Soil as natural capital
Ecosystem services and farmers economy

SOIL SERVICE project (FP7)

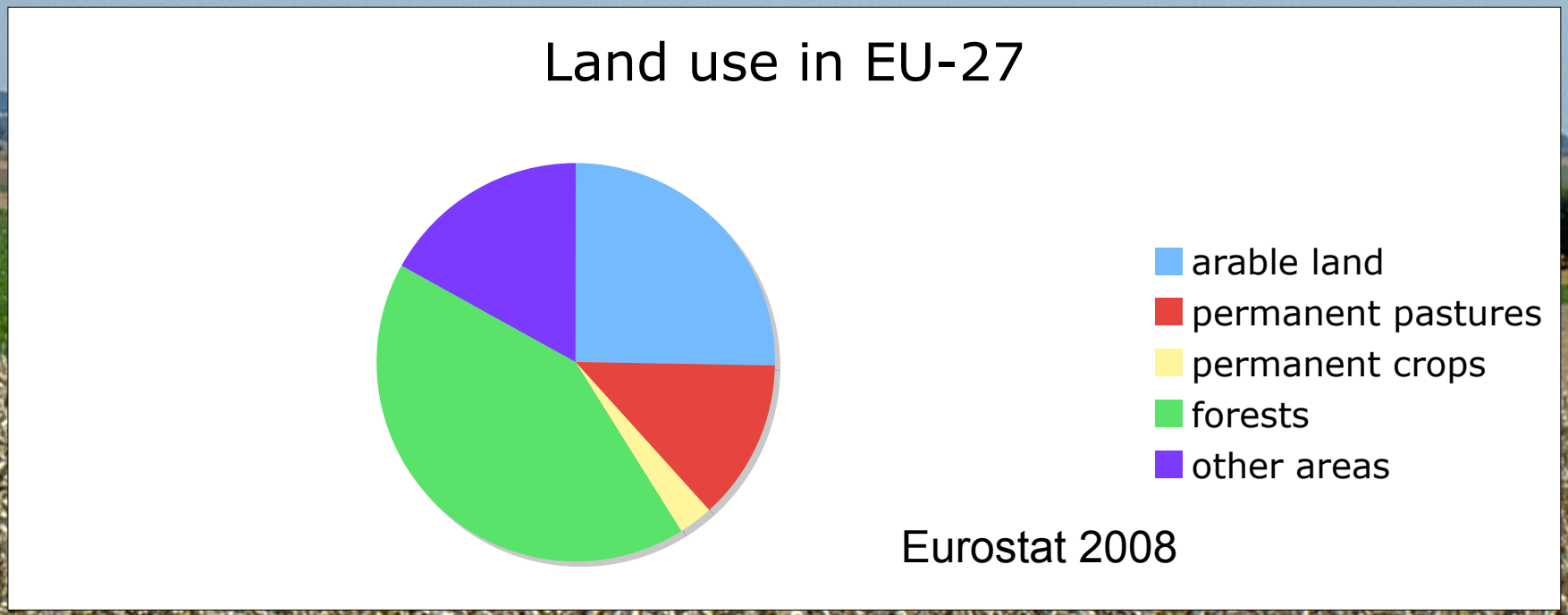
Katarina Hedlund Lund university

SOIL SERVICE project

Land use projections

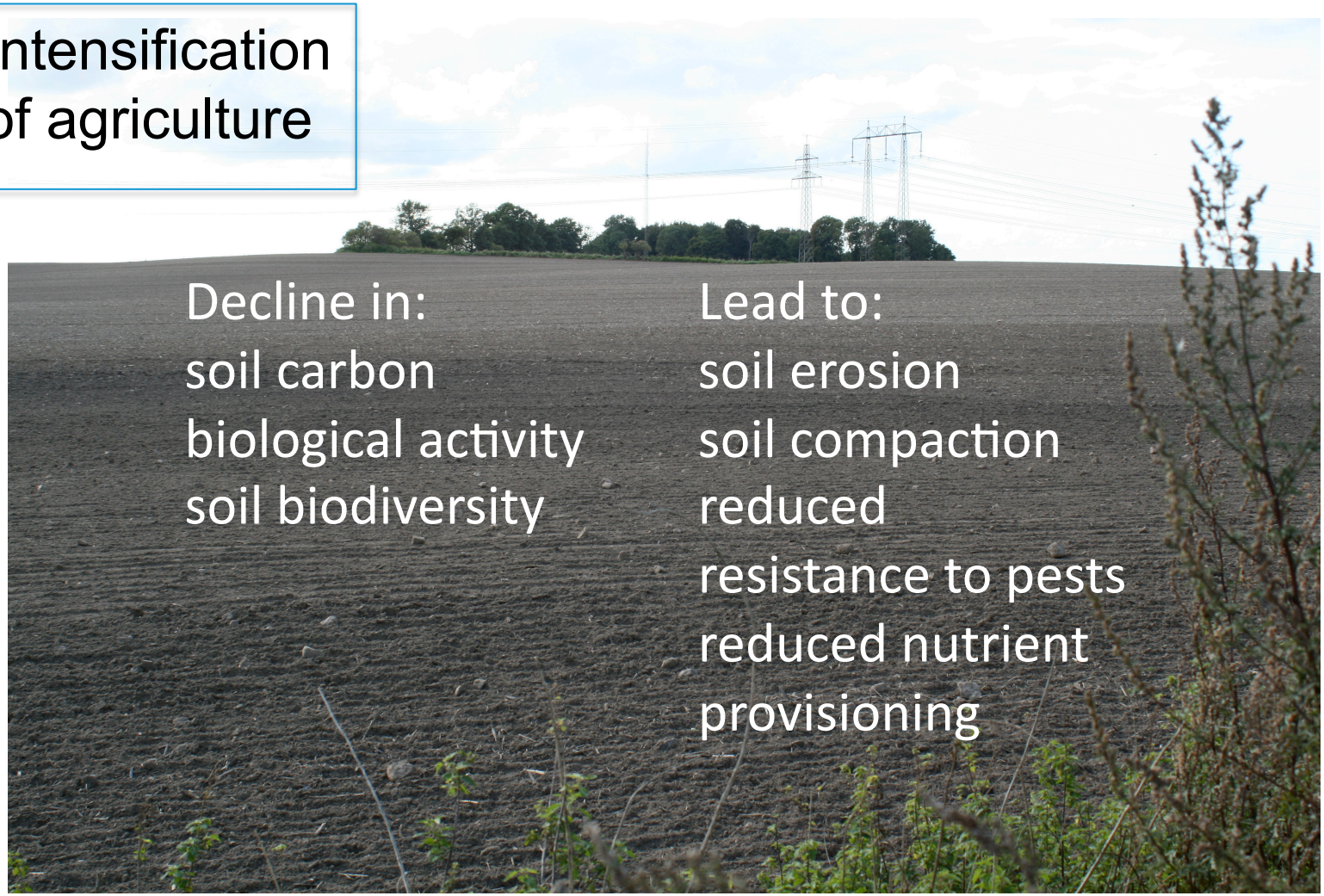
- Production of goods is increasing
  - Food, biofuels, timber, water use
- Natural habitats are declining
- Mitigating climate change
  - Increased pressure on land for production of biomass

Current land use in Europe



Agriculture and soil threats

Intensification of agriculture



How to conserve ecosystem services and biodiversity ?

Protected areas

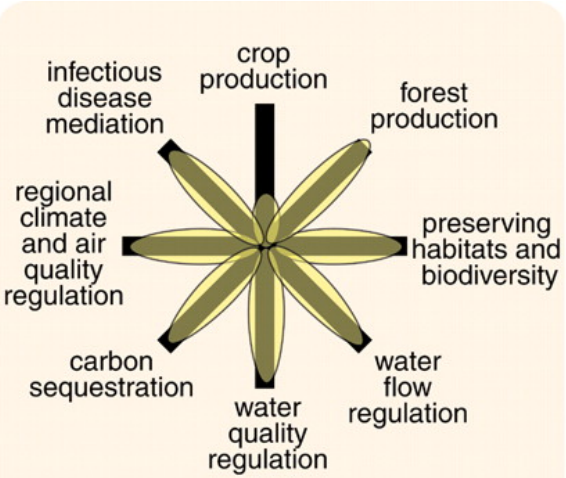
Extensification

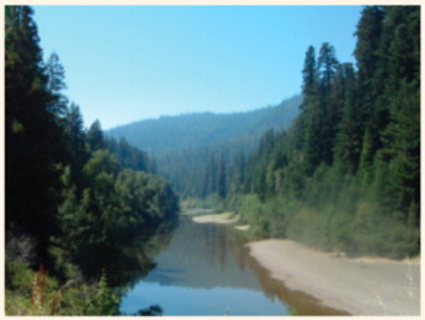
Heterogeneity in landscapes

Integrate ecosystem services in intensive management

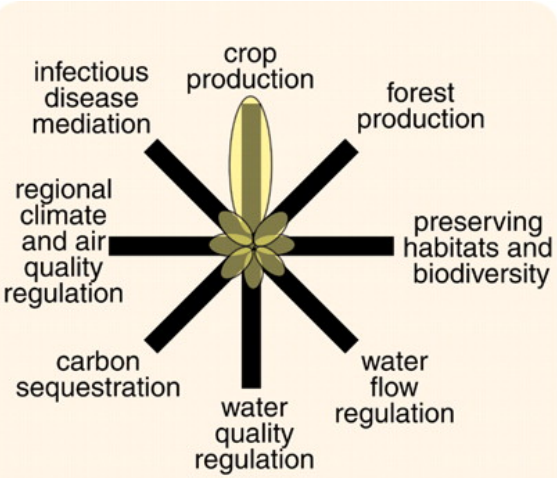
- Cover crops
- Variable crop rotations
- Low tillage farming

