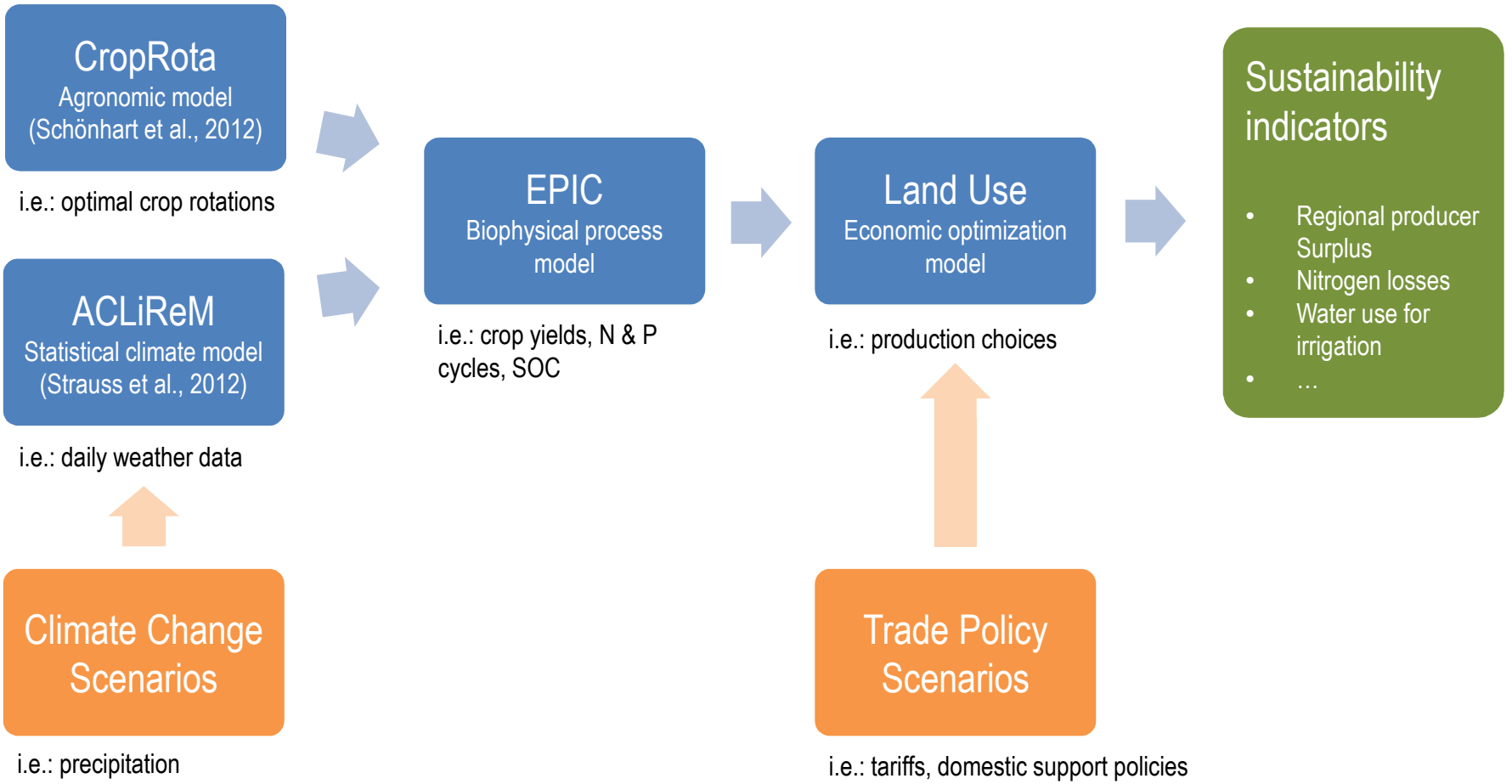
Case study
Marchfeld, Austria

- Not many studies assess the combined effects of trade and climate change
  - →Case study for the **Marchfeld** region in Austria

- Intensive agricultural production area → Trade
- Semi-arid climate → Climate Change

- Special environmental concerns since the 70ies:
  - Groundwater pollution with nitrates
  - Groundwater scarcity due to large scale irrigation

