



UNIVERSITY of HOHENHEIM

INSTITUTE OF FARM MANAGEMENT (410 B)



Bioenergy Potentials from Agriculture Considering Global Food Security and Sustainability Aspects

Dr. Nicole Schoenleber



Demand Drivers of Agricultural Growth

- **Population growth: more than 9 billion people in 2050 (according to UN projections in 2010)**
- **Income growth (demand shifting due to changing diet)**
- **Continuously rising oil prices**
- **Political energy targets: biofuels and bioenergy**

Key drivers

Objectives

Approach

Projections /
Results

Conclusions

Demand Drivers of Agricultural Growth



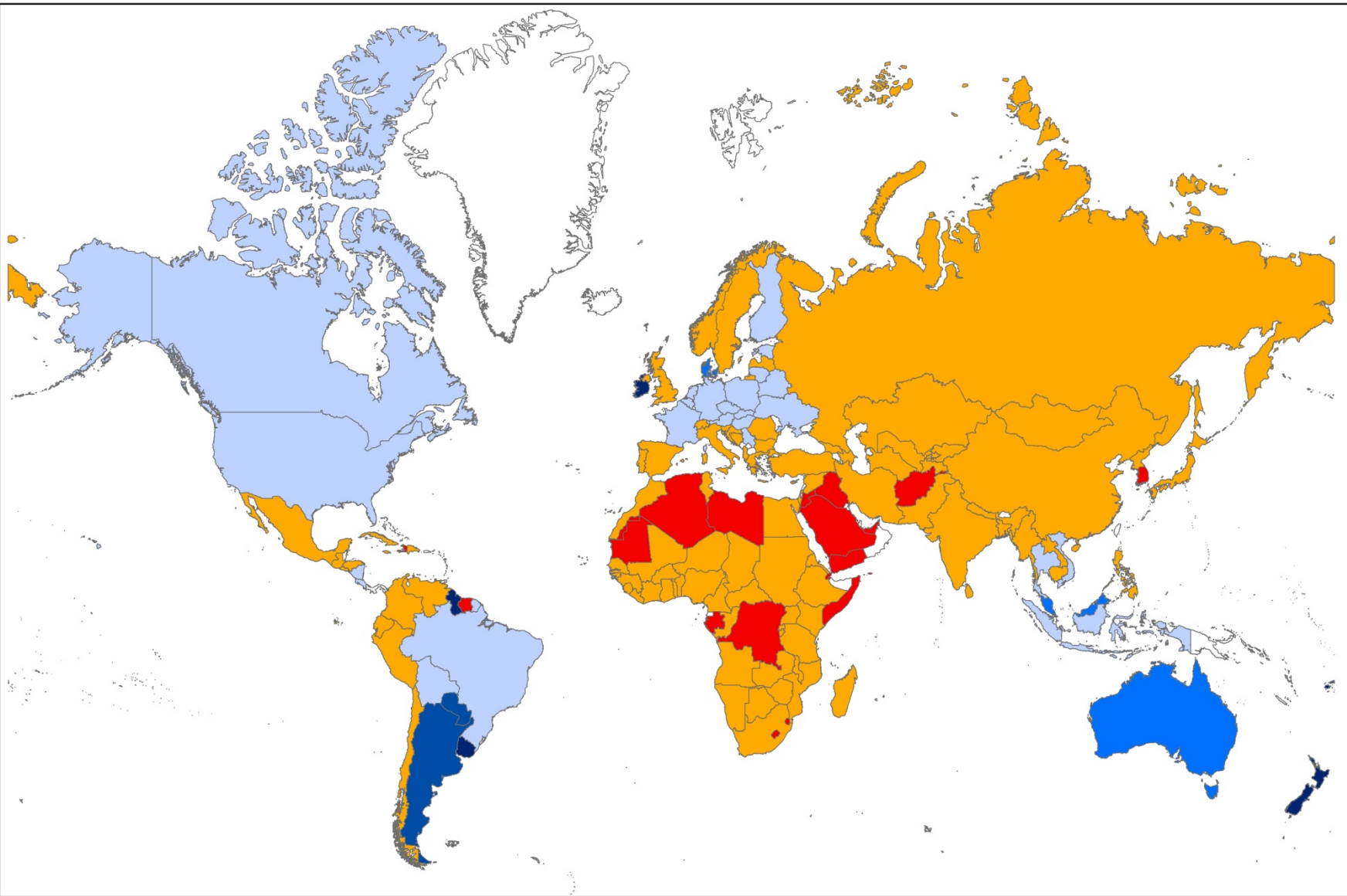
Key drivers

Objectives

Approach

Projections /
Results

Conclusions



Share of self-sufficiency in food supply of staple foods
(i.a. grain, starchy roots, sugar, vegetable oils, meat, milk): Basis 2007