Biodiversity and ecosystem services

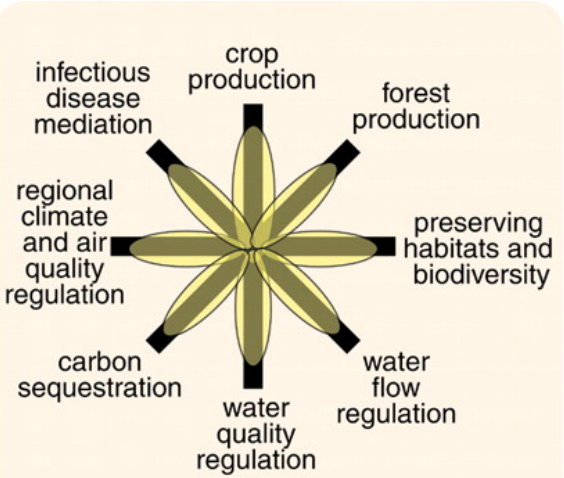




natural ecosystem



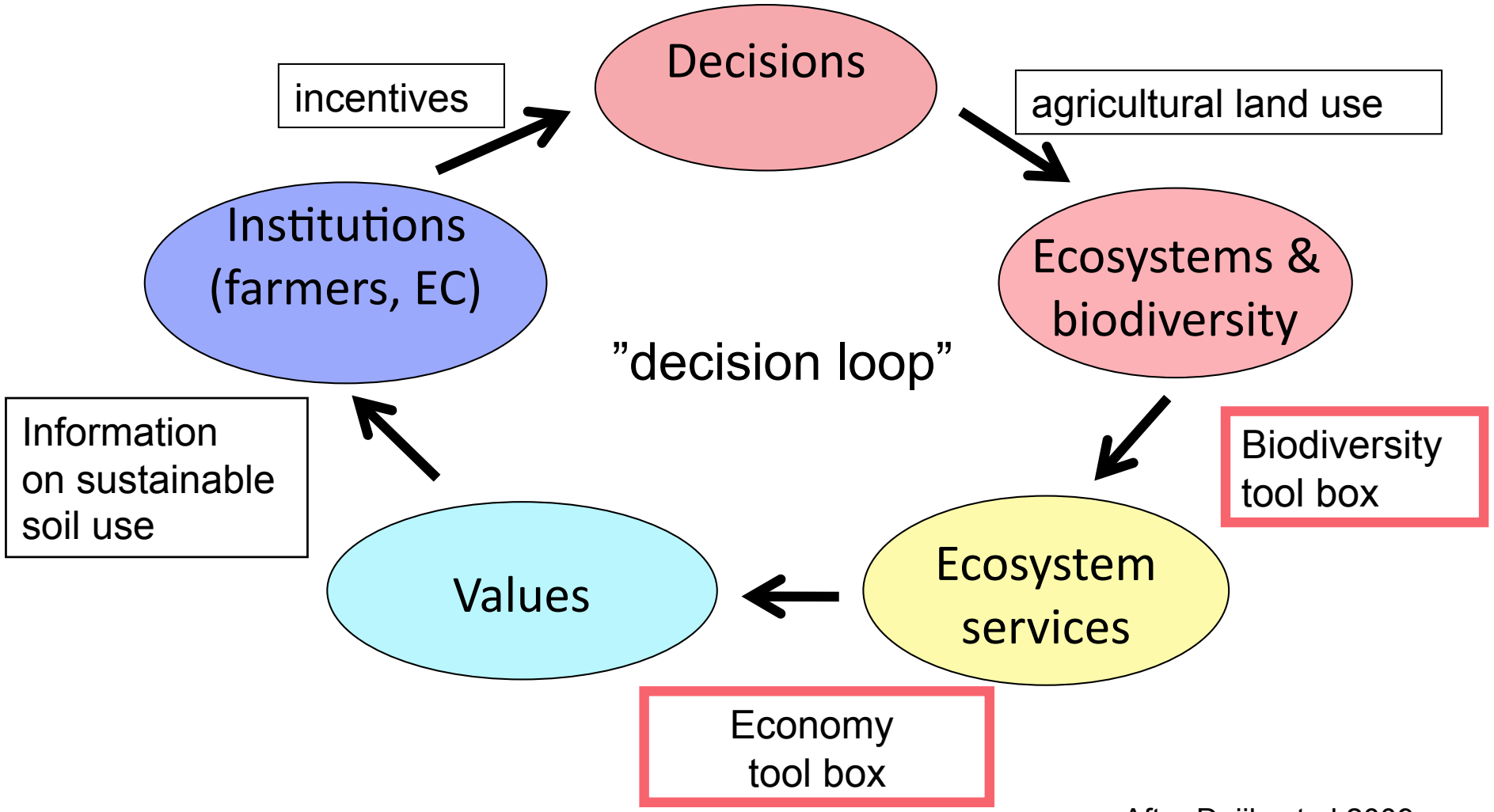
intensive cropland



cropland with restored ecosystem services

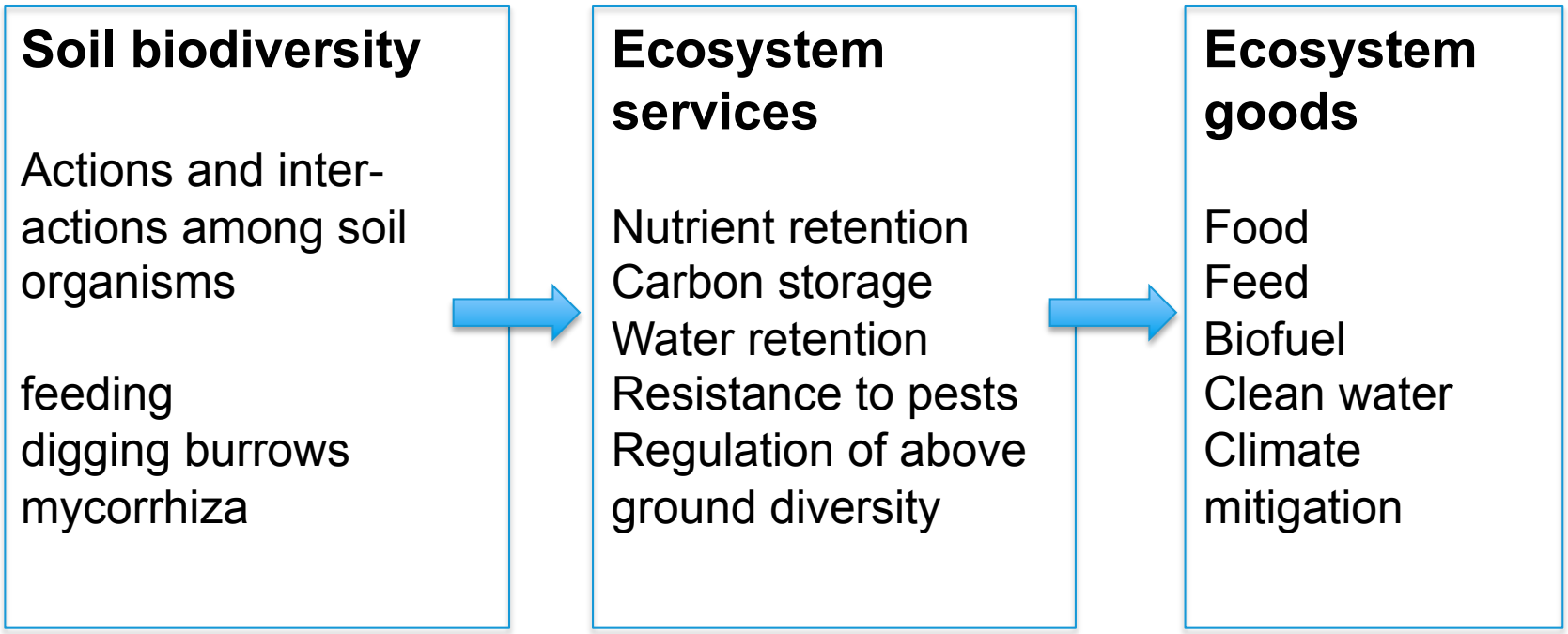
Foley et al Science 2005

Using ecosystem services for decisions



After Daiily et al 2009

Soil is a natural capital



SOIL SERVICE study regions

Regions for soil biodiversity and farm economy studies

SOIL SERVICE Field studies

Gradient of intensive crop rotation
to pastures in each region

Sweden

Greece

Biodiversity tool box

Soil biodiversity

Ecosystem services

Agricultural land use:

crop rotation
biofuel crops
pastures

Link diversity to functions:

