



International Institute for
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science for global insight

Shared Socio-economic Pathways (SSPs)

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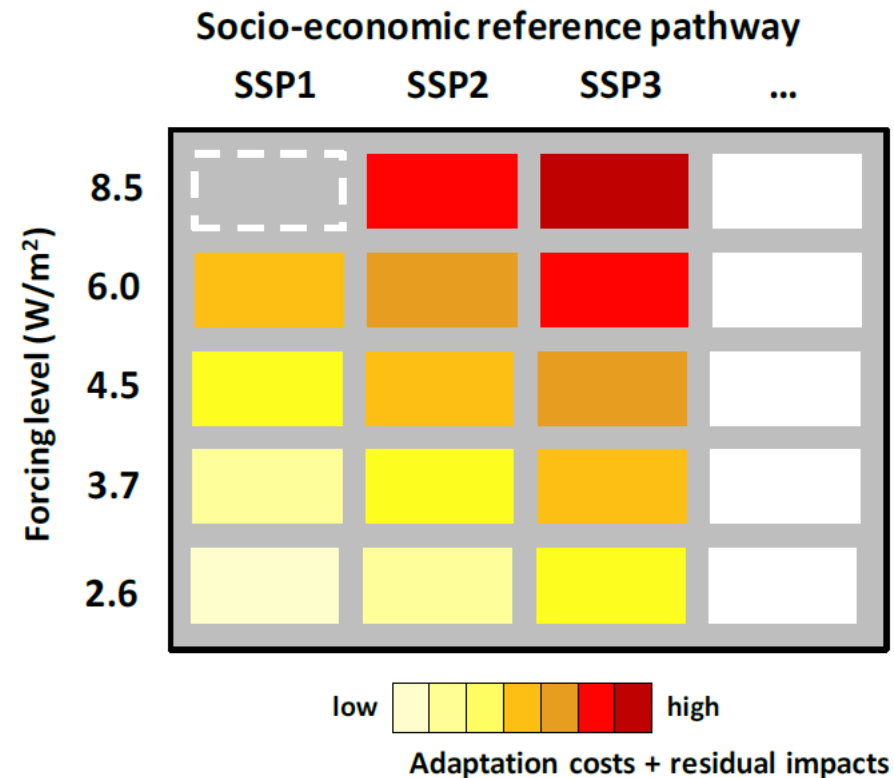
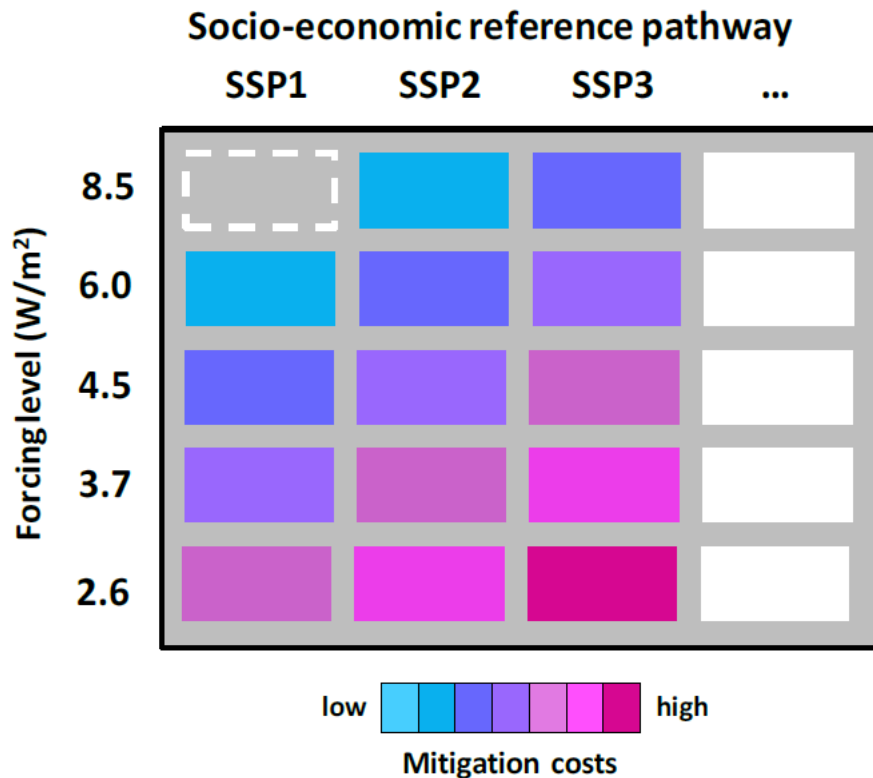


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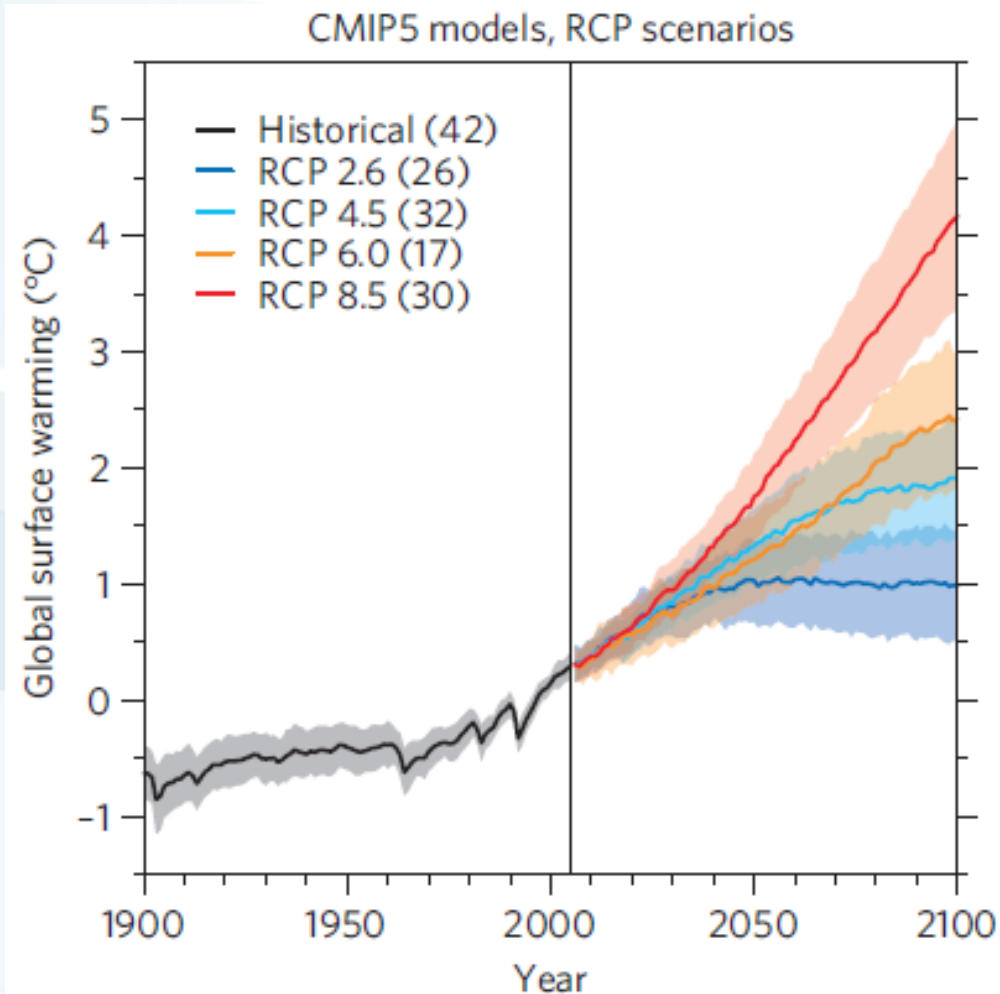
New "IPCC" scenarios matrix approach

GHG emissions / Mitigation (IAM)