0,00 - 0,50 0,51 - 1,00 1,01 - 1,50 1,51 - 2,00 2,01 - 3,00 3,01 - 8,00 no data

Own calculations according to data from FAOSTAT

Demand Drivers of Agricultural Growth



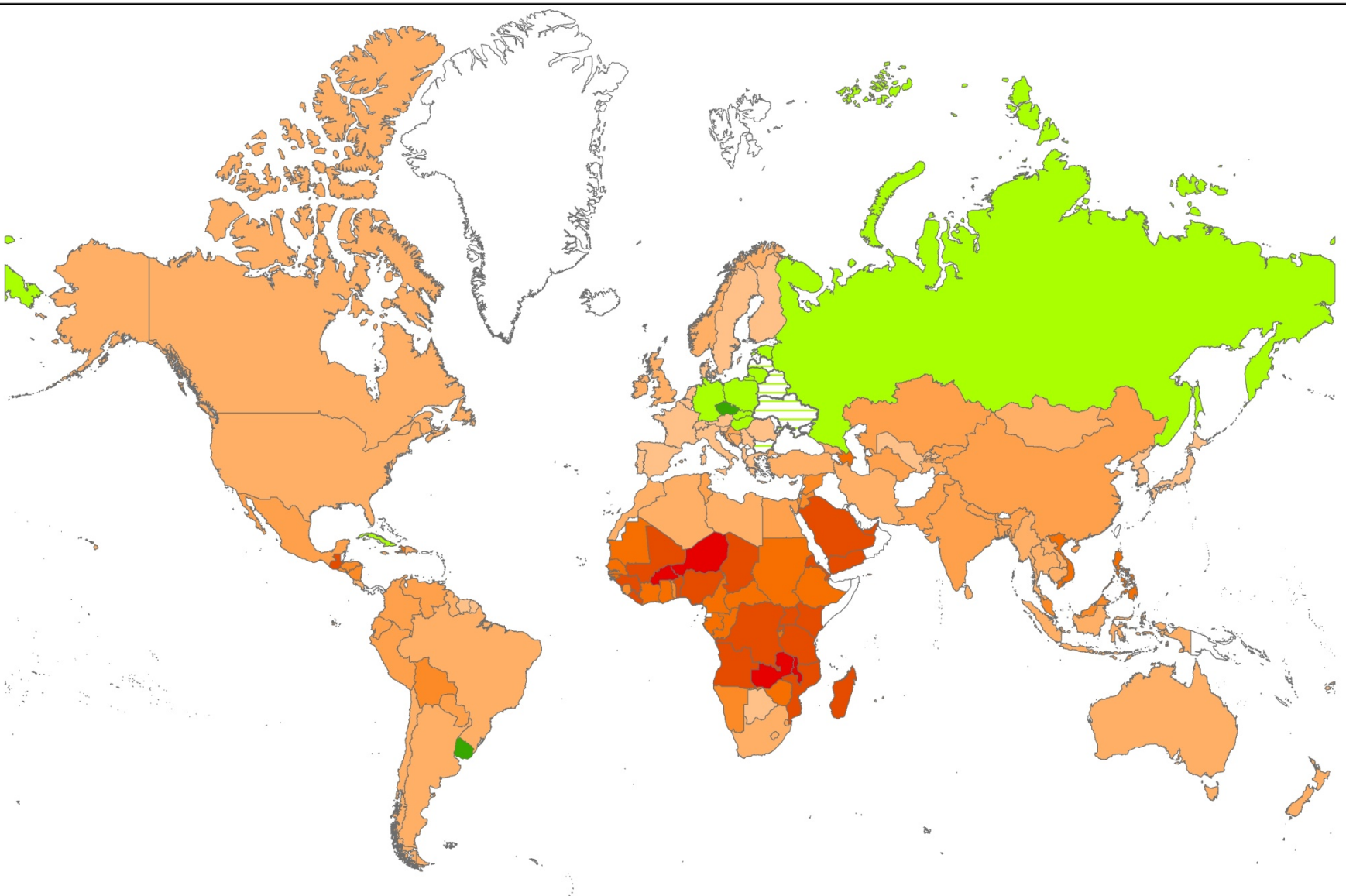
Key drivers

Objectives

Approach

Projections /
Results

Conclusions



Change in consumption: Basis 2007 to 2050 [in %]



Own calculations according to data from UN 2010, FAOSTAT



Supply Drivers of Agricultural Growth

- **Commodity prices**
- **Scarcity of natural resources: water and land**
- **Conservation and biodiversity**
- **Climate change**
- **GHG mitigation and carbon sequestration**
- **Political framework and research**