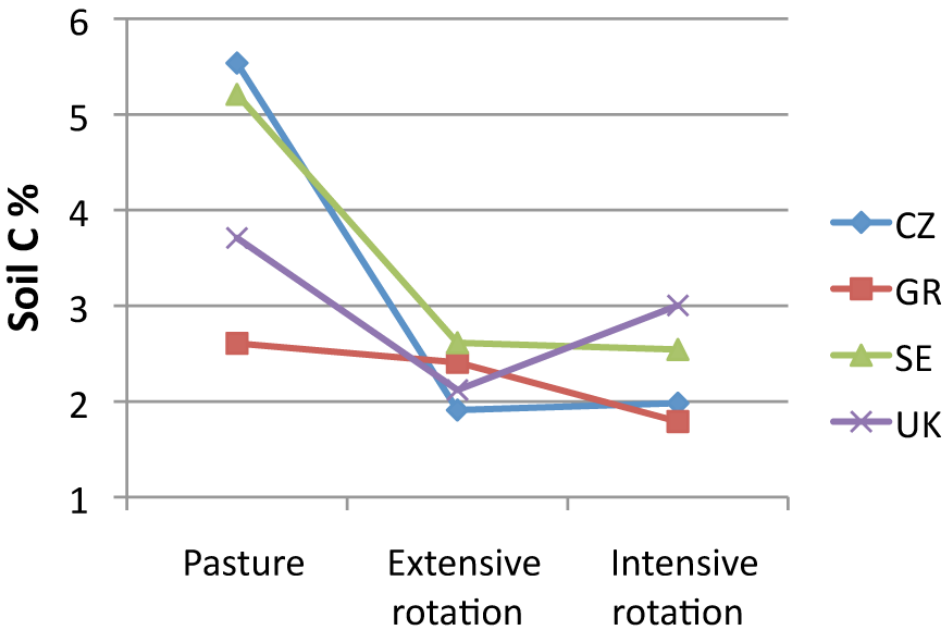
biodiversity
food webs

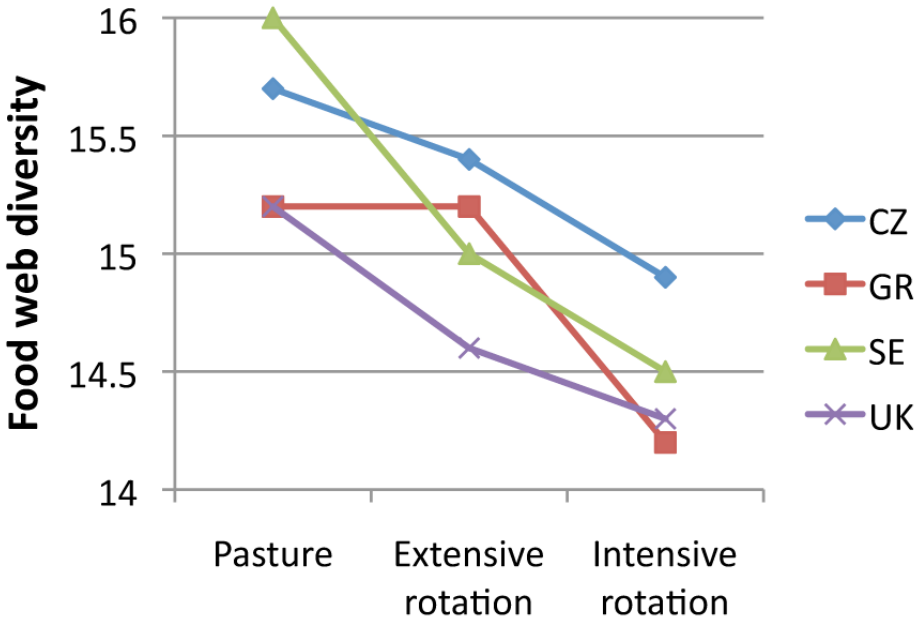
Quantify ES:

nutrient retention
carbon retention
resistance to pests
stability of services

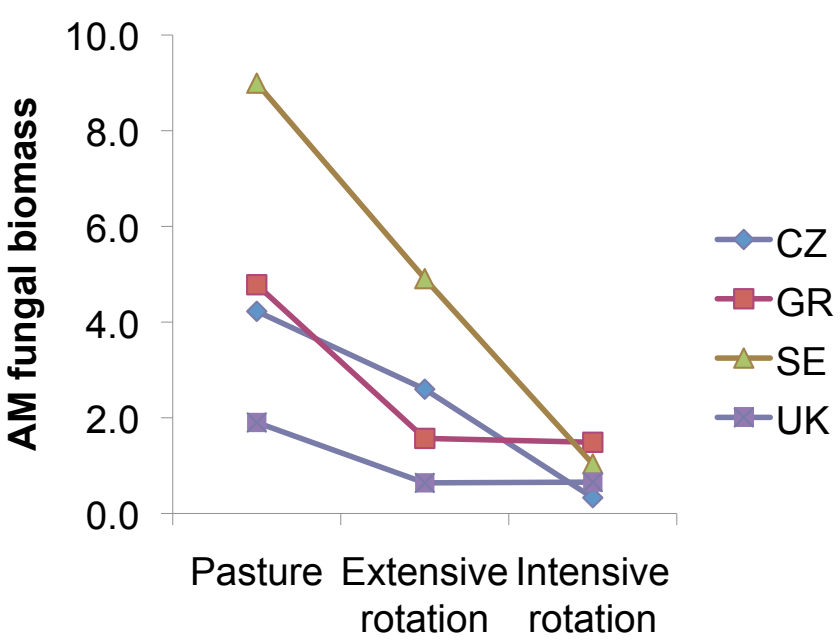
Soil biodiversity and agriculture

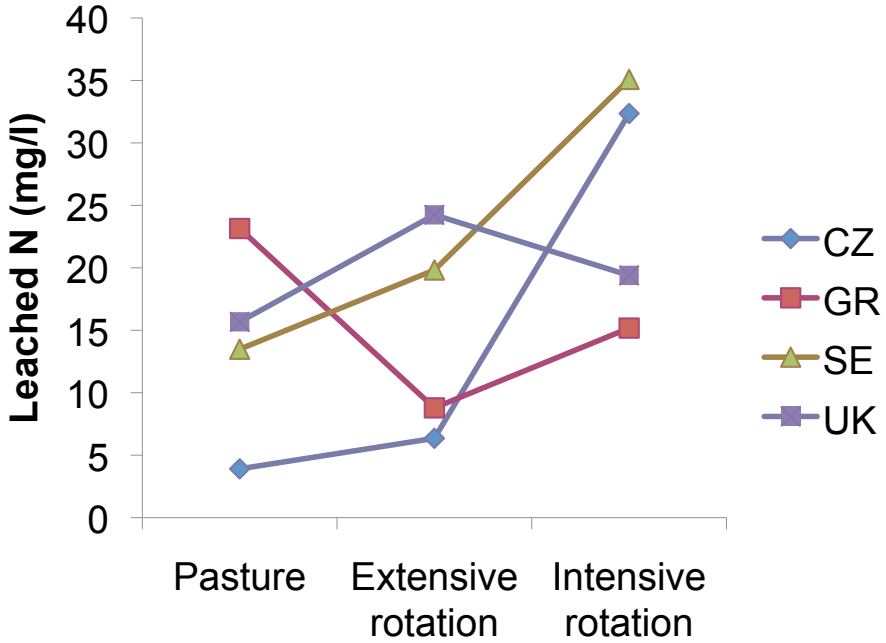
soil biodiversity—correlated to ecosystem services





Nutrient retention



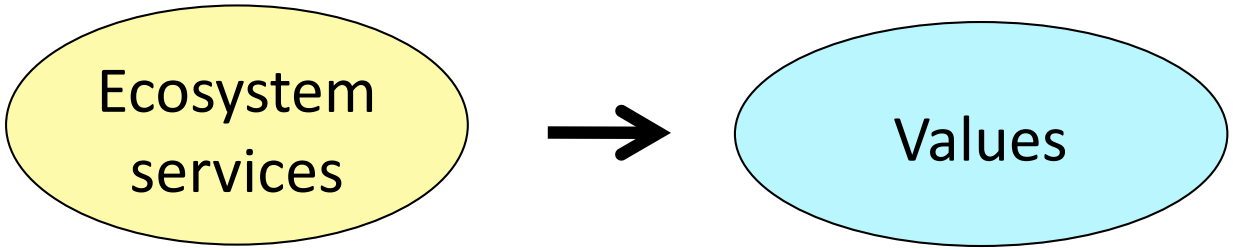


Soil biodiversity & intensive agriculture

Pastures to crop rotation:

- Reduce species diversity
- Lower food chain length
- Soil carbon: 10 – 0.8 %C
- Soil nitrogen: 0.4 - 0.1%N
- Phosphorous uptake by AM fungi: from 150 to 15 kg/ha
- Reduced soil mixing: from 100 to 5 tons/ha

