# Uthålliga odlingssystem i ett framtida svenskt lantbruk

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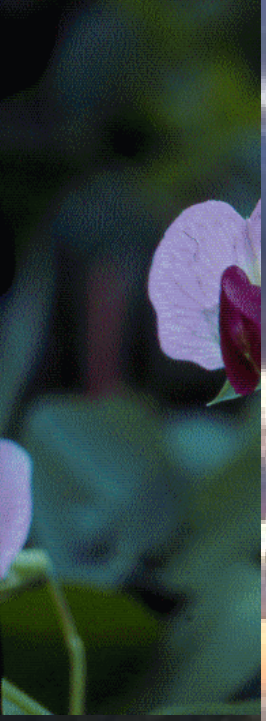


# The global agenda for sustainable food production

Produce more healthy food

with

less climate and environmental impacts

while

inputs are decreased, regulations enhanced and the climate becomes more variable

# Which resources and what to do?

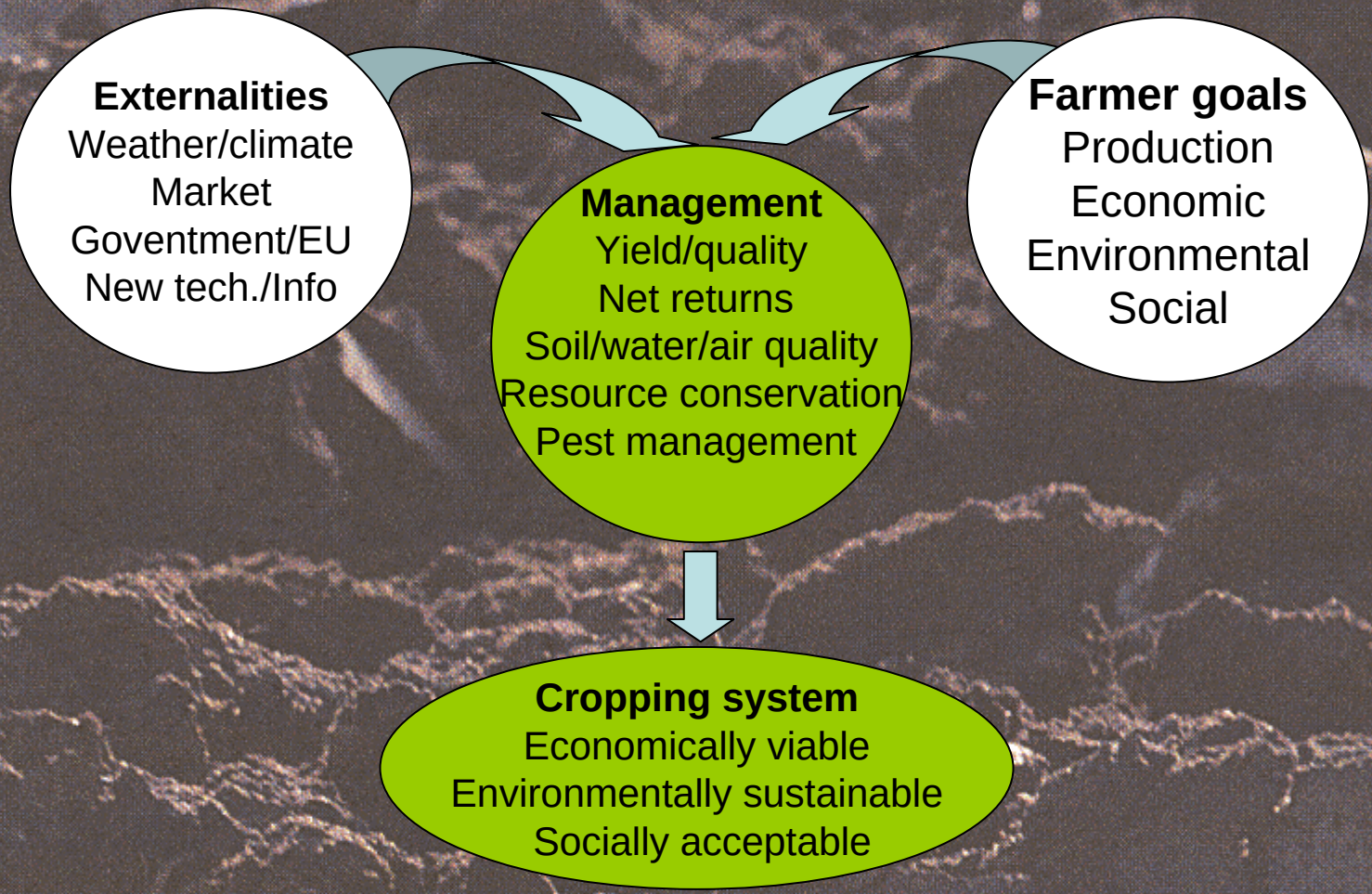
- Farmer knowledge and attitudes
- Cropping systems science incl systems approach
- Agroecological intensification
- Multifunctionality
- Model agriculture (role models – OiB/OF/?)
- Assessment of production systems
  - 4 E´s – economy, ethics, environment, energy
- Decision support systems

