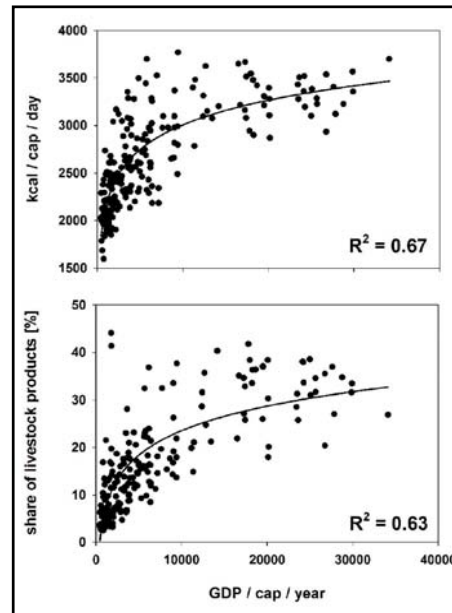
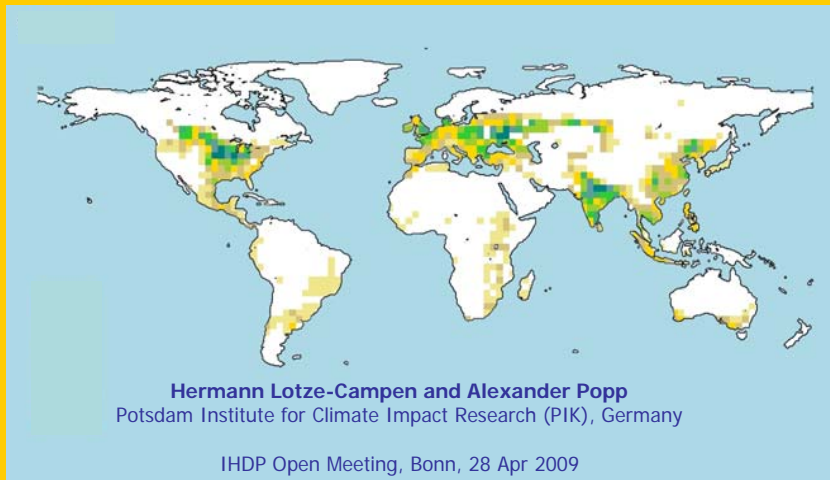


Global trade-offs between land expansion, intensification and international trade: the role of technological change in agriculture

