



# Food and nutrition security in Europe – a quantification of multi- stakeholder scenarios

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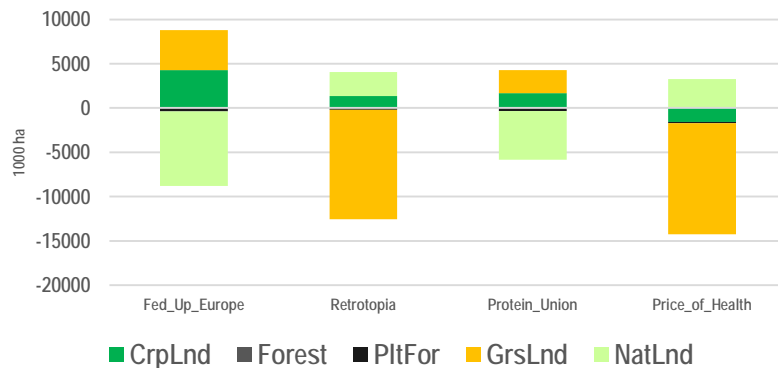
## Identification of global drivers of change



## Narratives for EU focused scenarios from a stakeholder workshop (TRANSMANGO project)



## Quantification of scenarios with Agricultural Sector Model GLOBIOM



# Stakeholder process for scenarios

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## ▶ **A pool of stakeholders**

- ▶ Institutional bodies: European Commission, MS Ministries
- ▶ Academics
- ▶ Private actors of the agrifood chain
- ▶ NGOs

## ▶ **A three-stage process with consultation on:**

- ▶ i. consult on relevant drivers → selection of 8 most important + CC
  - ▶ Consumption patterns, envtl degradation, poverty & inequality, social & technical innovation, urban/rural population dynamics, market concentration, trade agreements, resource use
- ▶ ii. stages in drivers (e.g., 'rising' inequality + 'stable' population + degraded 'evnt') → elimination of impossible combinations & selection of 4 contrasted ones (OLDFAR model)
- ▶ iii. Further characterization of the 4 narratives

# Explorative Scenarios - narratives

## Fed up Europe

- unhealthy diets
- negative environmental impacts
- low poverty but high inequality
- low innovation but free markets
- resource crisis

## The Retrotopia

- migrants are kept out
- greying societies
- unhealthy vegan/vegetarians
- low poverty with low inequality
- high innovation
- protected markets

## The Protein Union

- creating new sources of protein
- high meat then insects & art. meat
- high poverty, low inequality
- high innovation
- protected markets
- resource scarcity

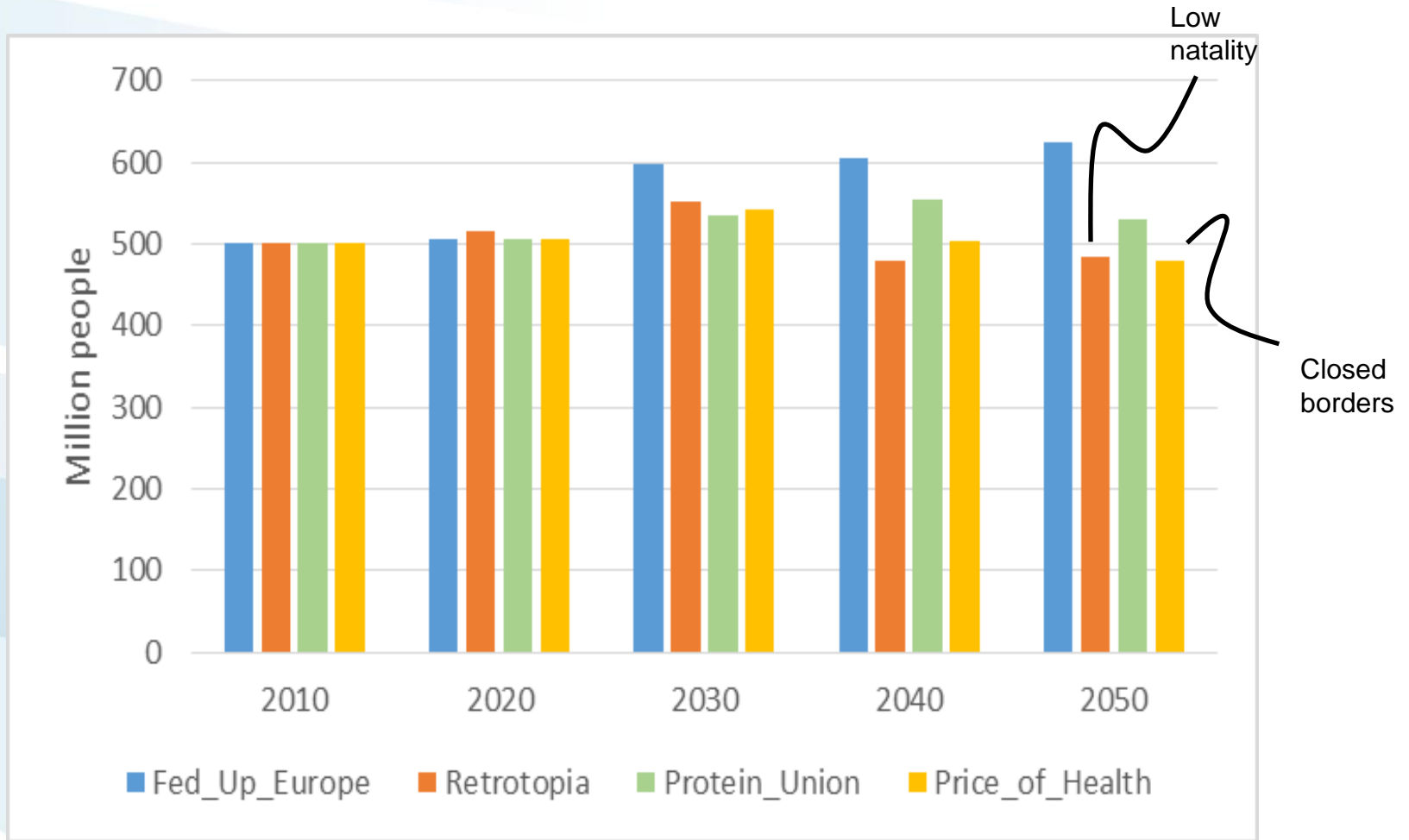
## The Price of Health

- Europeans returning to rural lives
- strong government
- healthy vegan/vegetarian food
- high poverty and inequality
- high innovation
- protected markets

