Climate Impacts, Adaptation, Mitigation and Agronomy

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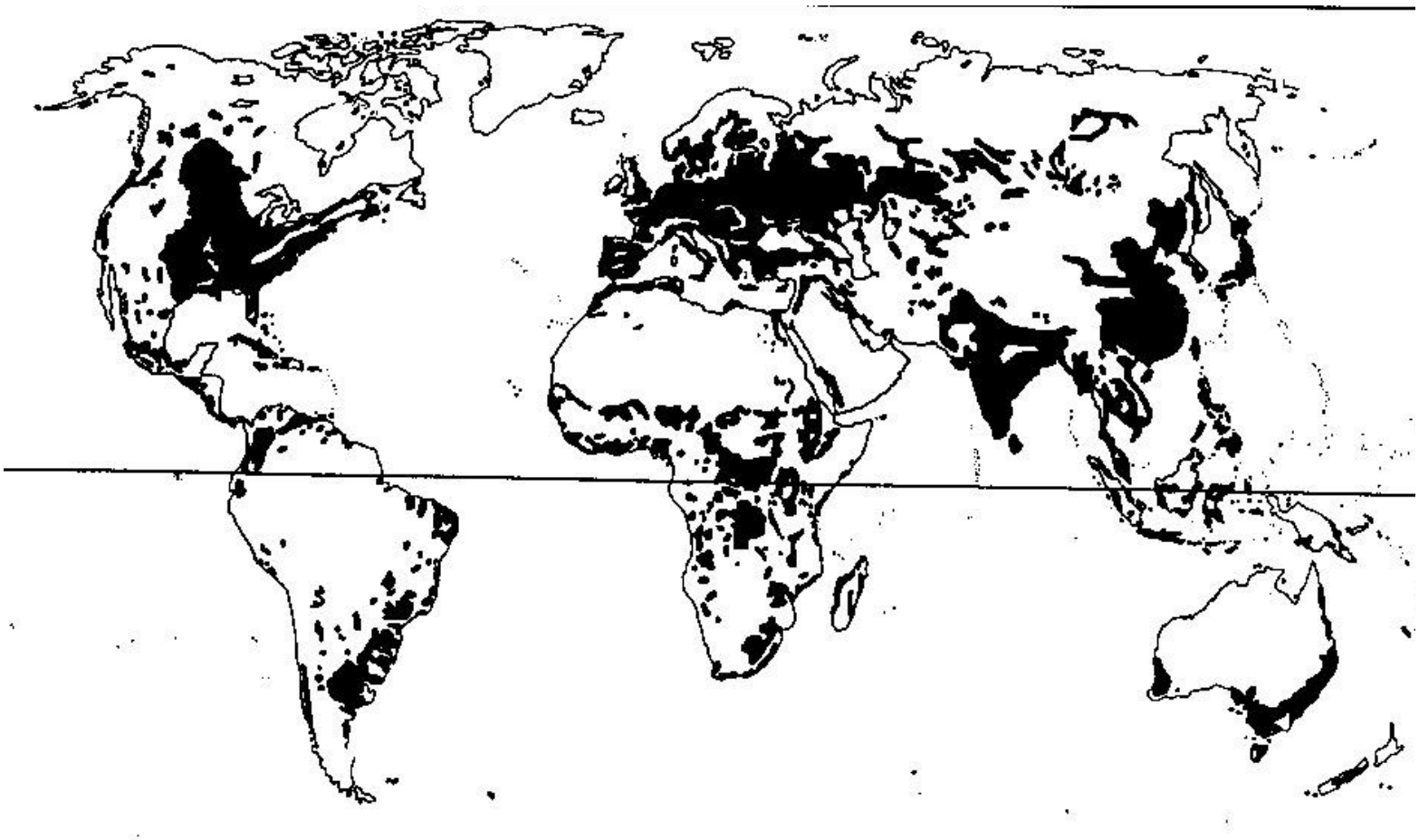
Themes

- **A little geography and history**
- Mitigation and Adaptation
- What does agriculture need?

Global agroecosystems



Evans 1998

How humans have fed and feed themselves

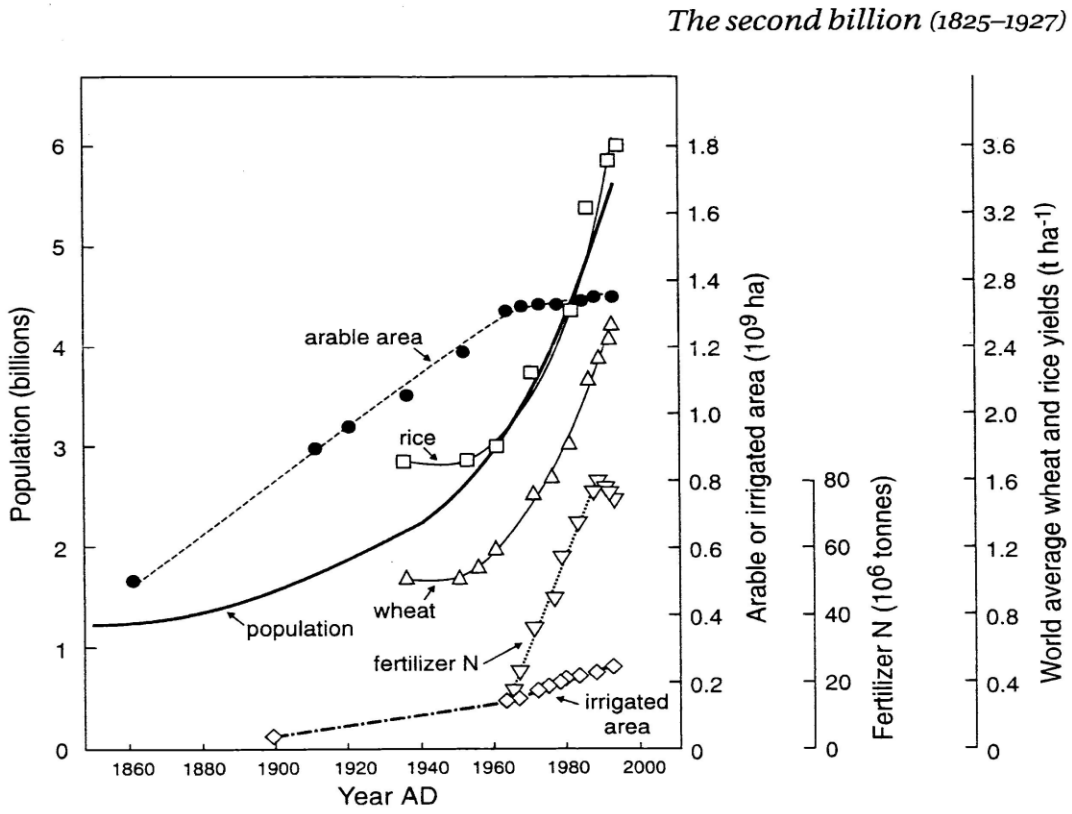
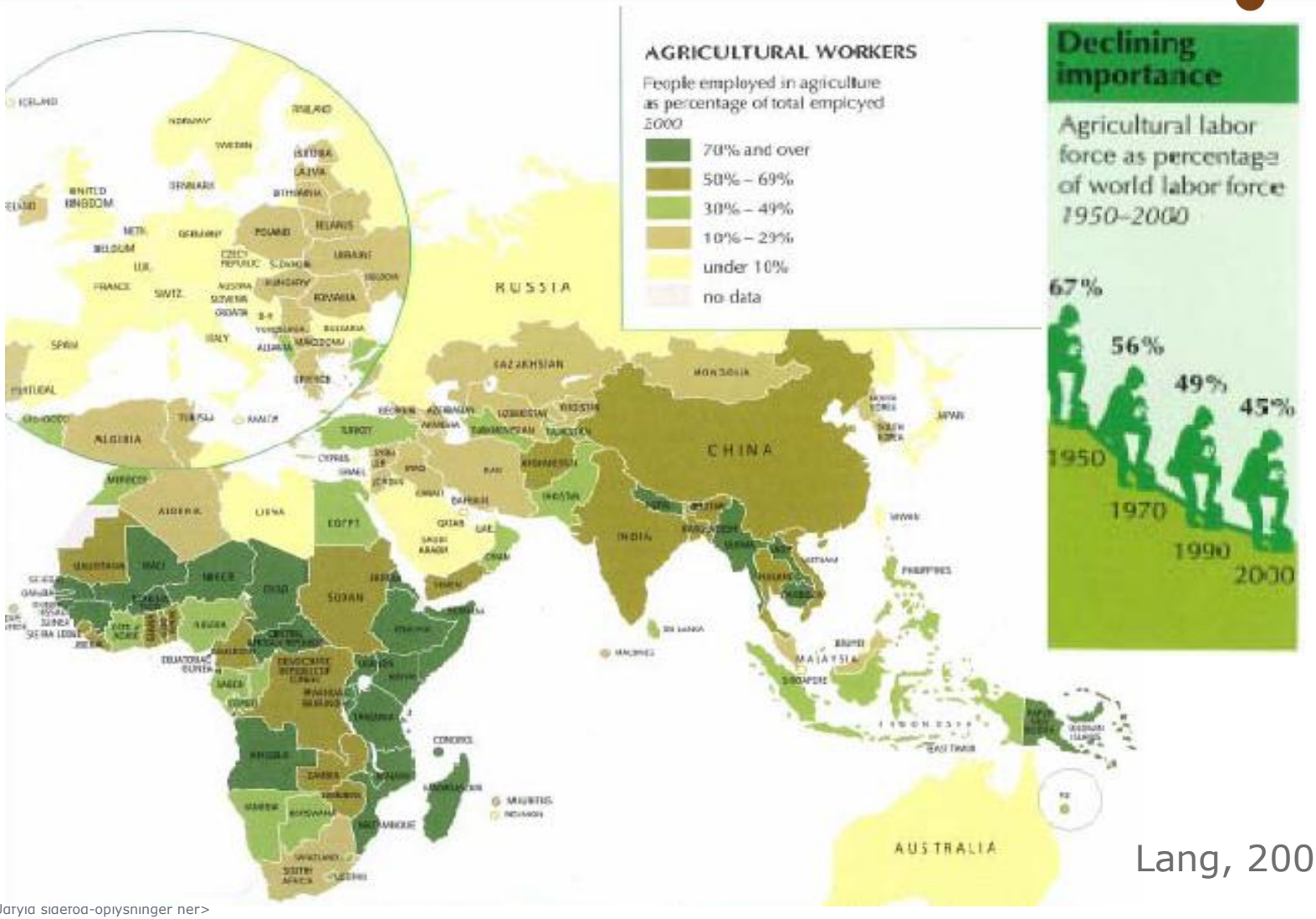