Key drivers

Objectives

Approach

Projections /
Results

Conclusions

Supply Drivers of Agricultural Growth



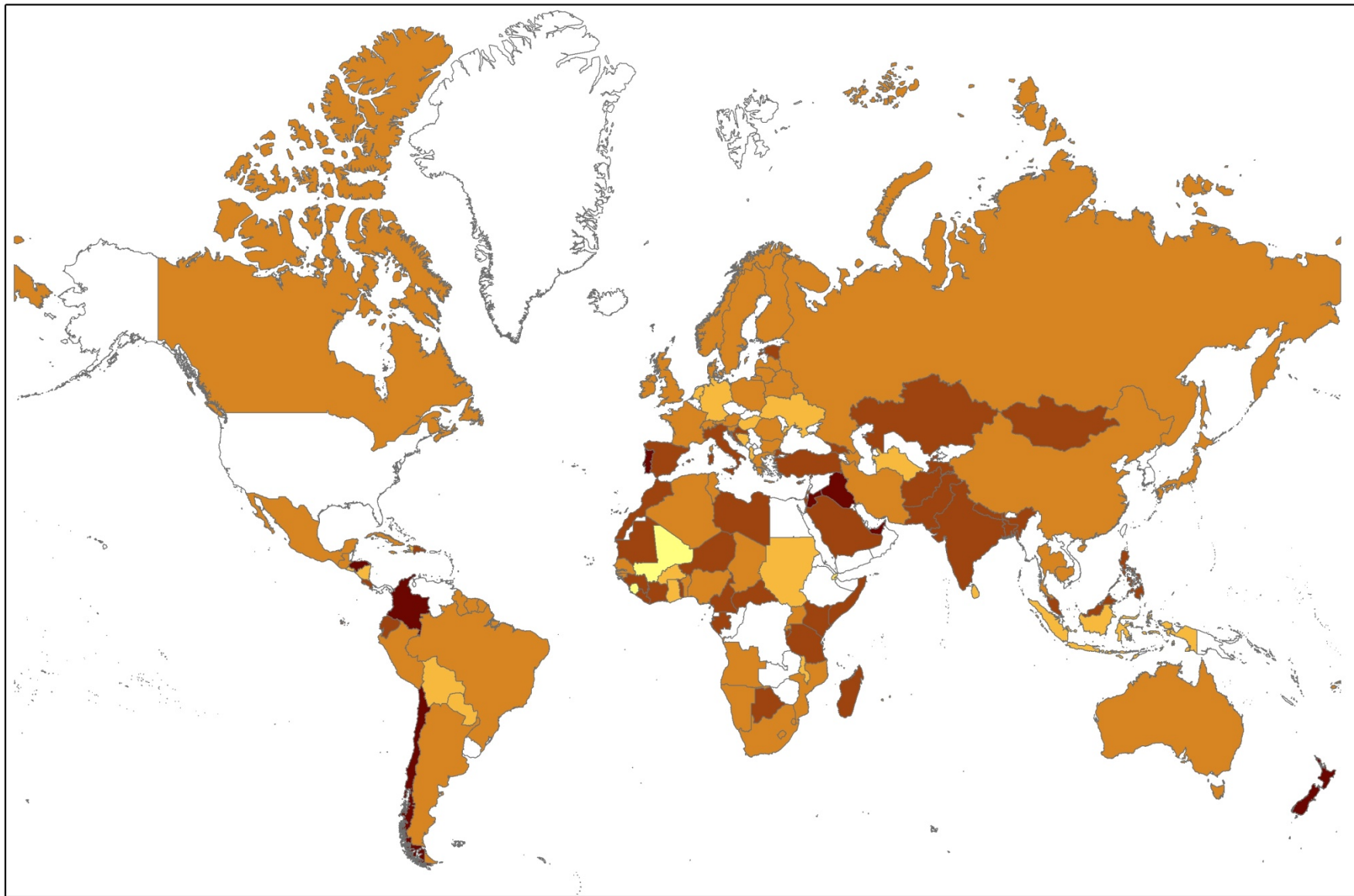
Key drivers

Objectives

Approach

Projections /
Results

Conclusions



Change of available arable land per capita from 1992 to 2009 [%]

-82,0 - -50,0 **-49,9 - -25,0** **-25,1 - 0,0** **0,1 - 25,0** **25,1 - 50,0** **50,1 - 80,0** no data

Own calculations according to data from The World Bank (2012)



Objectives

- **Global potential analysis and estimation of agricultural land resources for non-food biomass production**
- taking into account future development of food demand, availability of agricultural land etc.
- scenario calculations under certain assumptions
- **Global potential analysis of agricultural commodities (energy crops, residuals) and bioenergy outputs**