Integrated modeling framework

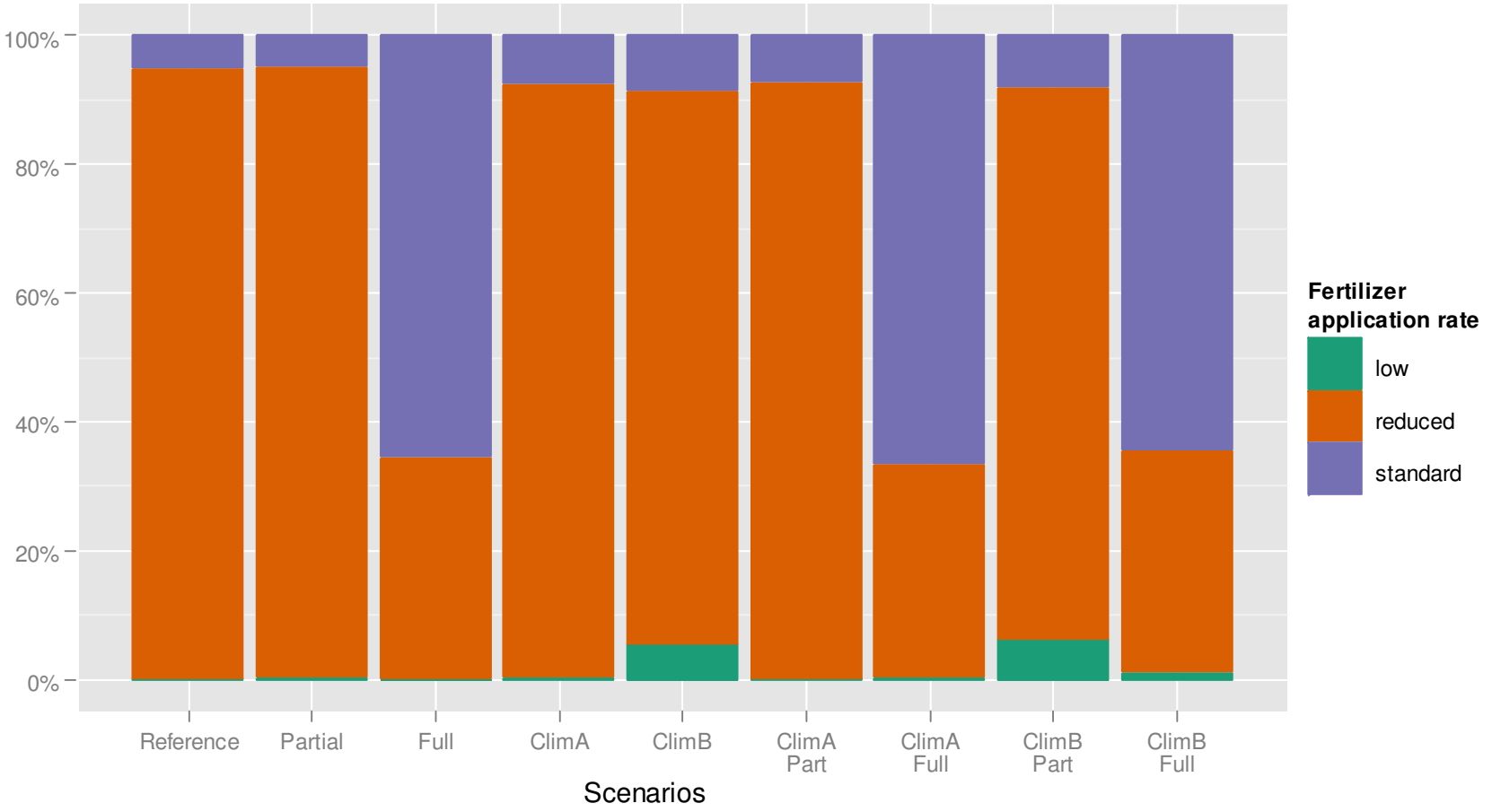


Reference and global change scenarios

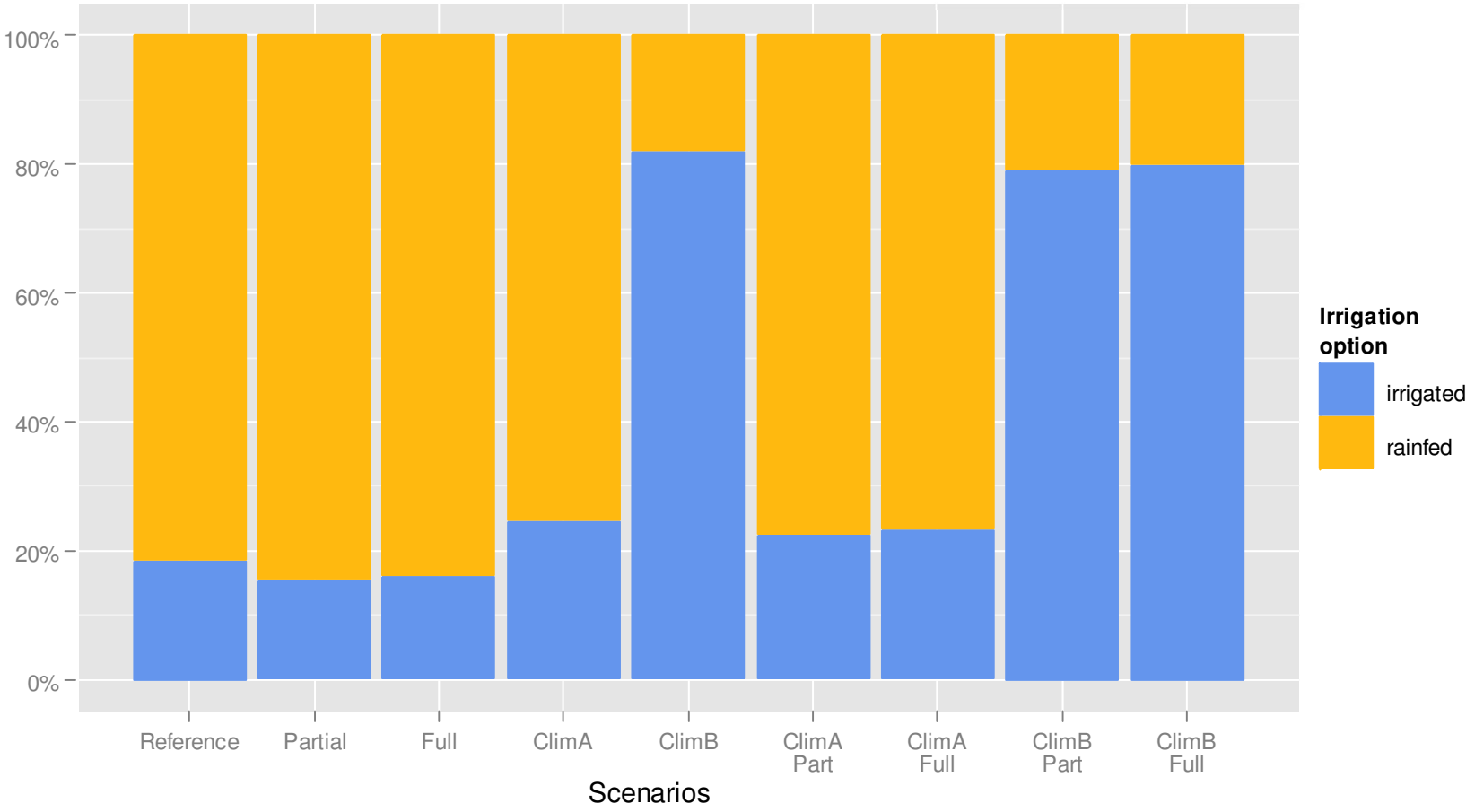
	Reference	Scenarios	
Climate Change	**ClimPast**	**ClimA**	**ClimB**
Period	1976-2005	2011-2040	2011-2040
Temperature	Observed	+1.5C°	+1.5C°
Precipitation sums	Observed	No change	**-20%**