Figure 17 Increases this century in world population, arable area, the average yields of wheat and rice, the amount of N fertilizer used, and the irrigated area of the world[59].

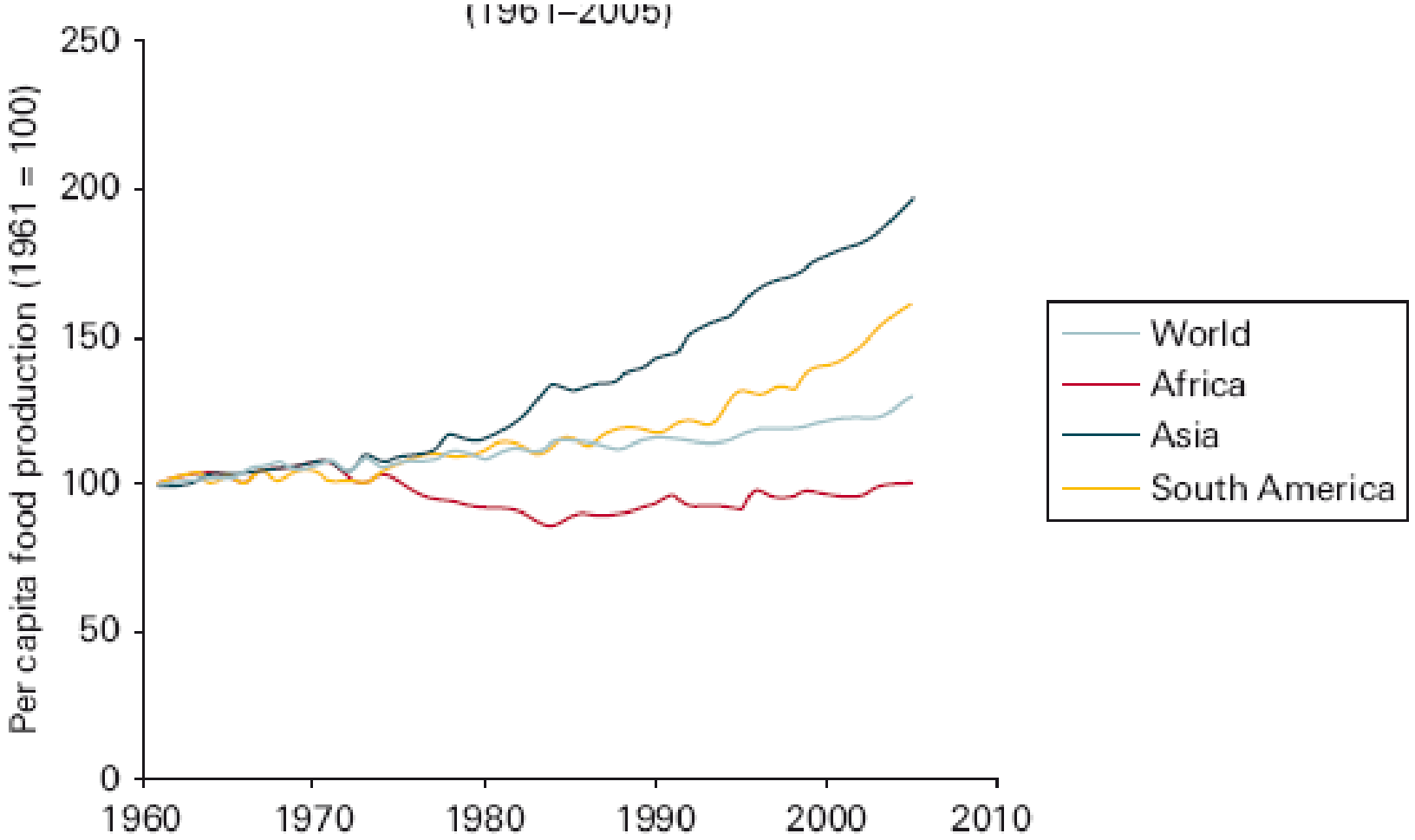
Evans 1998

The global agricultural workforce



Lang, 2007

Agricultural production per capita: 1961 to 2005



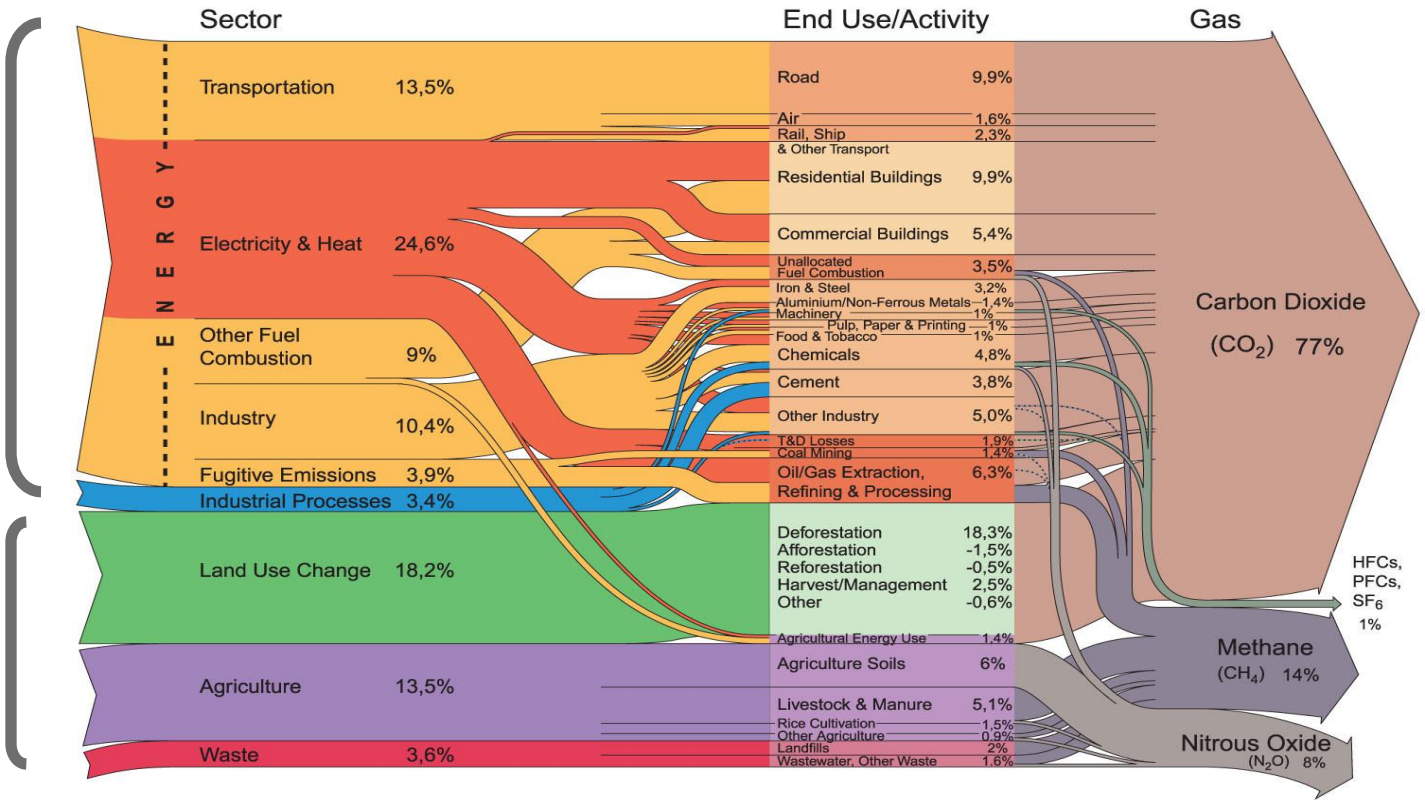
Royal Soc 2009

Themes

- A little geography and history
- **Mitigation**
- What does agriculture need?

GHG emissions by sector

World Greenhouse gas emissions by sector



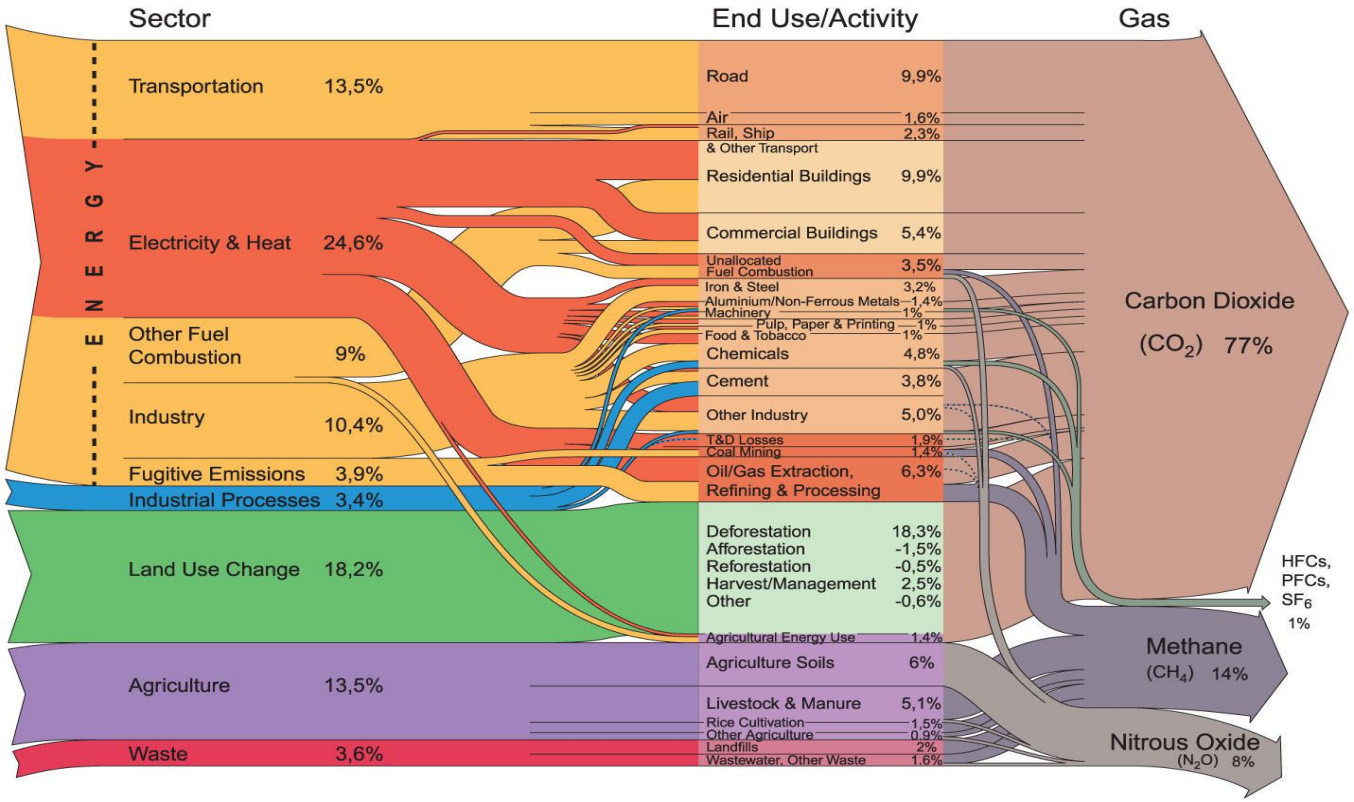
All data is for 2000. All calculations are based on CO_2 equivalents, using 100-year global warming potentials from the IPCC (1996), based on a total global estimate of 41 755 $MtCO_2$ equivalent. Land use change includes both emissions and absorptions. Dotted lines represent flows of less than 0.1% percent of total GHG emissions.