Economy tool box



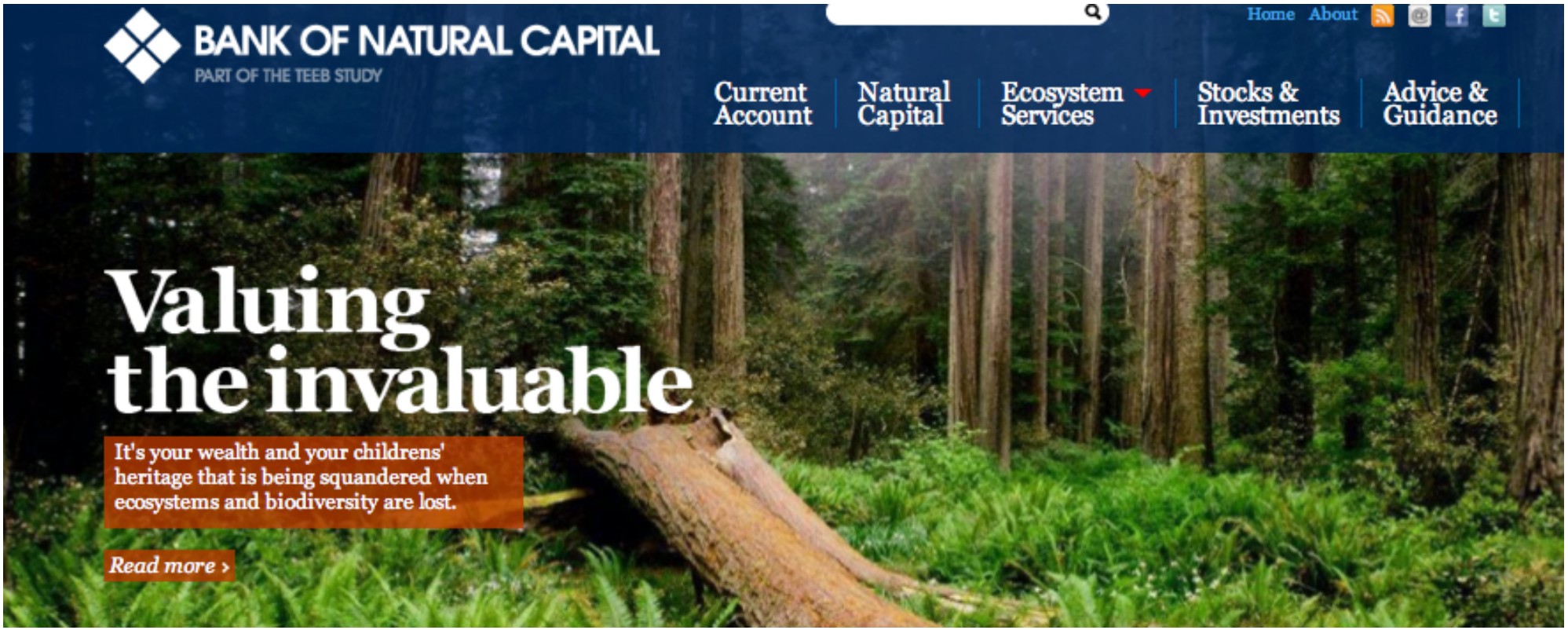
Link production of services with beneficaries

farmers

society

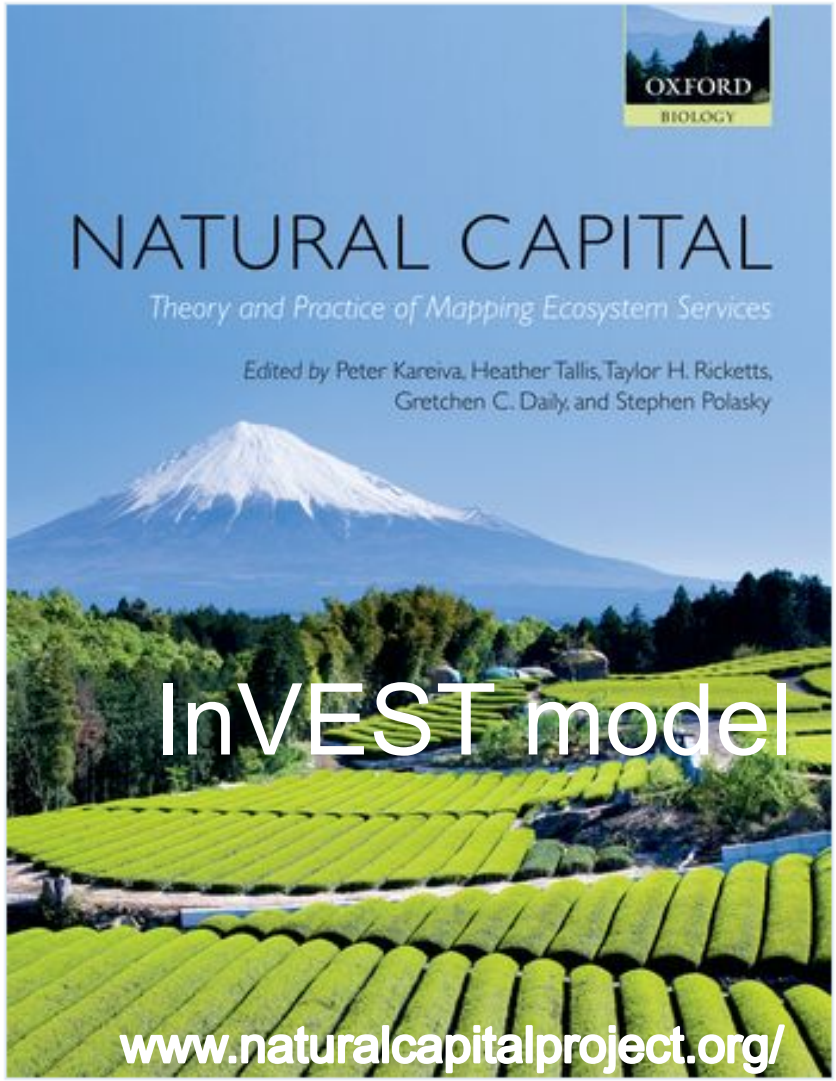
(Mark Brady Agrifood)

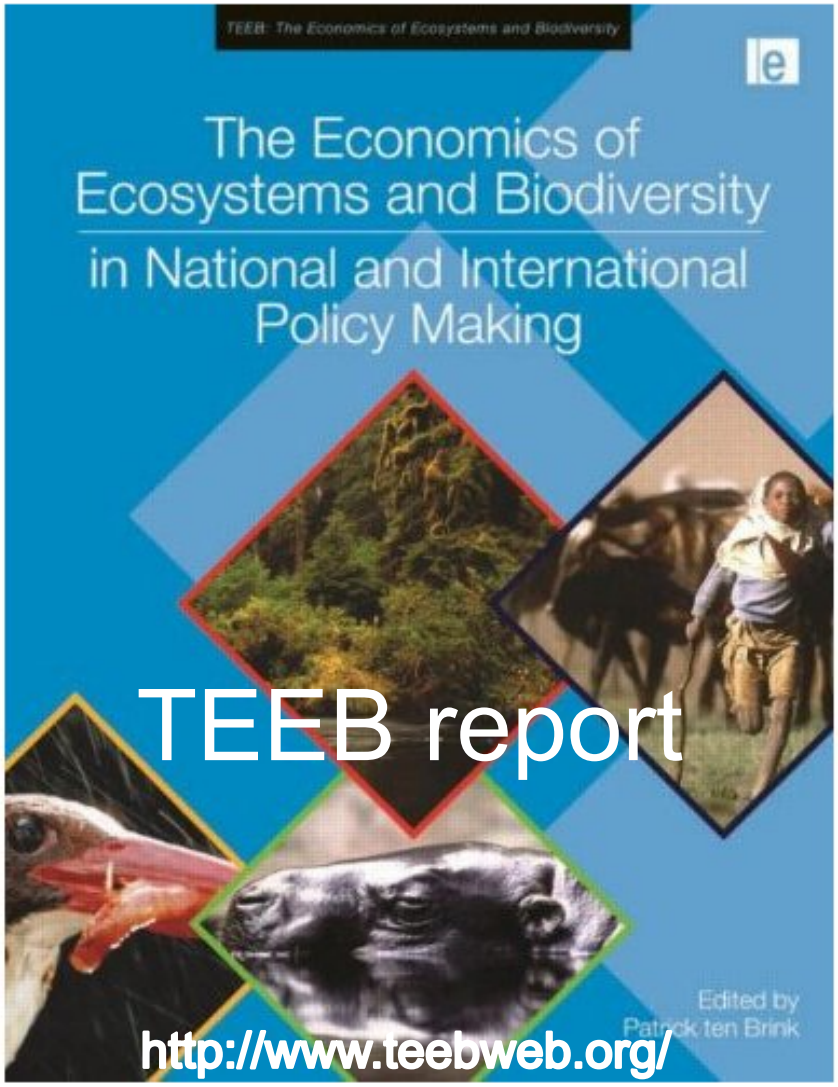
"Natural Capital" - The ecosystem services from nature which are essential for human life.