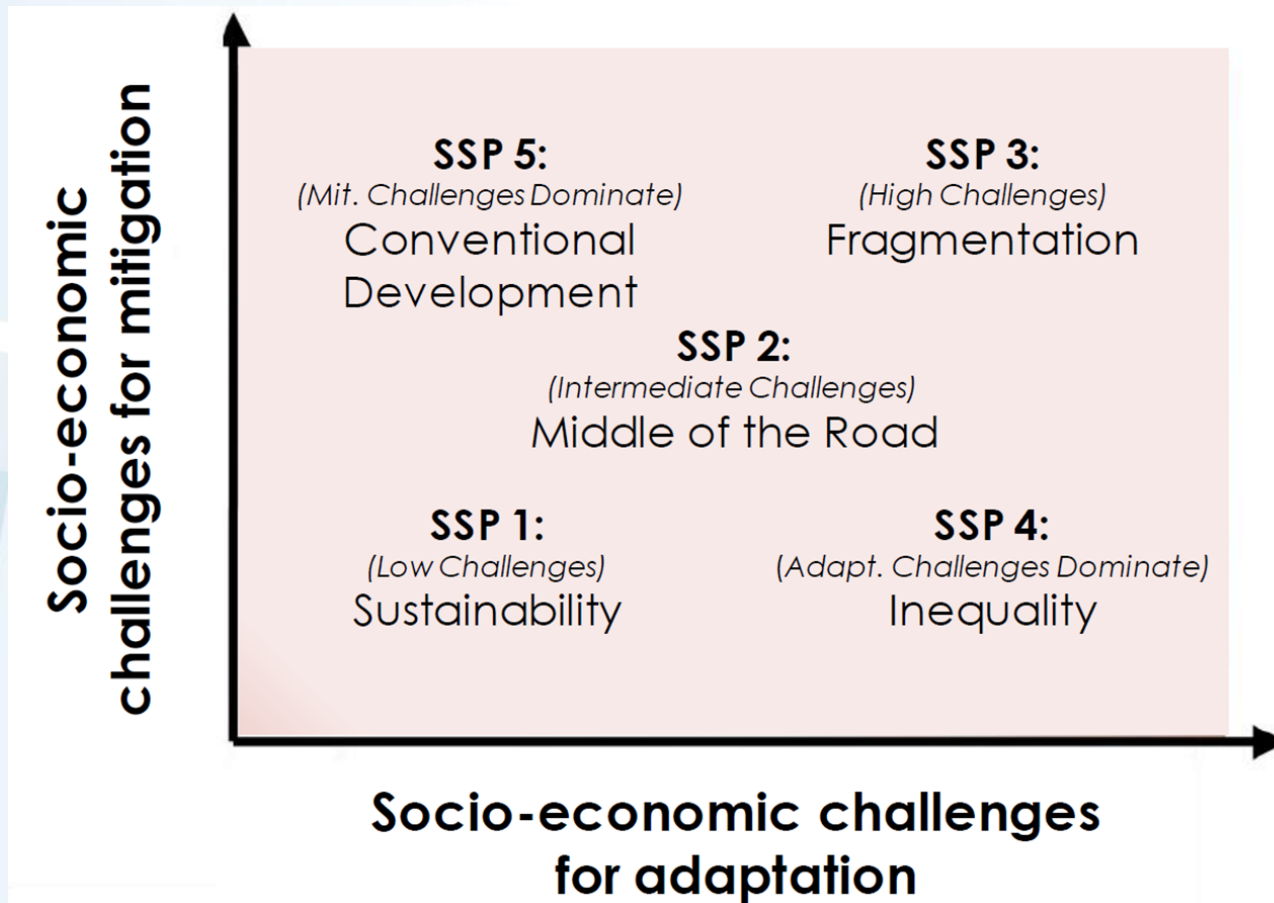
Climate change / Adaptation (IAV)



Representative concentration pathways (RCPs)



Shared Socio-economic Pathways (SSPs)



Shared Socio-economic Pathways (SSPs)

- **Narrative**
- **Quantitative elements**
 - Inputs to models such as population, rates of technological change, income growth rates
 - Other indicators, such as Human Development Index, income distribution, etc.
- **Does not include:**
 - typical model output such as emissions, land use, climate change
 - climate policy (mitigation or adaptation)
 - not influenced by climate change

(O'Neil, 2012)

Scenario elements in GLOBIOM

- ▶ **Demographics:**

Population growth, Fertility, Mortality, Migration, Level and type of urbanization, Education

- ▶ **Economy and lifestyles:**

Growth, Structure, Inequality, International trade, Globalization, Consumption, Diets

- ▶ **Policies and institutions:**

International cooperation, Environmental policy, Institutions

- ▶ **Technology:**

Development, Transfer, Carbon intensity, Energy Intensity

- ▶ **Environment and natural resources:**

Fossil constraints, Environment, Agriculture

SSP2: Middle of the Road

General

- ▶ medium economic growth overall
- ▶ slow convergence between LIC and HIC
- ▶ inequality remains high
- ▶ population growth moderate – high in some LICs
- ▶ reducing resource intensity (slower than SSP1)
- ▶ reducing fossil fuel dependency (slower than SSP1)
- ▶ uneven planned urbanization in LIC
- ▶ world economy fragmented – reduced flows of trade and technologies
- ▶ rapid technological change in HIC but not shared with LIC

Agriculture

- ▶ trade barriers in agricultural markets remain

SSP1: Sustainability

General

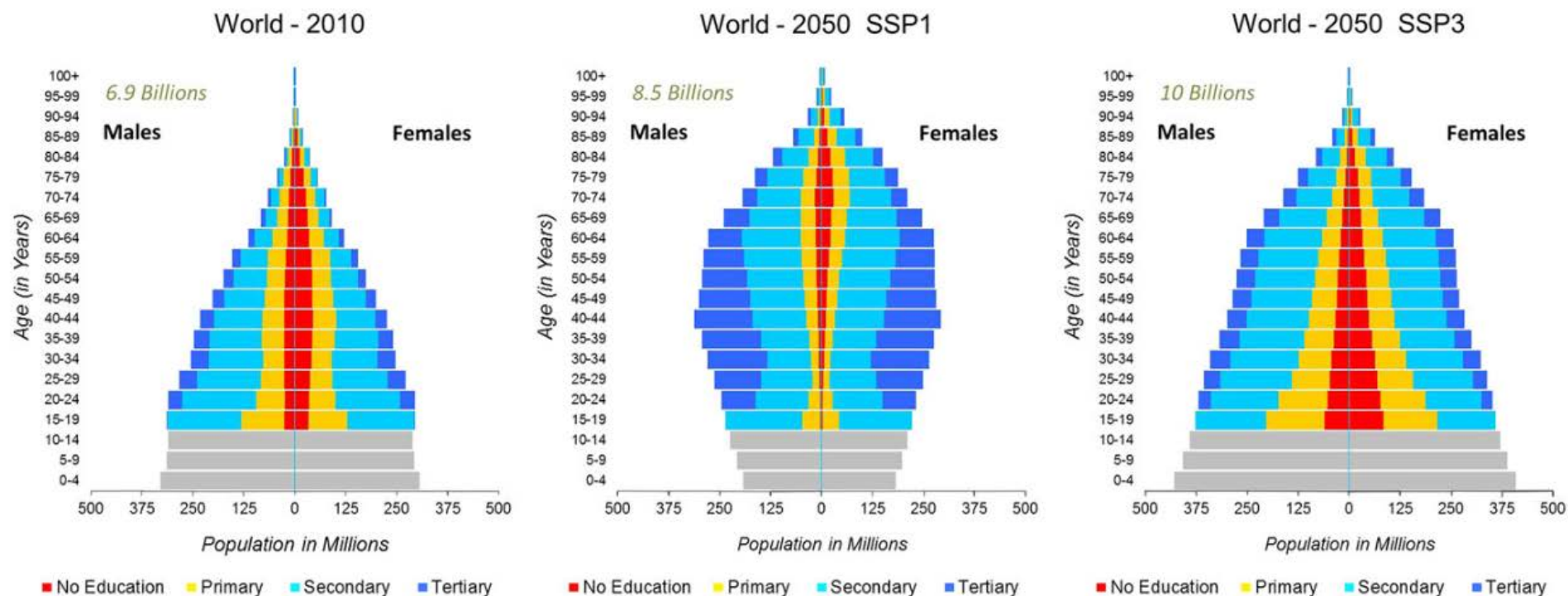
- ▶ rapid development of Low Income Countries (LIC)
- ▶ reduction of inequality among and within economies
- ▶ low population growth
- ▶ reducing resource intensity and fossil fuel dependency
- ▶ increased planned urbanization in LIC and MIC
- ▶ opened globalized economy
- ▶ countries cooperate to achieve development and environmental goals
- ▶ rapid technological change and technology transfer

Agriculture

- ▶ high land productivity
- ▶ rapid tech change – yield increasing technologies
- ▶ rel. low level of animal products consumption
- ▶ open trade

SSPs: Quantitative elements

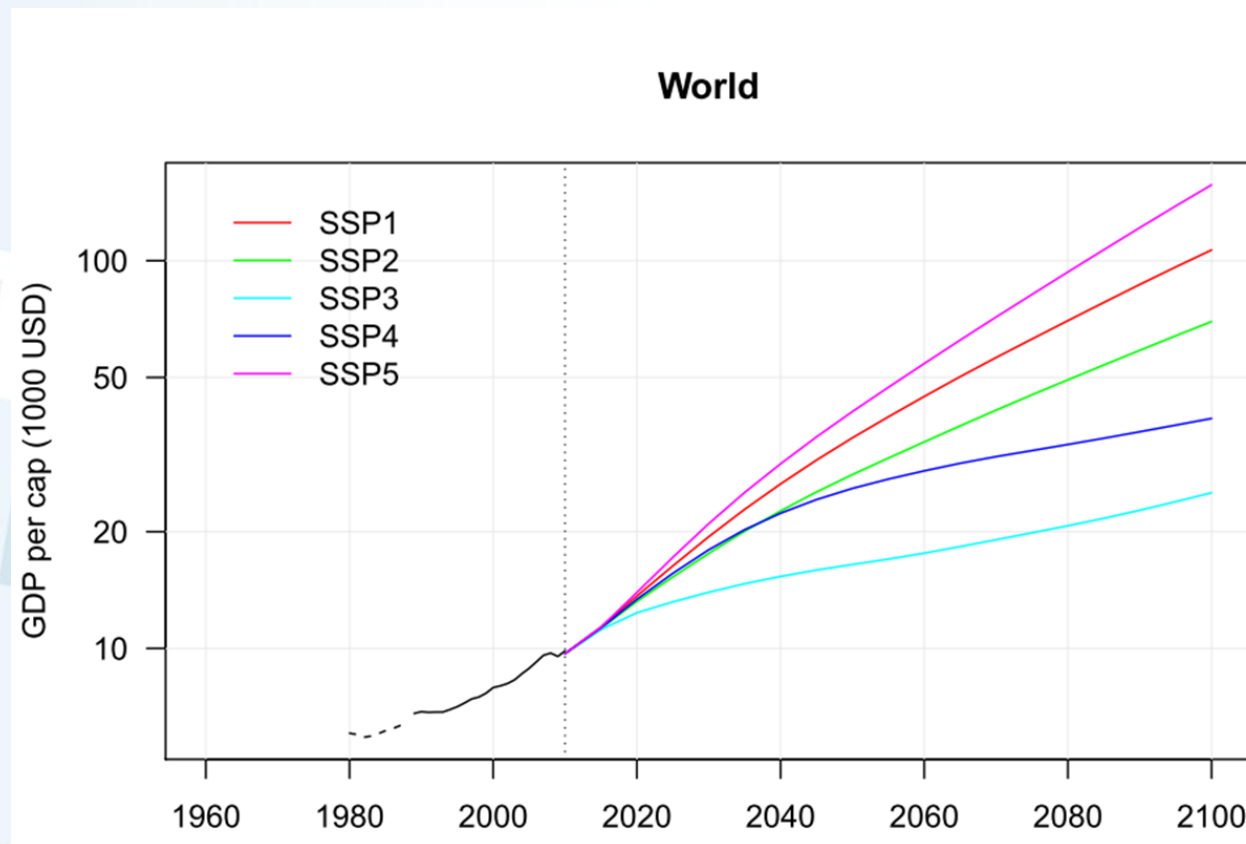
Population



(KC & Lutz, 2014)