Source: World Resources Institute, Climate Analysis Indicator Tool (CAIT), Navigating the Numbers: Greenhouse Gas Data and International Climate Policy, December 2005; Intergovernmental Panel on Climate Change, 1996 (data for 2000).

UNEP

GHG emissions

World Greenhouse gas emissions by sector



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UNEP

The Kaya Identity Equation - IPCC

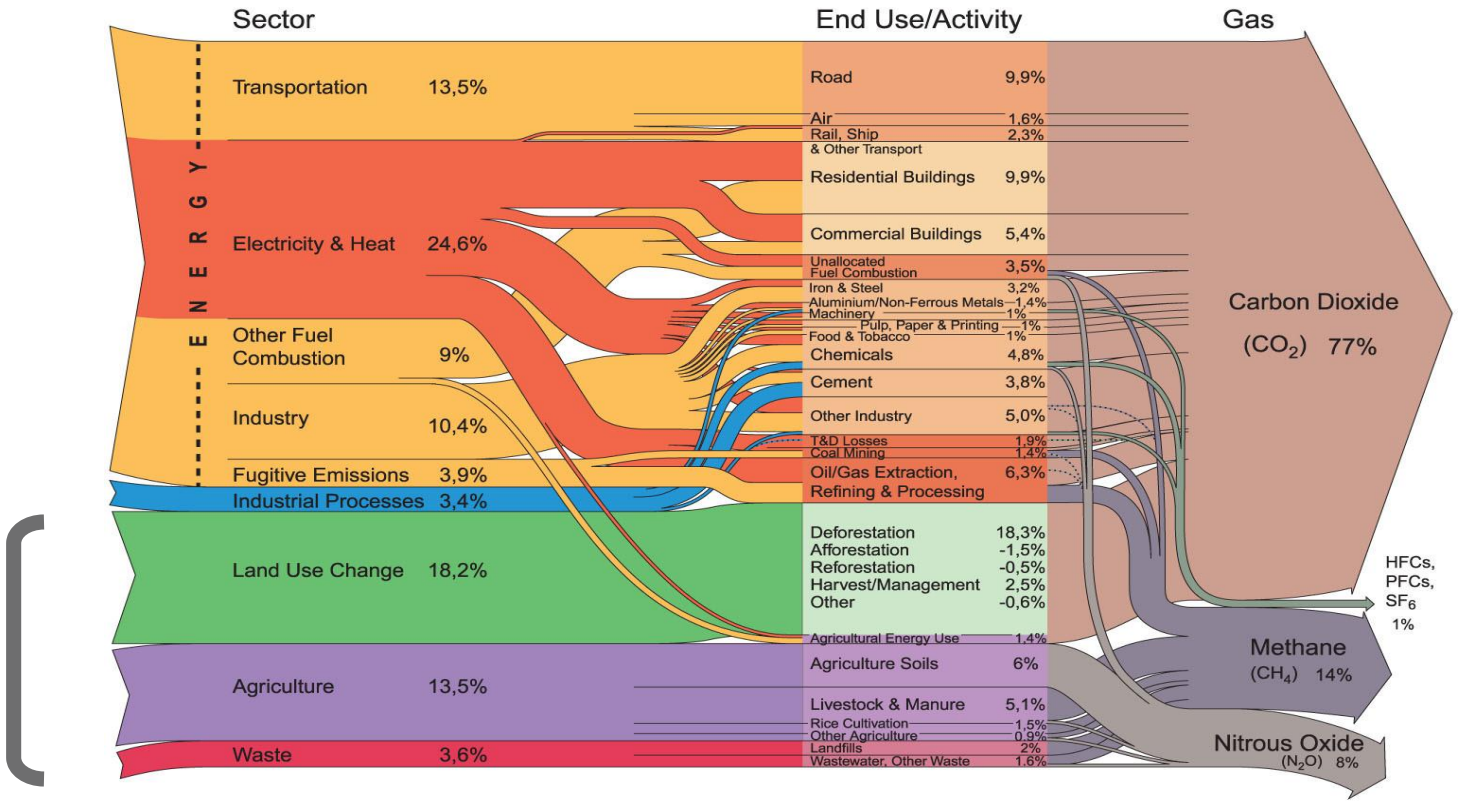
$$\frac{GHG}{ENERGY} \times \frac{ENERGY}{GDP} \times \frac{GDP}{POP} \times POP = GHG$$

Fuels | Sectors | Services

Industrial emissions

GHG emissions

World Greenhouse gas emissions by sector



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UNEP

JRP's Land-Use Identity Equation

$$\frac{NEE}{AREA} \times \frac{ENERGY}{NEE} \times \frac{GHG}{ENERGY} \times AREA = GHG$$