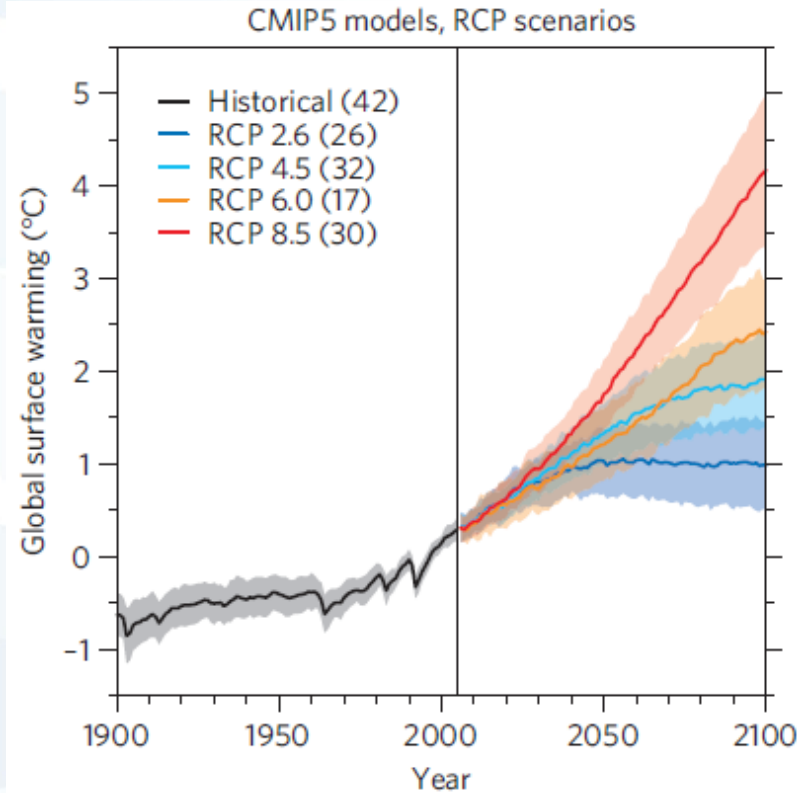
# Stakeholder process for scenarios

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    - ▶ elimination of imp. combinations & selection of 4 narratives (OLDFAR model)
  - ▶ iii. Further characterization of the 4 narratives
- ▶ **Scenario quantification** (based on SSP & RCP scenarios)