Key drivers

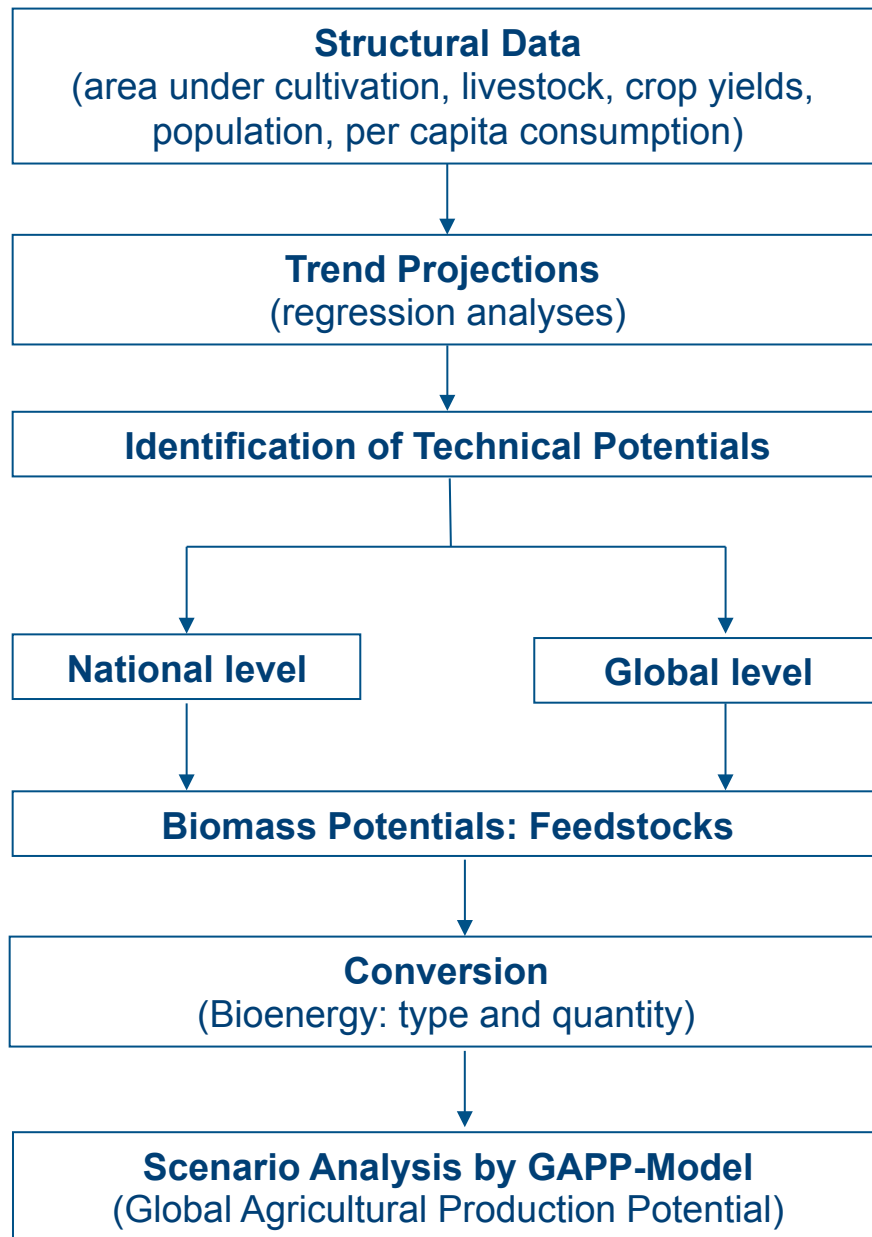
Objectives

Approach

Projections / Results

Conclusions

Methodological approach: GAPP-Model



Model characteristics:

- empiric
- comparative-static
- deterministic scenario-model
- Excel-based
- database: FAOSTAT, UN

→ includes **148 nations** being of importance in agricultural production

Key drivers

Objectives

Approach

Projections / Results

Conclusions

Scenarios

- Reference (business as usual)

- continuation of land use changes such as forest clearance, ploughing up of grassland
- Future development (trend projections) of food demand, availability of agricultural area, crop yields etc. are based on the past 20 years

- Change of consumption patterns

- Change in productivity (crop yields)

