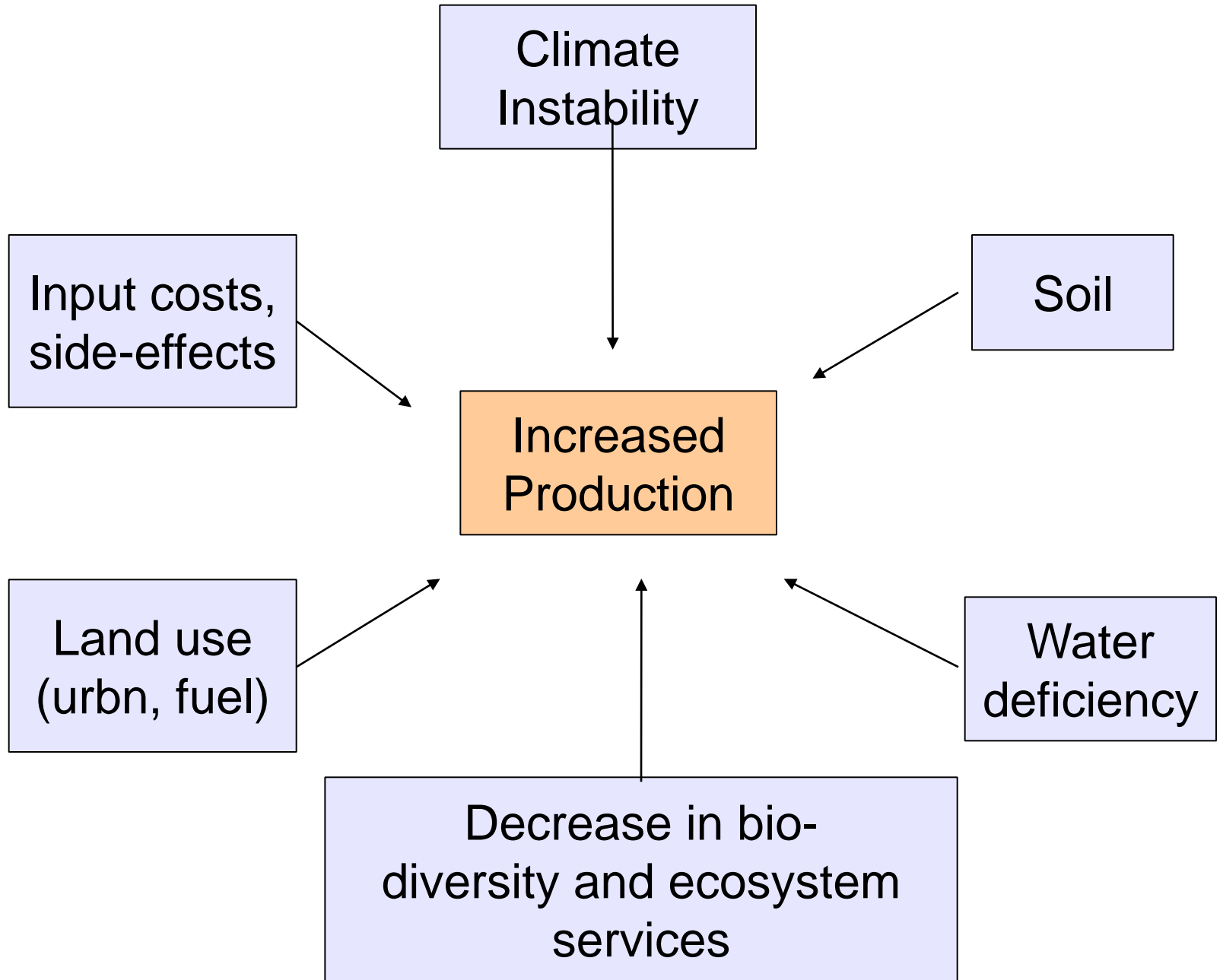
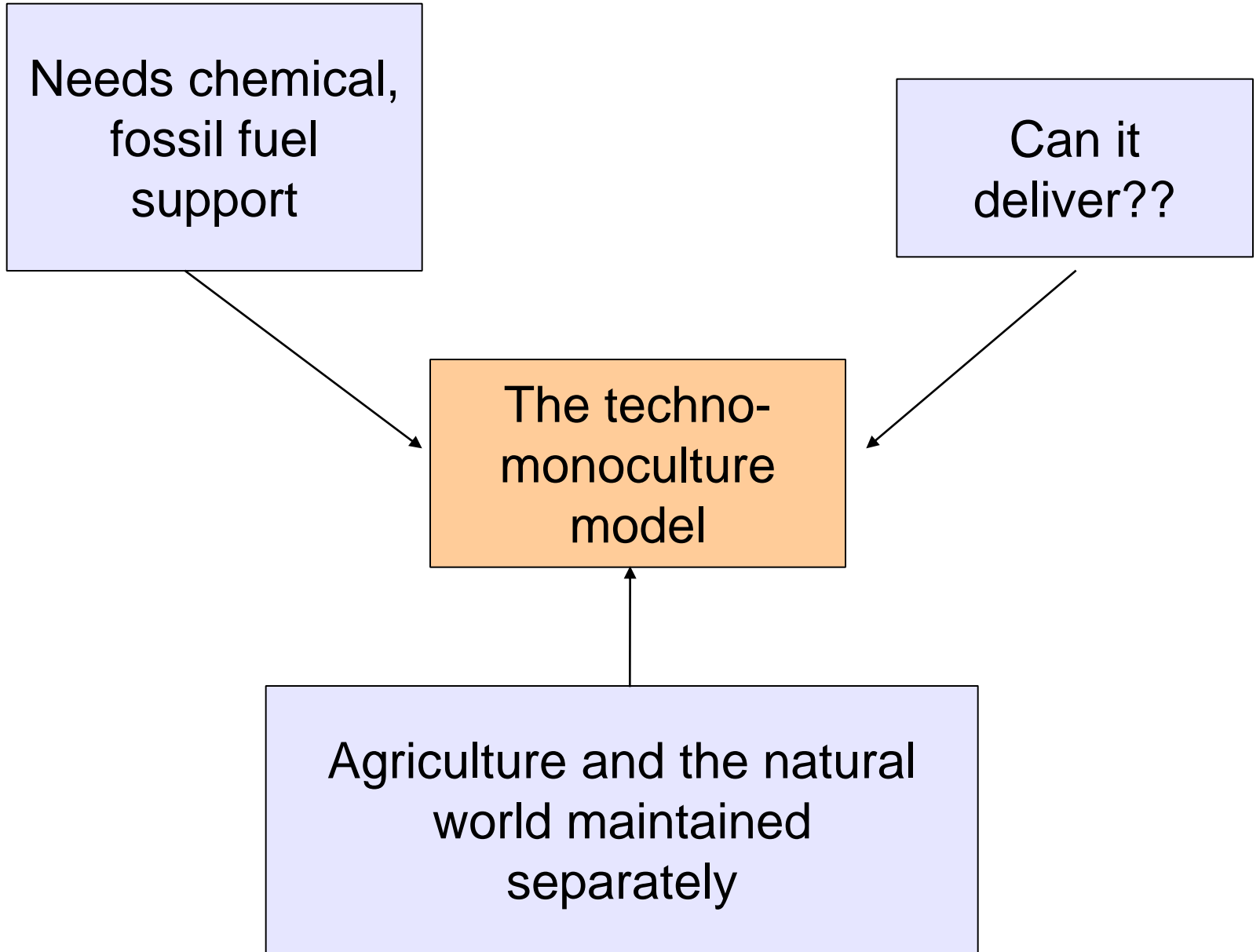