# Population – EU28



# Climate scenario development



## Perturbation

## Climate

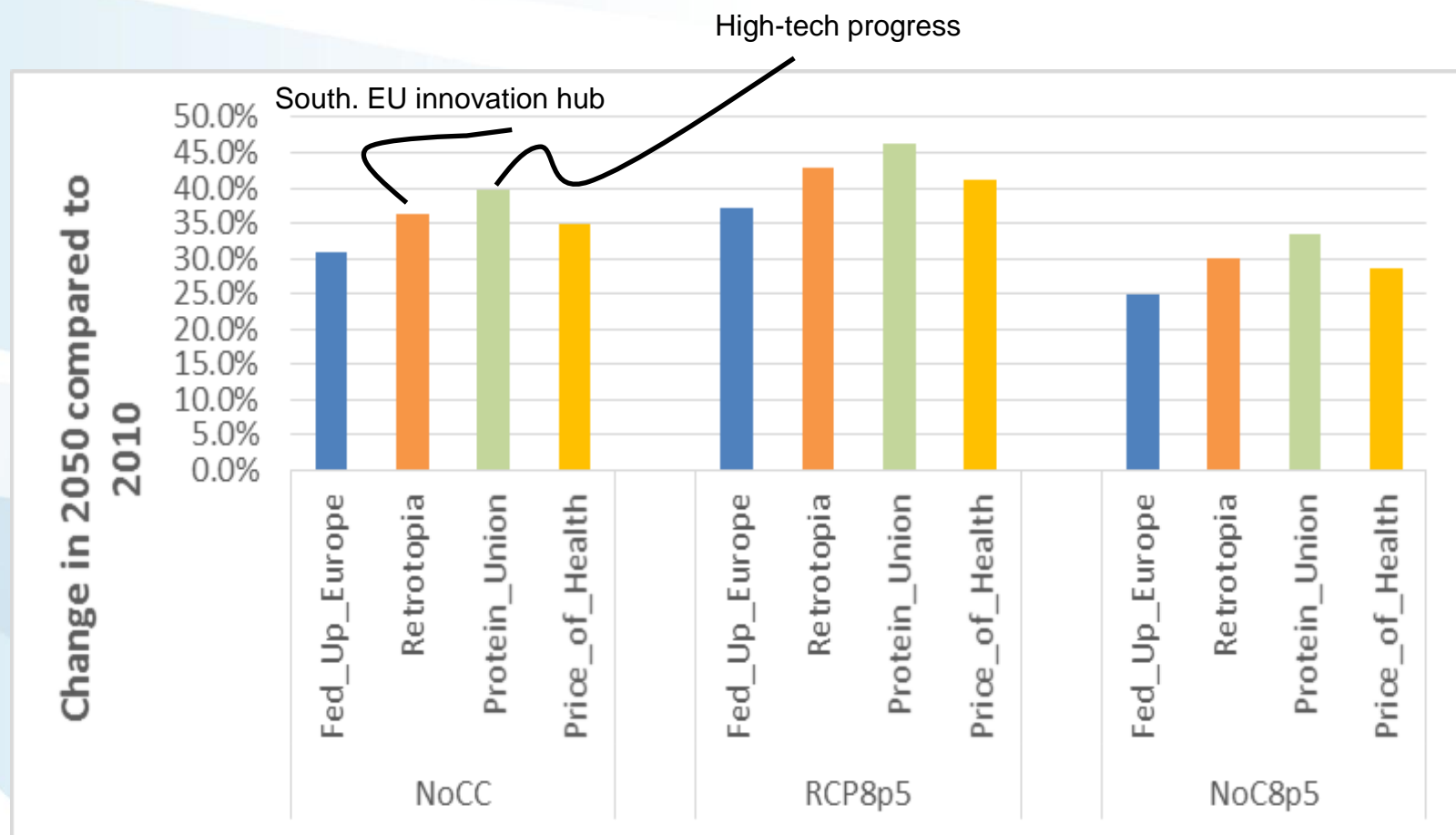
## Biophysical

## Economic





# Yield changes for cereals in EU28



NoCC – no climate change

Rcp8p5 – climate change impacts with CO<sup>2</sup> fertilization effects

NoC8p5 – without CO<sup>2</sup> fertilization effect

# Exogenous livestock production efficiency changes



## **Further assumption on:**

- Diet preferences**
- Trade openness**
- etc.**

# The model

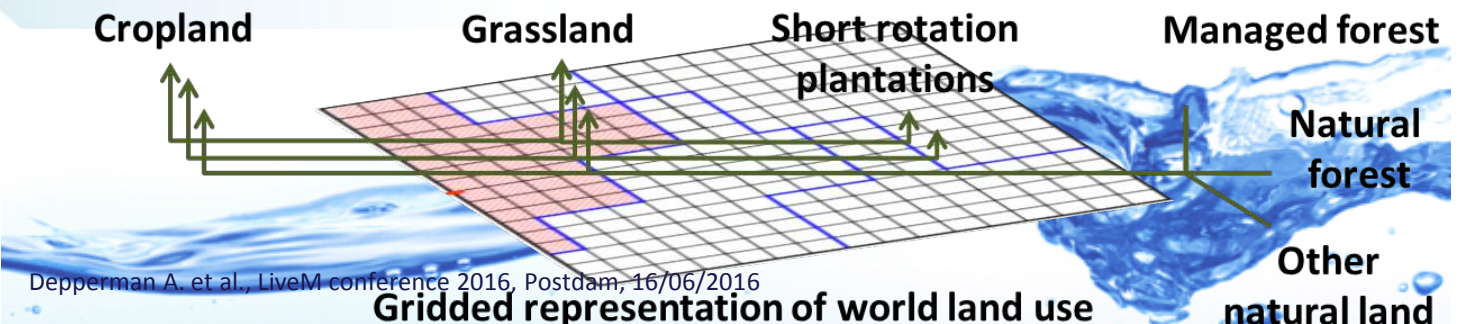
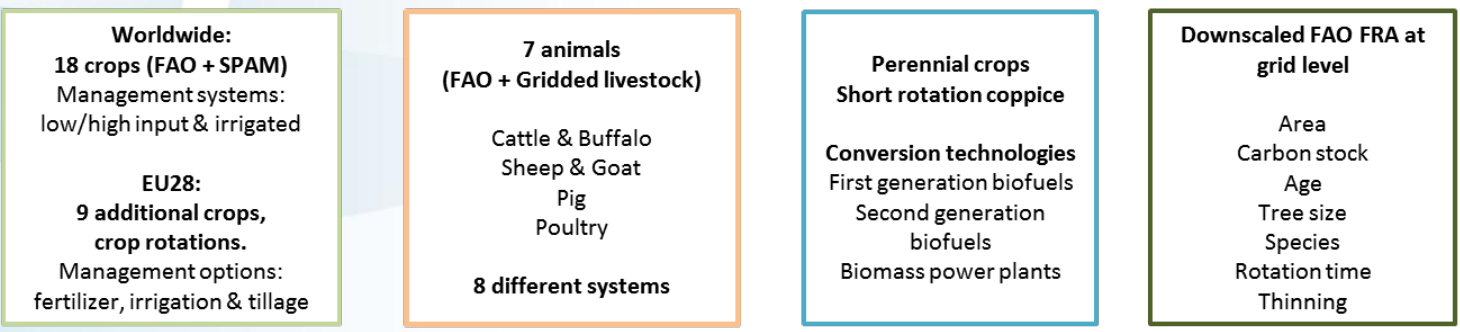
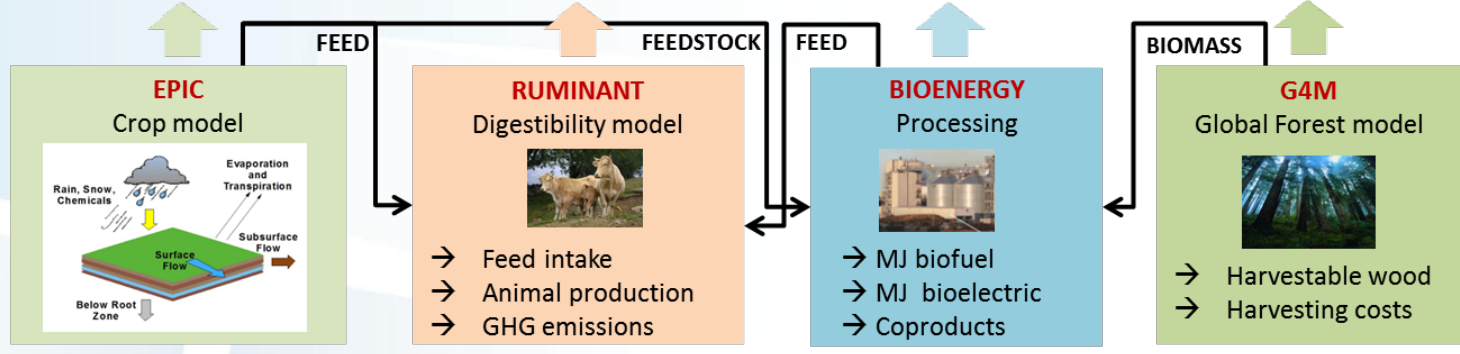
# GLOBIOM

- ▶ **Global scale model based detailed spatial resolution (>200k cells)**
- ▶ **Partial equilibrium**
  - ▶ Agricultural, wood and bioenergy markets
  - ▶ 30 world regions
  - ▶ Bilateral trade flows based on spatial equilibrium approach
- ▶ **Bottom-up approach**
  - ▶ Explicit description of production technologies a la Leontief
  - ▶ Technologies specified by production system and grid cell
- ▶ **Linear programming approach**
  - ▶ Maximization of consumer + producer (incl. trade costs) surplus
  - ▶ Non linear expansion costs
  - ▶ Optimization constraints
- ▶ **Base year: 2000**
- ▶ **Time step: 10 years, time horizon: 2030/2050 but also 2100**