- Ecological restrictions



Key drivers

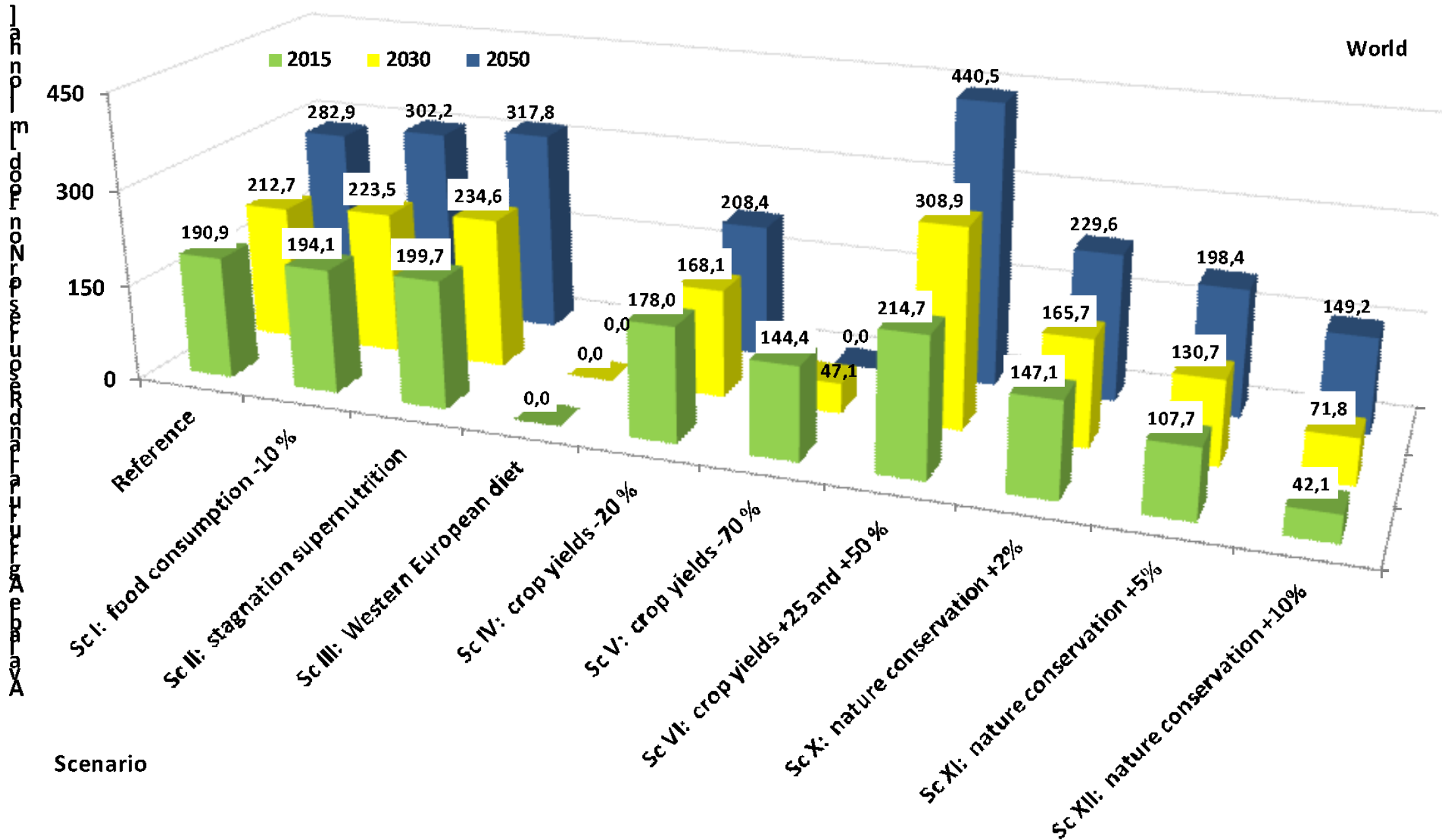
Objectives

Approach

**Projections /
Results**