SSPs: Quantitative elements

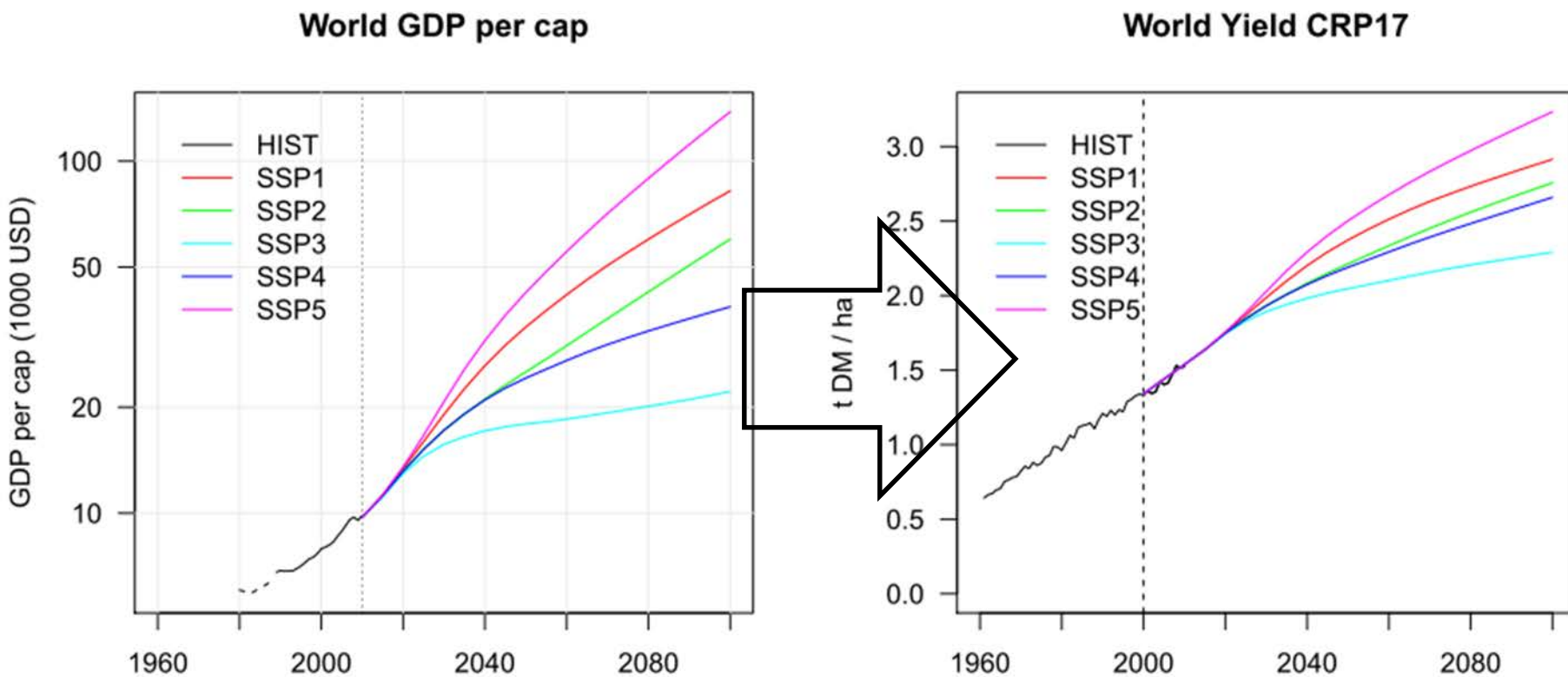
GDP per capita



SSP semi-quantitative elements

Agriculture and land use			
	SSP1	SSP2	SSP3
Net deforestation	Afforestation (No net deforestation by 2050, +3% forest area by 2100 compared to 2010)	Deforestation/Afforestation (Forest loss of 1% by 2050, back to 2010 area by 2100)	Deforestation (Net forest loss of 3% by 2050 and 6% by 2100 compared to 2010)
Land productivity growth			
Crops: Yields	High yield growth (Annual yield growth from 0.51% p.a. in the North to 0.66% in the South)	Moderate yield growth (Annual yield growth from 0.46% p.a. in the North to 0.60% in the South)	Slow yield growth (Annual yield growth from 0.35% p.a. in the North to 0.35% in the South)
Crops: Input intensity	Low intensity (Elasticity of variable inputs incl. fertilizer use wrt technological change: 0.75)	Medium intensity (Elasticity of variable inputs incl. fertilizer use wrt technological change: 1.00)	High intensity (Elasticity of variable inputs incl. fertilizer use wrt technological change: 1.25)
Livestock: Feed conversion efficiency	Enhanced efficiency growth (Annual feed conversion efficiency change from 0.10% in the North to 0.26% in the South)	Moderate efficiency growth (Annual feed conversion efficiency change from 0.10% in the North to 0.24% in the South)	Slow efficiency growth (Annual feed conversion efficiency change from 0.07% in the North to 0.14% in the South)
Livestock: Endogenous productivity growth	High livestock systems transition (Annually, up to 5% of livestock production systems can be converted to an alternative system or the activity can be abandoned)	Medium livestock systems transition (Annually, up to 2.5% of livestock production systems can be converted to an alternative system or the activity can be abandoned)	Low livestock systems transition (No adjustment in the ruminant production system structure)
Environmental impact of food consumption			
Food demand	Slow consumption growth and more sustainable and healthy diets (Calorie consumption per capita growing – North : 1%, South: 16%. Livestock product share decreases in North by one third but increases in South, leading to a stable share of 15% globally)	Moderate consumption growth and increasing share of livestock products in the diet (Calorie consumption per capita growing by 11% in the North and 22% in the South. Livestock product share in the diet growing from 15% to 18%.)	Substantial consumption growth but lagging demand for animal proteins in diet in the South (Calorie consumption per capita growing by 5% in the North and 15% in the South. Livestock product share stays at 15%.)
Losses & Wastes	Fast reduction of losses & wastes (L&W) (L&W in the processing chains reduced from 12% to 7% in the Oilseed and Pulses sector and from 7% to 2.5% in the dairy sector over 2000 and 2050)	Medium reduction of losses & wastes (L&W) (L&W in the processing chains reduced from 12% to 7.5% in the Oilseed and Pulses sector and from 7% to 3% in the dairy sector over 2000 and 2050)	Slow reduction of losses & wastes (L&W) (L&W in the processing chains reduced from 12% to 9% in the Oilseed and Pulses sector and from 7% to 4.5% in the dairy sector over 2000 and 2050)

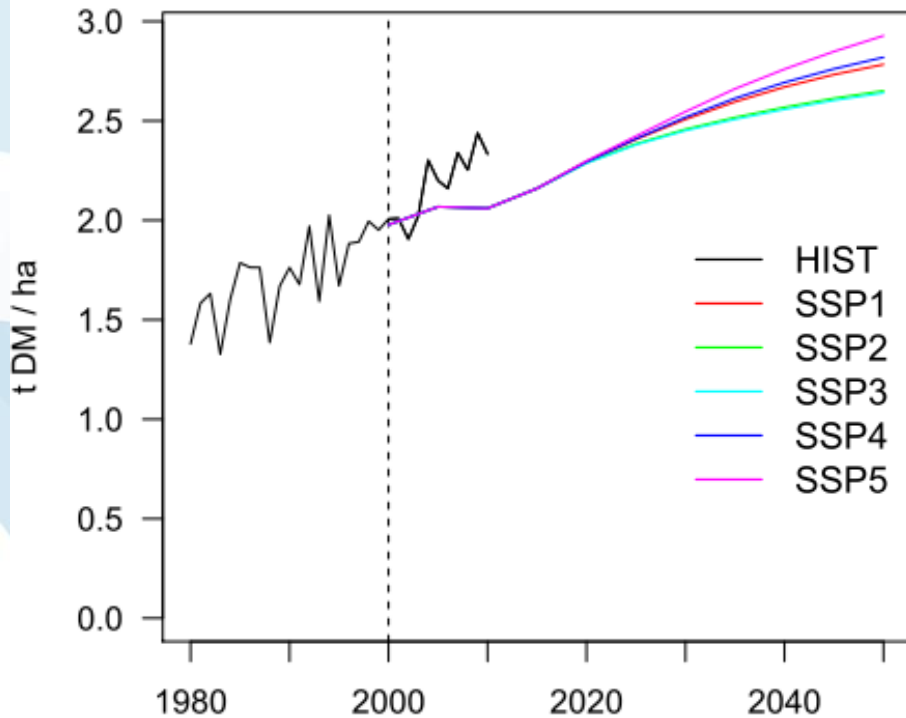
SSPs: Crop yield development (GLOBIOM)