http://bankofnaturalcapital.com/category/ecosystem-services/agriculture/

Valuation of ecosystem services





Value of the soil ecosystem services

Value to farmers

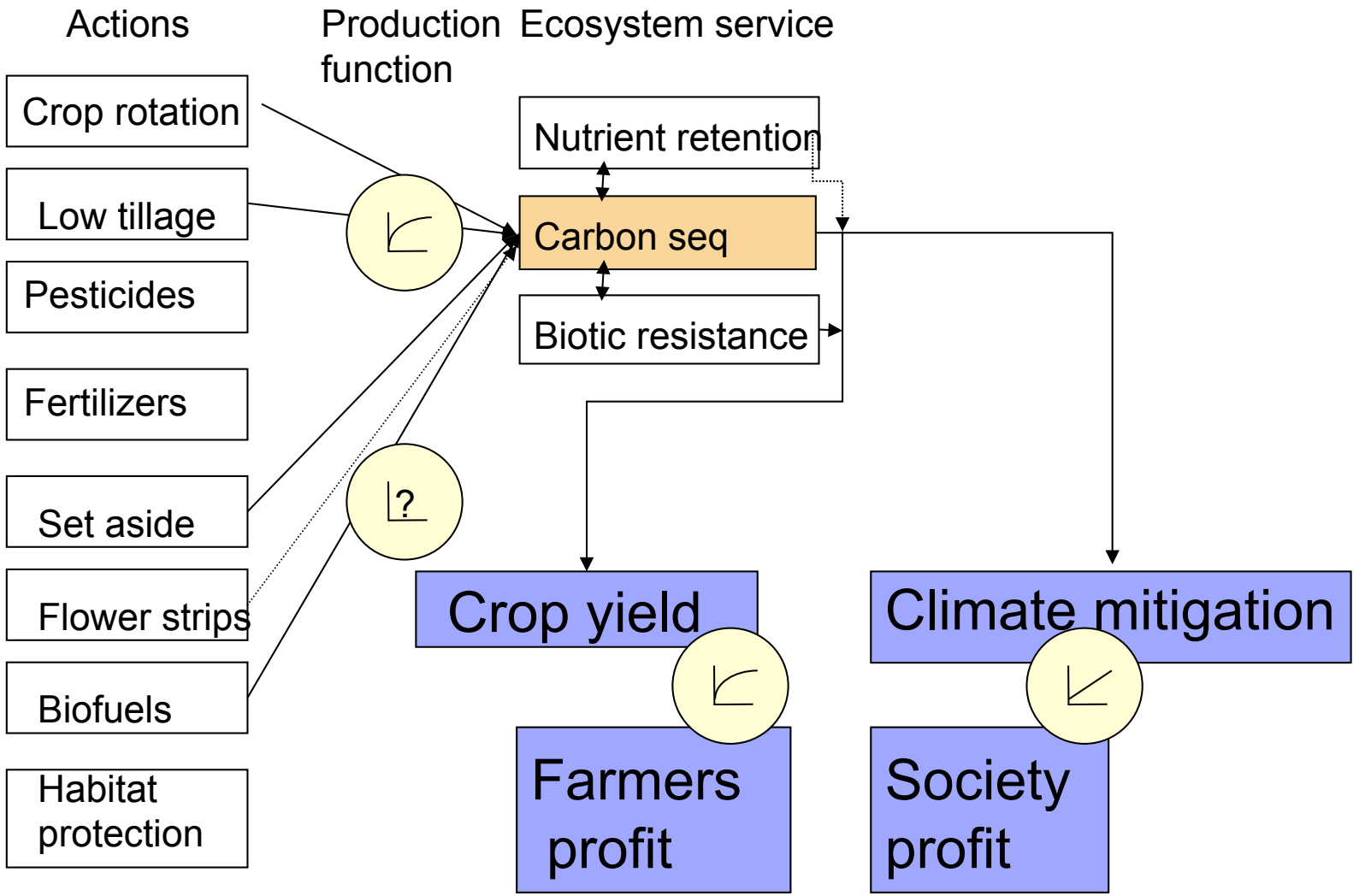
- Fertile soils
- Water retention
- Less erosion
- Less use of
  - fertilizers
  - pesticides

Value to society

- Reduce eutrofication
- Clean water
- Carbon retention

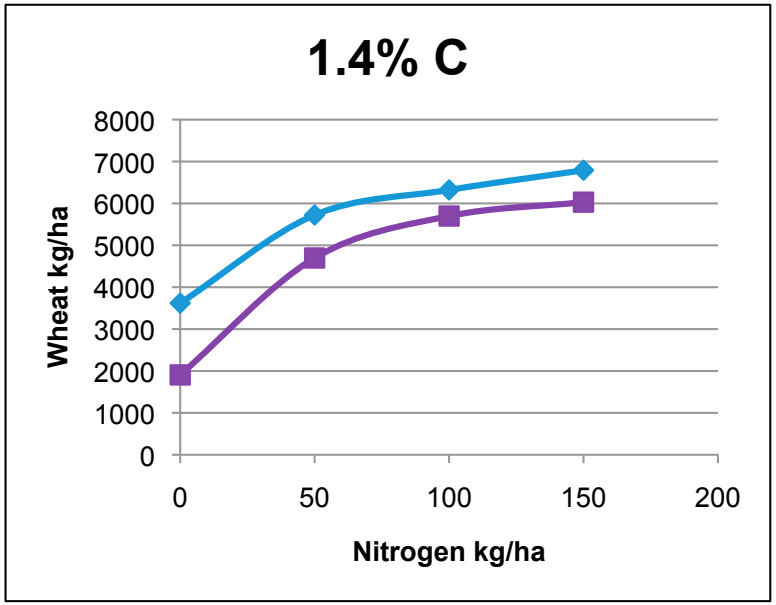
€?