Population, GDP, consumer preferences

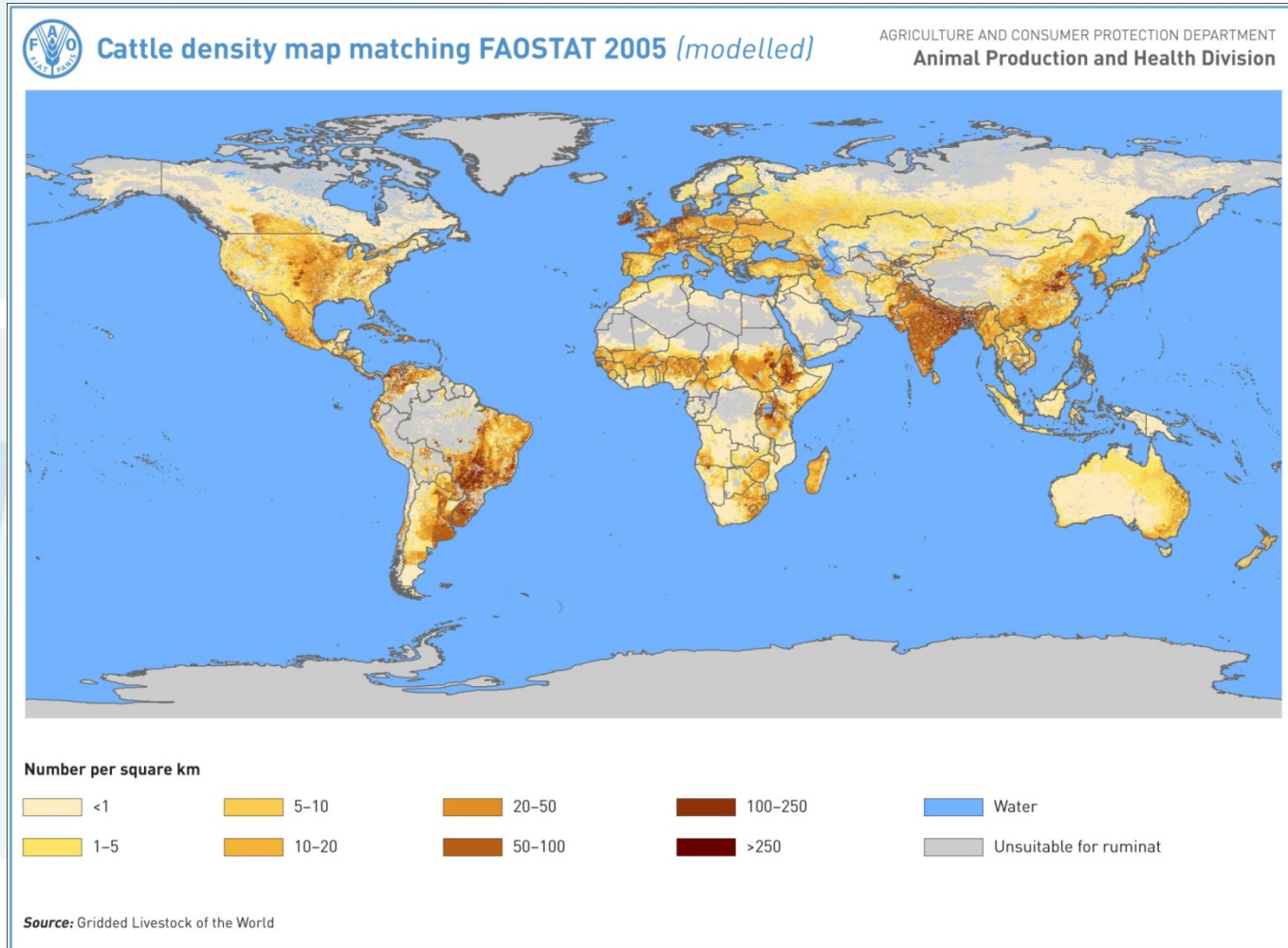


Demand  
Markets  
Production  
Land use  
Land cover



# Livestock

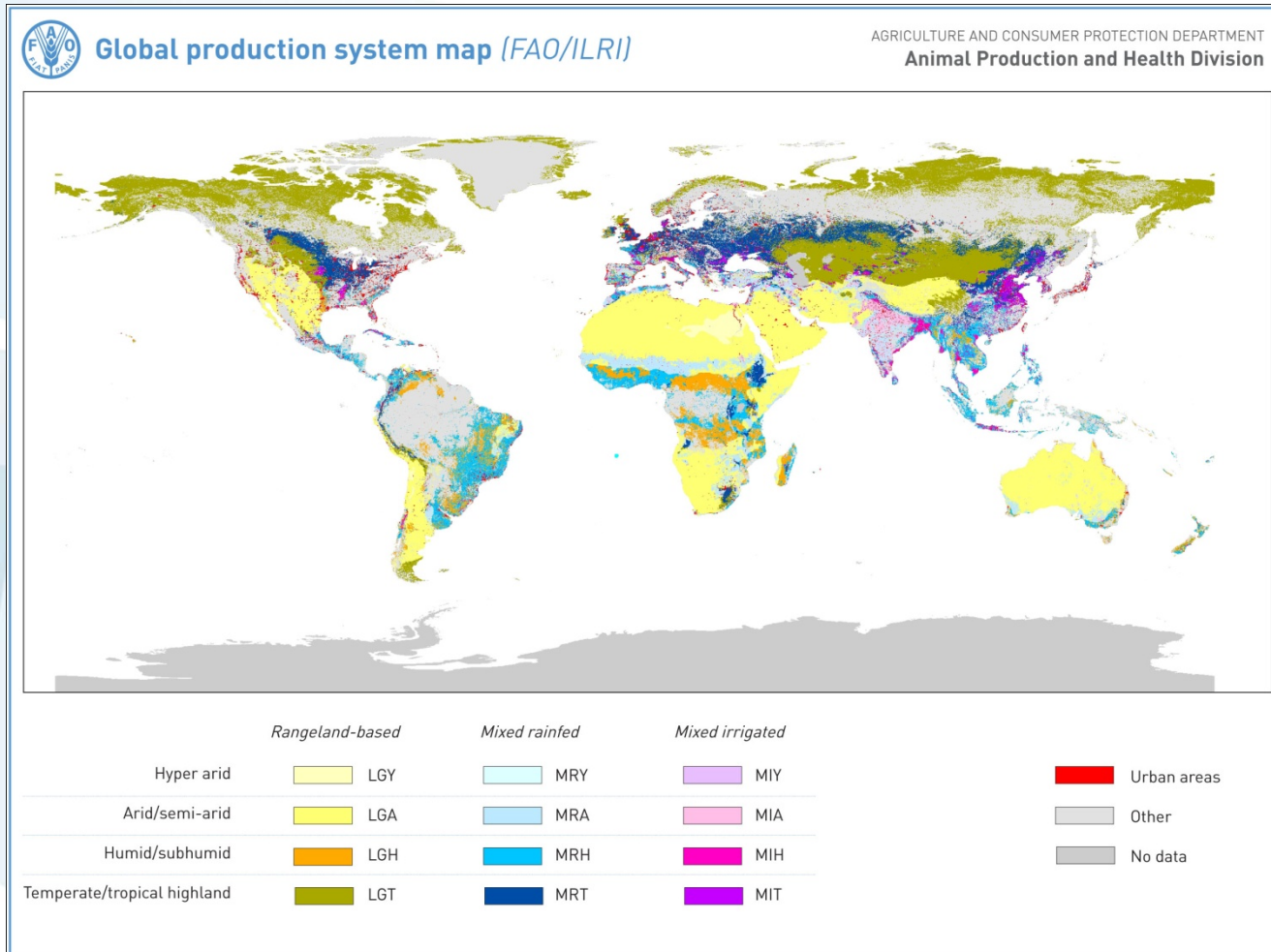
## Gridded Livestock of the World – Robinson et al. (2011)