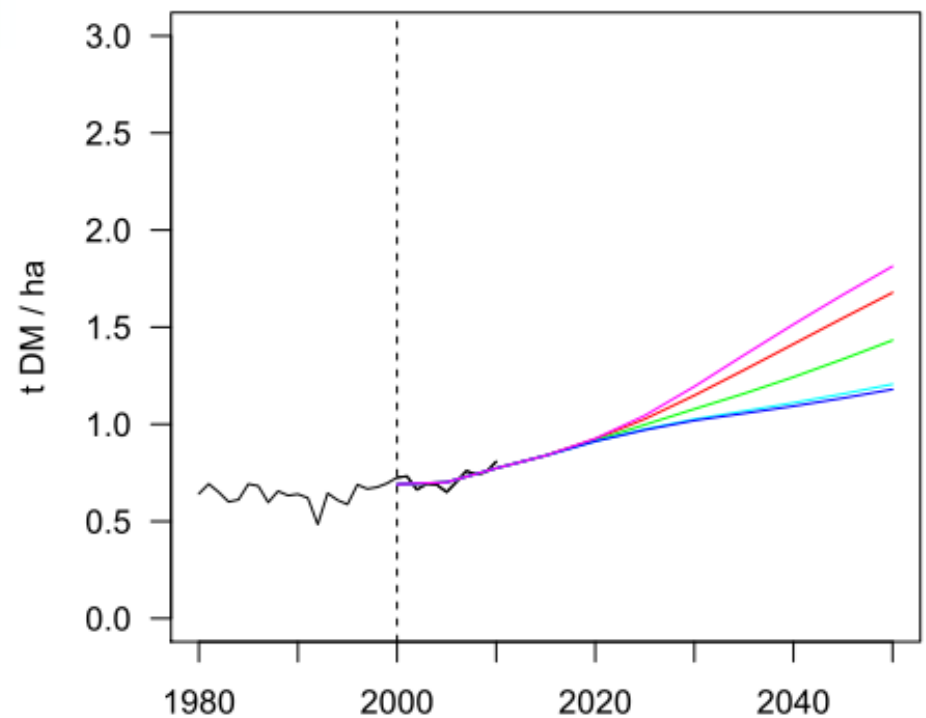
Crop yield developments projected as a function of GDP per capita based on econometric estimation on 1980-2010, and 4 income group clusters.

SSPs: Crop yield development (GLOBIOM)

USAREg Yield CRP17



SouthernAf Yield CRP17

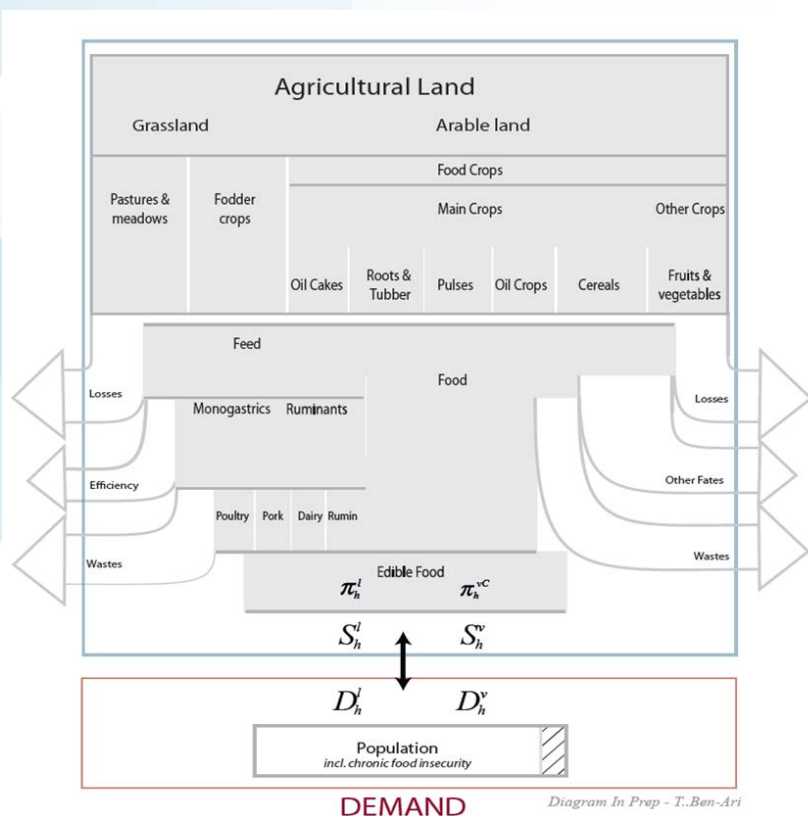


Assumptions about N-intensity of the yield growth:

0.75 – SSP1, 1 – SSP2, 1.25 – SSP3

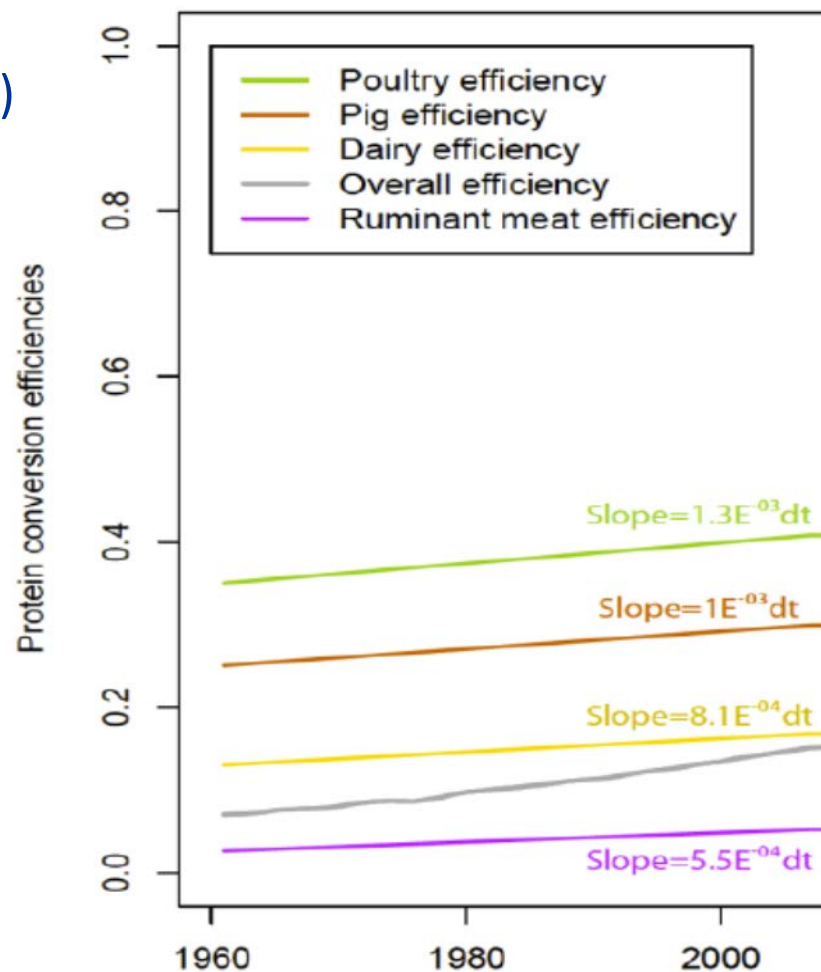
SSPs: Feed conversion efficiencies (GLOBIOM)

Historical FCE not available in FAOSATA
 Decomposed by using an identity
 model AgRIPE (Soussana et al. forthcoming)

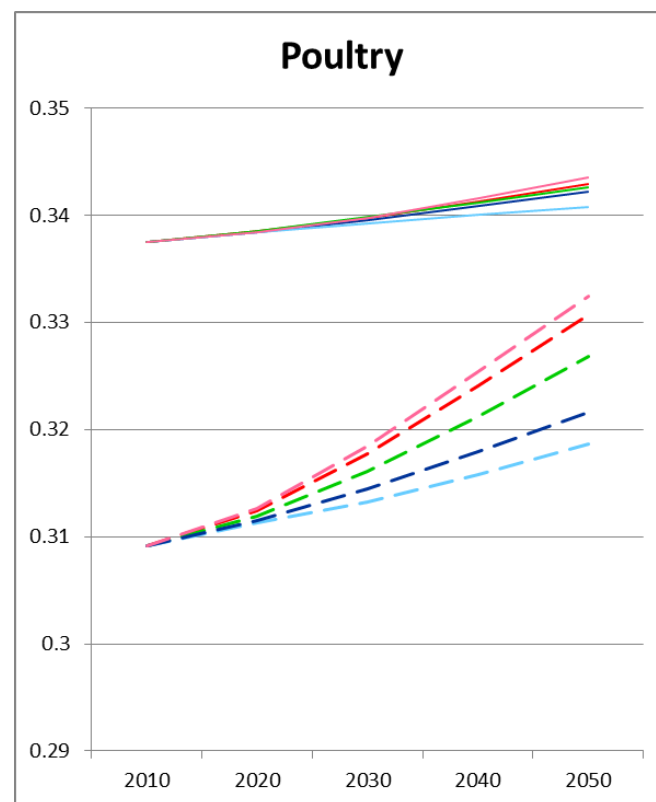
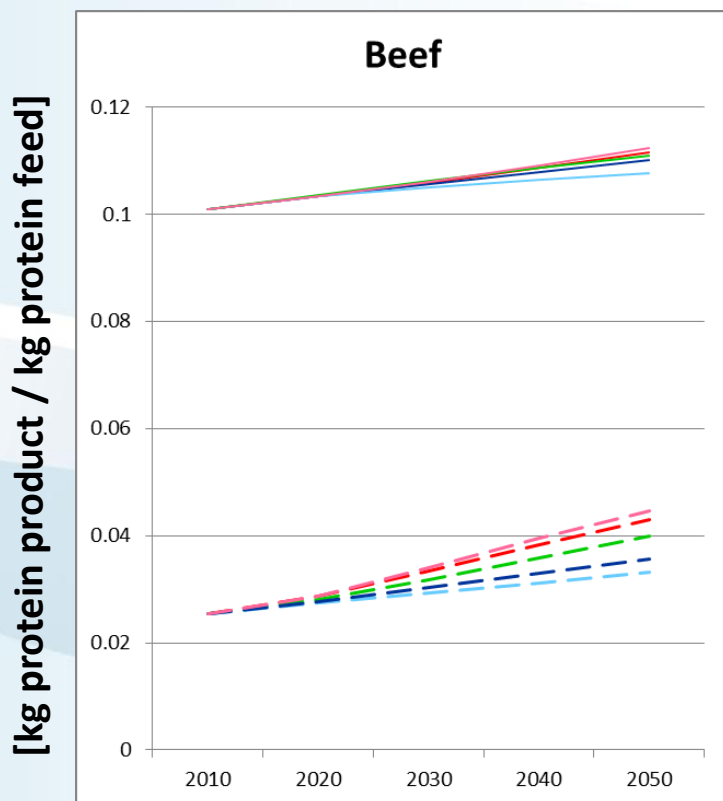