Valuation of ecosystem services

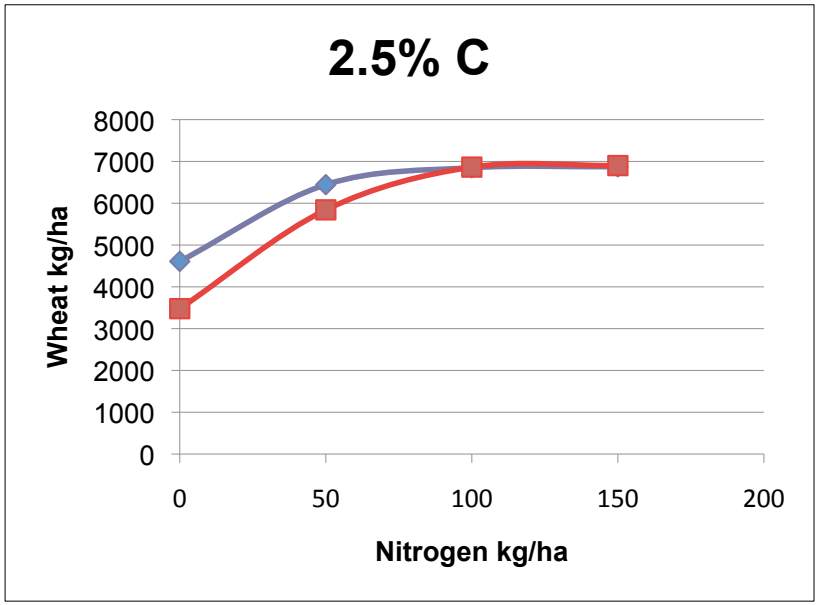


Agricultural production functions

Farm A

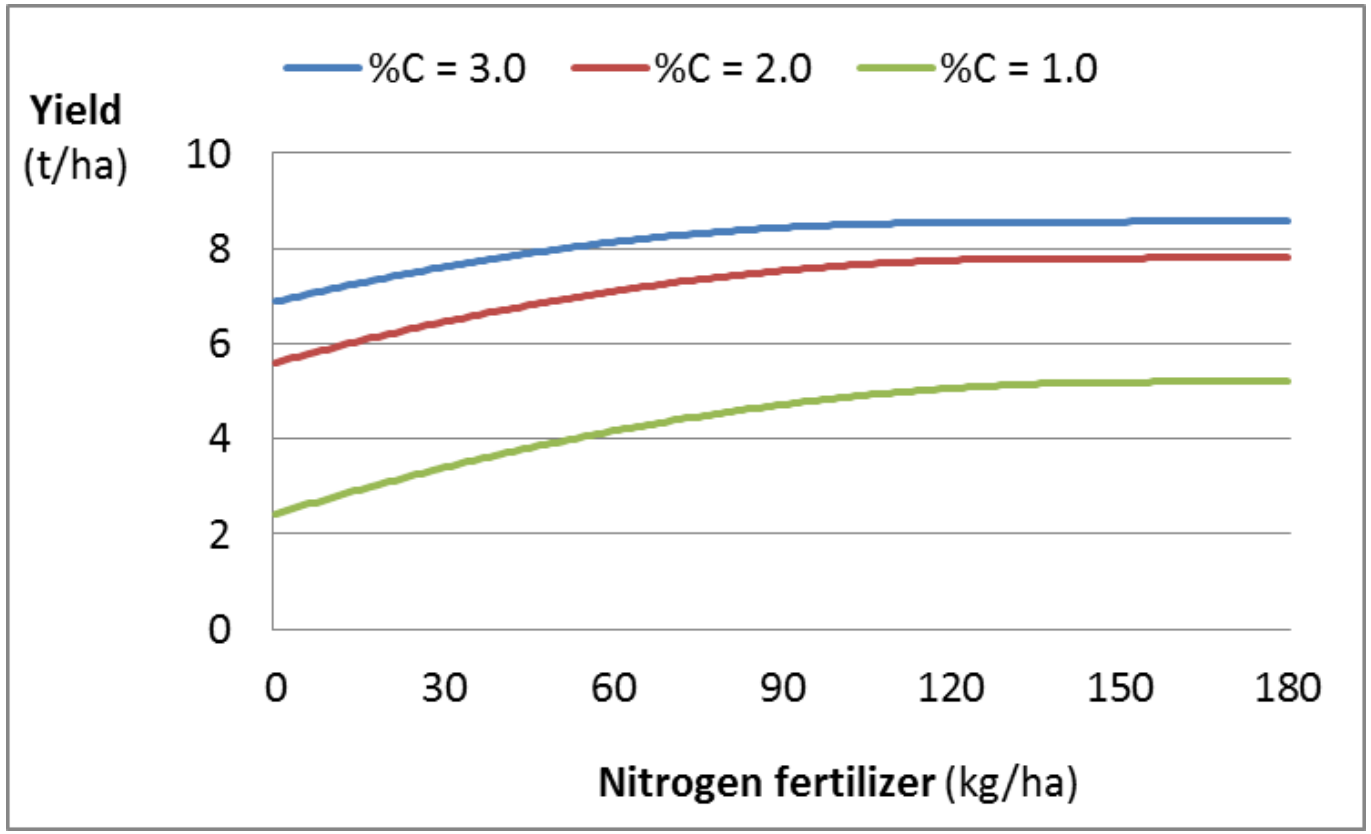


Farm B

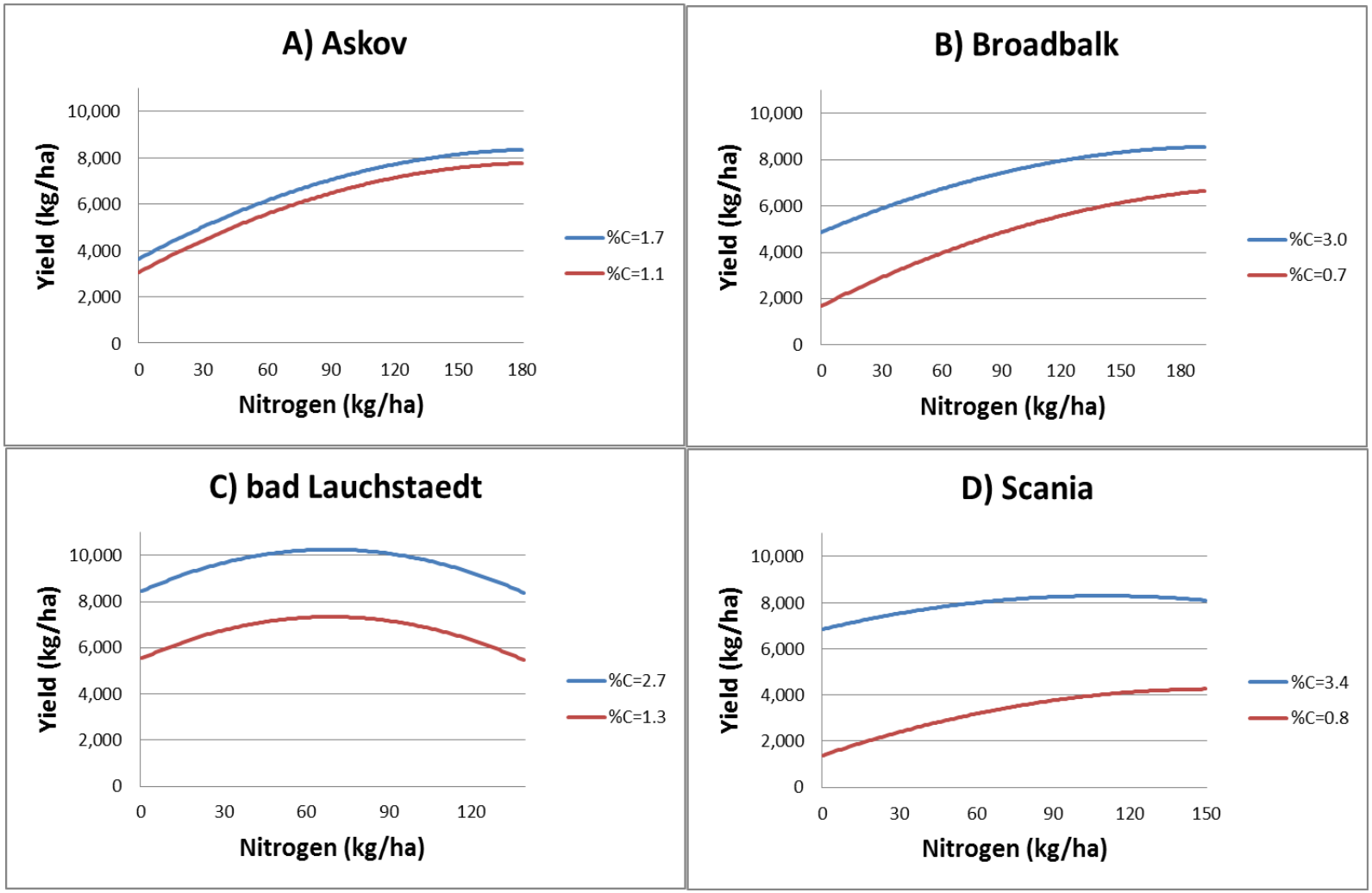


0.2 % C between the treatments

Economic valuation:
Carbon a currency for natural capital



Effect of changing soil natural capital on wheat yield

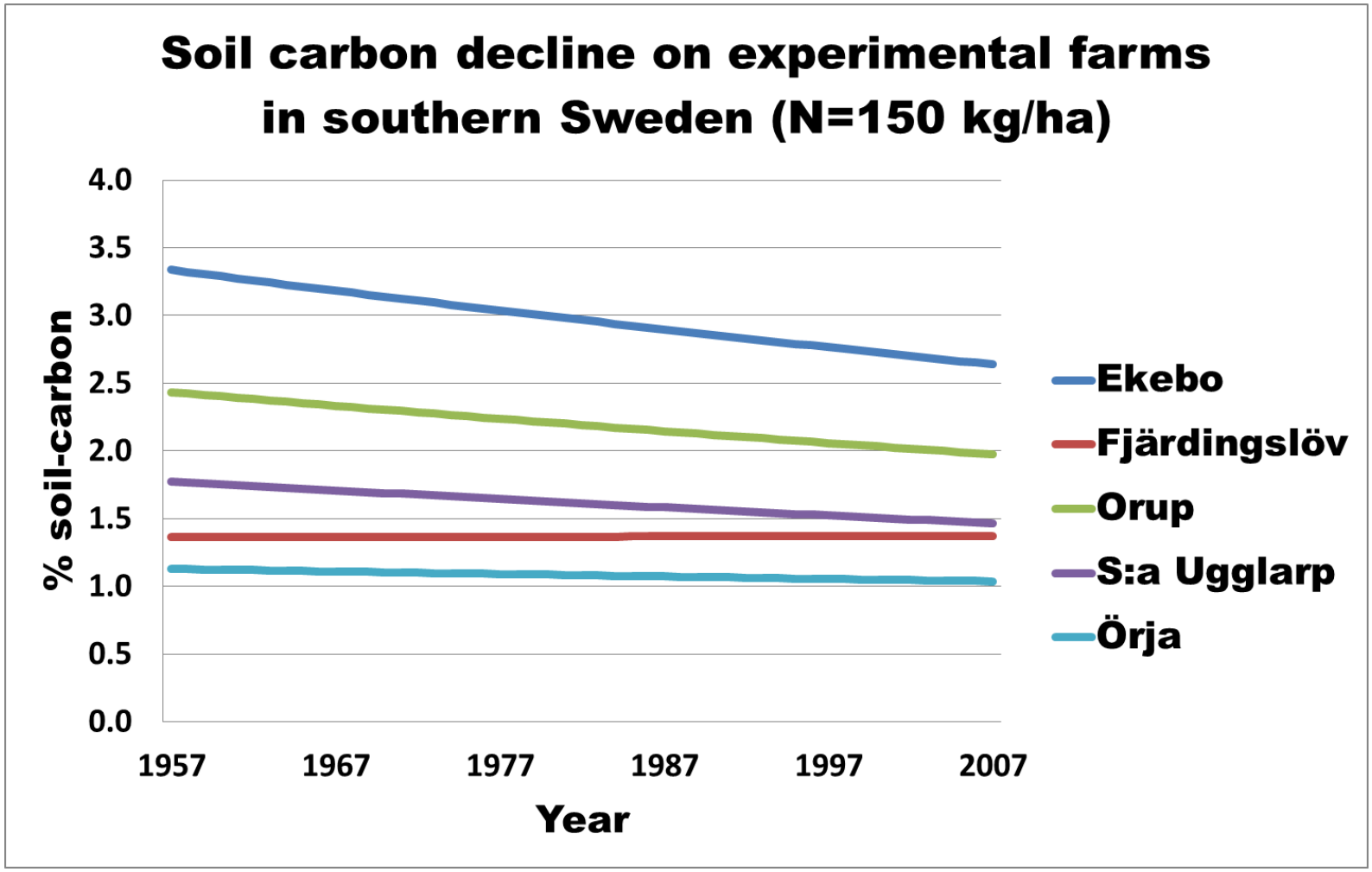


How can we affect Soil C

Management	C decline per year	
Intensive cereal production	-1.0%	UK
Inorganic fertilisers	-0.5%	SE
Farm yard manure (5 ton/ha)	-0.2%	SE
Straw addition (3 ton/ha)	-0.2%	DK

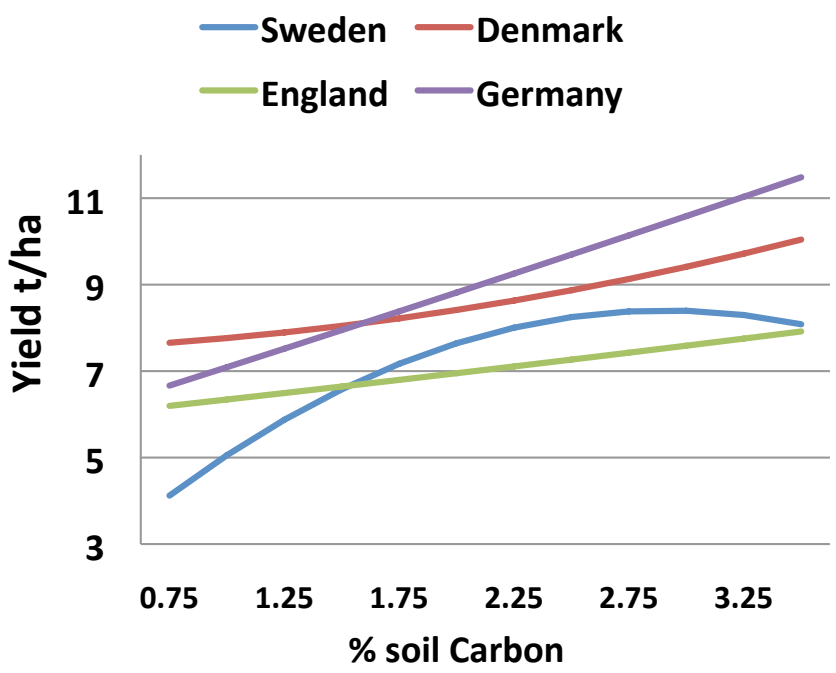
Management	C increase per year	
Cover crops	0.2%	FR
Straw addition (12 ton/ha)	0.3%	DK
Farm yard manure (35 ton/ha)	0.4%	UK
Sewage sludge	0.9%	SE
Miscanthus grass (bioenergy)	?	