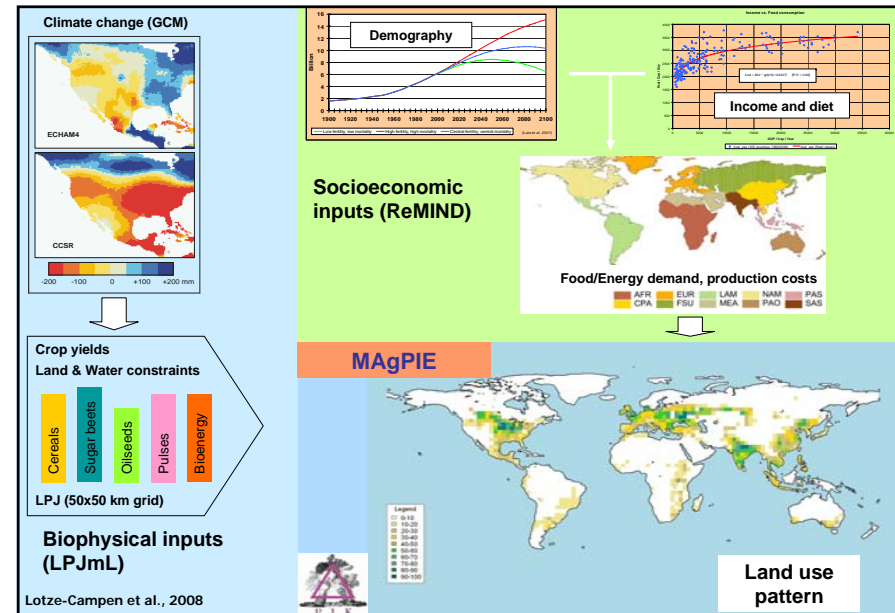


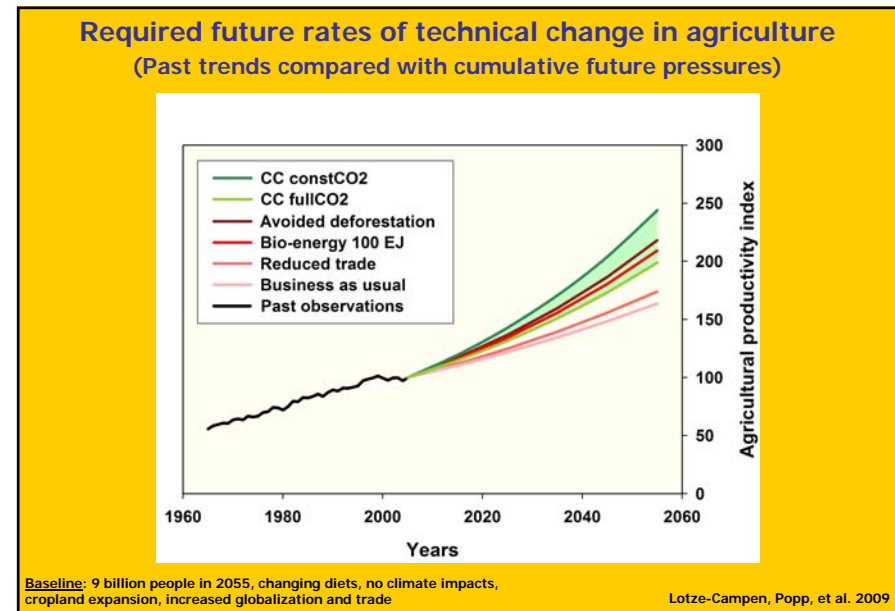
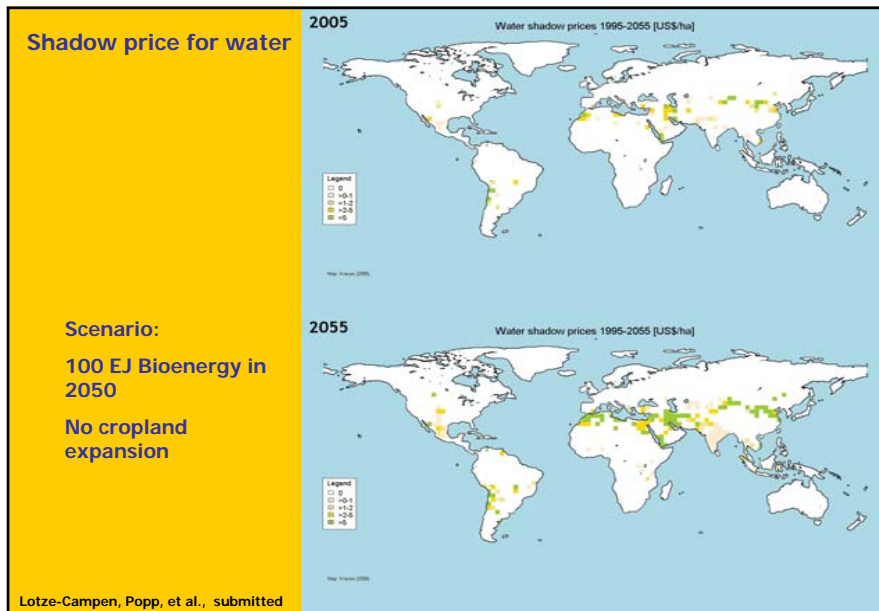
Changes in food demand

Popp, Lotze-Campen, et al., submitted

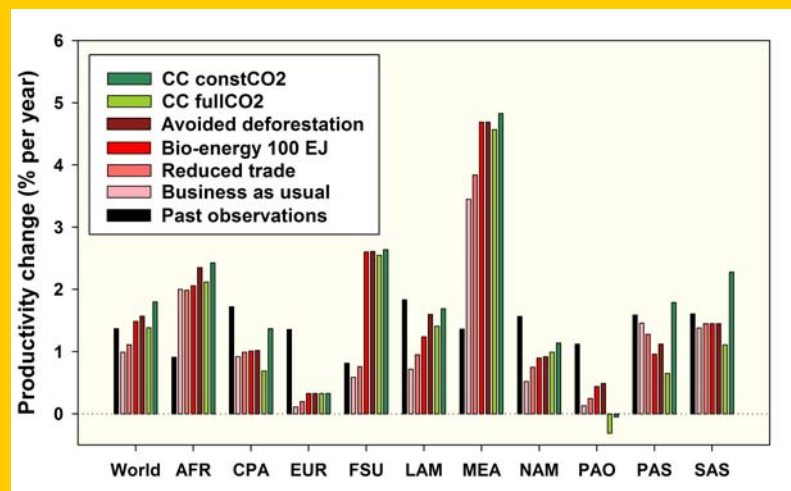
Constraints on food production under climate change