Historical feed conversion efficiencies

[kg protein in product / kg protein in feed]



SSPs: Feed conversion efficiencies (GLOBIOM)



— Europe - SSP1
 — Europe - SSP2
 — Europe - SSP3
 — Europe - SSP4
 — Europe - SSP5
- - SubSaharanAfr - SSP1
 - - SubSaharanAfr - SSP2
 - - SubSaharanAfr - SSP3
 - - SubSaharanAfr - SSP4
 - - SubSaharanAfr - SSP5

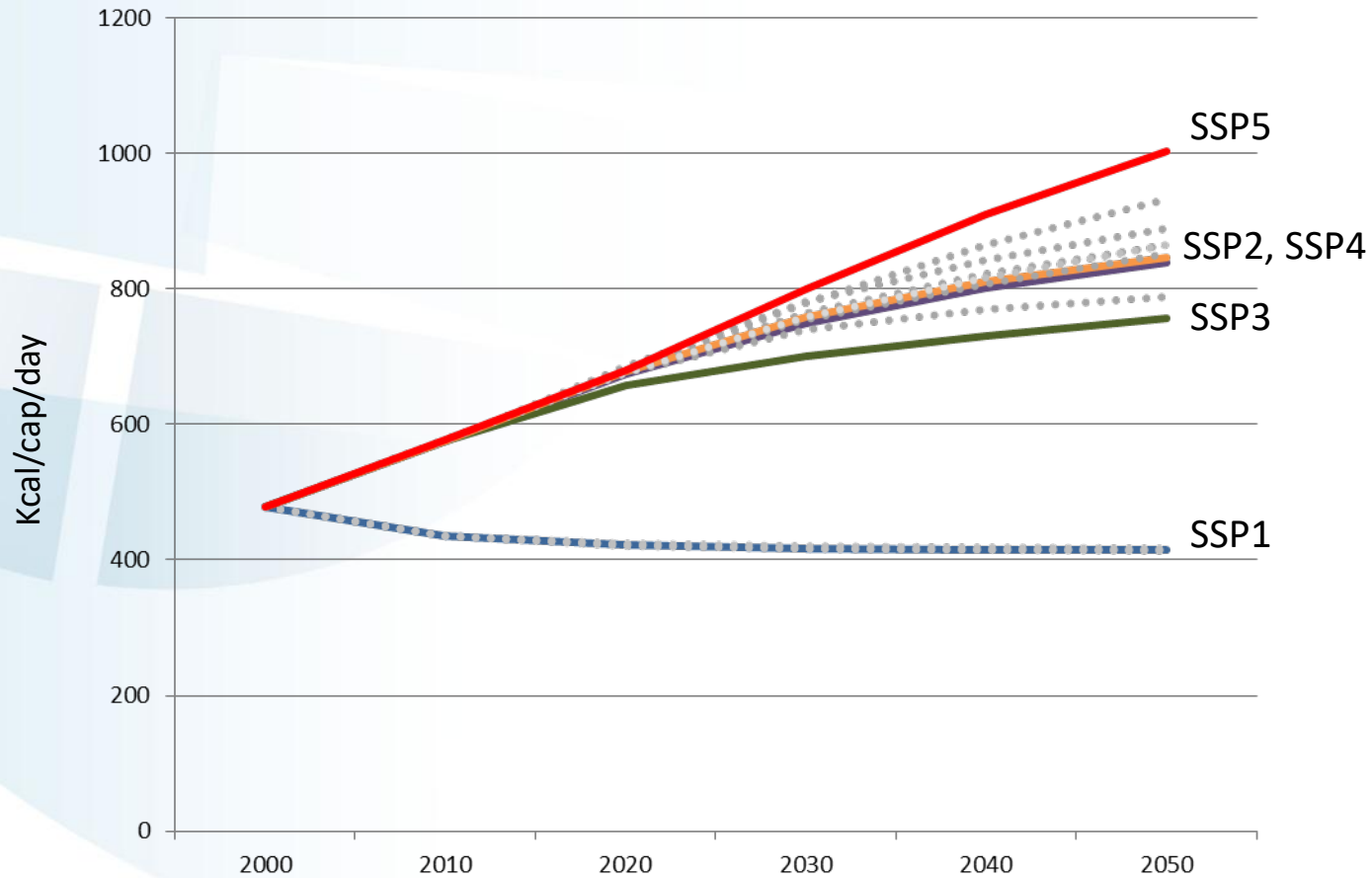
SSPs: Dietary preferences (GLOBIOM)

$$\frac{Q_{i,r,t}}{\bar{Q}_{i,r,t}} = \left(\frac{P_{i,r,t}}{\bar{P}_{i,r,2000}} \right)^{\varepsilon_{i,r,t}^{price}}$$

$$\text{where } \bar{Q}_{i,r,t} = \frac{POP_{r,t}}{POP_{r,2000}} \times \left(\frac{GDP_{r,t}^{cap}}{GDP_{r,2000}^{cap}} \right)^{\varepsilon_{i,r,t}^{GDP}} \times \bar{Q}_{i,r,2000}$$

- **SSP2** - these future diets follow the projections from FAO at the horizon 2050 through income elasticities re-calibration
- **SSP1** - future diets are considered to be more sustainable than in the FAO baseline, elasticities recalibrated to reflect
 - Countries converge to 3300 kcal/cap/d only
 - If anim conso > 75 g prot./cap/day ? reduction to that level
 - If anim conso < 25 g prot./cap/day ? increase to that level
 - red meat decreased or capped at 5 g prot./cap/day for all
- **SSP5** - Countries converge to diets of USA & Europe composition

China – Animal products food consumption



SSPs: Losses and wastes (GLOBIOM)