# Agroecological intensification (Cassman, 1999)

- Exploitable gap between average farm yield and genetic yield potential is closing
- Requirements:
  - Improved soil quality
  - Precise management of production factors in time and space
  - Scientific advancement in plant physiology, agroecology and soil science

- Systems approach (2+2=5)

# Cropping systems



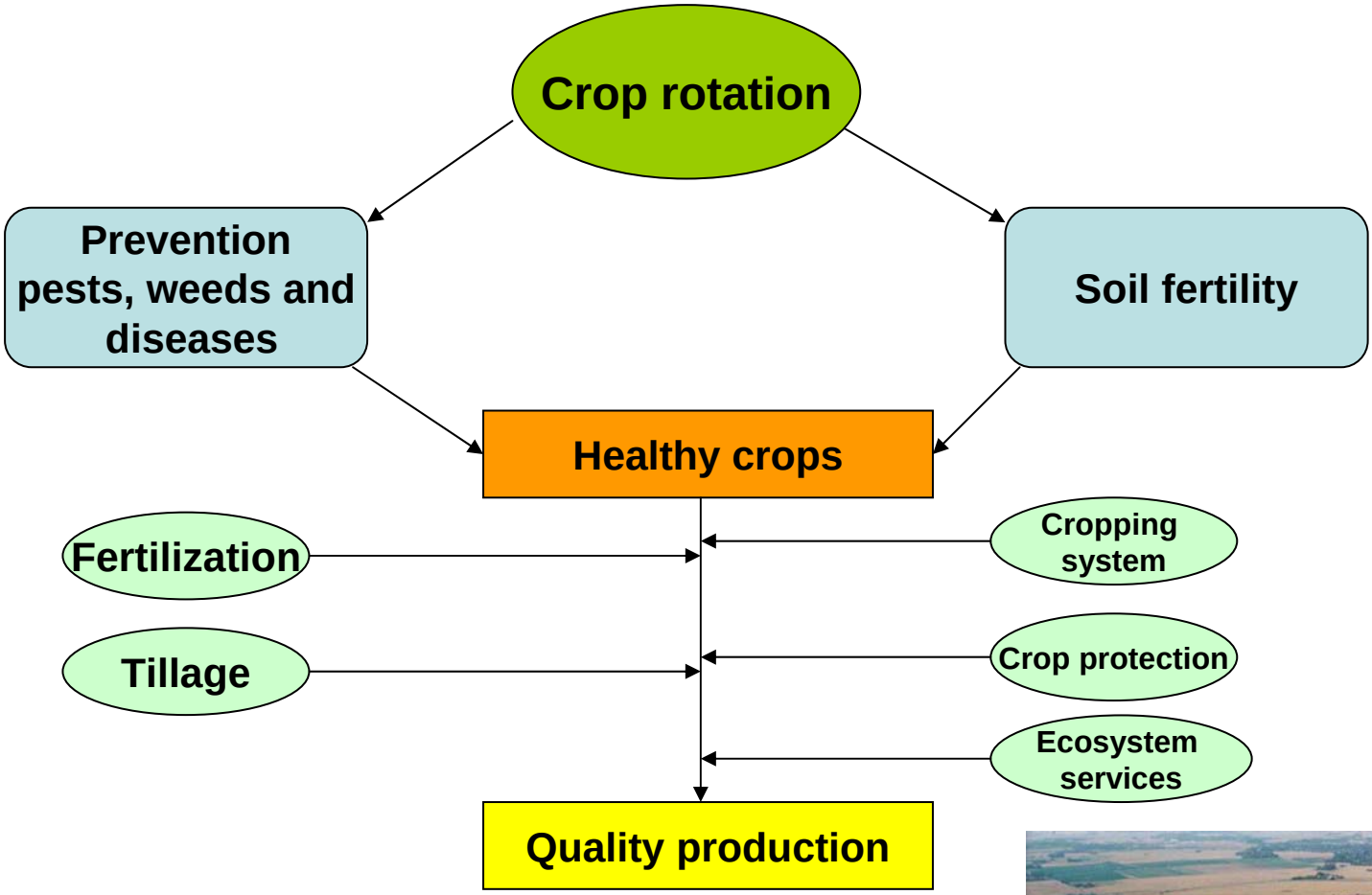
# Cropping systems integrate:

- The nature of crops (species, varieties)
- Crop succession  (rotation)
- Management techniques applied

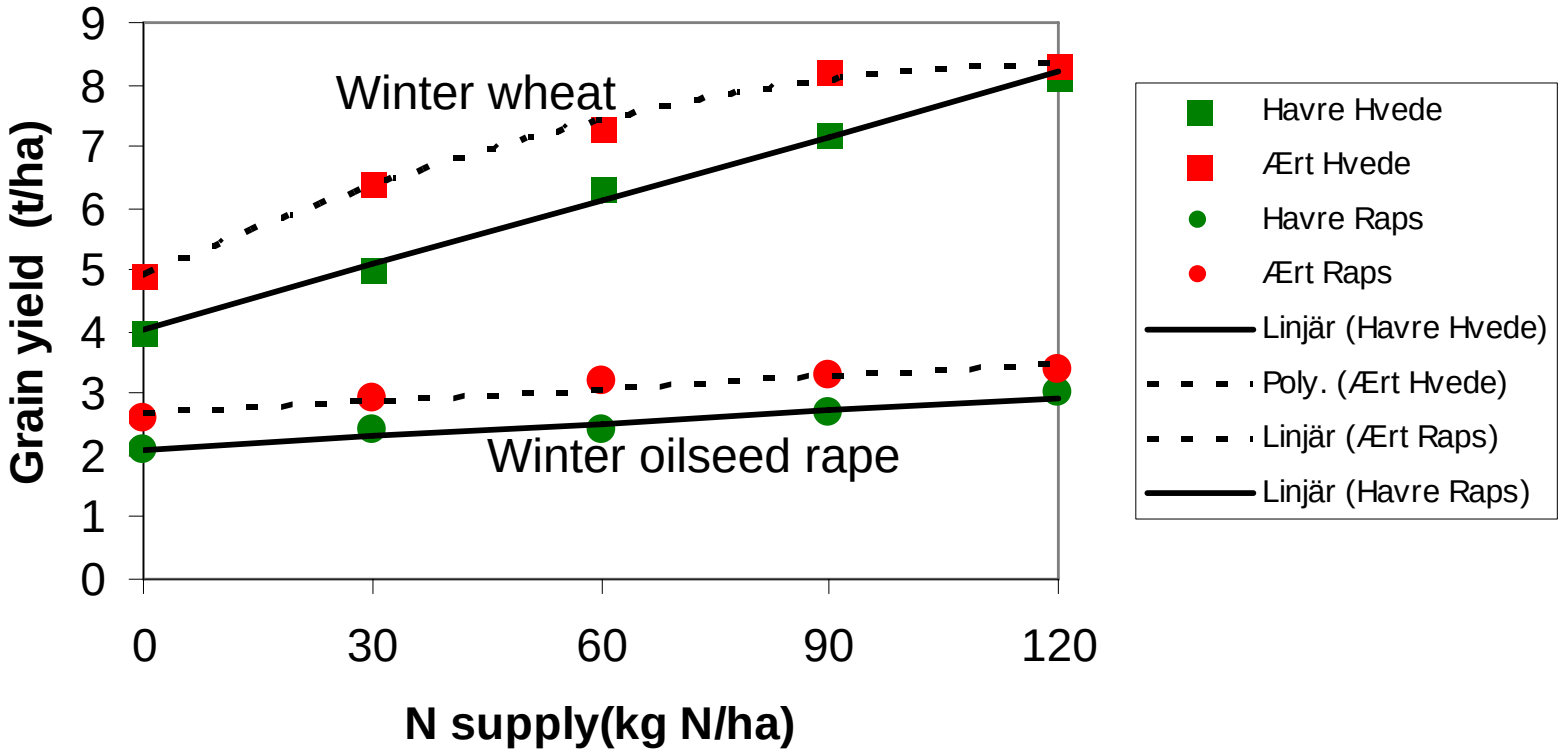
# Cropping systems for the future

- Integrated systems: account for both economical and environmental considerations
- Shift from emphasis on greater yields to cost reduction, improved quality of products and multifunctionality
- Substituting expensive and potentially polluting inputs (especially fertilizers and pesticides) by agricultural knowledge, labor (brain) and non-chemical cultivation techniques
- Systems include longer rotations and more perennial crops to increase cropping options and reduce risks
- Systems exploit synergism in time and space through crop succession to improve crops yields without additional inputs and deterioration of the environment and climate