Trade Policies	**BAU**	**Partial**	**Full**
Domestic tariffs	Ø 1998-2011	-45%	-100%
Agri-environmental payments	ÖPUL 2007	ÖPUL 2007	**-100%**
Single farm payment	Observed	-50%	-100%

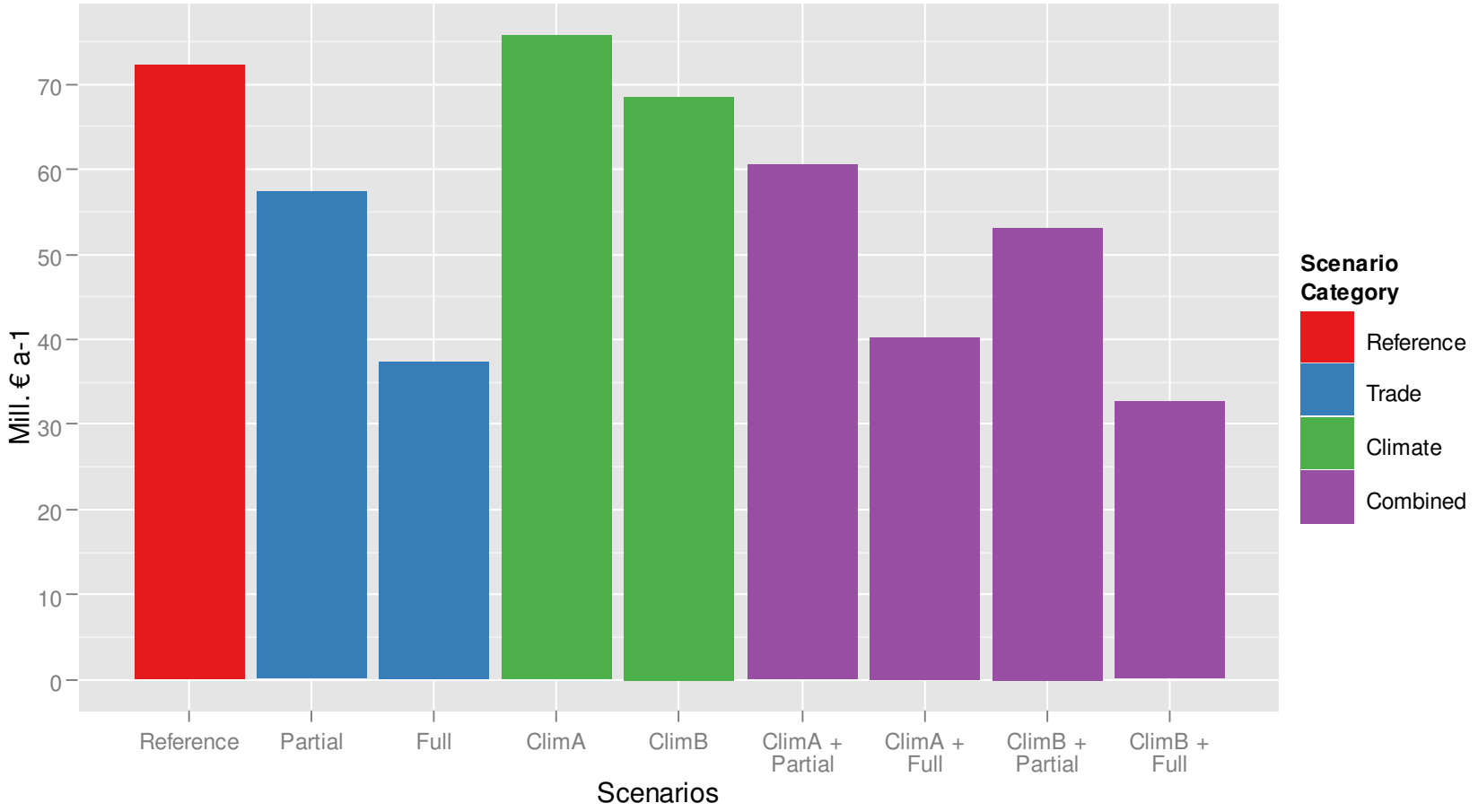
Scenario results
Shares of fertilization systems