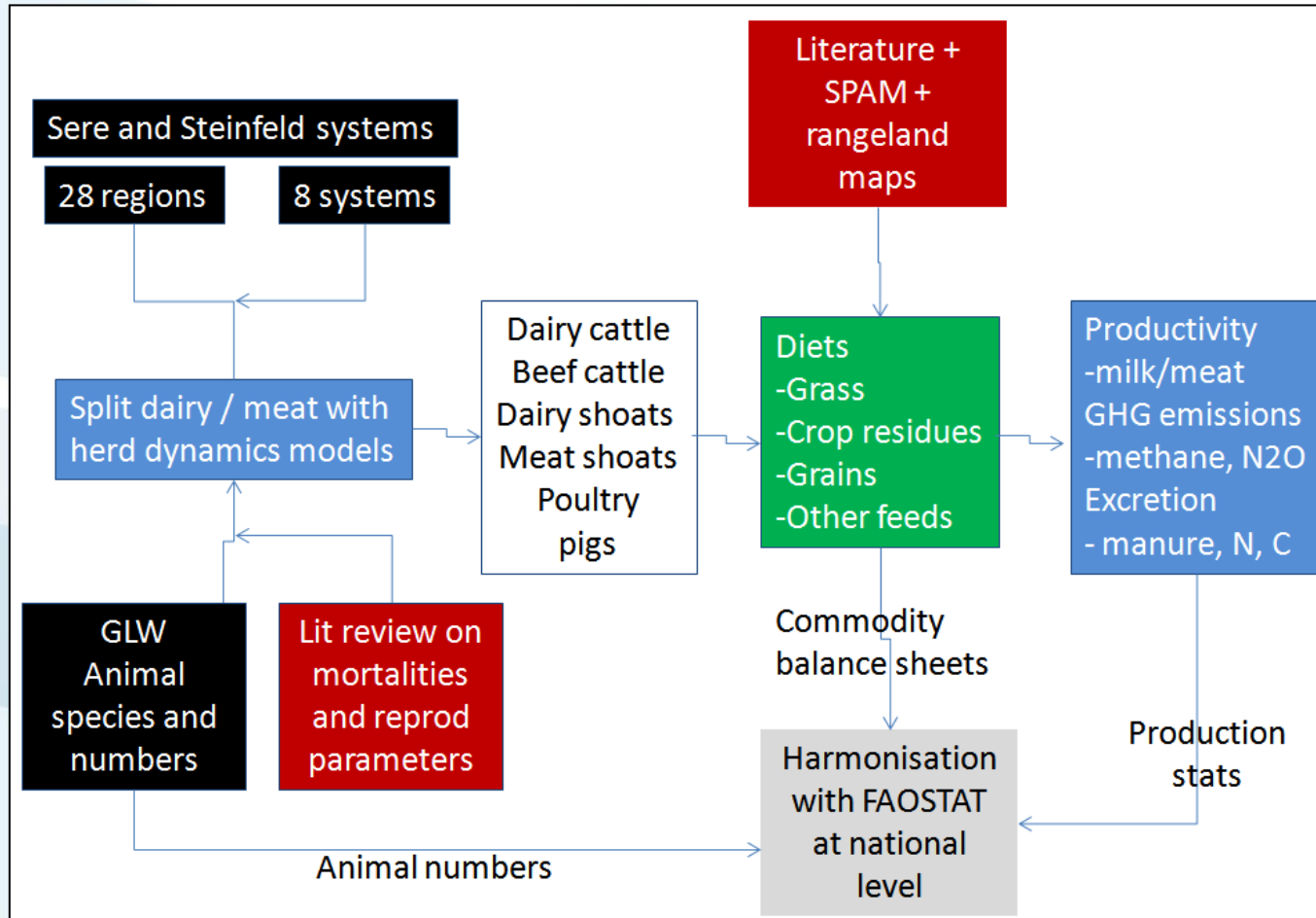
# Livestock production systems distribution

Sere and Steinfeld (1996) classification updated by Robinson et al. (2011)



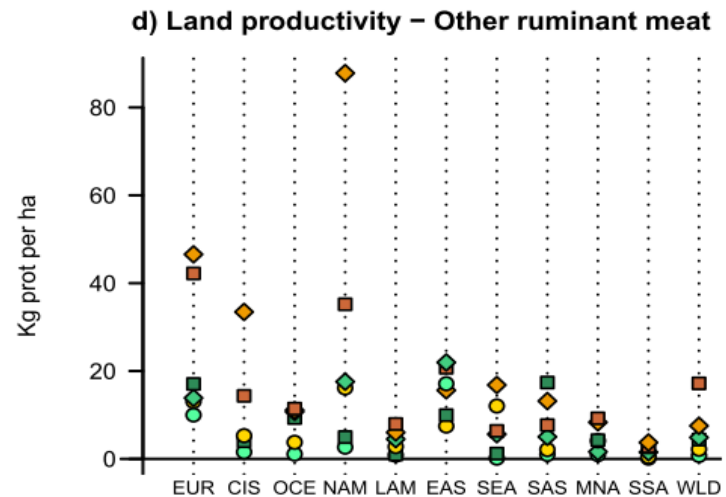
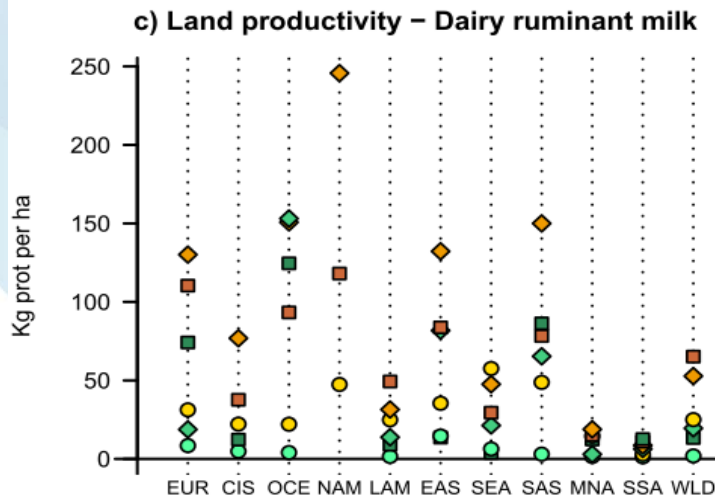
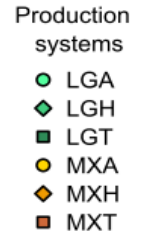
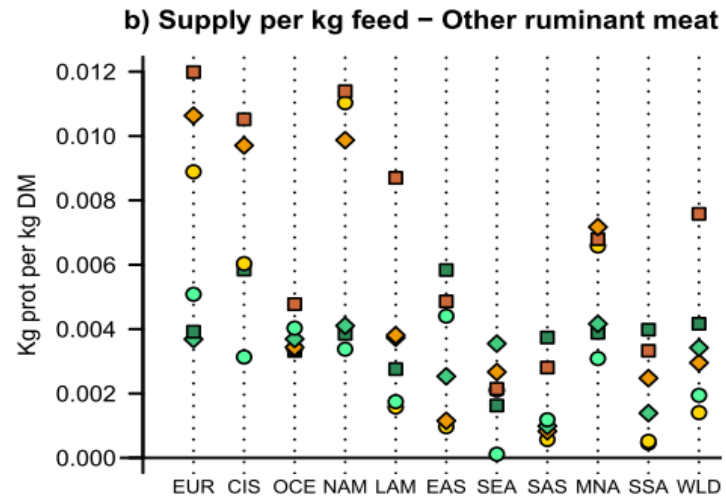
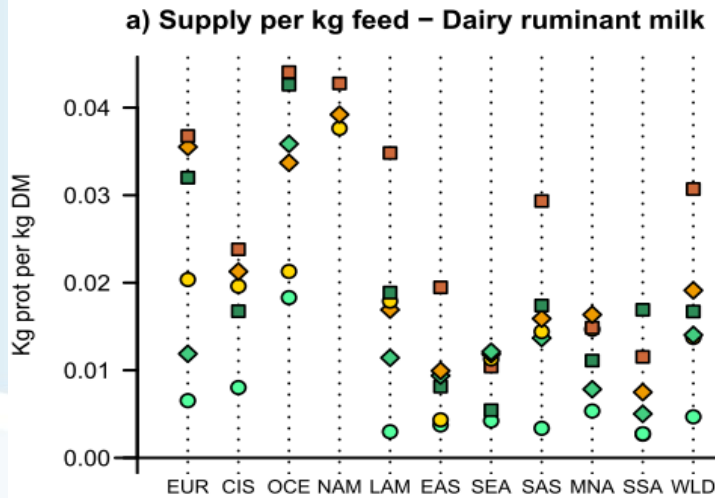