# Crop Rotation – the most important management tool?

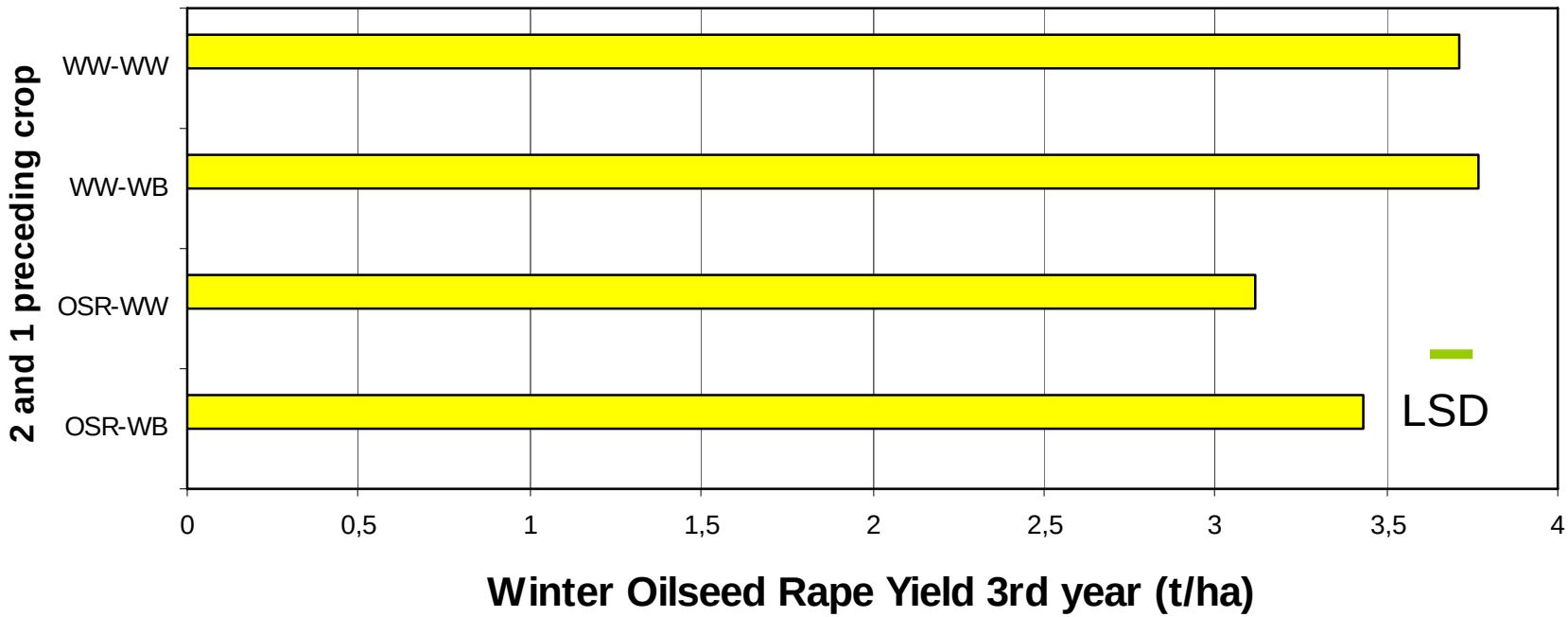



# Preceding value of pea and oat on winter wheat and winter OSR