- Climate impacts
- Agricultural GHG emissions
- Increasing energy prices
- Bioenergy demand
- Biodiversity protection



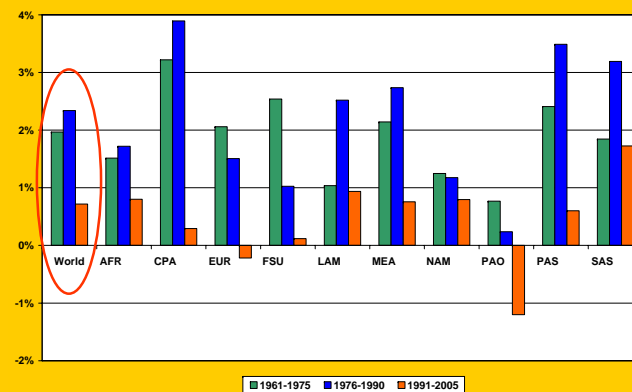


Required rates of technical change in agriculture (2005-2055)



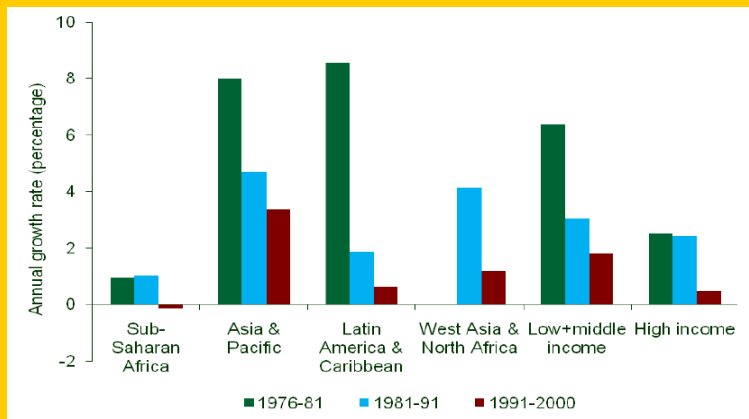
Lotze-Campen, Popp et al. 2009

Productivity change in agriculture in the past



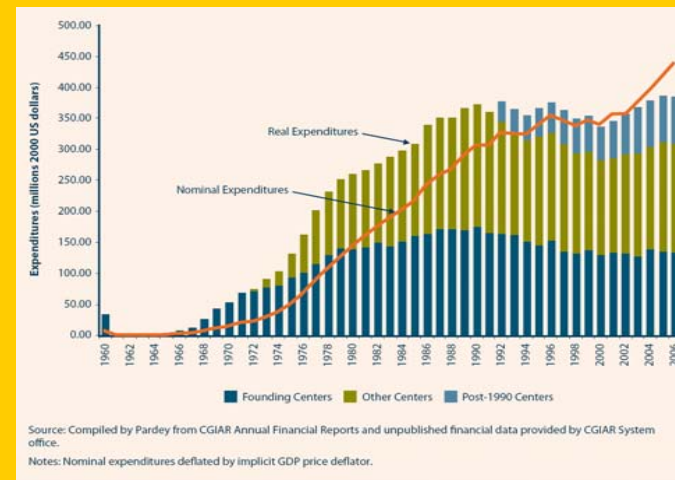
Lotze-Campen et al. in prep., FAOSTAT

Declining growth rates in public agricultural R&D



Beintema et al. 2008

Stagnating R&D expenditures on CGIAR centers



Source: Compiled by Pardey from CGIAR Annual Financial Reports and unpublished financial data provided by CGIAR System office.

Notes: Nominal expenditures deflated by implicit GDP price deflator.

Pardey et al. 2007

Conclusions

- Global demand for agricultural products will continue to rise, while land and water resources will become scarce.
- Climate change will increase uncertainty in production conditions.
- The demand for technological progress in agriculture will rise.
- Climate change adaptation strategies have to be developed (e.g. technology, insurance, trade).
- Emissions from agriculture have to be included in a global mitigation strategy.
- Bioenergy should be developed under fair competition with other technologies (e.g. through cap and trade system including all sectors).
- Research and technology development has to be increased in agriculture (e.g. plant breeding, soil management, livestock production).
- Many studies have shown serious under-investment in agricultural R&D. Public investments have to be increased.
- Recent price rises on agricultural markets have shown negative consequences of neglected agricultural R&D.
- A productive and low-emission agriculture requires integrated land use management approaches.

Challenges for global governance

- Technology development and transfer
- International trade (re-allocation of resource use)
- Management of resources and public goods:
 - Emission trading or taxes
 - Use rights for land and water
 - Compensation payments for global public goods (e.g. REDD)