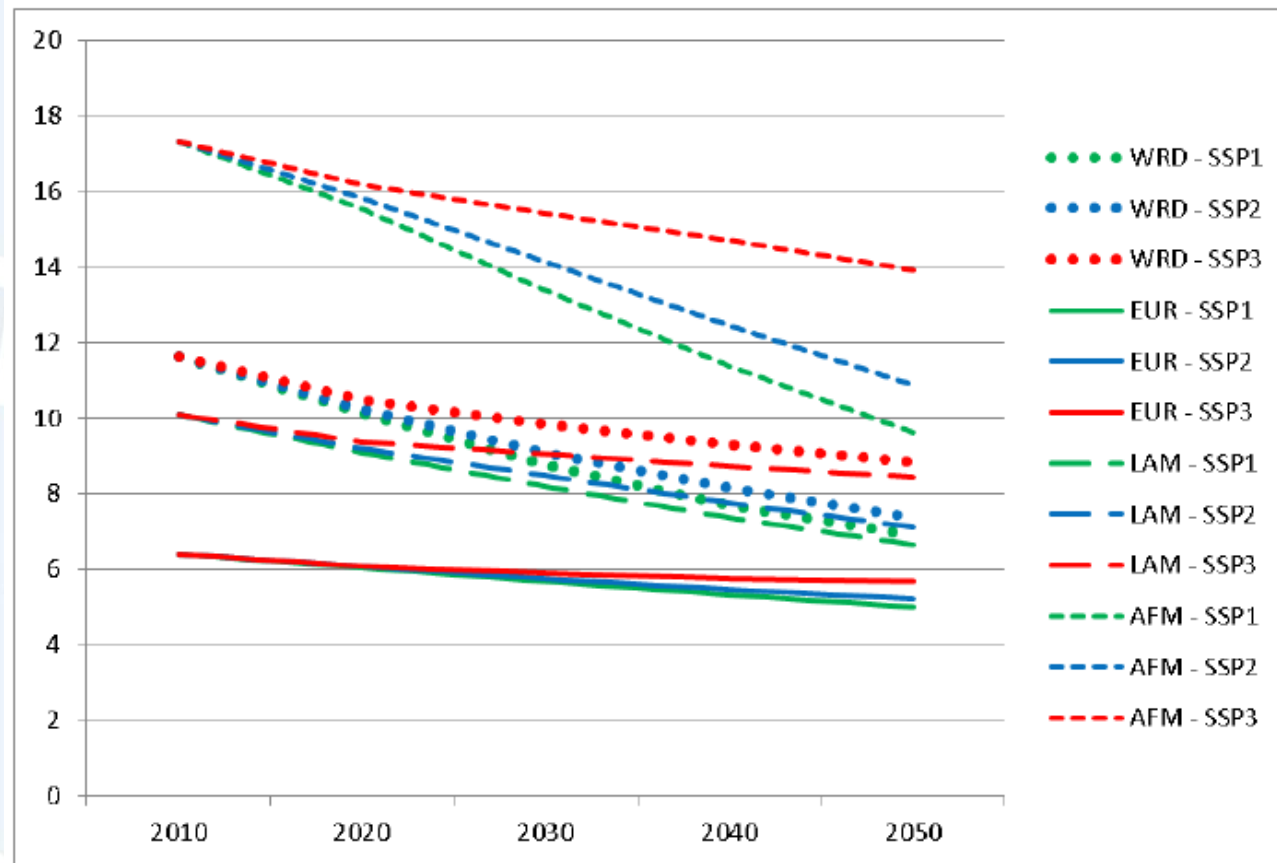
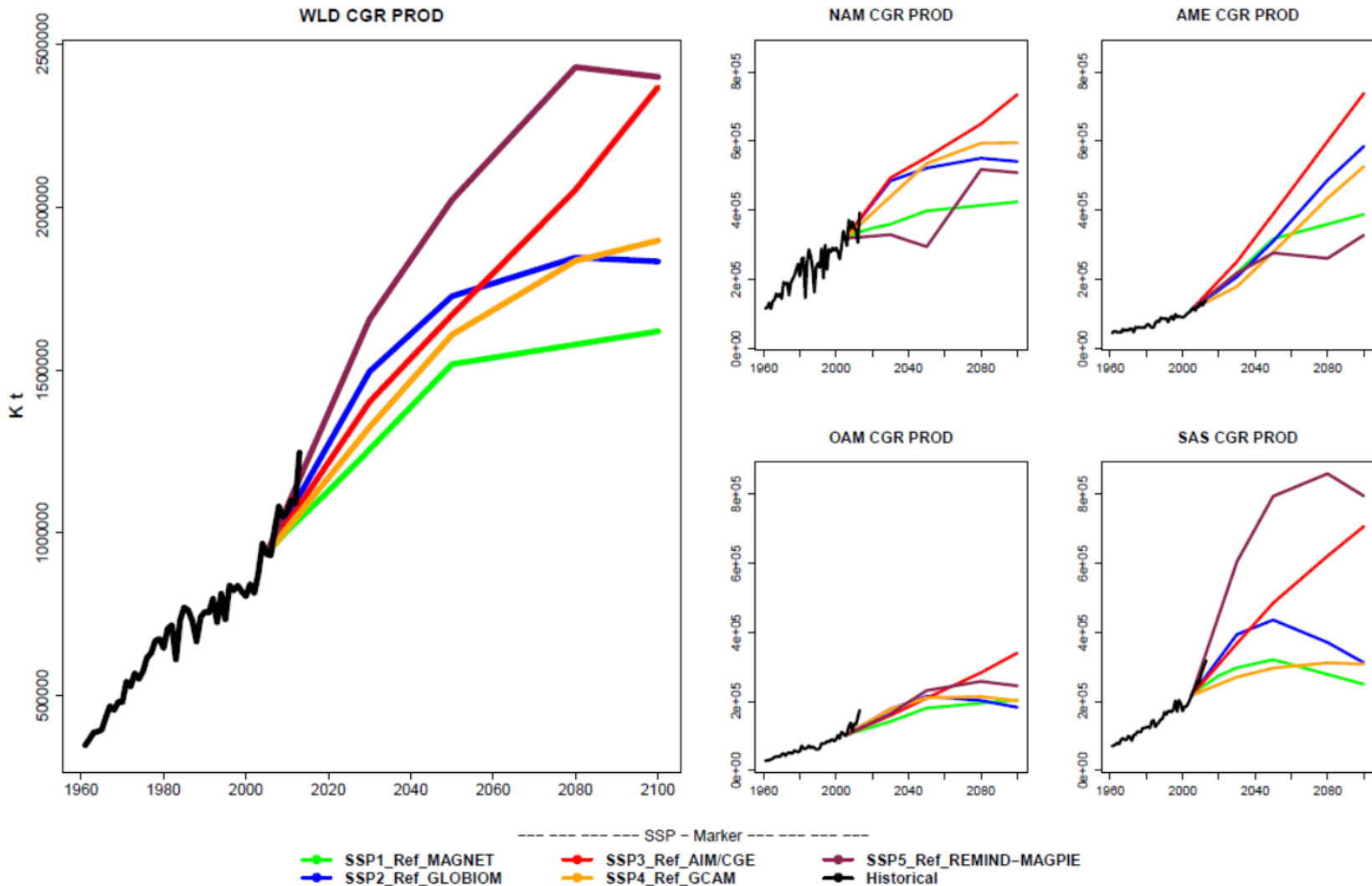


Figure 8: Losses and wastes development in the Oilseeds&Pulses sector [%].

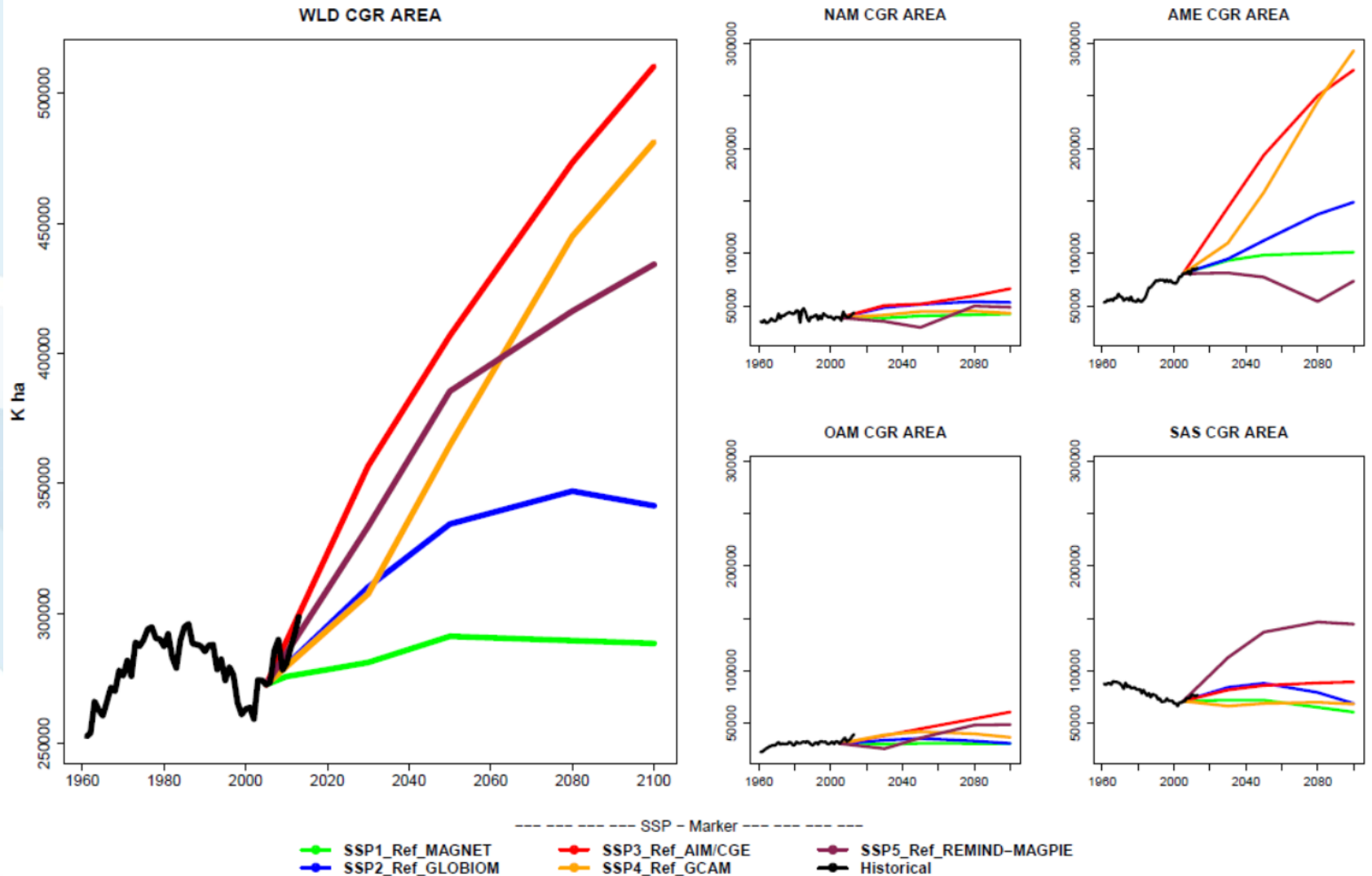
SSPs: Marker scenarios

- ▶ **For each SSP, one model selected as reference - marker**
 - ▶ SSP1: **IMAGE-MAGNET** (van Vuuren et al. GEC 2017)
 - ▶ SSP2: **MESSAGE-GLOBIOM** (Fricko et al. GEC 2017)
 - ▶ SSP3: **AIM/CGE** (Fujimori et al. GEC 2017)
 - ▶ SSP4: **GCAM** (Calvin et al. GEC 2017)
 - ▶ SSP5: **REMIND-MAGPIE** (Kriegler et al. GEC 2017)
- ▶ Summary of land use related results (Popp et al. GEC 2017)