# Production systems parameterization



Herrero et al. (2013)

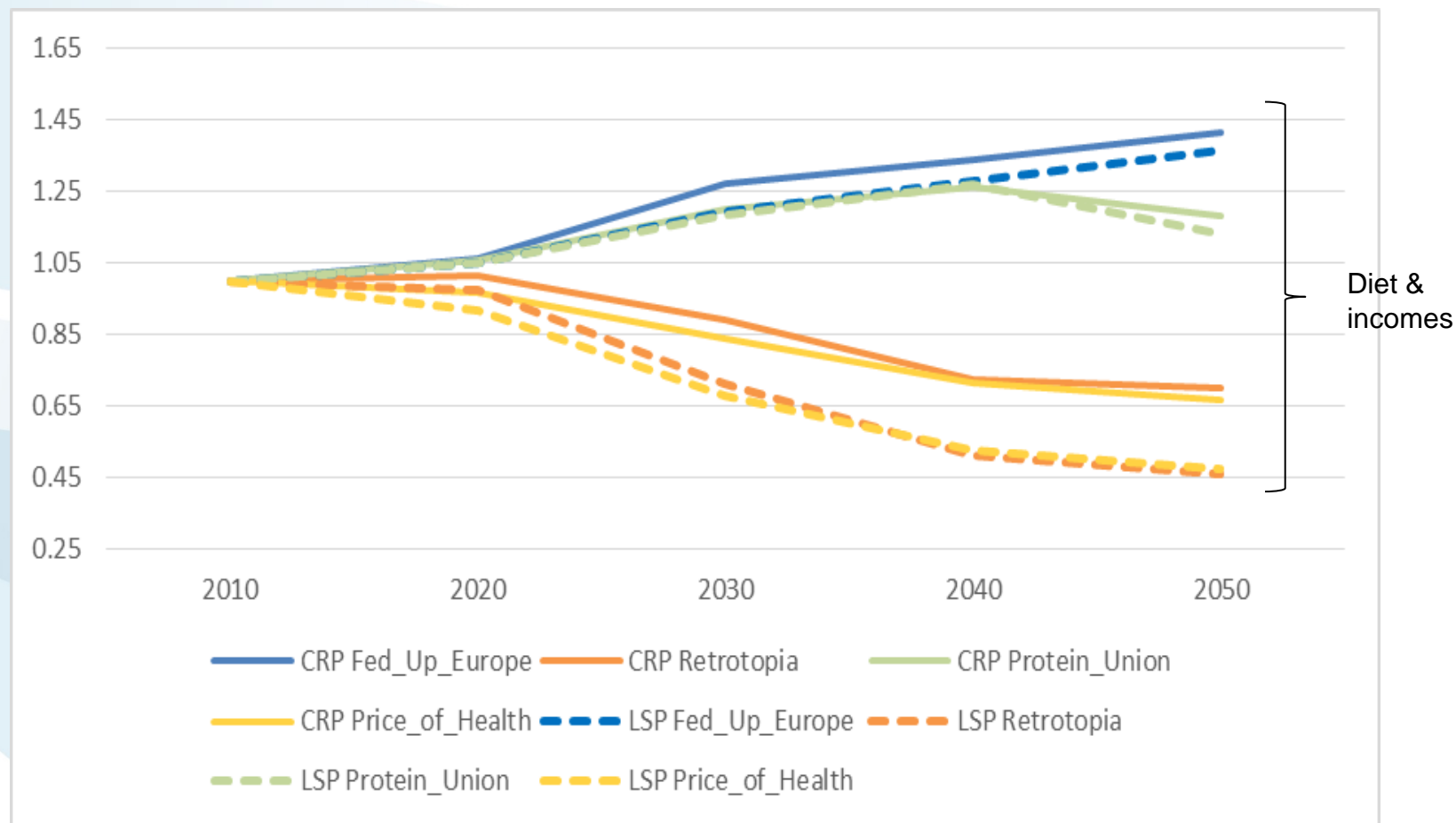
# Ruminant production efficiency



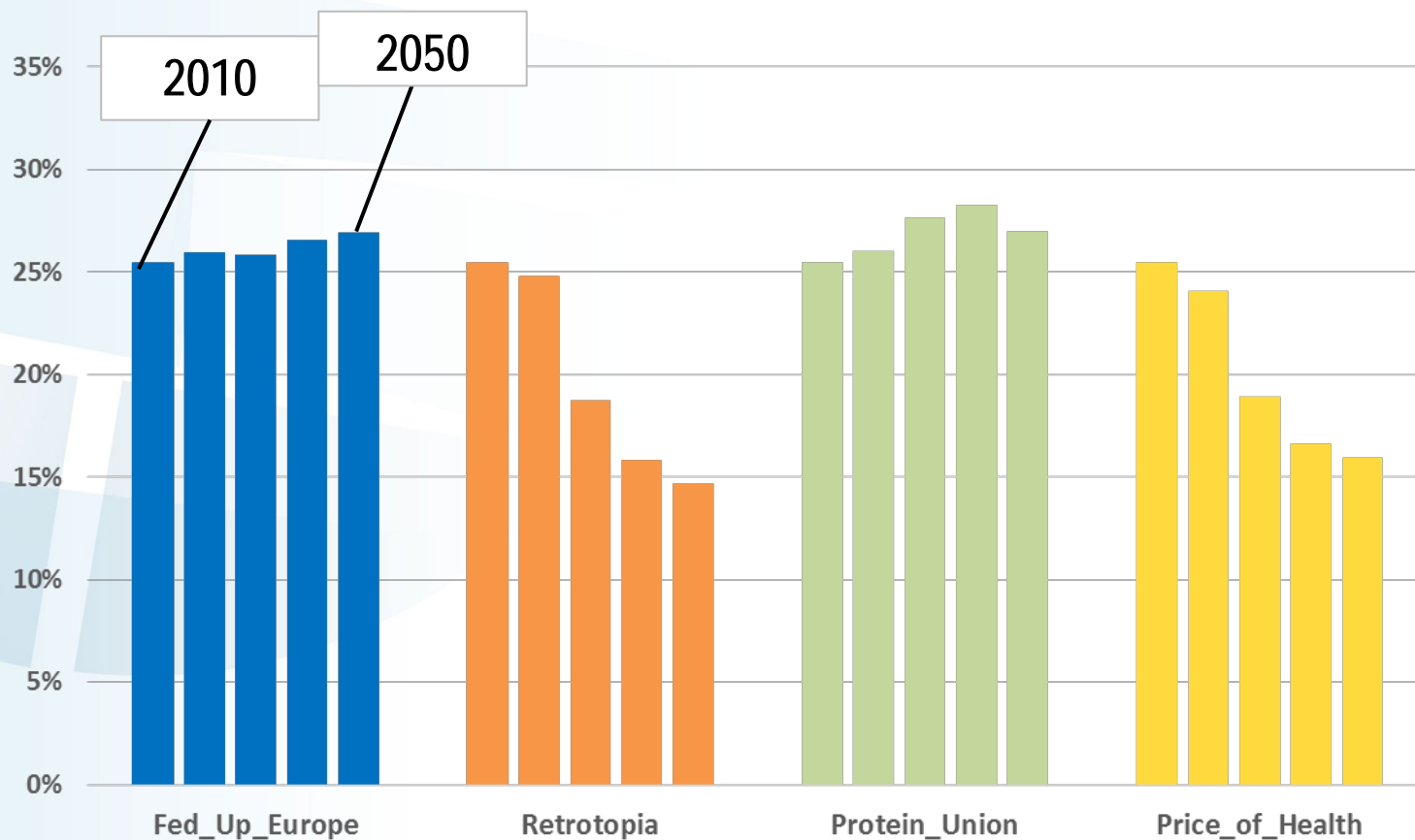
Herrero et al. (2013)