# Sustainable agriculture is in our nature

Martin Wolfe and Joanne  
Smith

The Organic Research Centre and  
Wakelyns Agroforestry, Suffolk



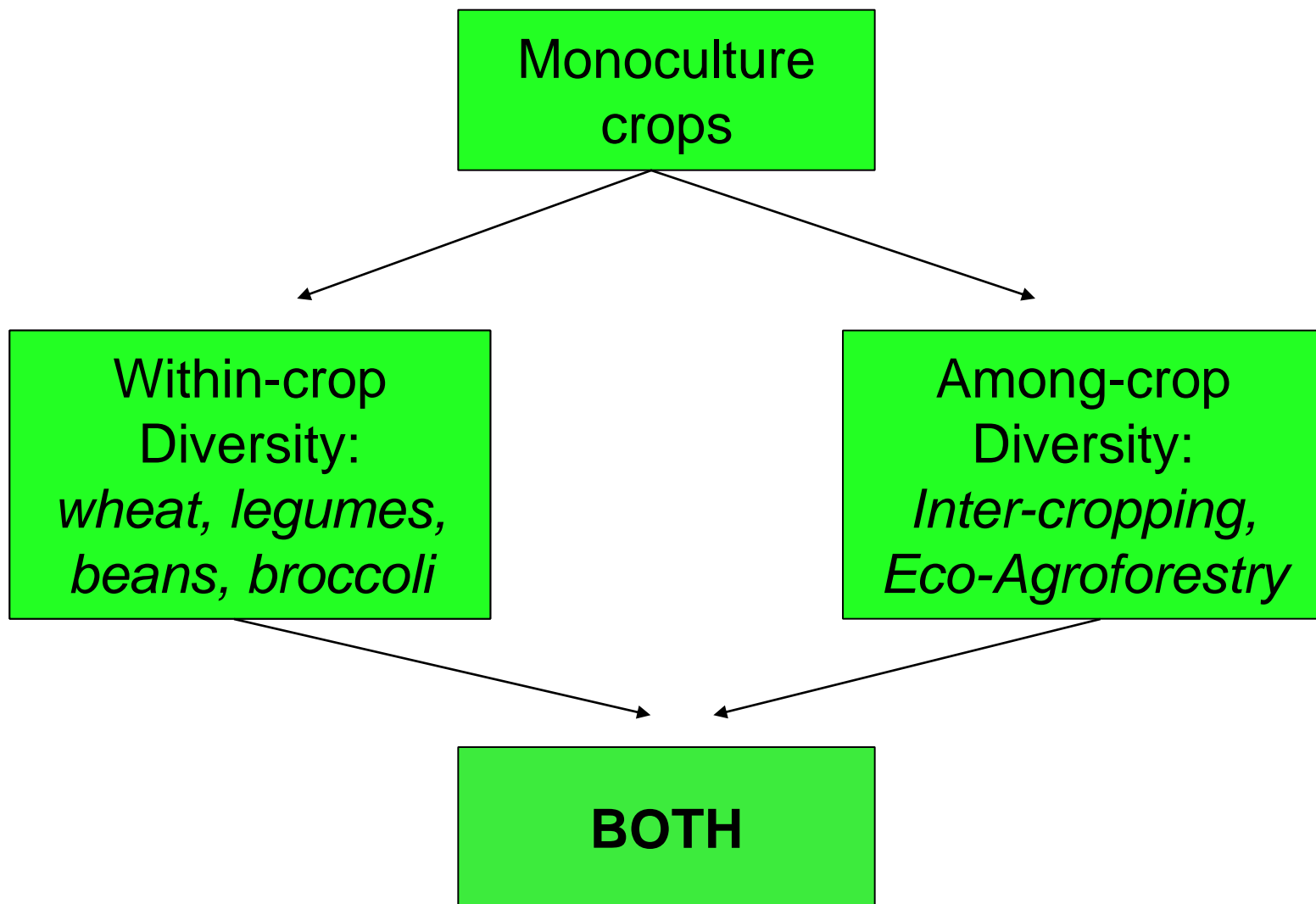


# Is organic farming the answer?

- Crop rotation
- Complex clover leys
- Builds-up own crop nutrition
- No herbicides, insecticides, fungicides, growth regulators
- More and larger hedges