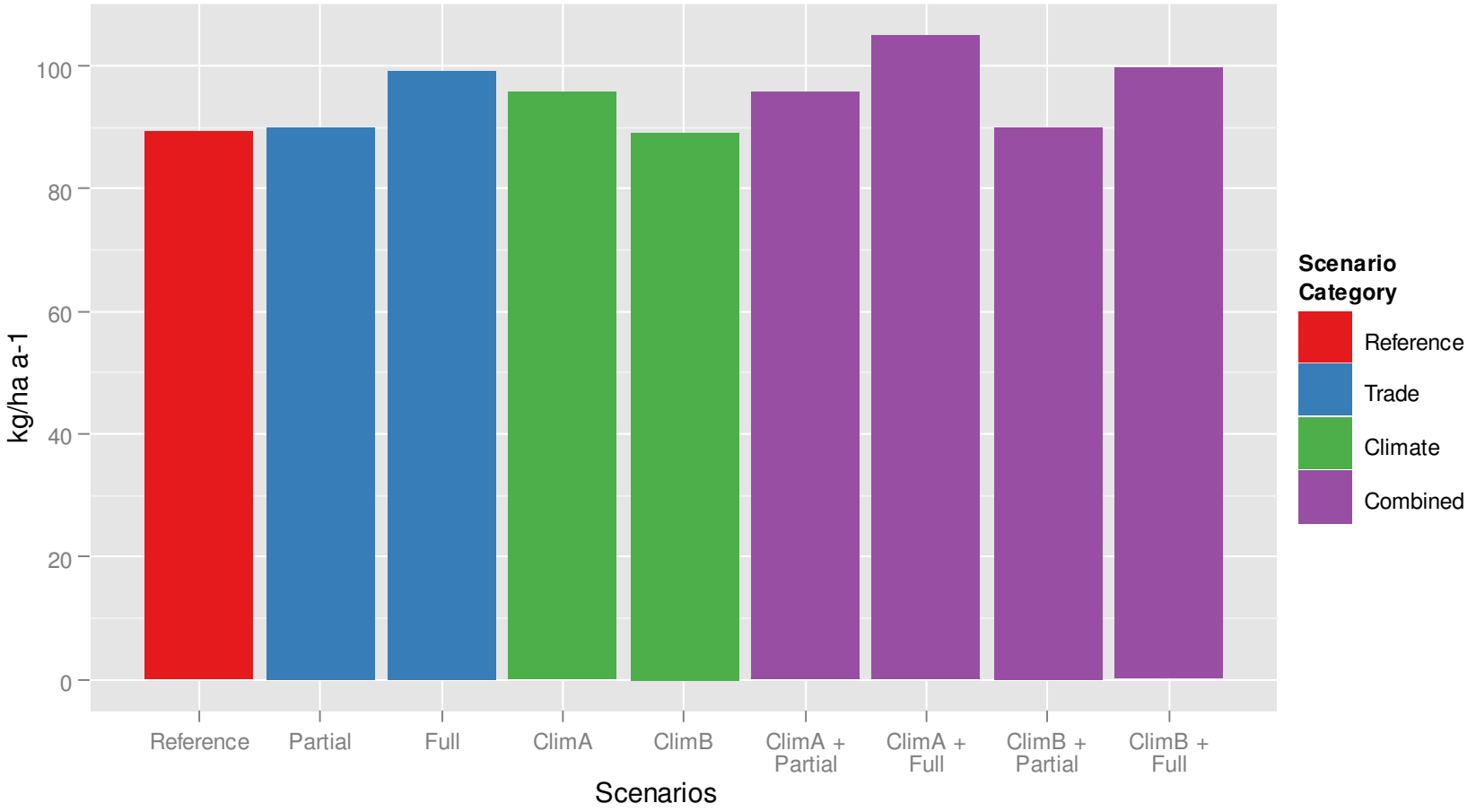
Scenario results
Shares of irrigation systems