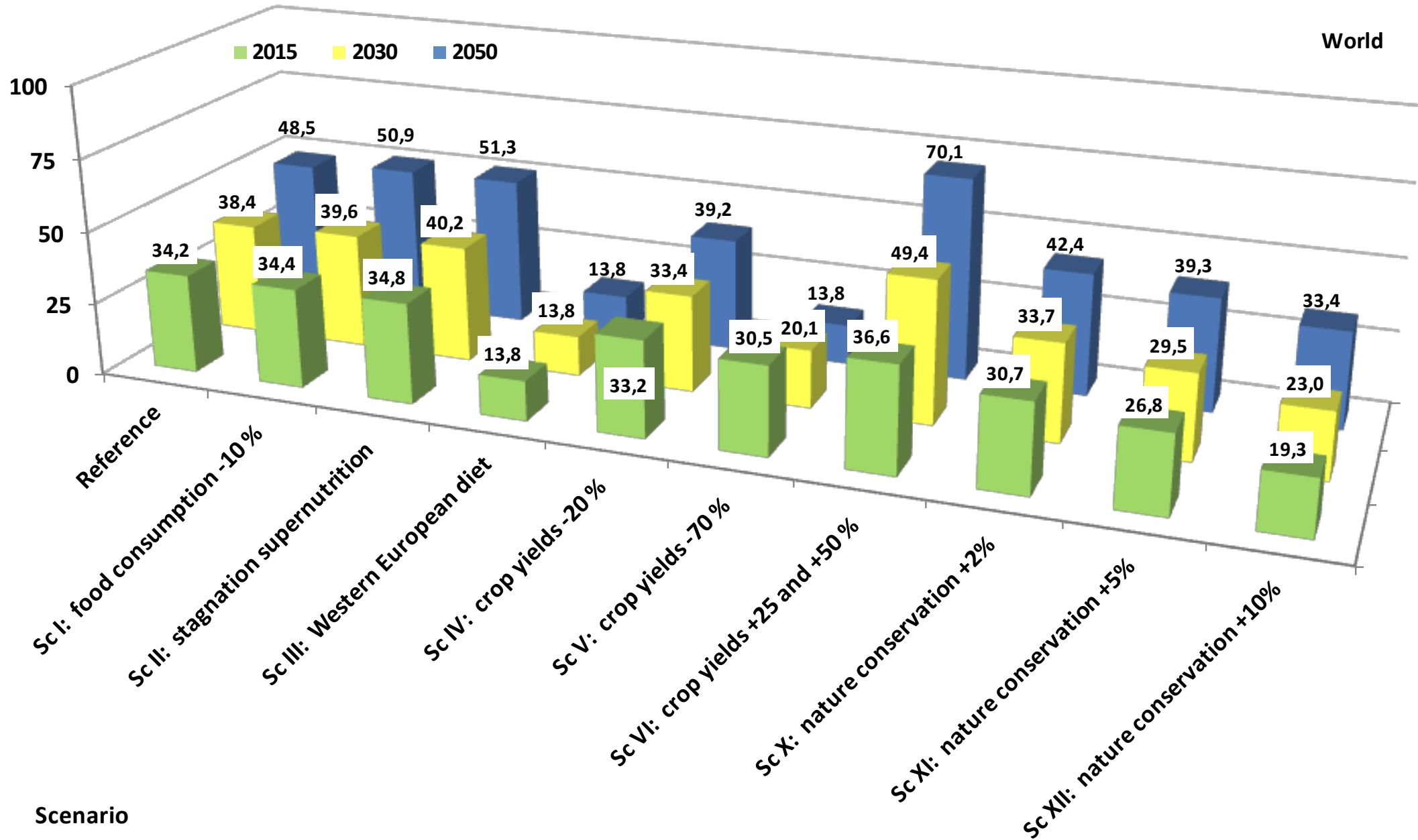
Conclusions

Agricultural Land Potentials according to Scenarios considering Global Food Security