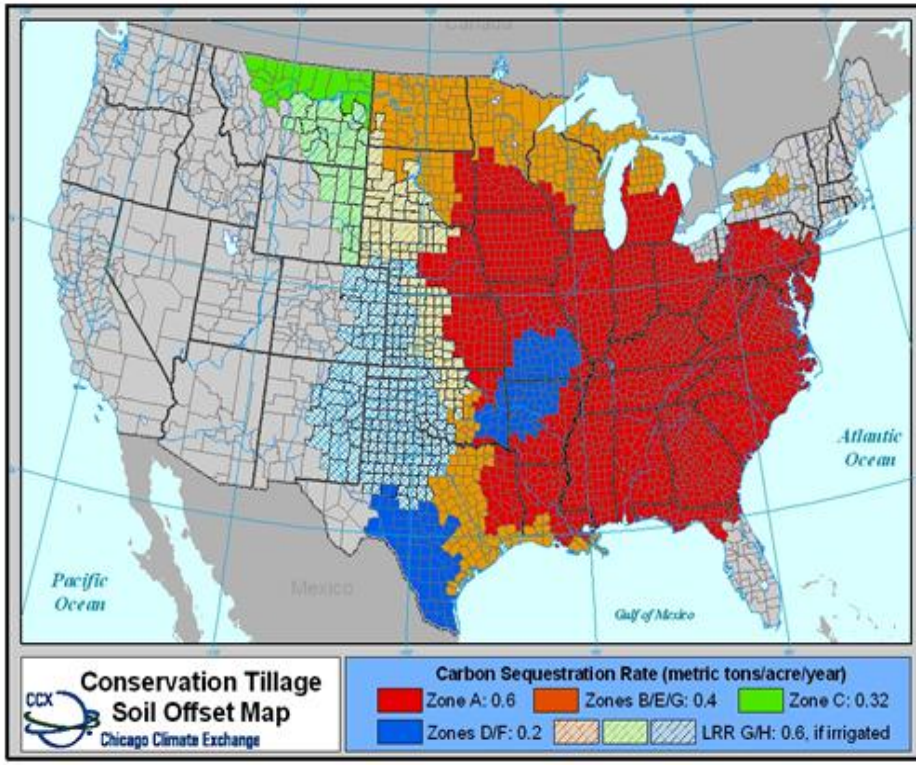
Production Technology Fuels

Land use emissions

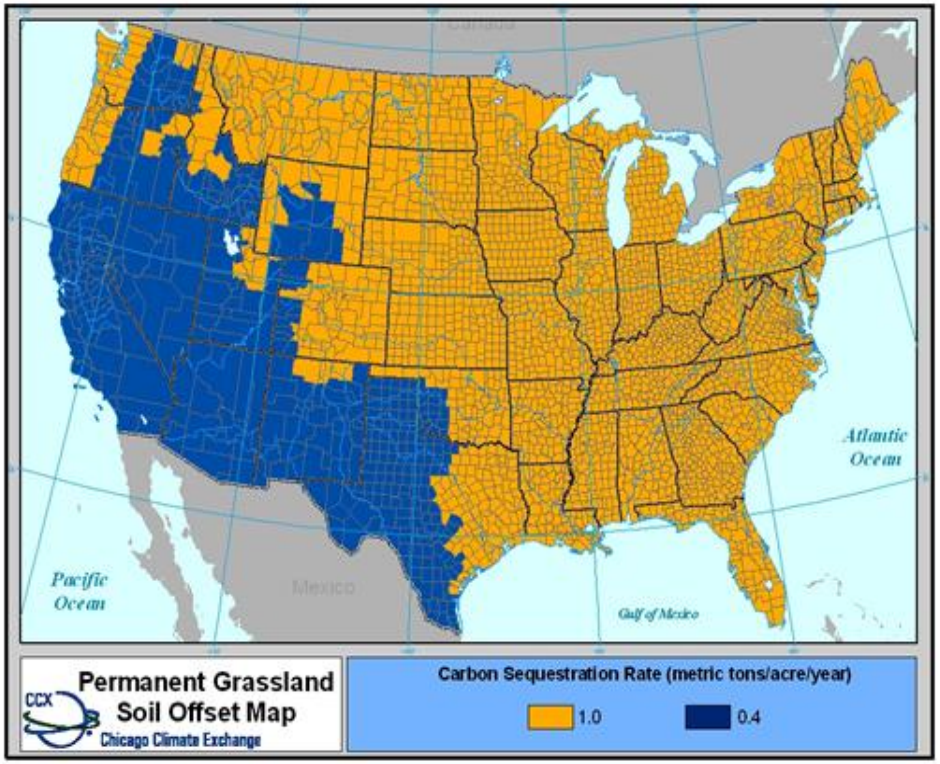
Porter unpubl.

The US agricultural C market

Conservation Tillage



Permanent Grassland



Canadell 2009

What makes a good carbon offset?