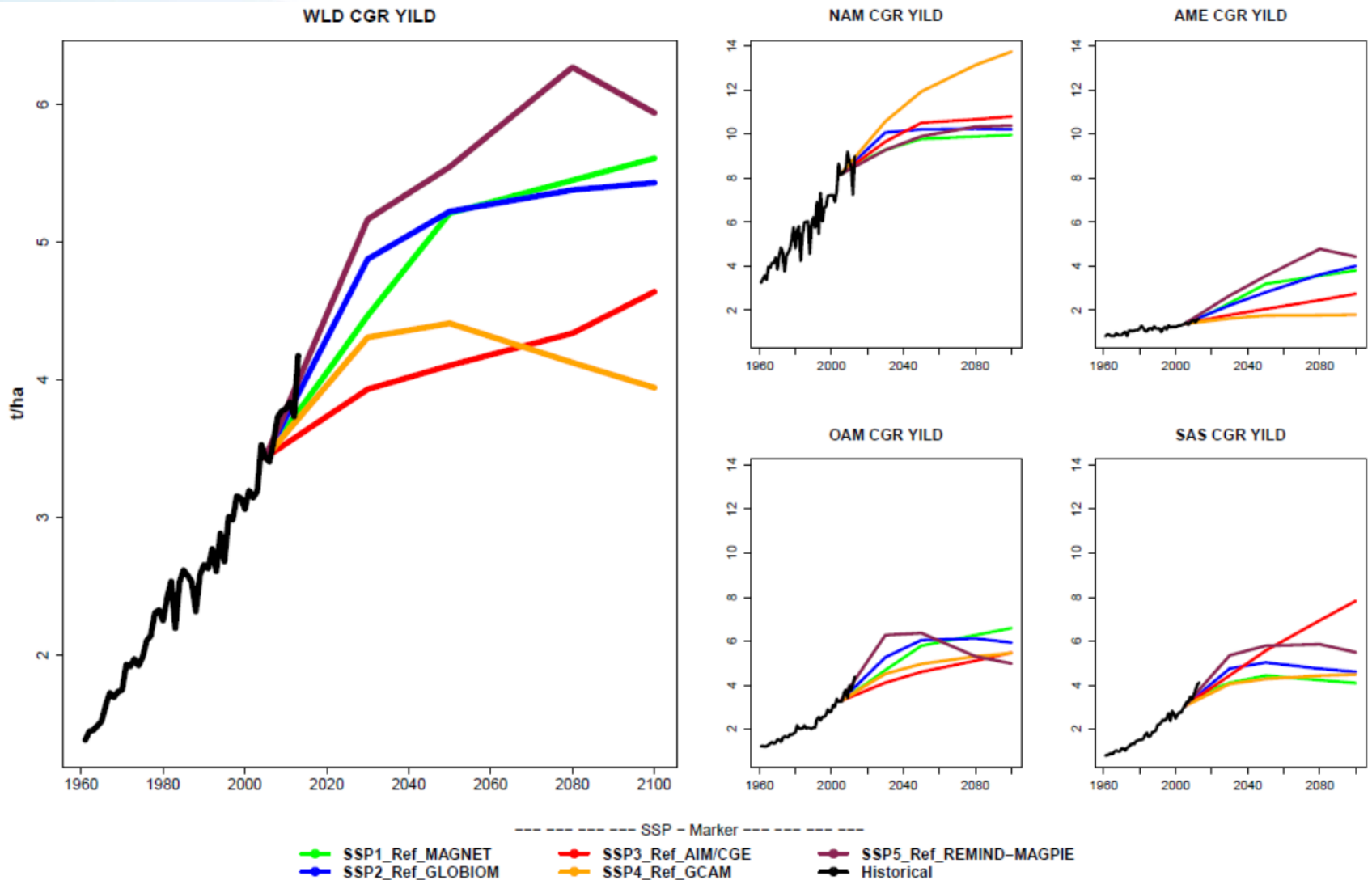
SSPs results: Coarse grains production



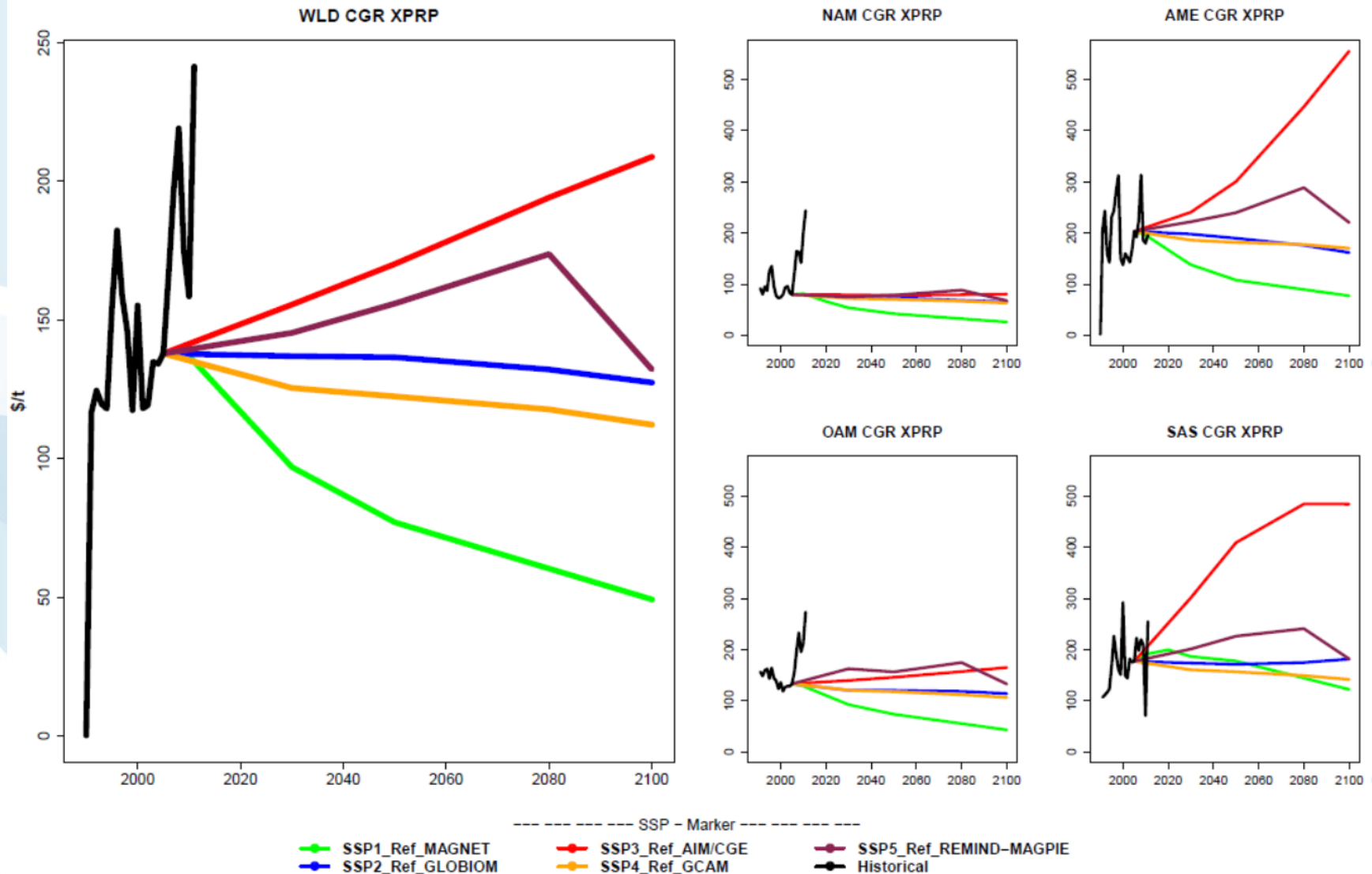
SSPs results: Coarse grains area



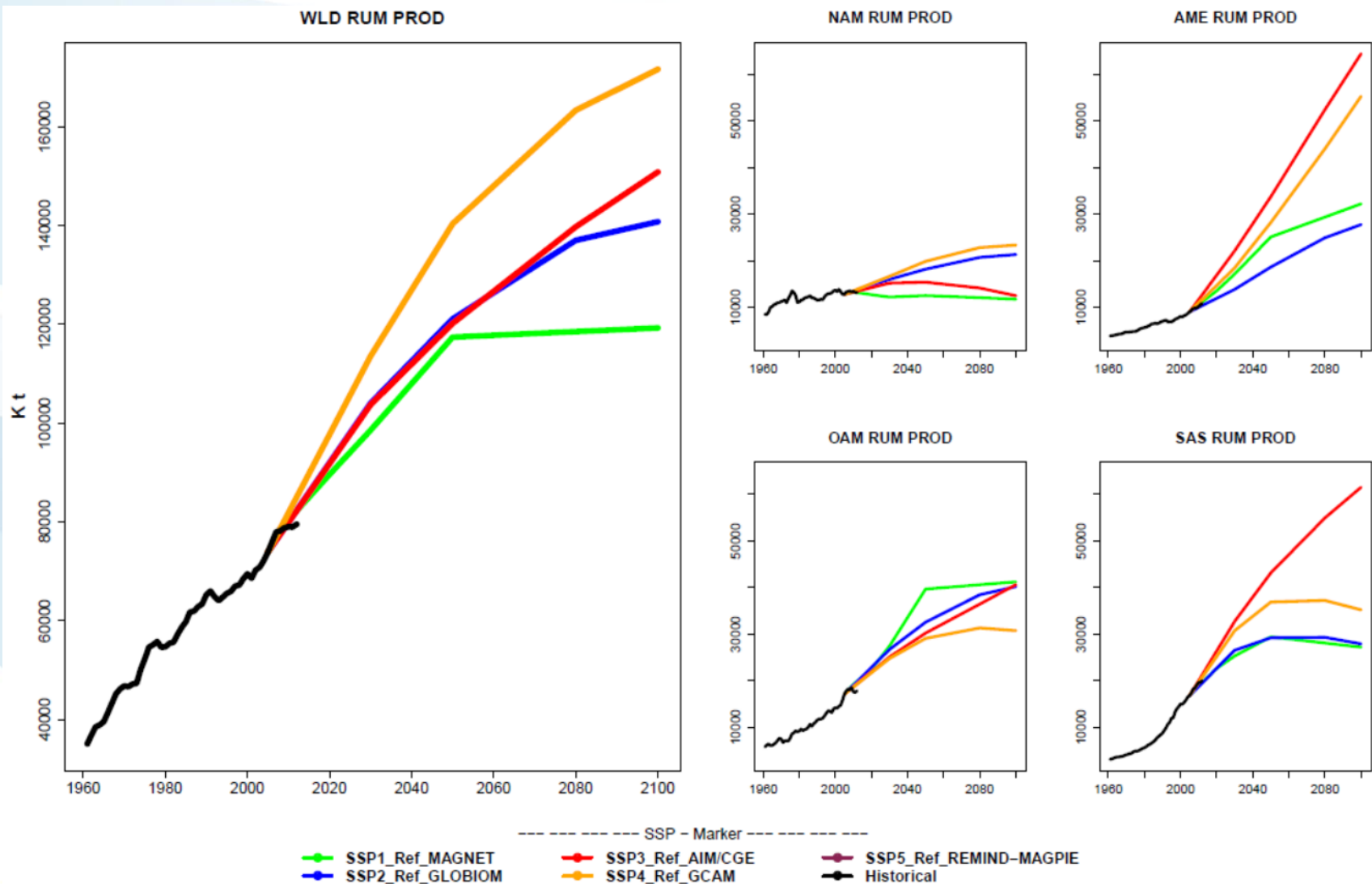
SSPs results: Coarse grains yields