Long term decline of soil-C in Europe

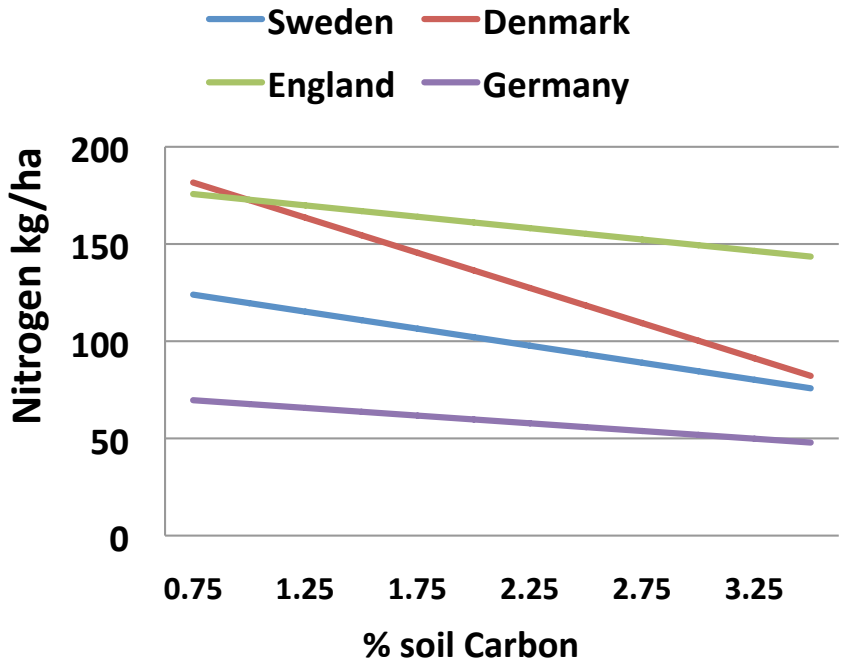


Optimal use of soil C

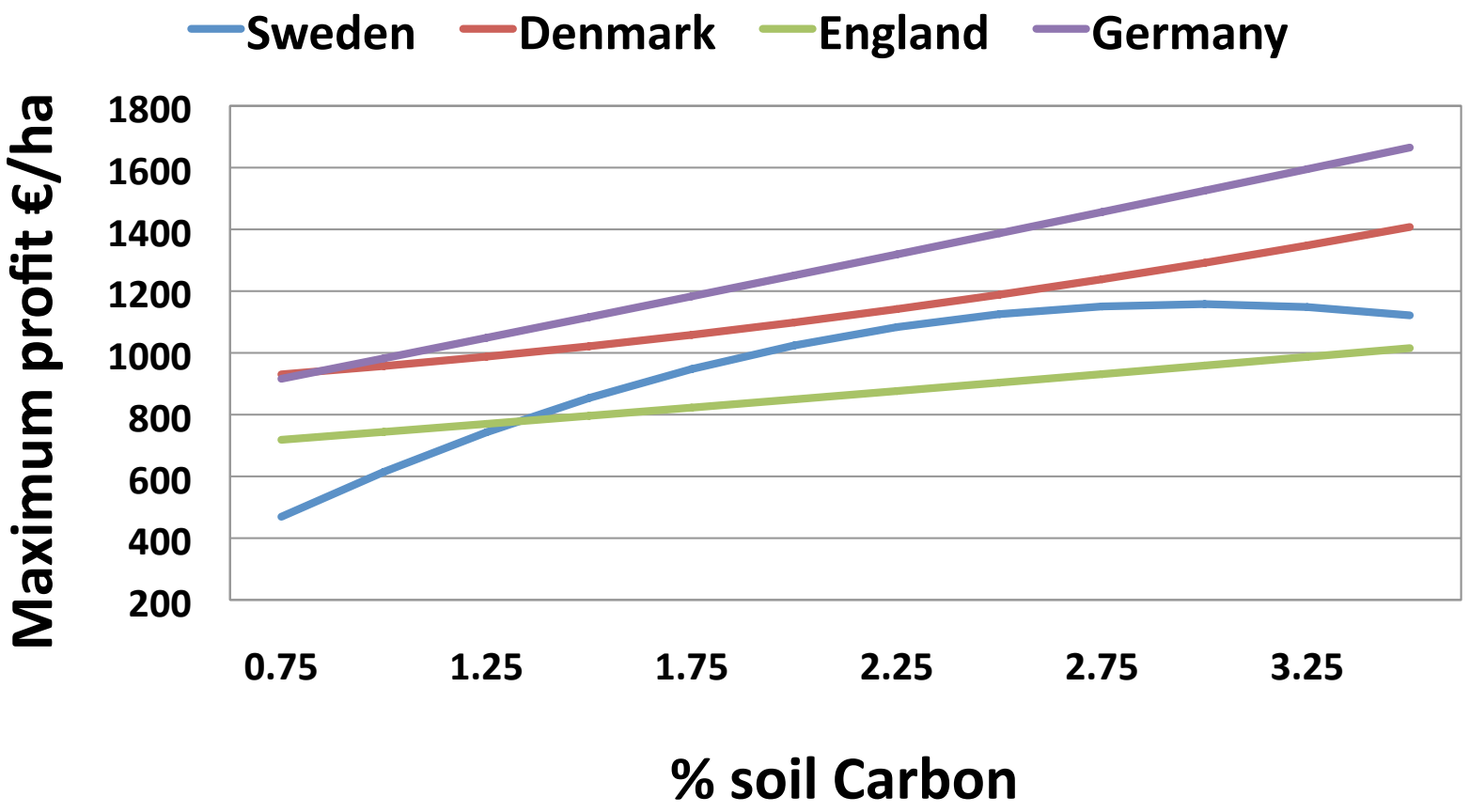
Optimal yield



Optimal fertiliser use



Carbon a natural capital



Scenarios for predicting the future

	World Market	Regional Enterprise	Global Sustainability	Local Stewardship
Yields	High	Medium	Medium	Low
Crop Price	Low	Low	Low	Medium
Energy price	Low	Medium	Medium	High
Global pop	Low	High	Low	Medium

Adopted from the ACCELERATES project
(Abildtrup, et al. 2006

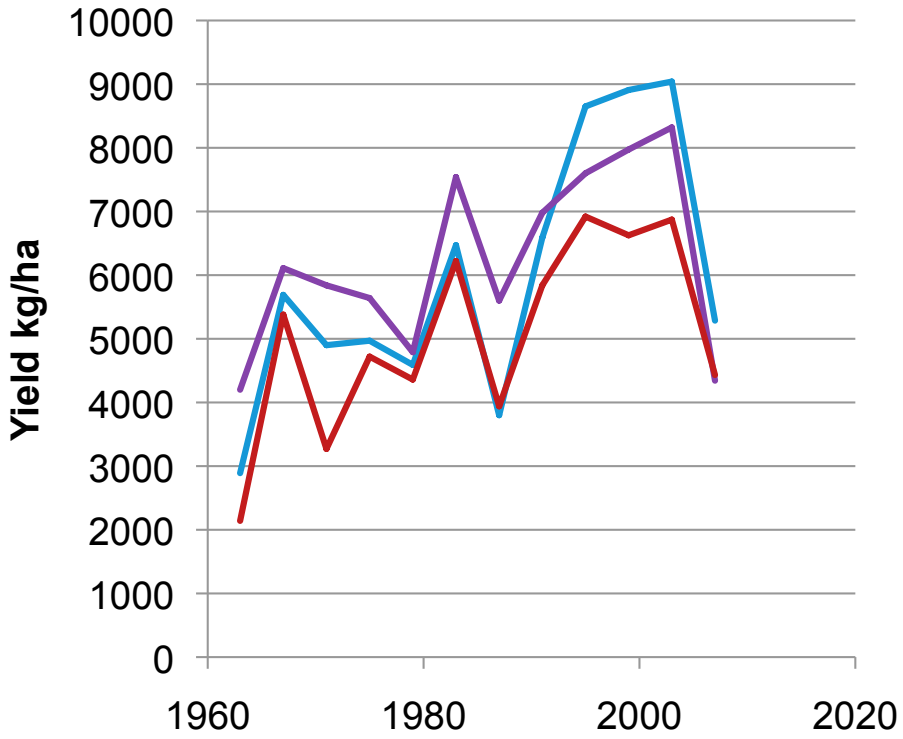
Farm profits and C change in 2035

No change in C	2010	WM	RE	GS	LS
Yield (kg/ha)	7 907	13 673	10 858	10 824	8 295
Total revenues (€/ha)	**1 832**	**2 364**	**2 223**	**2 591**	**2 233**
Farmers profit (€/ha)	**813**	**1 321**	**1 084**	**1 160**	**783**