Additional

No Leakage

Measurable

Permanent

Transparent

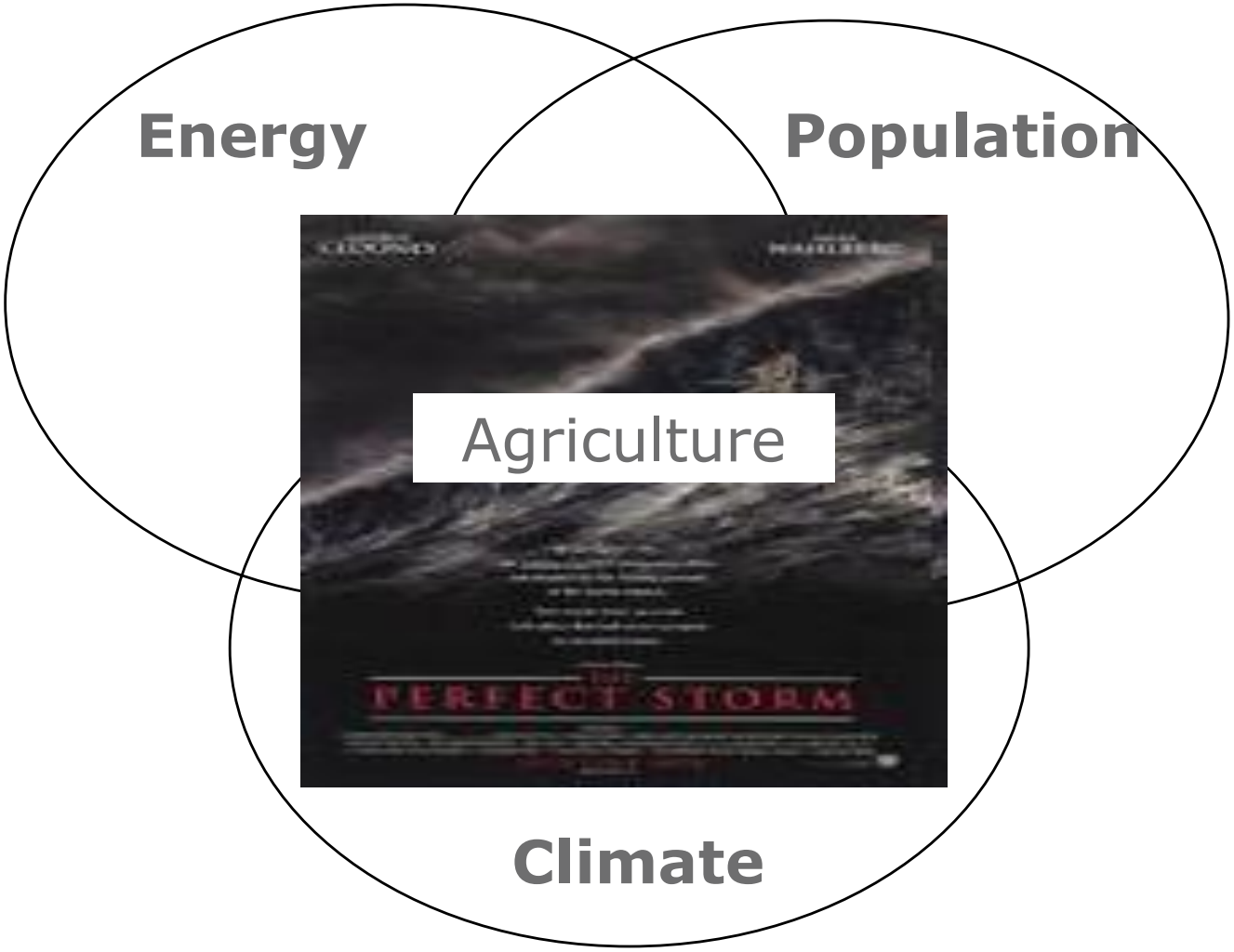
Verifiable by a third party

Carbon Reductions and Offsets, Global Carbon Project 2007

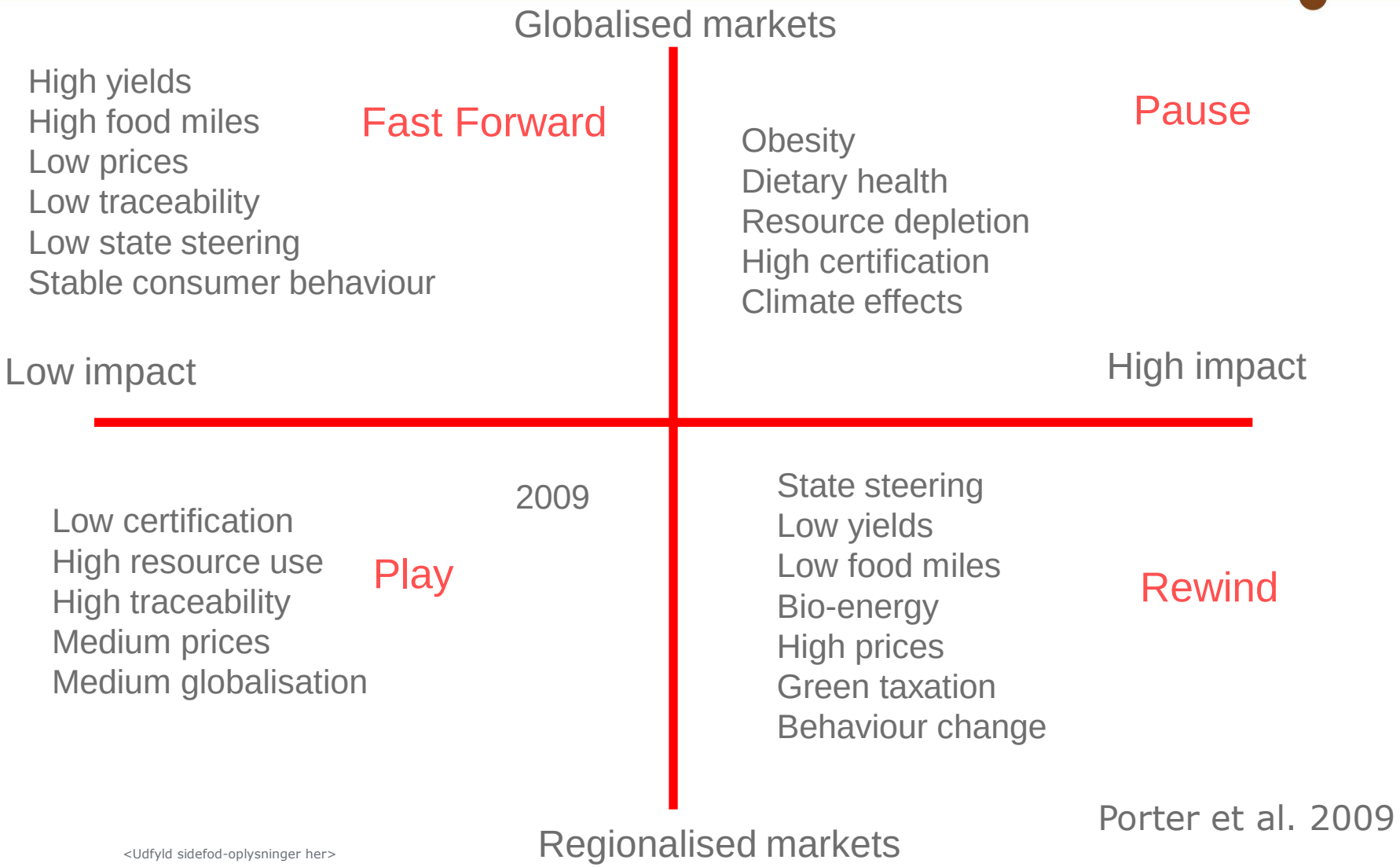
Themes

- A little geography and history
- Mitigation
- **What does agriculture REALLY need?**