# RESULTS

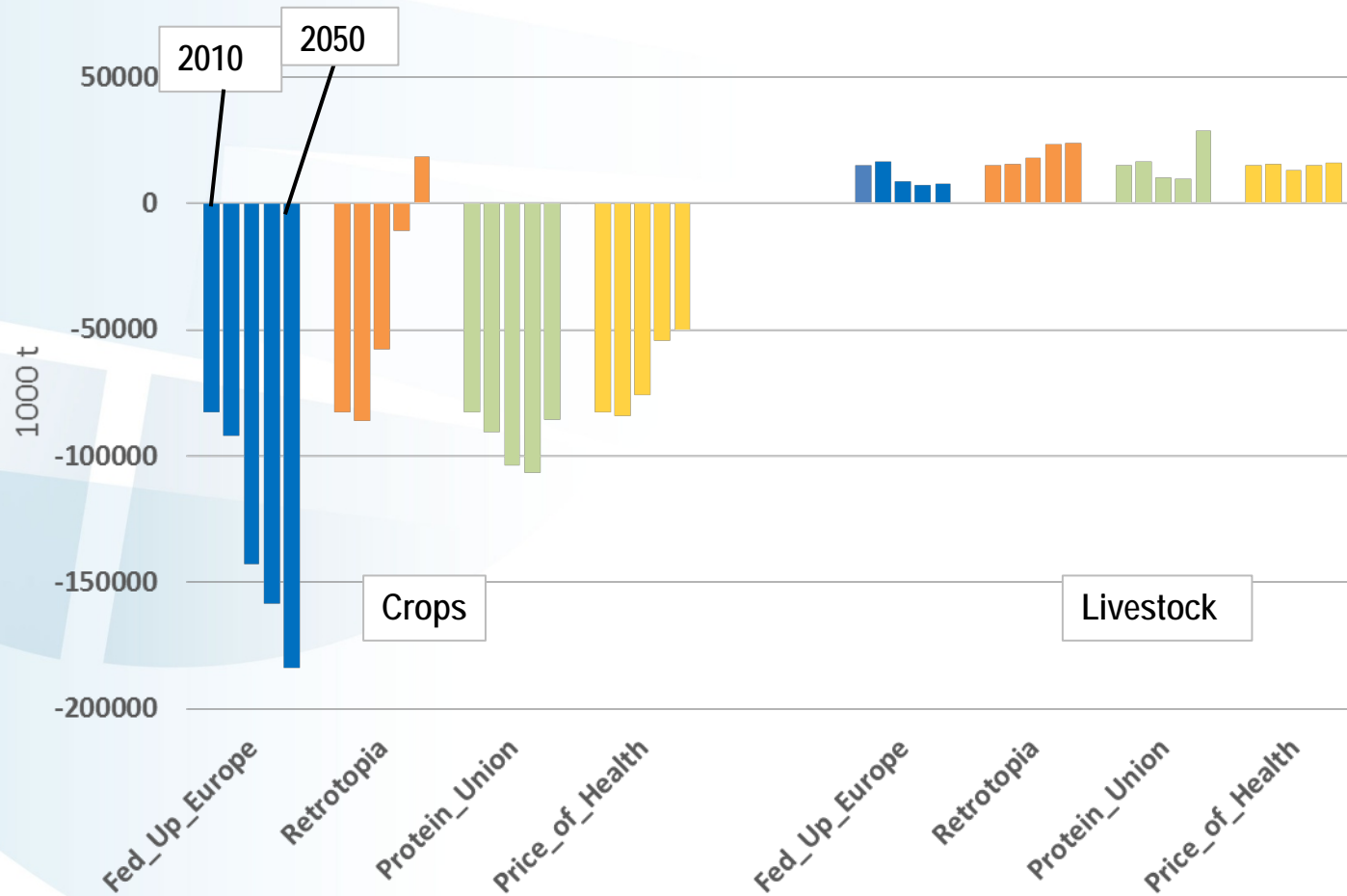
# Domestic use of crops (CRP) and livestock products (LSP) in the EU28 (Index 2010 = 1)