C change - 0.5 %/yr		WM	RE	GS	LS
Yield (kg/ha)		13 144	10 438	10 406	7 974
Total revenues (€/ha)		**2 057**	**1 935**	**2 255**	**1 944**
Farmers profit (€/ha)		**974**	**742**	**753**	**416**

C change +0.5 %/yr		WM	RE	GS	LS
Yield (kg/ha)		13 953	11 081	11 046	8 464
Total revenues (€/ha)		**2 709**	**2 548**	**2 970**	**2 560**
Farmers profit (€/ha)		**1 703**	**1 457**	**1 603**	**1 179**

Insurance value of conserving soil-C

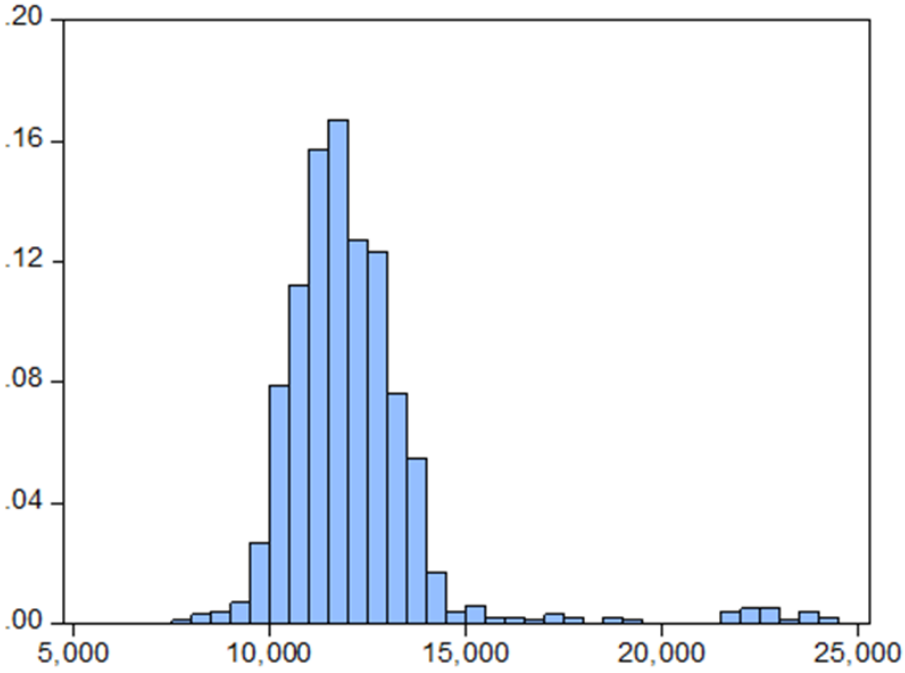


Yields vary with climate

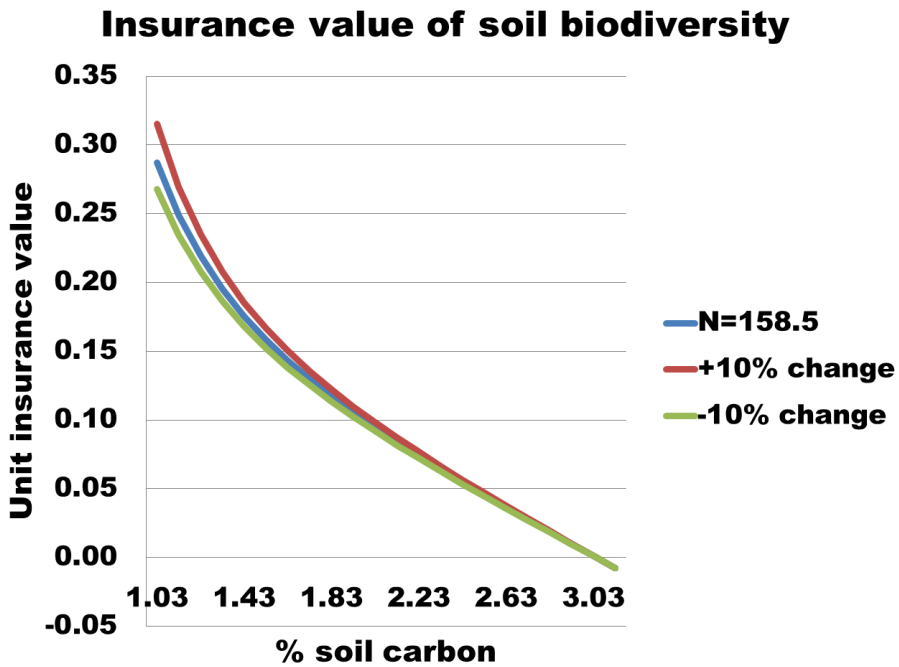
Winter wheat harvests from 3 farms in Sweden

Insurance value of conserving soil-C

Variance in profits implies risk



Cost of insurance of reducing risk



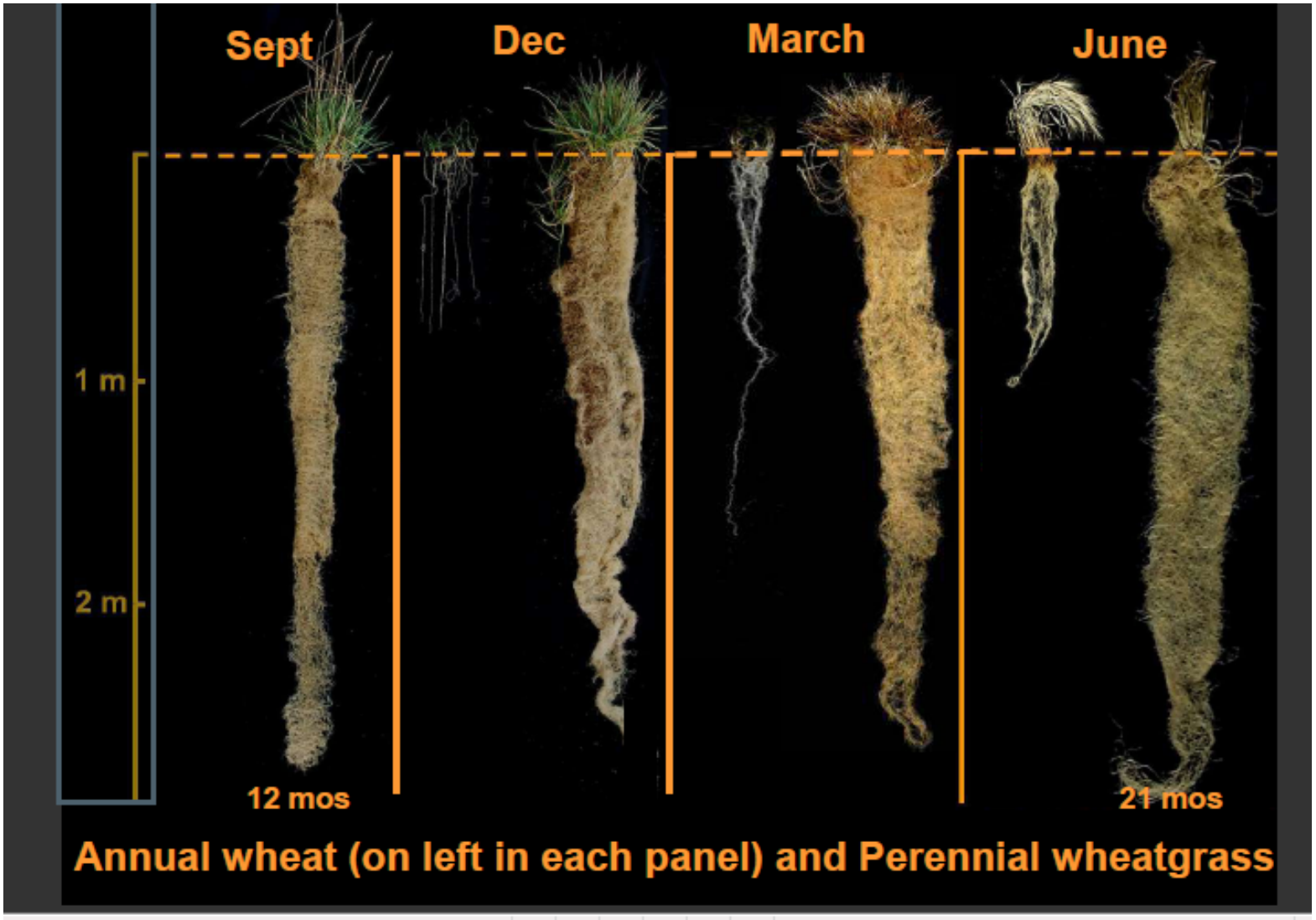
Soil a natural capital

- Promoting soil C means increasing soil biodiversity and soil ecosystem services
  ➡ sustainable agriculture

- Processes are long term and farmers economy will be affected in the future
  ➡ long term investments

- Soil ecosystem services reduce risk
  ➡ production and market risks

Ways forward – perennial crops?



Wes Jackson, www.landinstitute.org

Ways forward – bioenergy crops?

Miscanthus

Salix

Phalaris

Poplar

Information transfer