Estimates of Future Bioenergy Supply

World



Estimates of Future Bioenergy Supply



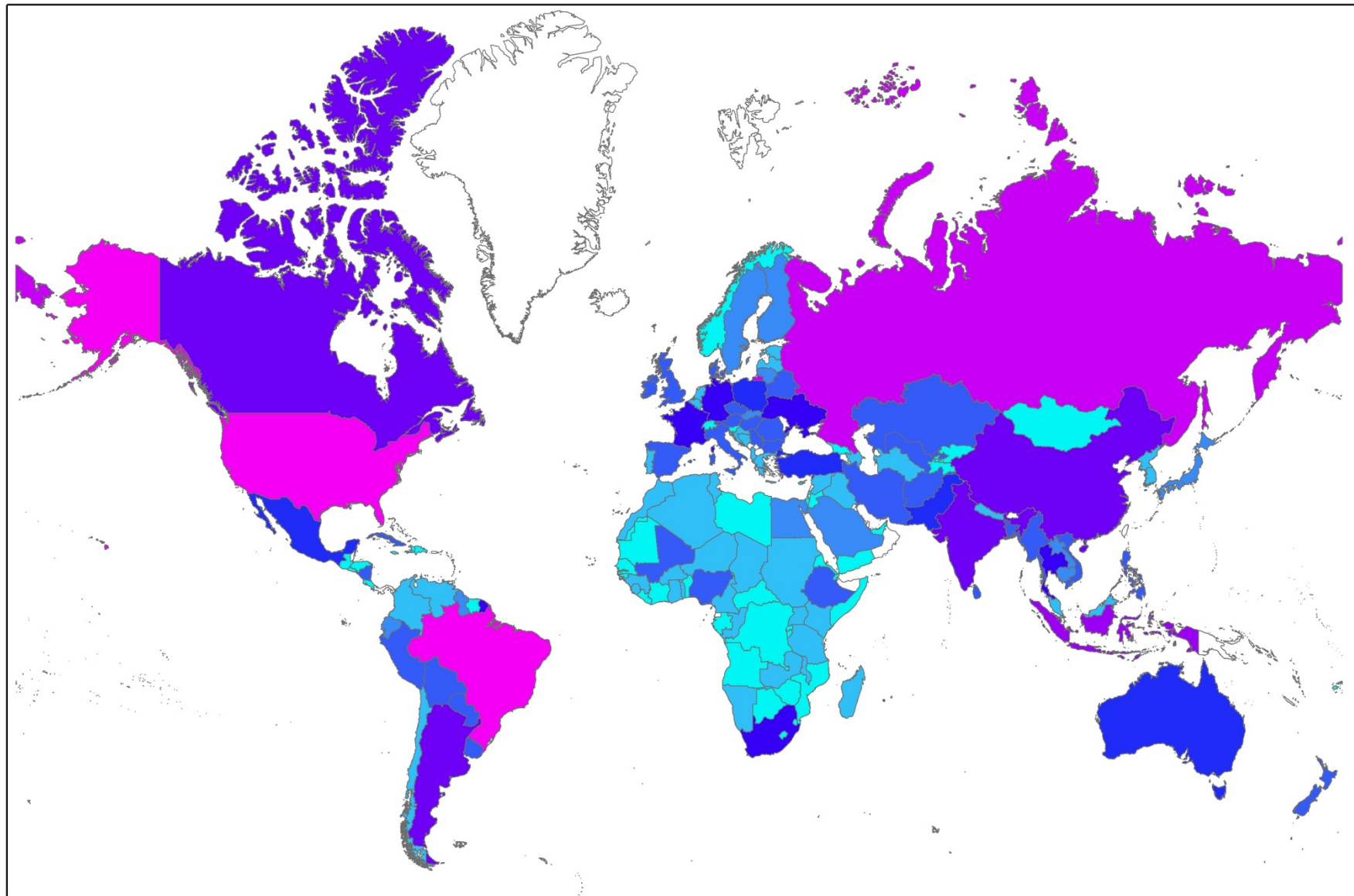
Key drivers

Objectives

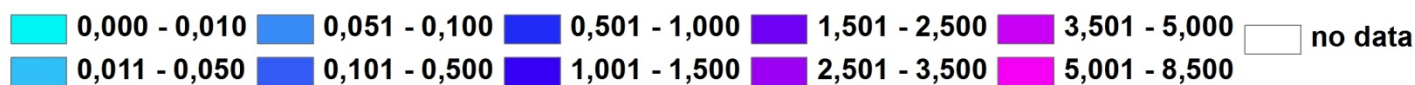
Approach

Projections /
Results

Conclusions

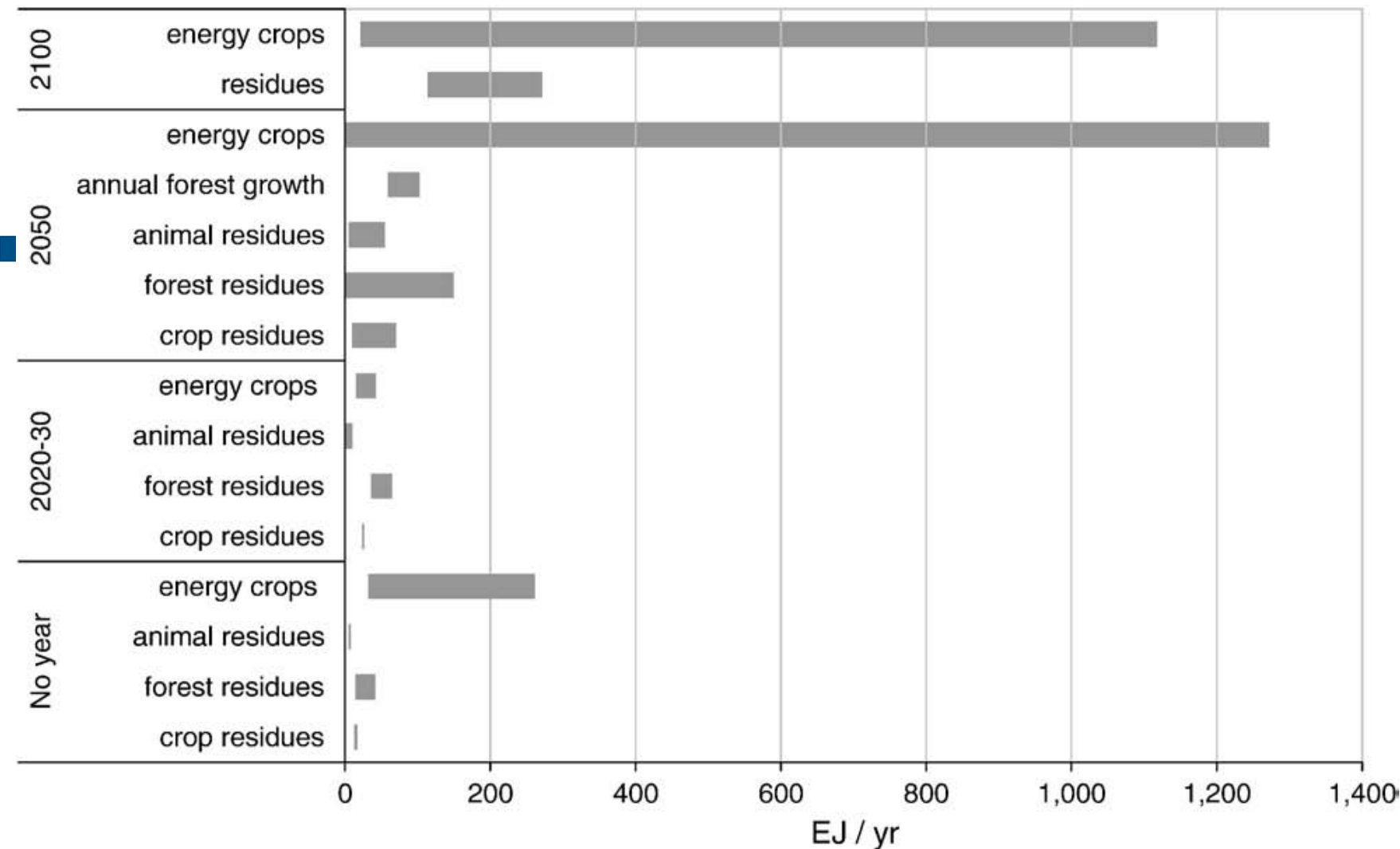


Bioenergy Potential in 2050 - Reference Scenario [in EJ/yr]



Own calculations according to data from FAOSTAT

Comparison of Results to Other Analyses - Ranges of Biomass Potentials of different Resource Fractions



Data of Bauen et al., 2004; Campbell et al., 2008; Dessus et al., 1993; Faaij, 2007; Fischer and Schrattenholzer, 2001; Hall et al., 1993; Hoogwijk et al., 2003, 2005; Johansson et al., 2004; Kaltschmitt and Hartmann, 2001; Moomaw et al., 2001; Moreira, 2006; Smeets et al., 2007; Smeets and Faaij, 2007; Sims et al., 2007; Wolf et al., 2003; Yamamoto et al., 1999, 2001.

Source: Thrän D, et al, Global biomass potentials — Resources, drivers and scenario results, Energy for Sustainable Development (2010), doi:10.1016/j.esd.2010.07.004

Key drivers

Objectives

Approach

Projections / Results

Conclusions



Summary of Results

- Currently 70-80 million ha agricultural land for renewables
- Bioenergy supply from agricultural feedstock is in particular determined by
 - future food demand
 - productivity growth in agriculture
 - recultivation of fallow land
 - climatic and ecological restrictions
- 'Surplus' regions: Europe, North and South America, Oceania
- 'Deficit' regions: Africa and Asia (excl. Russia)
- Technical (gross) bioenergy potential of 13 - 70 EJ/year by 2050 (approx. 2 - 13% of global primary energy consumption in 2008)

Key drivers

Objectives

Approach

Projections /
Results

Conclusions



Conclusions (I)