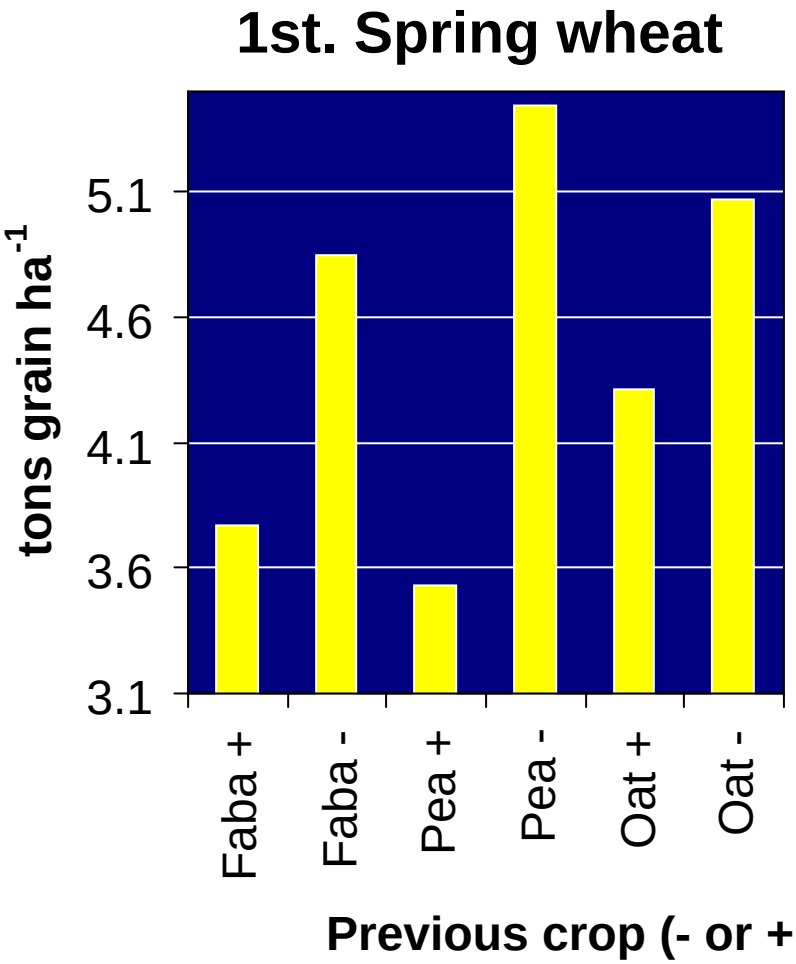

Jensen and Haahr, 1990

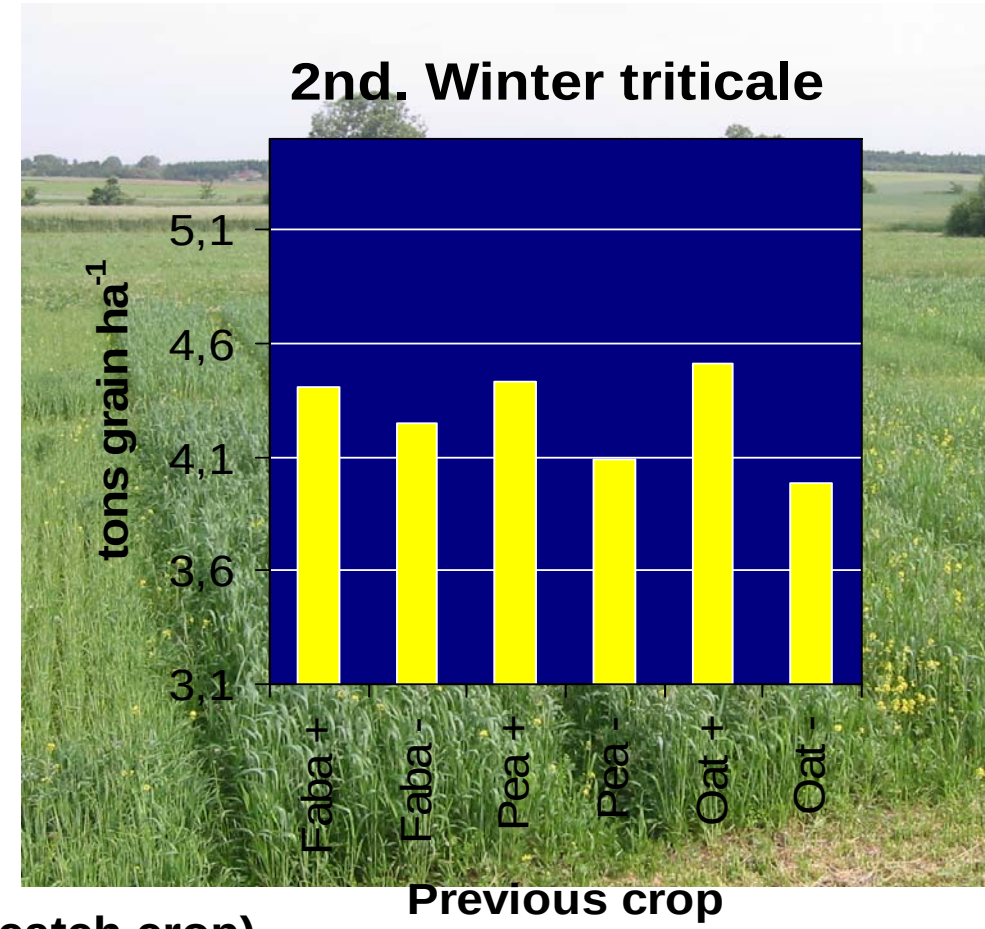
# Precropping effects on oilseed rape




After Sieling and Christen 2008