- Smaller fields
- More mixed farms

*- all help, but a LONG way to go*

# ORC Research Programme



# Unifying concepts in ecology (Loreau 2010)

There are positive correlations between:

## **A) DIVERSITY AND STABILITY**

(e.g. wheat populations)

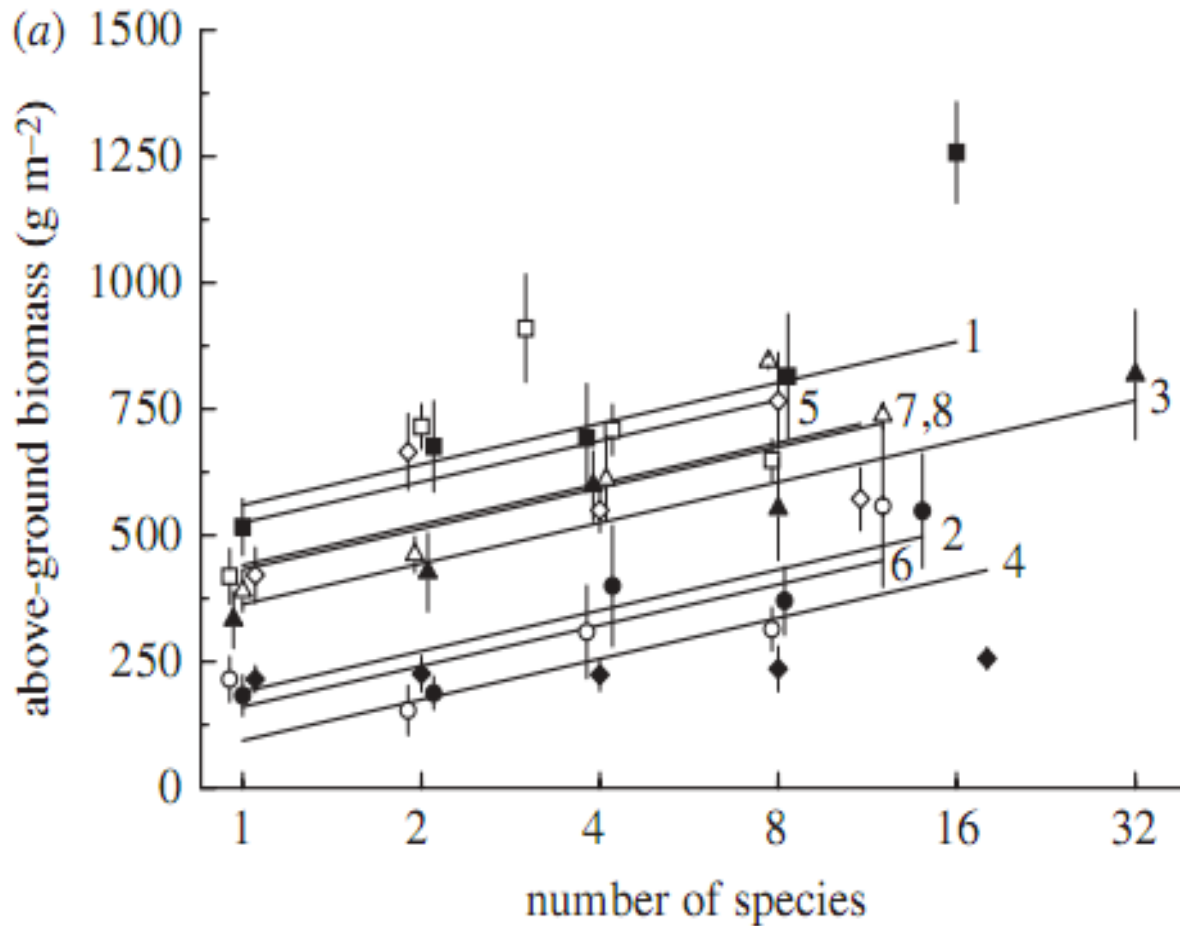
## **B) DIVERSITY AND PRODUCTIVITY**

(e.g. large-scale natural grassland projects)