- **Uncertainties in wide range of results of land / energy potentials → scenario calculations try to compensate these uncertainties**
- **Similar studies/analyses vary in approach, assumptions, aggregation level**
- **Reliable political framework as pre-condition to make these potentials available (stimulation of investment activities) ...**
- **... but no supportive measures which significantly influence agricultural production of exports for global food security**

Key drivers

Objectives

Approach

Projections /
Results

Conclusions



Conclusions (II)

- **Extension of agricultural crops is limited, thus sustainable conversion of residual and waste products increase bioenergy potentials**
- **Efficiency increase of/in biorefineries secures higher energy outputs in future**
- **Conversion of biomass / energy crops according to sustainability criteria (i. e. GHG mitigation), economic key factors etc. is indispensable**

Key drivers

Objectives

Approach

Projections /
Results

Conclusions



Research Project

„ Optimierung der Biomassenutzung nach Effizienz in Bereitstellung und Verwendung unter Berücksichtigung von Nachhaltigkeitszielen und Welternährungssicherung “

‘ Optimizing agricultural biomass use according to efficiency, sustainability and global food security ’

Financially funded by:
Federal Ministry of Food, Agriculture and Consumer Protection
Agency for Renewable Sources
[FKZ 22003911; Project completion in January 2014]

Gefördert durch:



Bundesministerium für
Ernährung, Landwirtschaft
und Verbraucherschutz

aufgrund eines Beschlusses
des Deutschen Bundestages





Thank you for your attention

Contact details (E-mail):

Dr. Nicole Schoenleber: nicole.schoenleber@uni-hohenheim.de

Prof. Dr. Enno Bahrs: bahrs@uni-hohenheim.de

Prof. Dr. Juergen Zeddies: juergen.zeddies@uni-hohenheim.de

www.uni-hohenheim.de