The Eye of the Perfect Storm



1. Global agricultural future scenarios

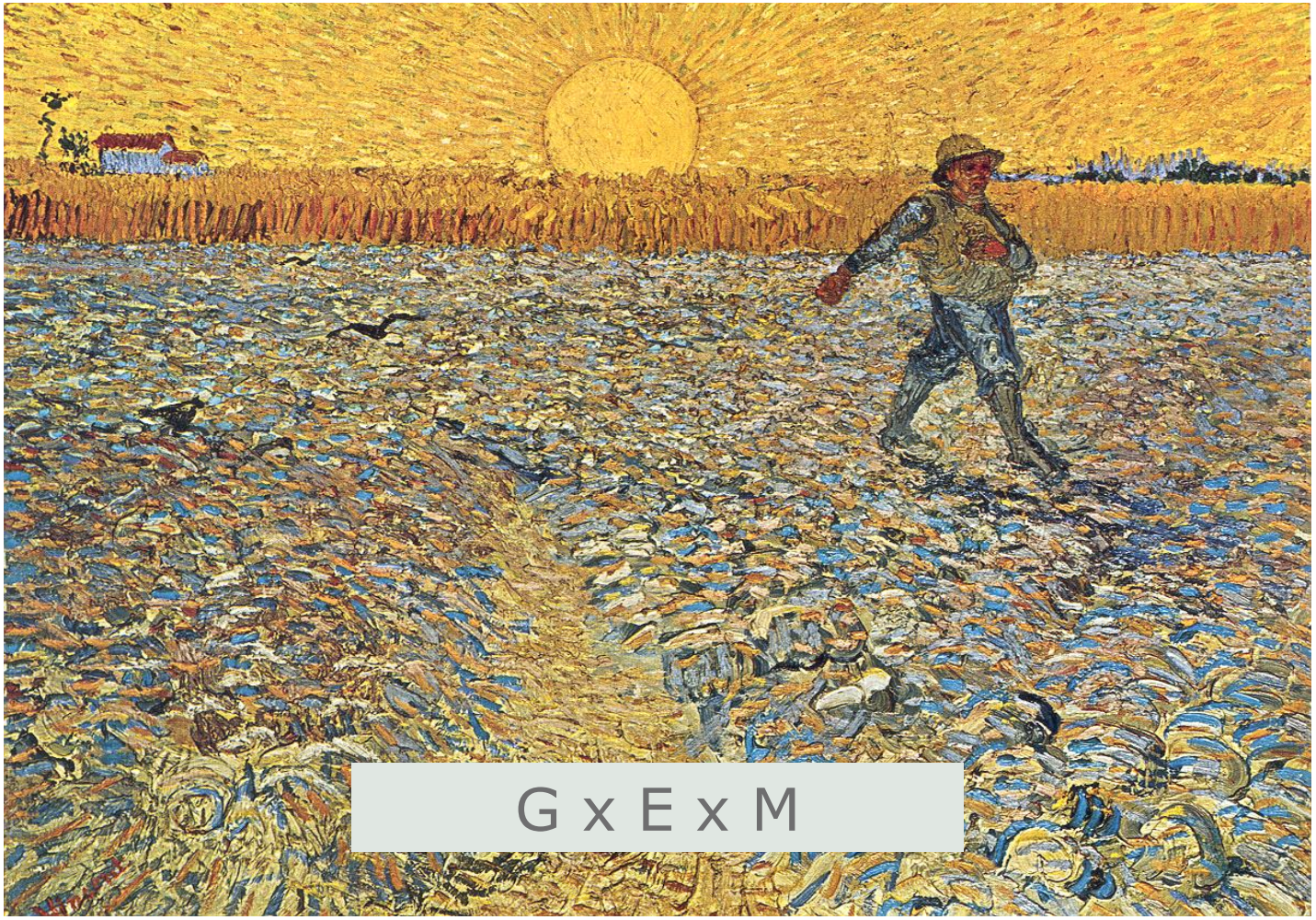


Porter et al. 2009

Scenarios summary

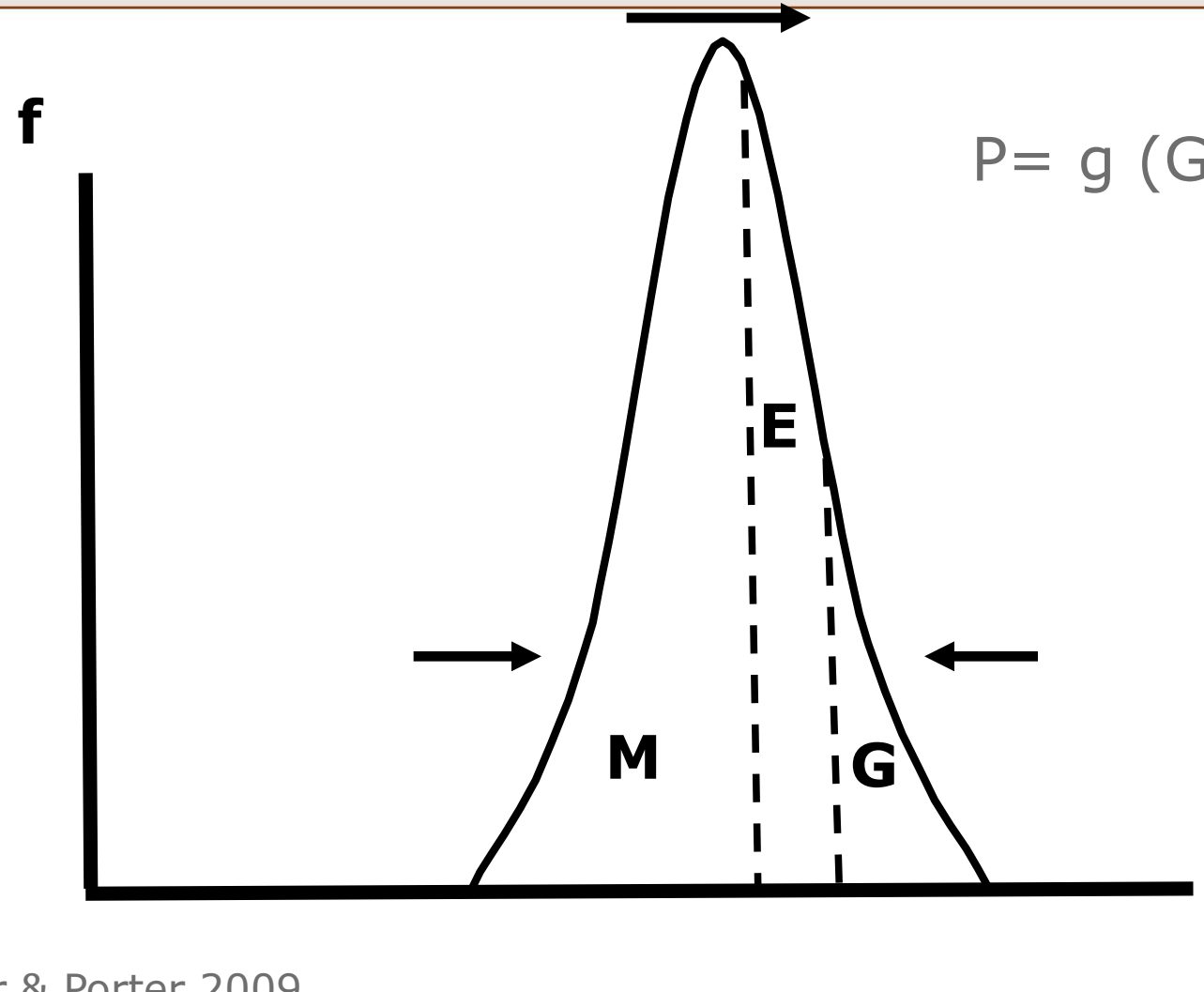
- Fast-forward: Leads to increased globalisation and deals with problems as they arise.