# Diversity and Productivity

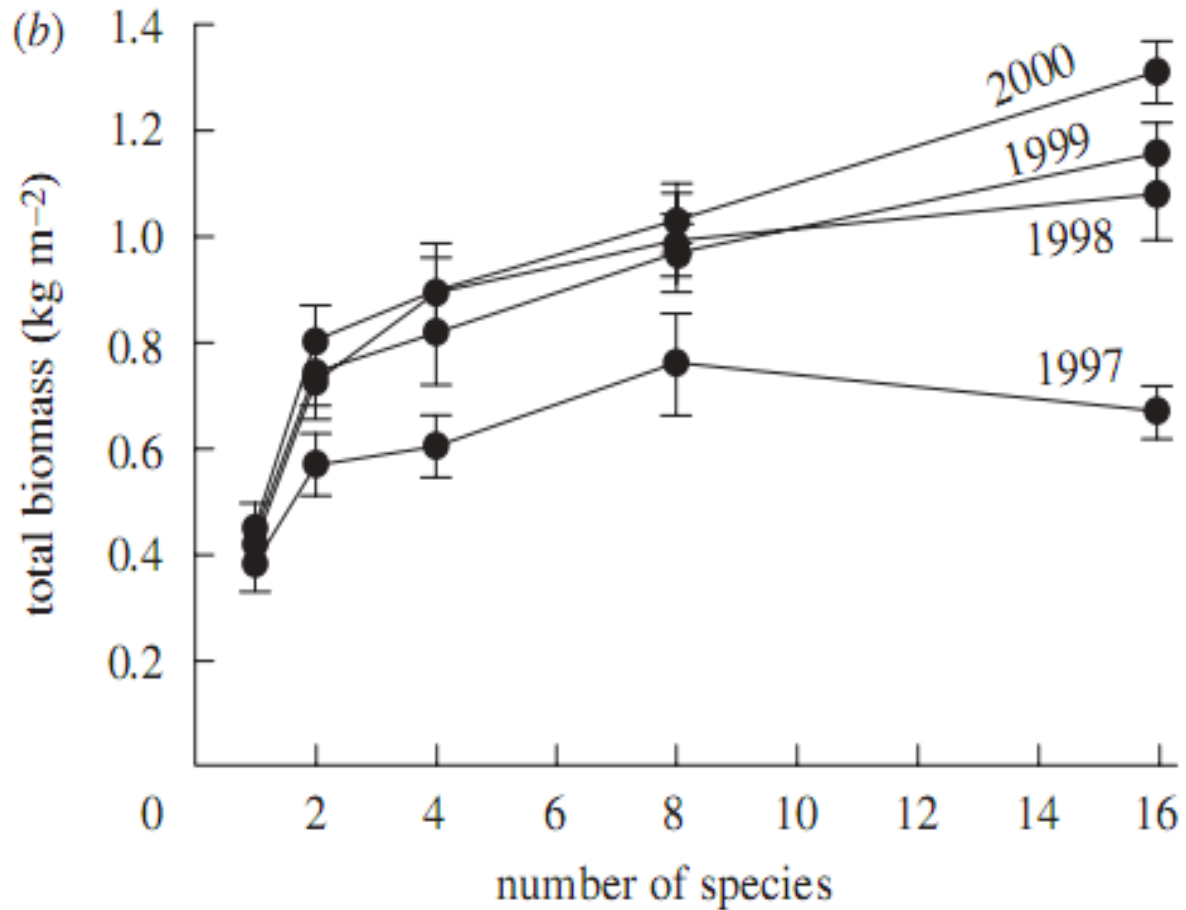
## Natural grassland experiments

# BIODEPTH project: biomass and diversity at eight European sites





# Cedar Creek: Biomass and biodiversity improves with time



**- and the importance of  
perenniality**



# Advantages of long-term perennial grassland versus annual wheat

## A. Above Ground

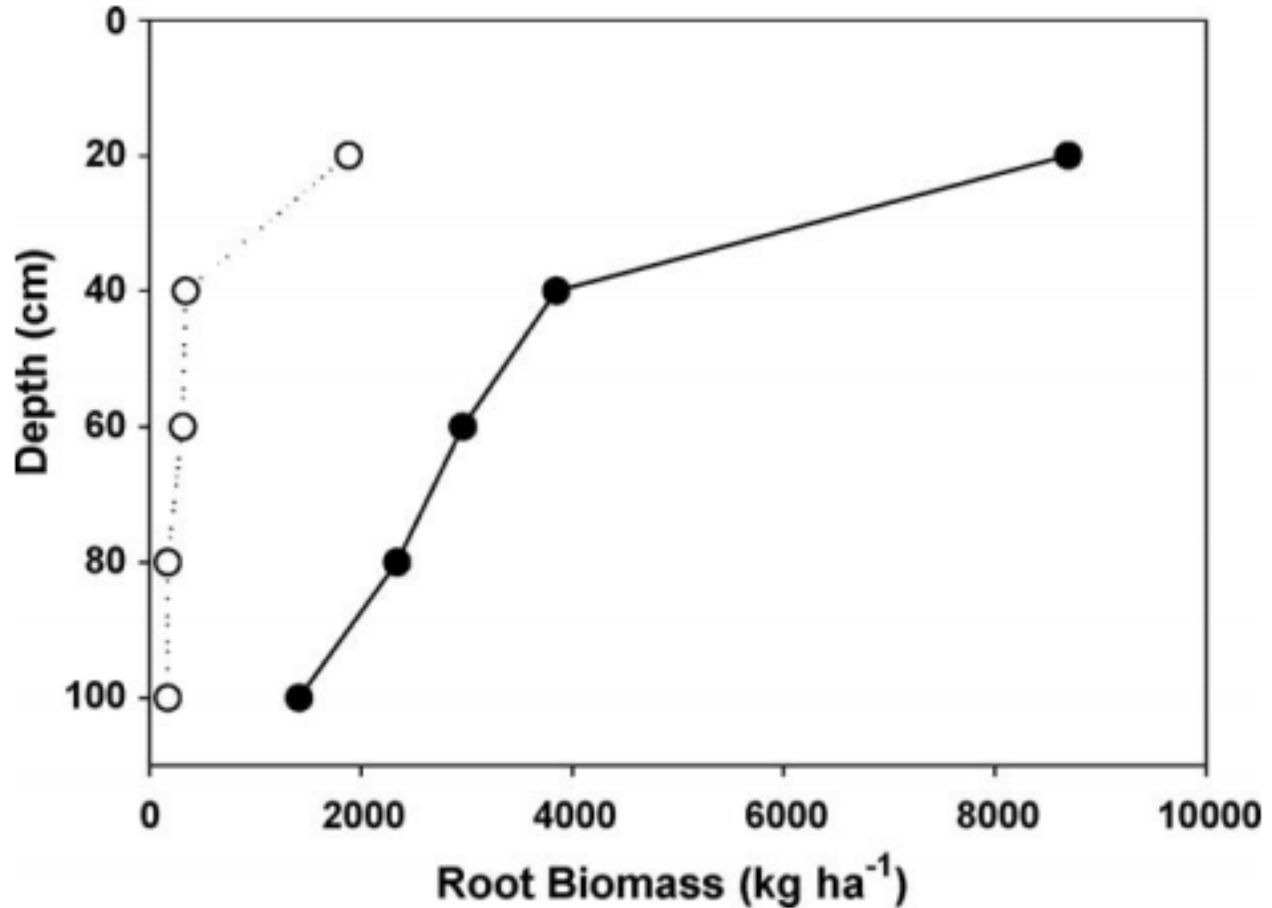
- Higher N yield, no inputs
- Perennials dominant, high diversity
- Pollinators, herbivores, detritivores more, more diverse

## B. Below Ground

- Roots longer, deeper
- Food webs more diverse and structured
- Soil: more C and N, better structure, less leaching
- Better water quality (reduced NO<sub>3</sub>-N load)

