

The net-benefit of bio-energy for climate change mitigation

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Bio-energy and climate change mitigation

Bio-energy application

Transport sector: Biofuels, electricity for electric vehicles

Energy sector: Electric power, heat and hydrogen

Negative emissions by CCS (Carbon Capture and Storage)

3 categories of bio-energy supply

- Traditional bio-energy (47 EJ yr⁻¹)¹
- Agricultural and forest residues (50-80 EJ yr⁻¹)²
- Bio-energy from dedicated energy crops

¹ IEA 2006

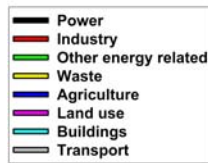
² WBGU 2008

Bio-energy and climate change mitigation

Bio-energy potential
 ranges from 50 to 1000 EJ¹

Concerns of sustainability

- Food security
- Biodiversity
- Water security
- **Co-emissions**



CO₂ from land expansion

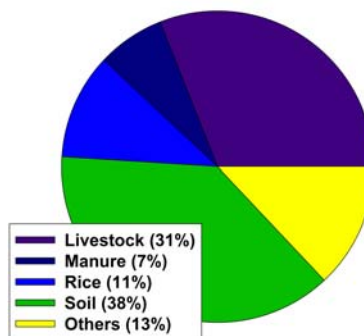
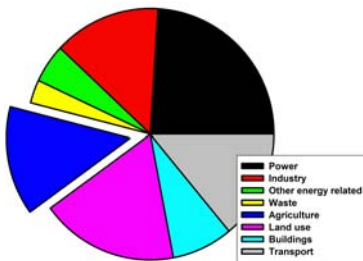
N₂O from agricultural intensification (N-fertilization)