- Pause: Hold technology at current levels and accept the limits to growth.
- Play: Regional markets continue and problems dealt with piecemeal.
- Rewind: Strong legislative framework, centralised and highly regional.

2. GEM



Van Gogh, The Sower, 1888

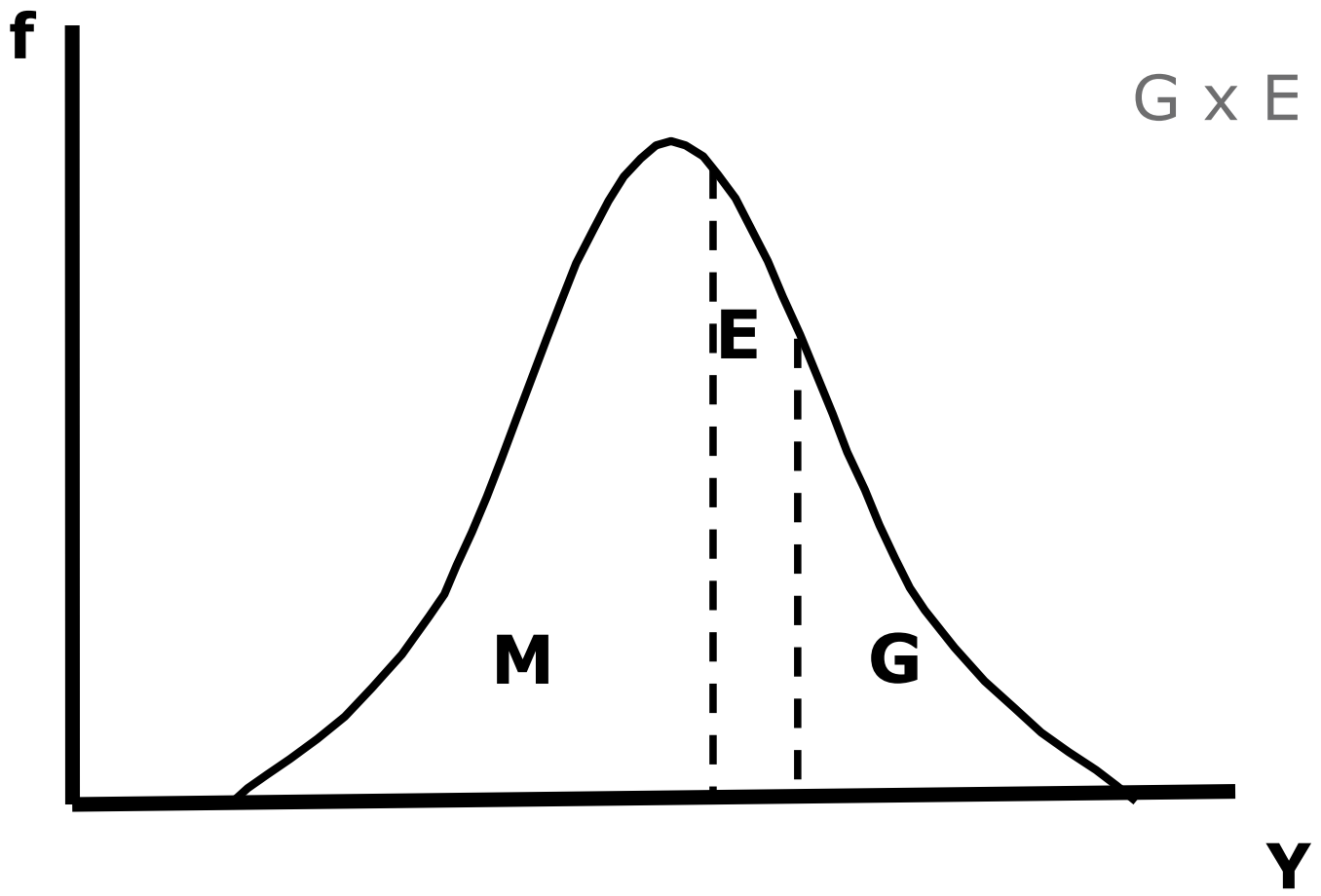
3. The agronomy of food production - GxExM