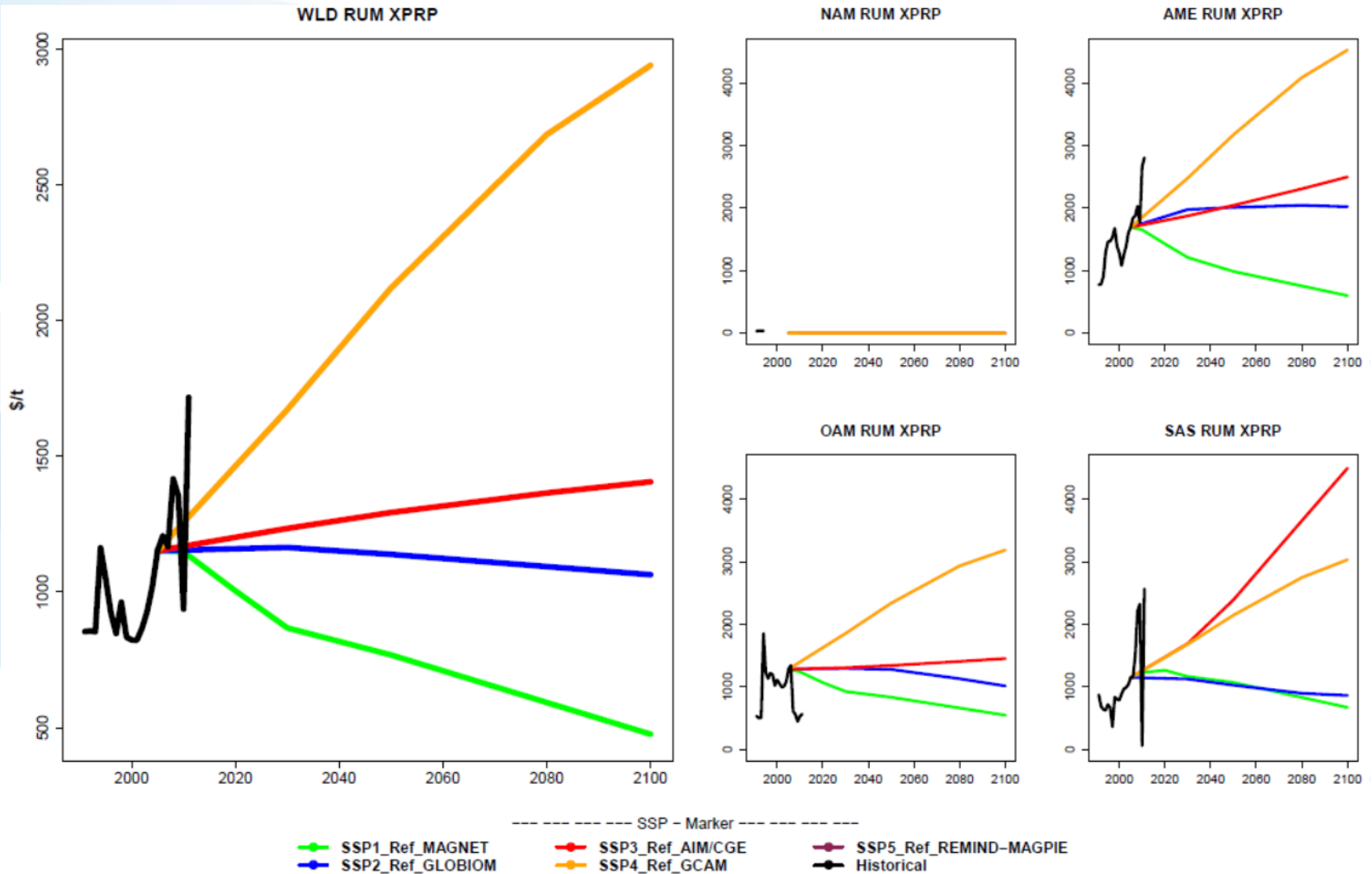
SSPs results: Coarse grains prices



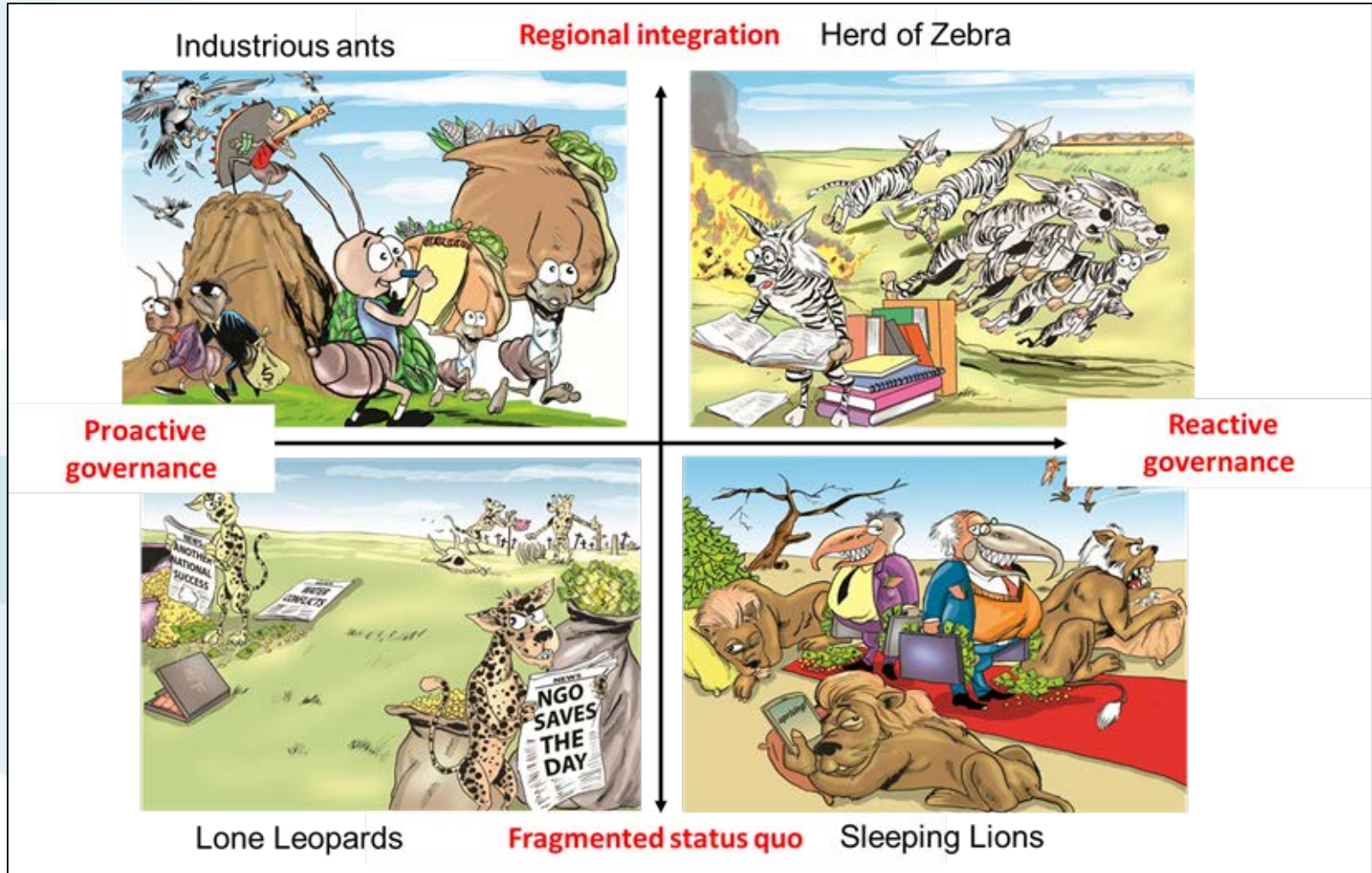
SSPs results: Ruminant production



SSPs results: Ruminant prices



SSPs: Regional applications



Palazzo et al. GEC 2017