¹ Berndes et al. 2003

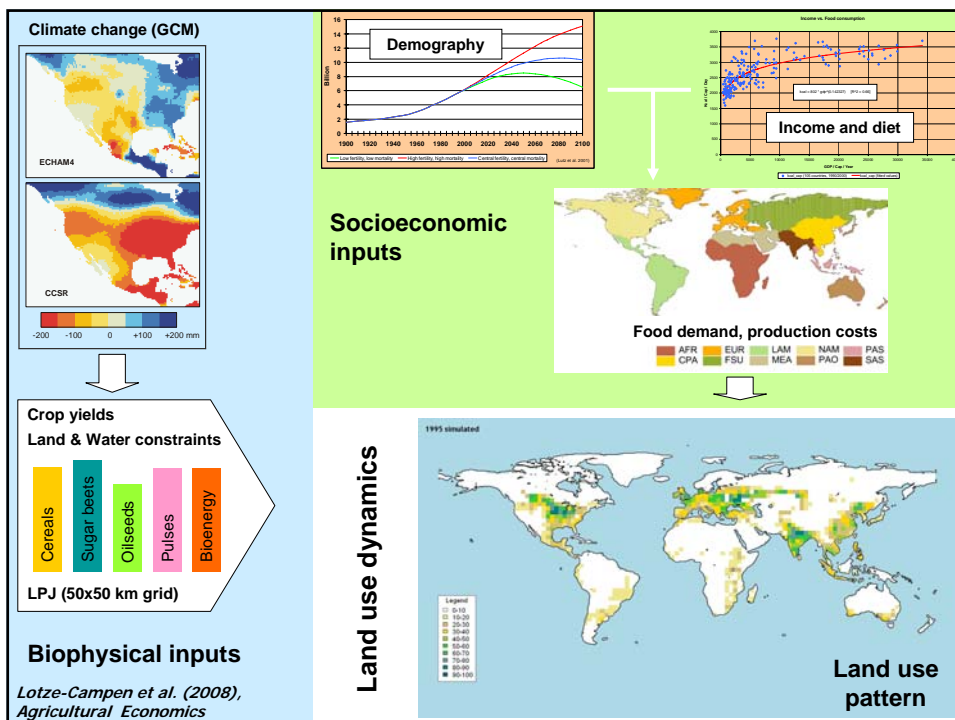
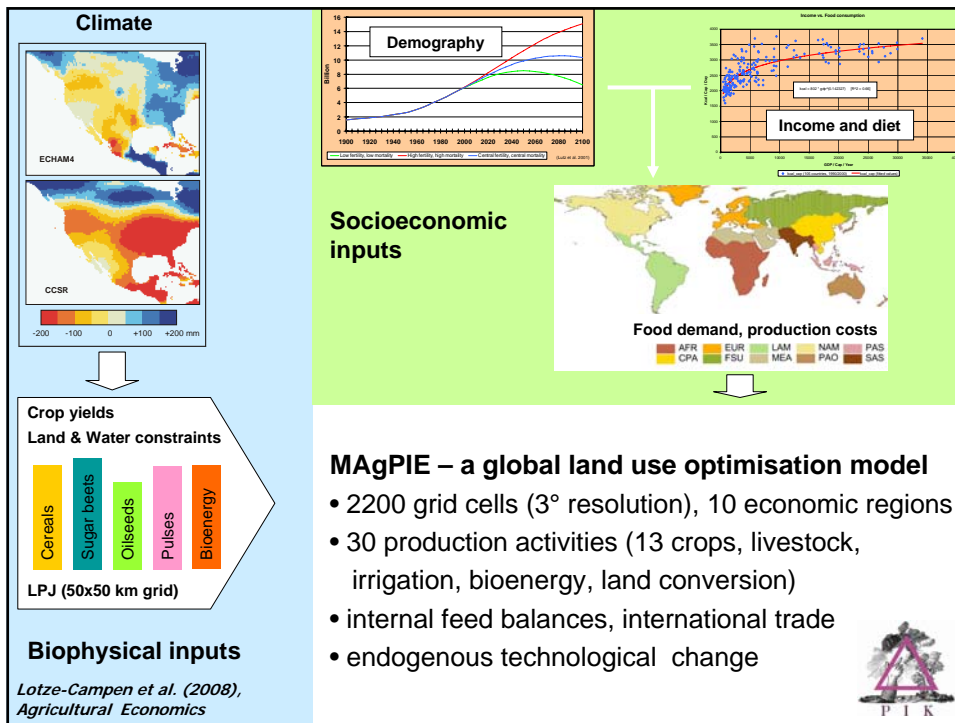
Agricultural Greenhouse Gas Emissions