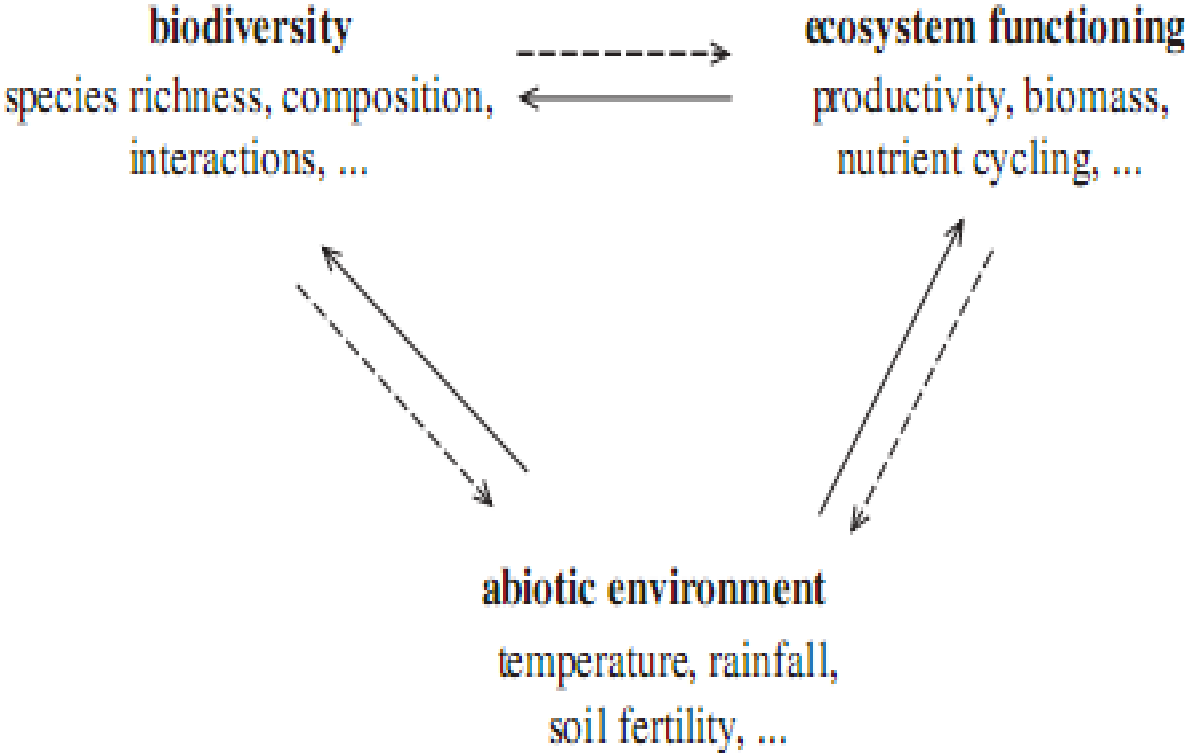
*(Glover et al., 2010)*

# Root biomass below native perennial prairie versus crop land in Kansas (Culman et al. 2010)



**Fig. 1.** Root biomass in the Niles grassland (closed circles) and cropland (open circles) site at 0–20 cm, 20–40 cm, 4–60 cm, 60–80 cm, and 80–100 cm.

# Feed-back systems



Loreau 2010



*- this is what we survive by - the natural world – or,  
as it is now frequently termed -*

## **Ecosystem Services**

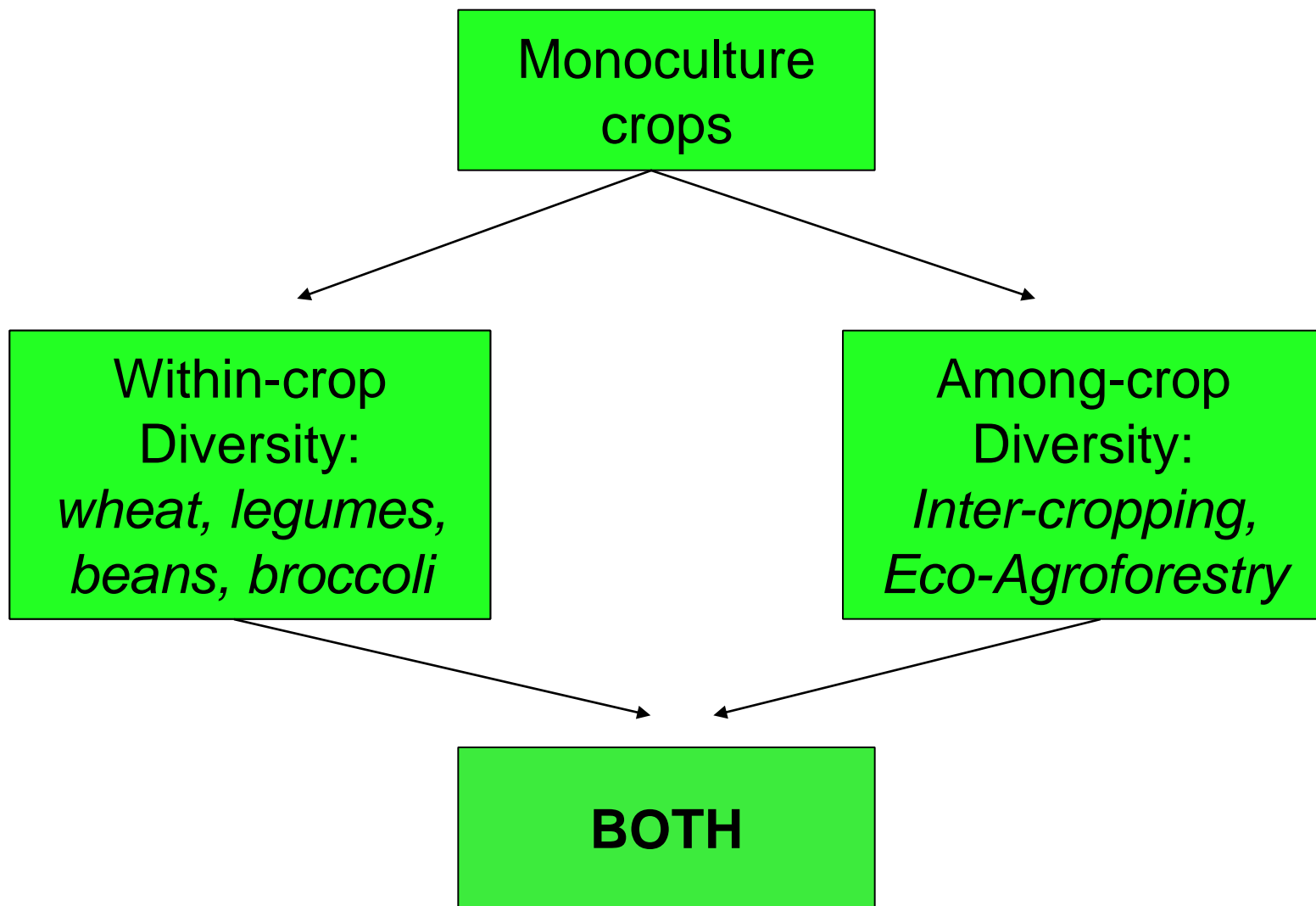
**Provisioning** (food and water, materials, energy);