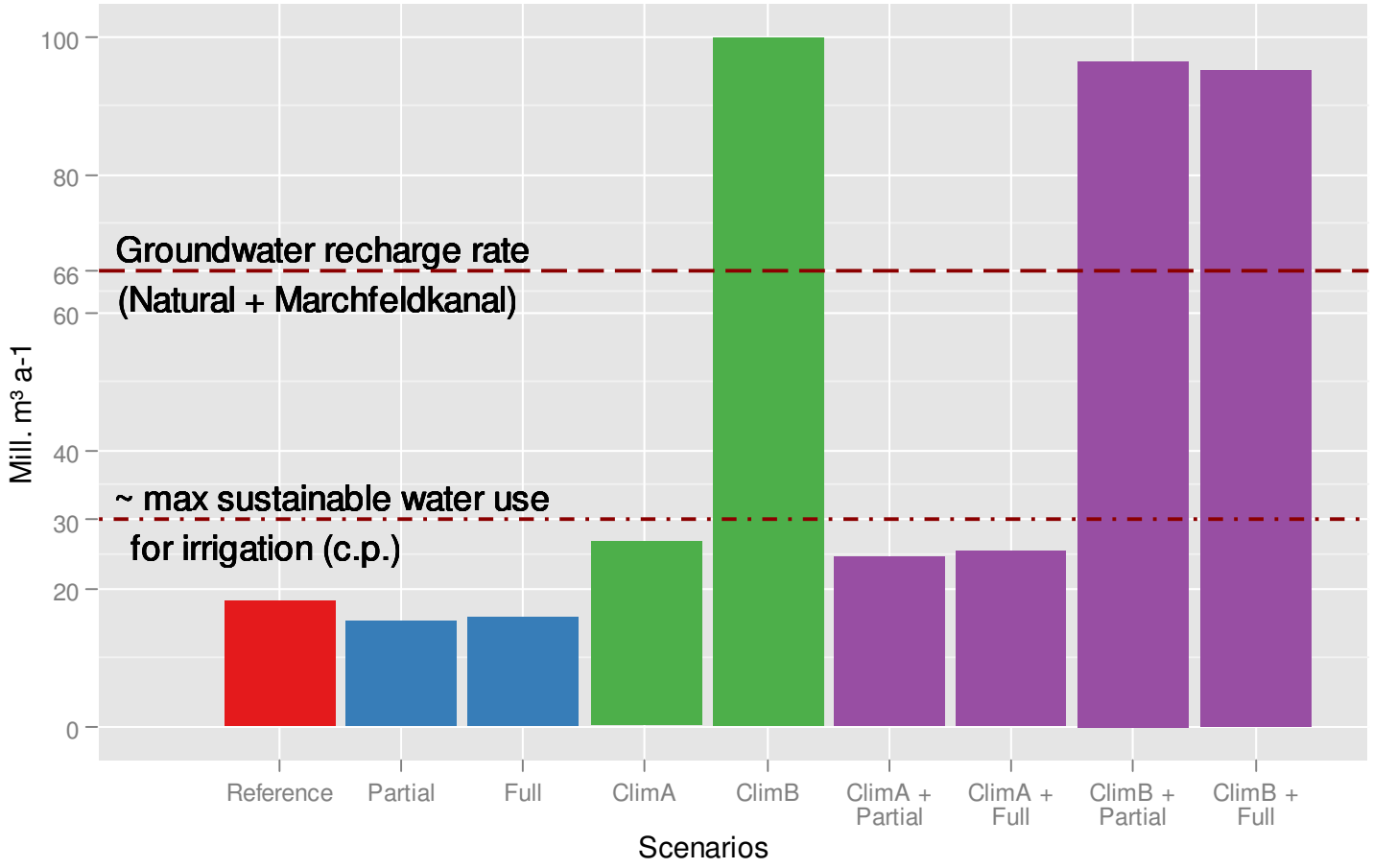
Scenario results
Regional producer surplus (RPS)



Scenario results
Total nitrogen losses



Scenario results
Water use for irrigation



Scenario Category

- Reference
- Trade
- Climate
- Combined

max. sustainable water use = groundwater recharge rate minus

- Industry (17 Mill. m³)
- Municipalities (5 Mill. m³)
- Subsurface net losses (14 Mill. m³)

→ only an **approximation**!