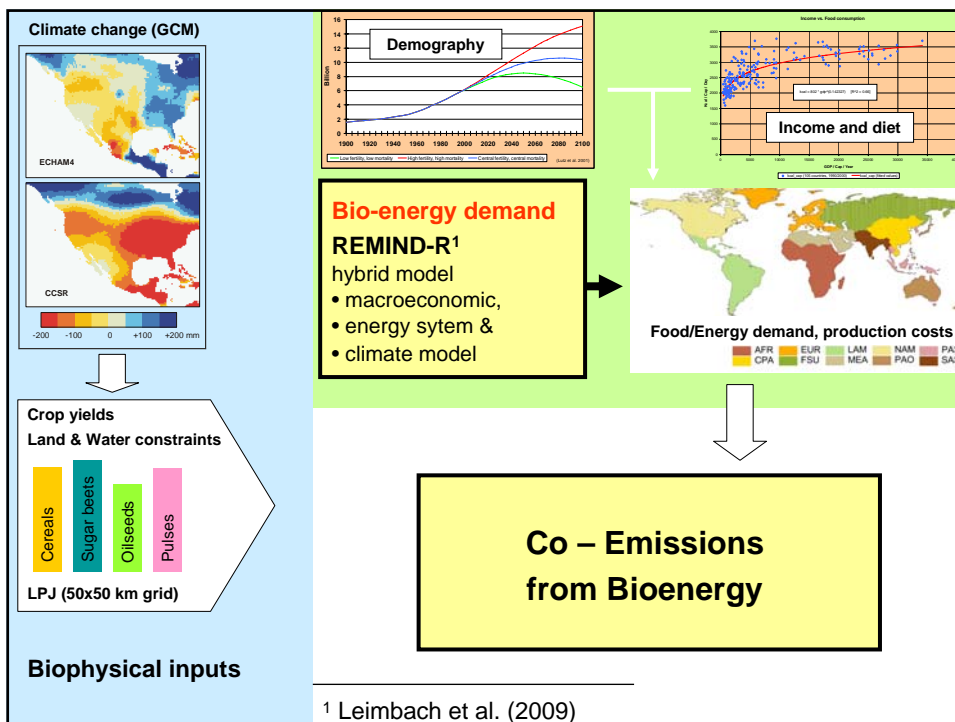
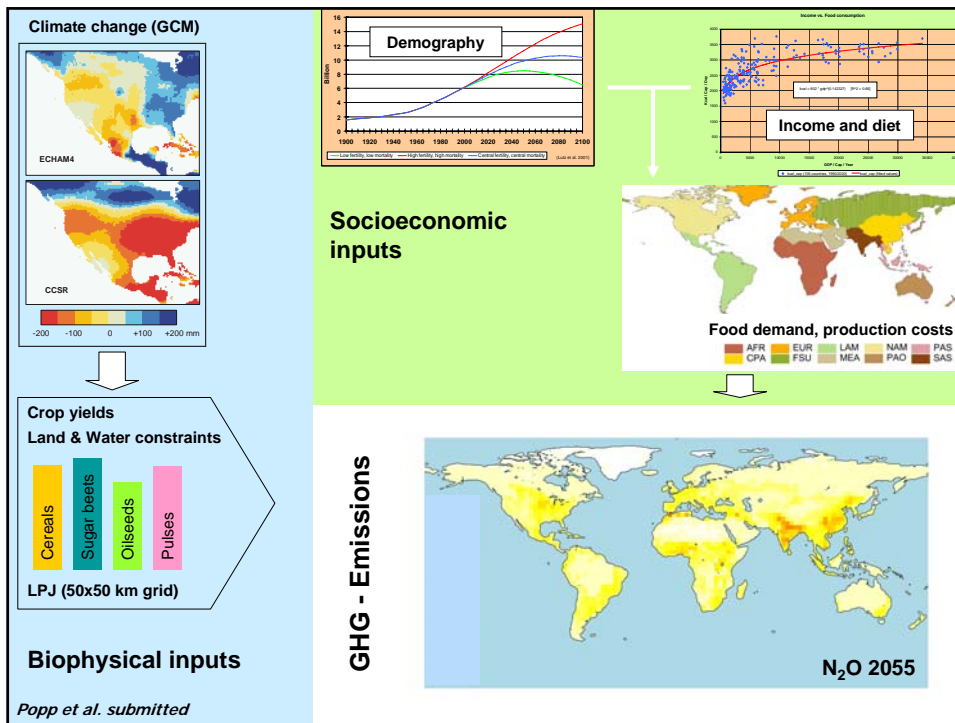
Total Emissions in 2000¹:
 42 Gt CO₂-e

Agriculture contributes²:
 47% of total anth. CH₄ emissions
 58% of total anth. N₂O emissions