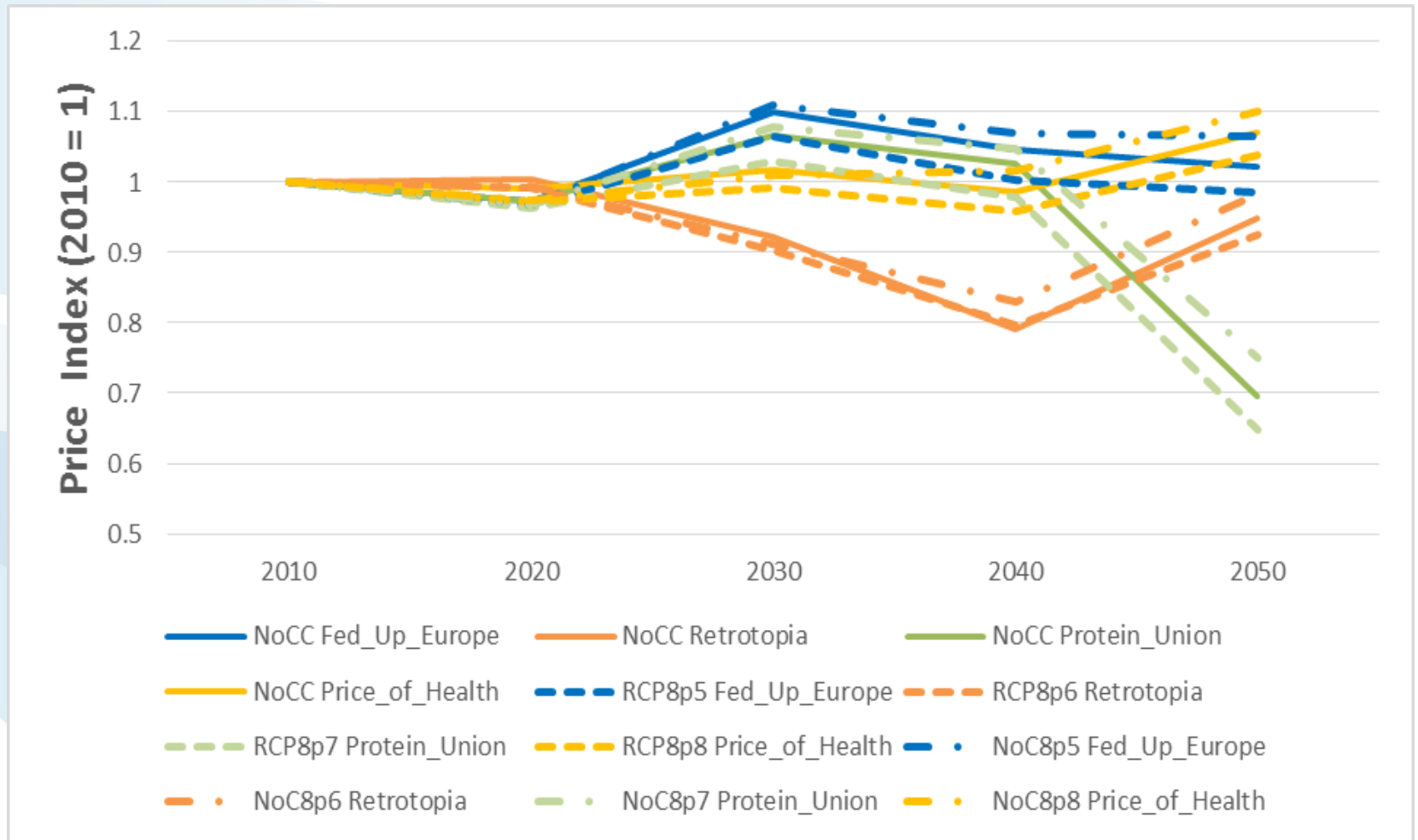
# Shares of calories from milk and meat in EU28 diet



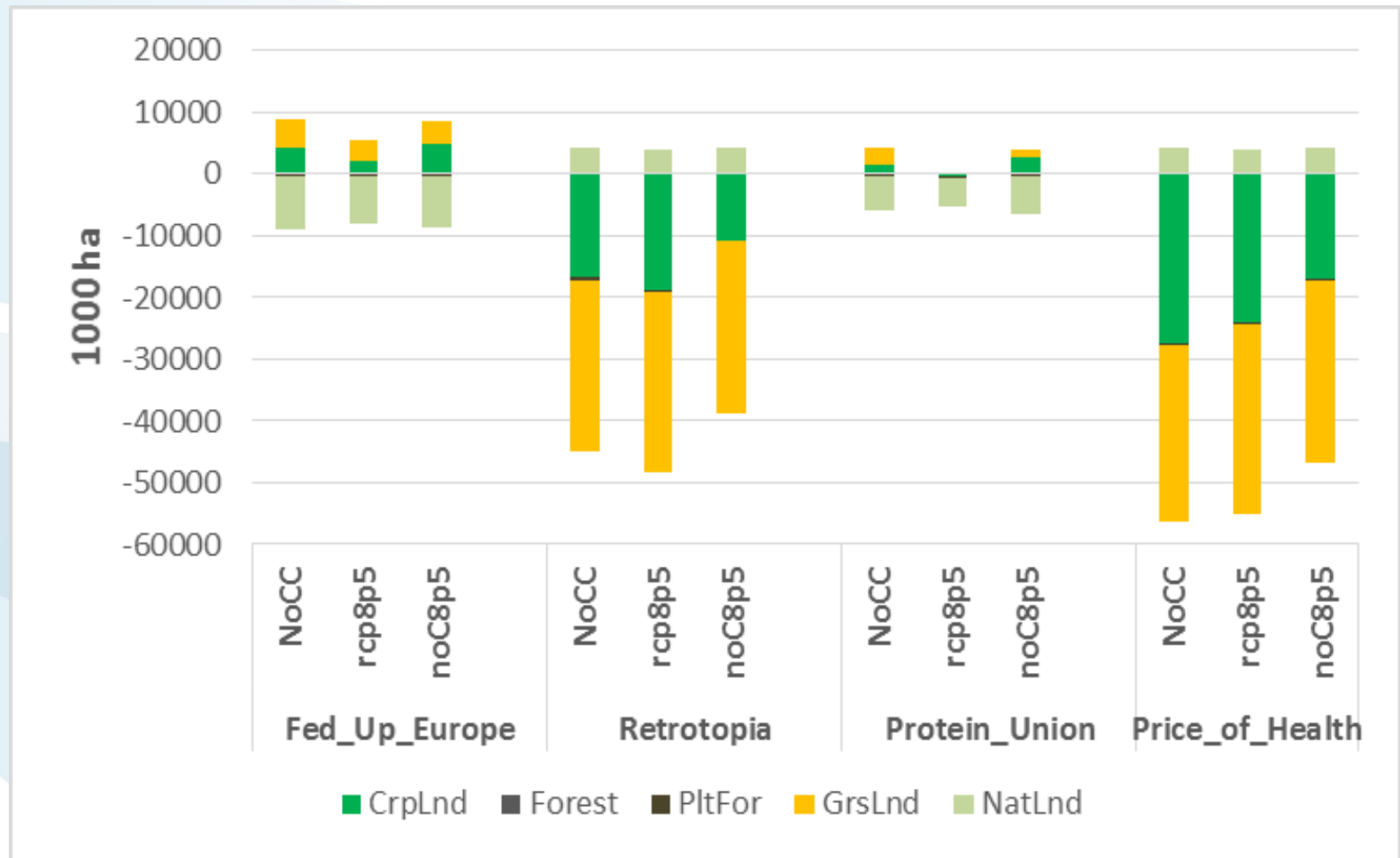
# Net trade (production – consumption) in EU28



# EU28 price developments for *livestock products*



# Land use change in 1000 ha by land cover class at EU28 level in 2050 compared to 2010





## Further results available on:

- Commodity specific results (beef, milk, wheat...)
  - Production quantities
  - Feed ratios
  - Fertilizer use
  - Water consumption for irrigation
  - Emissions
  - ...
  - + Results for the rest of the world
  - + Climate change
- **Potential future connection with regional/local livestock sector (case) studies**

# Implications for the livestock sector

- Main driver: exogenous preference changes (→ towards vegetarian diets in 2 scenarios)
- Livestock production follows demand trends
- Trade compensates partly
- Less pasture and cropland use, lower GHG emissions, less fertilization
- Main production side drivers:
  - environmental legislation (GHG taxes)
  - technical progress
- Drive prices



**Thank you !**

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