**Regulating** (carbon sequestration, climate regulation, decomposition and detoxification, purification of water and air, pests and diseases, pollination);

**Supporting** (nutrient dispersal and cycling, seed dispersal, primary production);

**Cultural** (spiritual, health and recreational benefits)

# ORC Research Programme



# Within-crop diversity: wheat populations

## POSITIVE

Capacity: more phenotypic and genotypic variation

Complementation: different genotypes complement each other

Compensation: if some fail, others take their place

Change: evolutionary shifts in response to selection

## NEGATIVE

Competition: may work against the four 'Cs' above.



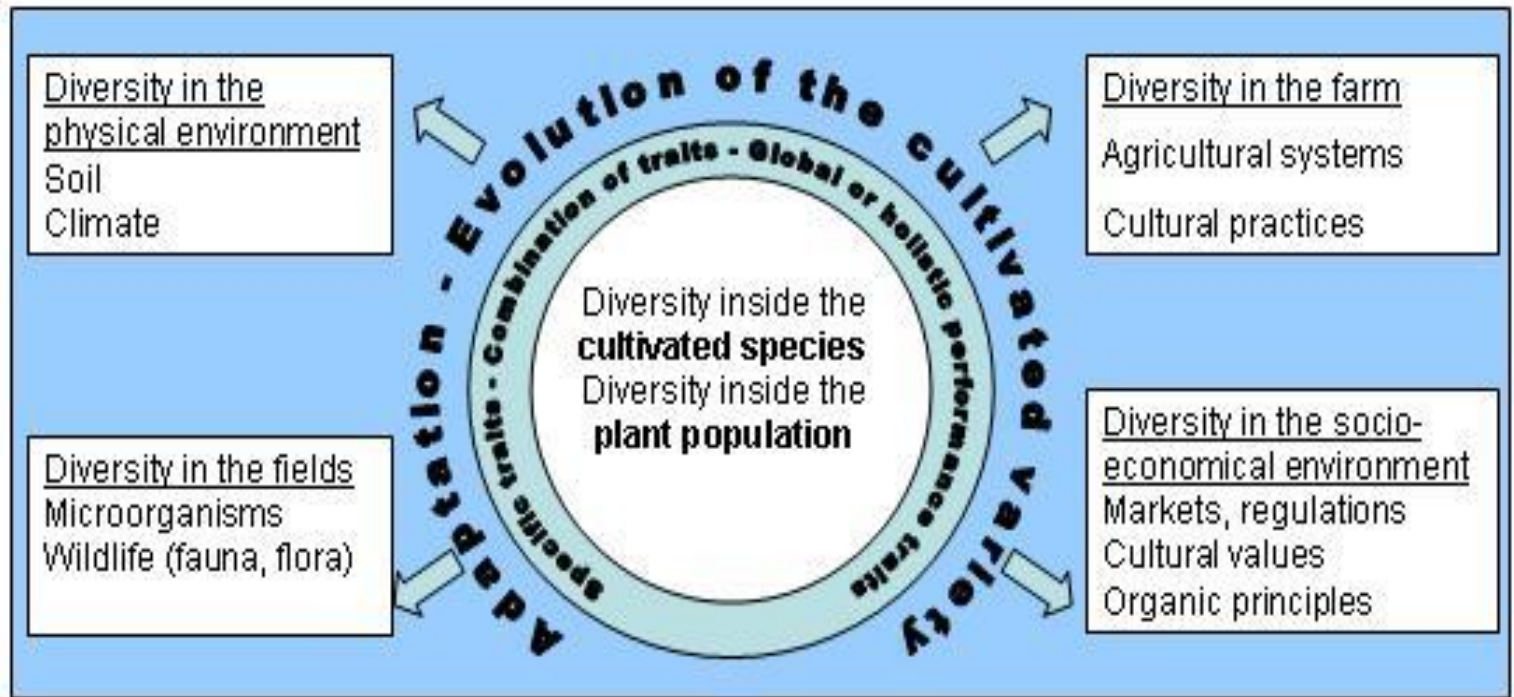




# Project 3: SOLIBAM



The SOLIBAM diagram (Strategies for Organic and Low-input Integrated Breeding and Management) – an EU project started in March 2010:



## Among-crop diversity:

# ECO-AGROFORESTRY

- the integration of tree management into agriculture
- *and the cultivation of woodland edge*

# The Organic Research Centre



# Contour planting in Argentina



# Advantages of tree integration

- Achieves ecosystem intimacy
- Carbon capture and storage
- Ammonia abatement
- Nutrient cycling
- Produces food, fuel and fibre
- Biodiversity
- Crop and animal protection and nutrition
- Also protects soil, water and air
- Employment opportunities; pension scheme

Inputs needed:

- Soil, sun, air, water – and some labour

# The Organic Research Centre



# Winter wheat and hazel in 2006

The Organic Research Centre



# Clover ley in 2008



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# Potato crop in 2009



# Hazel coppice recovery on single row (4 months)



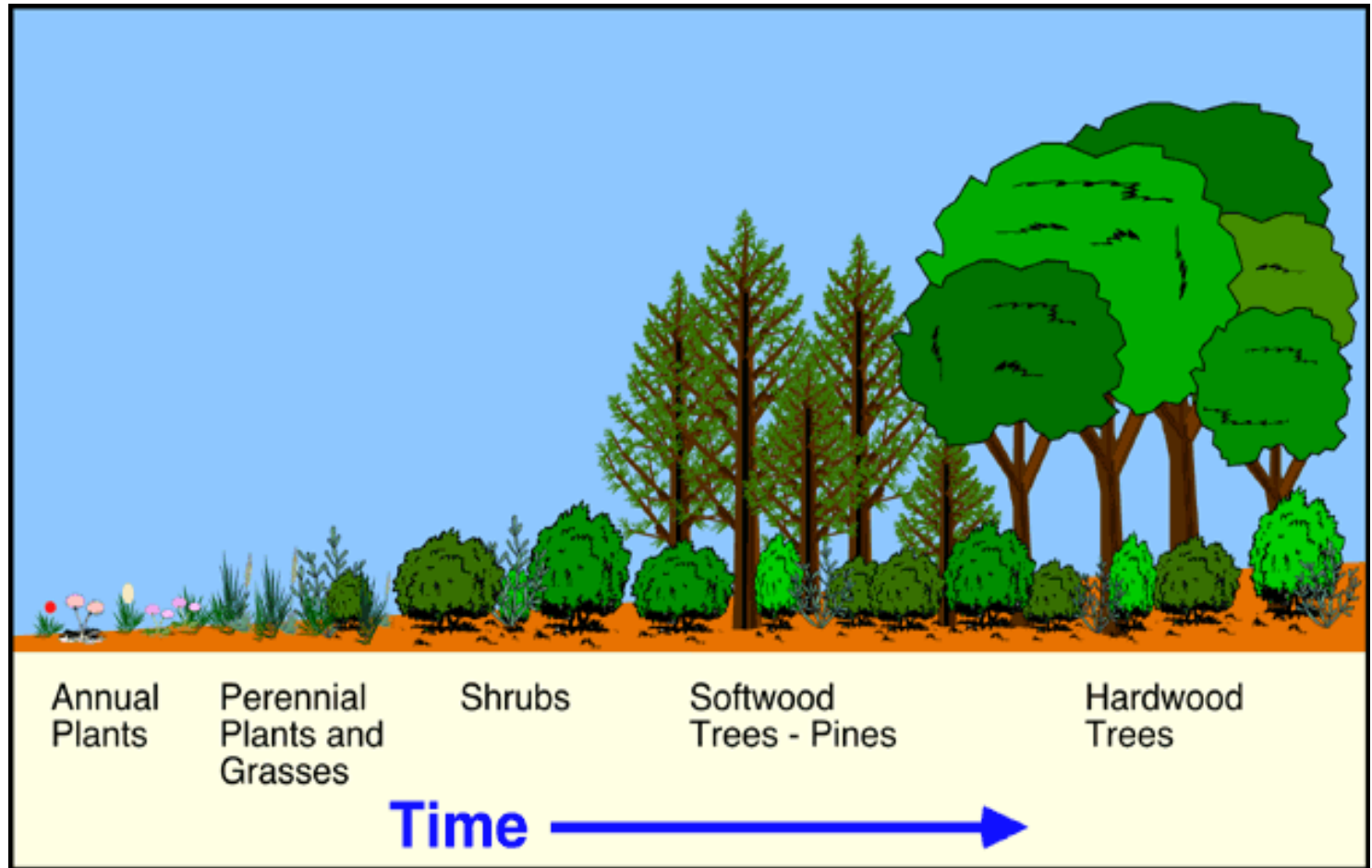
# The Organic Research Centre



# The Organic Research Centre



# Plant succession to climax vegetation



# Models of Plant Succession

- a) **FACILITATION MODEL** – early stage species change the abiotic environment which facilitates later stage species
  
  - b) **TOLERANCE MODEL** – later species have higher tolerance of diminishing resources
  
  - c) **INHIBITION MODEL** – later species accumulate by replacing earlier ones when they die
- *generally, diversity and thus stability and productivity, increase with time, until the mature phase*

# A silvo-pastoral system



# Wheat populations and diverse hardwood trees