$$P = g\,(G \times E \times M)$$

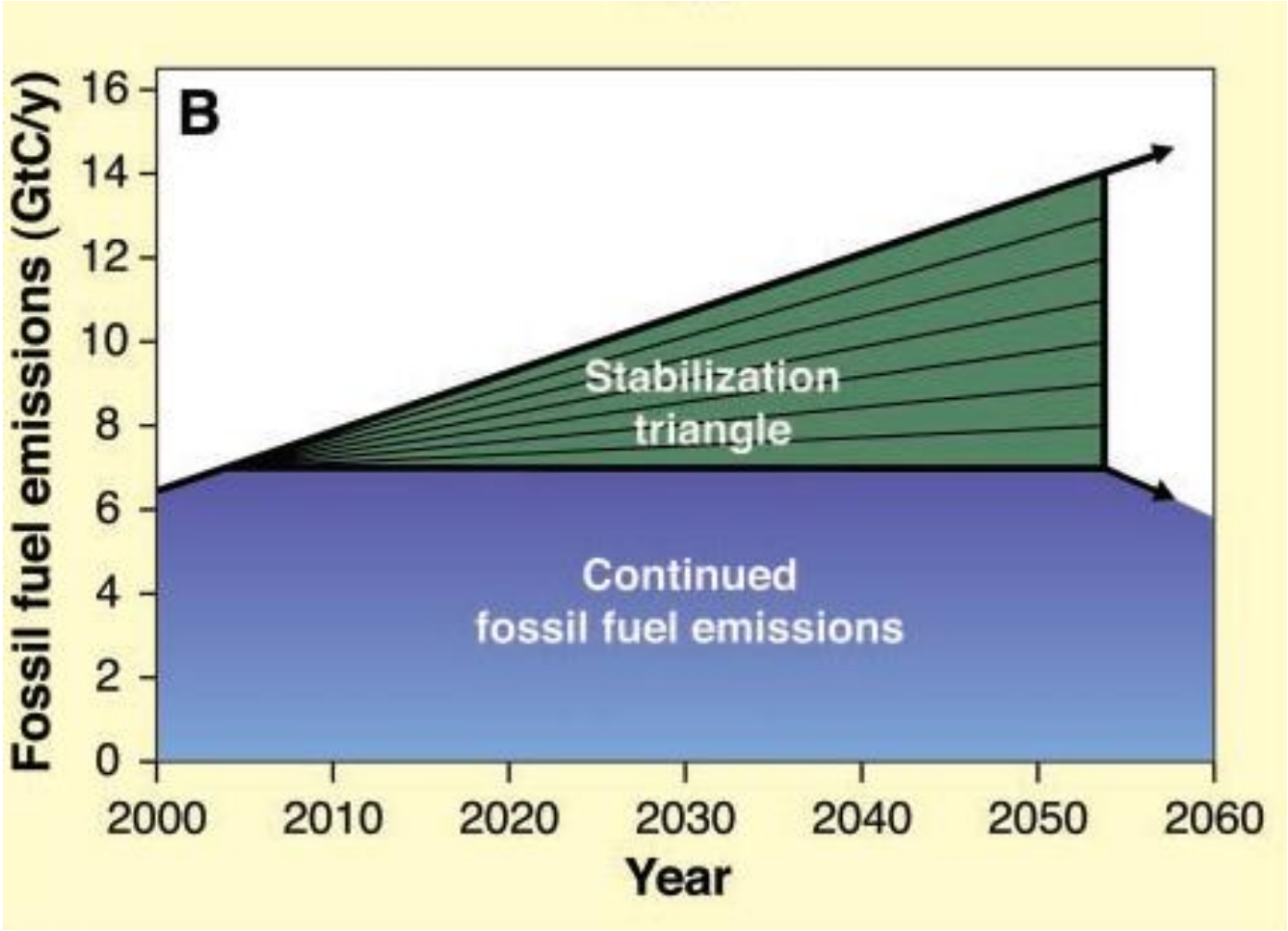
Fischer & Porter 2009

More variable and lower yields



Porter et al, unpubl

4. Food security wedges – cf climate wedges



Pacala et al 2006

Example climate wedges

Add 4 million 1-MW-peak windmills (100 times the current capacity)

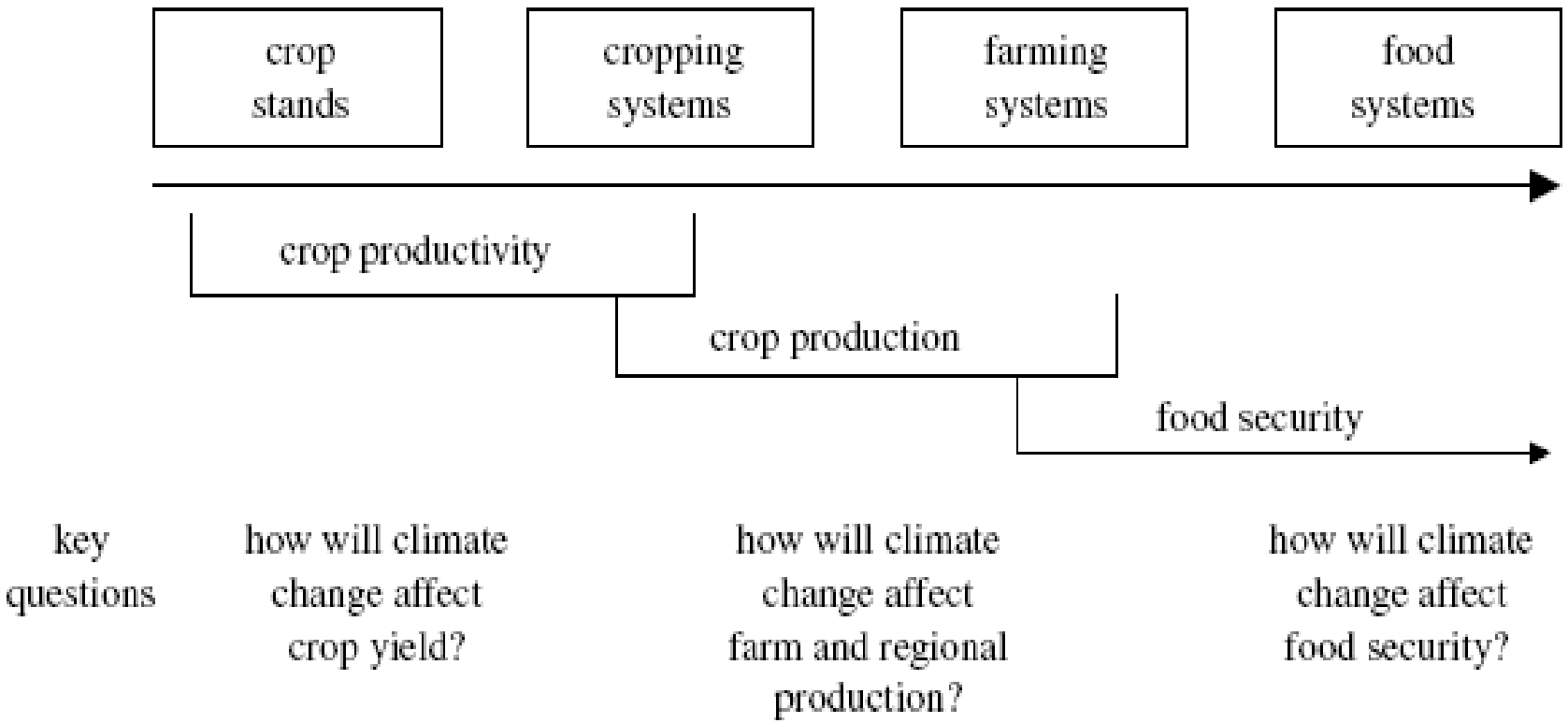
Decrease tropical deforestation to zero instead of 0.5 GtC/year, and establish 300 Mha of new tree plantations

Apply conservation tillage to all cropland (10 times the current usage)

Food security wedges?

Pacala et al 2006

Crop systems to food systems



Gregory et al., 2005

Conclusions

We have little time – 30 - 40 years

We need to understand and use GxExM

We need agronomy as the discipline of food production

We need plausible future scenarios for agriculture

We need food security wedges and food systems