¹ Stern 2006 ² IPCC 2007

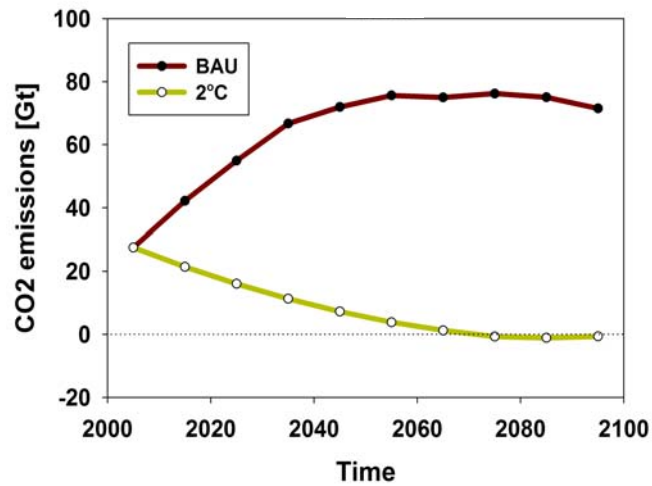




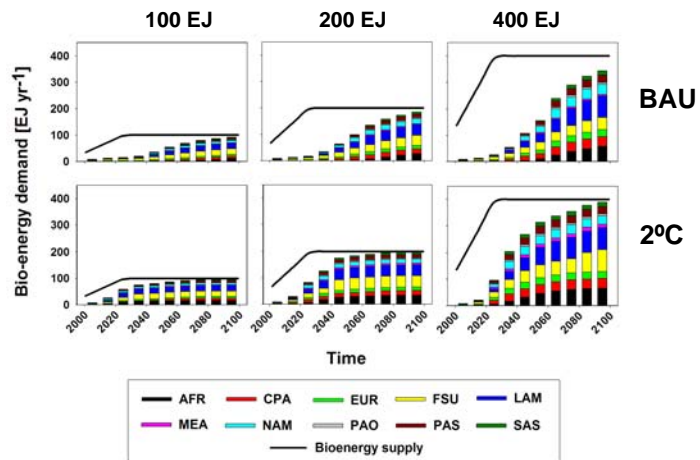
REMIND-R

BAU – no climate change mitigation

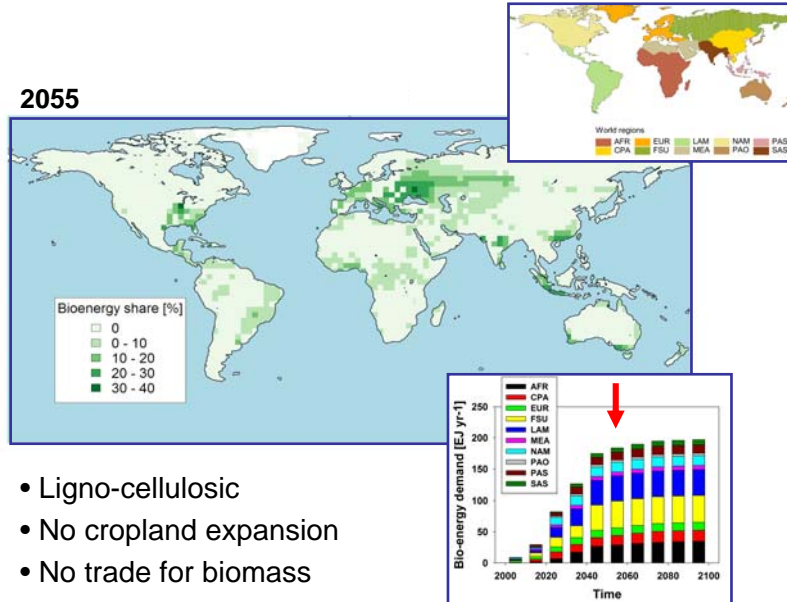
2°C – low stabilization scenario



Bioenergy demand

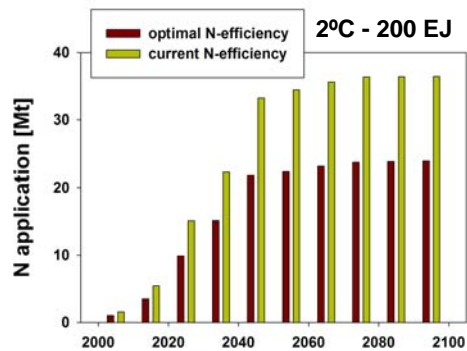


Bioenergy supply (200 EJ)