see www.marchfeldkanal.at

Summary of the results

- Trade impacts
  - If partial → income losses, less irrigation
  - If *laissez-faire* → Intensification → **More fertilization** → Higher N loads

- Climate change impacts
  - Higher temperatures → **More irrigation**
  - + Drought → Unsustainable water withdrawals likely

- Combined effects:
  - Losses in income either amplified (ClimB+Trade) or mitigated (ClimA+Trade)
  - Water withdrawals **decrease** if trade added to CC (but not much)

Policy implications

- Need for sustainable regional water policies, e.g.:
  - water pricing, or
  - subsidies for more efficient irrigation systems (drip irrigation)

- Trade liberalisation / CAP post 2013
  - ensure that agri-environmental schemes persist as trade friendly support measures

- Importance to take into account both effects

  → Impacts may be amplified or reduced

Outlook

- Apply modelling framework to Austria
  → include **marginal areas**

- Include soil conservation measures
  → **reduce soil erosion**

- Account for uncertainty (e.g. prices, weather)

- More indicators, e.g.:
  - GHG emissions
  - Biodiversity …

Thank you!

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References

Cited:

Briner, S., Elkin, C., Huber, R. and Grêt-Regamey, A. (2012). Assessing the impacts of economic and climate changes on land-use in mountain regions: A spatial dynamic modeling approach. *Agriculture, Ecosystems & Environment* 149: 50–63.

Olesen, J.E., Trnka, M., Kersebaum, K.C., Skjelvåg, A.O., Seguin, B., Peltonen-Sainio, P., Rossi, F., Kozyra, J., Micale, F. (2011). Impacts and adaptation of European crop production systems to climate change. *European Journal of Agronomy* 34, 96–112.

Schmitz, C., Biewald, A., Lotze-Campen, H., Popp, A., Dietrich, J.P., Bodirsky, B., Krause, M., Weindl, I. (2012). Trading more food: Implications for land use, greenhouse gas emissions, and the food system. *Global Environmental Change* 22, 189–209.

Schönhart, M., Schmid, E. and Schneider, U.A. (2011). CropRota – A crop rotation model to support integrated land use assessments. *European Journal of Agronomy* 34: 263–277.

Strauss, F., Formayer, H. and Schmid, E. (2012). High resolution climate data for Austria in the period 2008-2040 from a statistical climate change model. *International Journal of Climatology*: DOI 10.1002/joc.3434

Thaler, S., Eitzinger, J., Trnka, M. and Dubrovsky, M. (2012). Impacts of climate change and alternative adaptation options on winter wheat yield and water productivity in a dry climate in Central Europe. *The Journal of Agricultural Science*: DOI: 10.1017/S0021859612000093

Verburg, R., Stehfest, E., Woltjer, G., Eickhout, B. (2009). The effect of agricultural trade liberalisation on land-use related greenhouse gas emissions. Glob. Environ. Change 19, 434–446.

Other:

Laniak, G.F., Olchin, G., Goodall, J., Voinov, A., Hill, M., Glynn, P., Whelan, G., Geller, G., Quinn, N., Blind, M., Peckham, S., Reaney, S., Gaber, N., Kennedy, R., Hughes, A., (2013). Integrated environmental modeling: A vision and roadmap for the future. *Environ. Model. Software* 39, 3–23.

Rosenzweig, C., Jones, J.W., Hatfield, J.L., Ruane, A.C., Boote, K.J., Thorburn, P., Antle, J.M., Nelson, G.C., Porter, C., Janssen, S., Asseng, S., Basso, B., Ewert, F., Wallach, D., Baigorria, G., Winter, J.M. (2013). The Agricultural Model Intercomparison and Improvement Project (AgMIP): Protocols and pilot studies. *Agricultural and Forest Meteorology* 170, 166–182.

Trnka, M., Eitzinger, J., Dubrovský, M., Semerádová, D., Štěpánek, P., Hlavinka, P., Balek, J., SkaláK, P., Farda, A., Formayer, H., Žalud, Z. (2010). Is rainfed crop production in central Europe at risk? Using a regional climate model to produce high resolution agroclimatic information for decision makers. *The Journal of Agricultural Science* 148, 639–656.