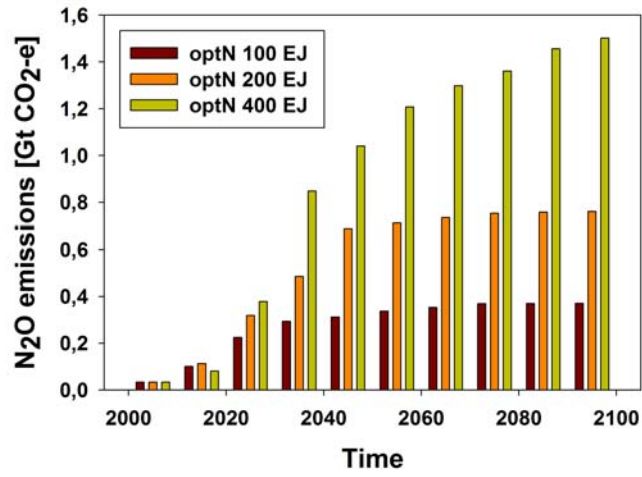
N application

- N-Fertilizer requirement based on average nutrient content of harvested biomass
- Optimal efficiency vs. current efficiency of N-application

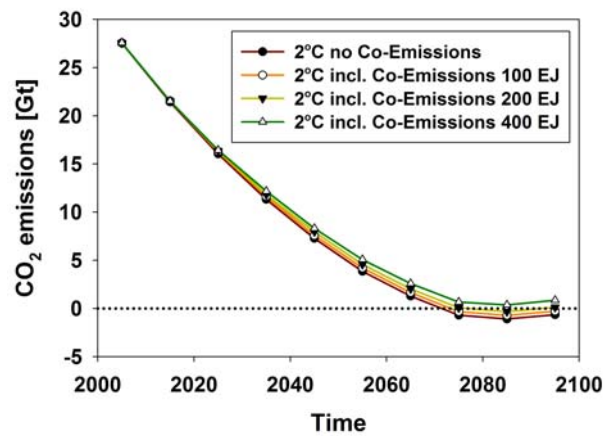


Additional N₂O emissions

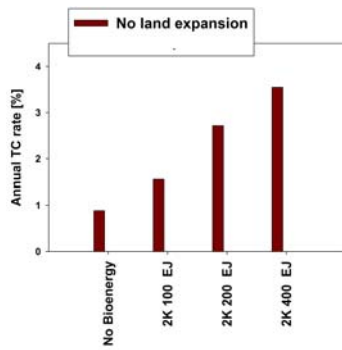
2°C



Additional N₂O emissions

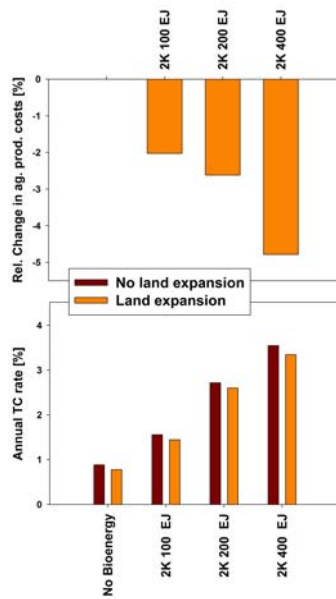


Outlook

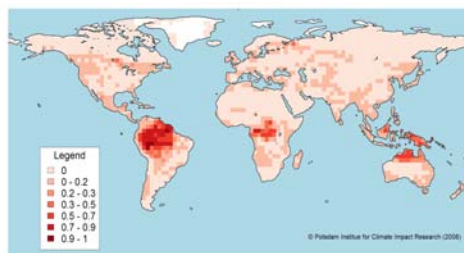


- Yield improvements needed

Outlook



Suitable unused land available for cropland expansion



- Yield improvements needed
- Land expansion decreases costs & need for yield improvements
- Co-emissions from land expansion?

Conclusion

- Bio-energy use emits considerable amounts of **GHGs in the agricultural sector**
- Additional emissions from **land-use expansion** have to be avoided!!!
- **Multi-sectoral approach** needed for climate change mitigation