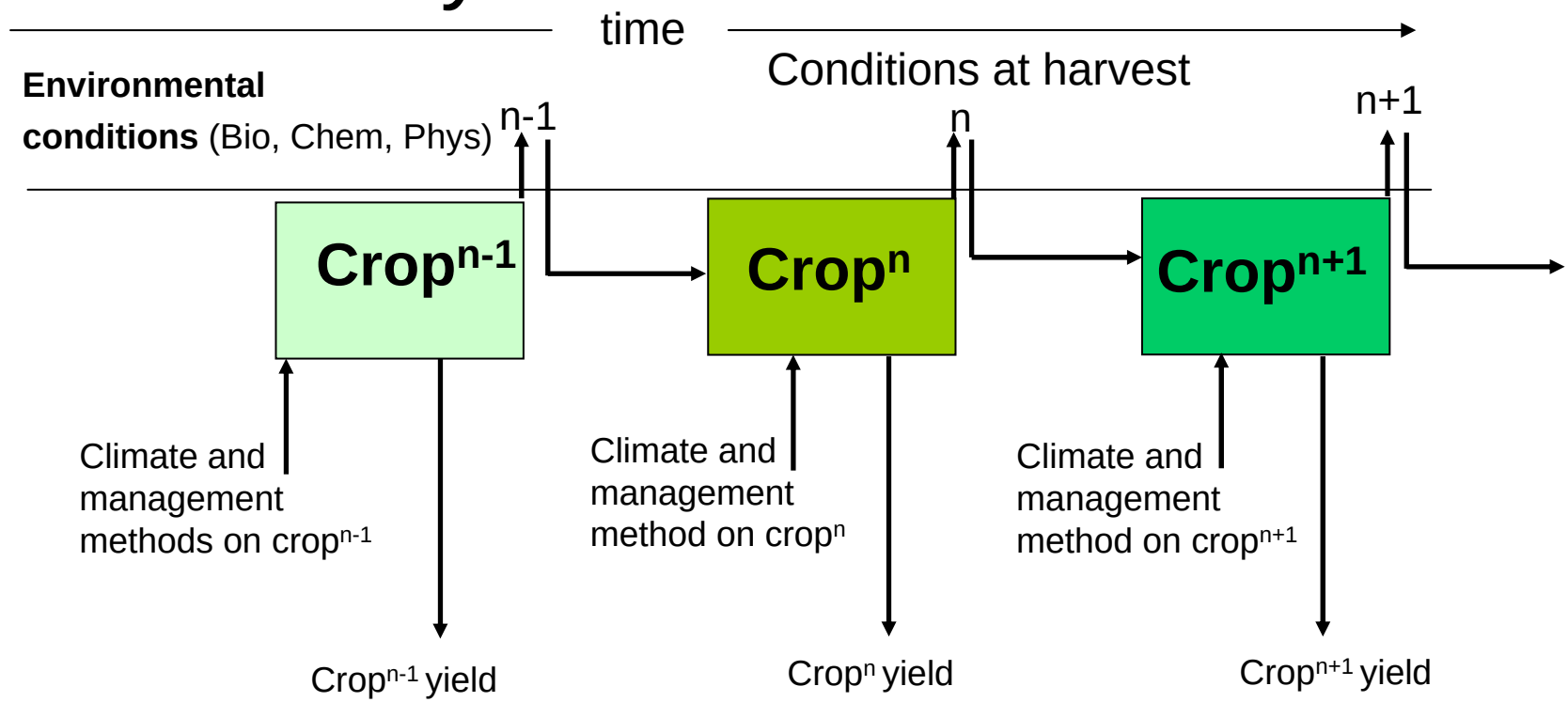
# Response of crops following grain legumes and a catch crop




*Source: GLIP Project; Hauggaard-Nielsen et al., 2010 in prep.*

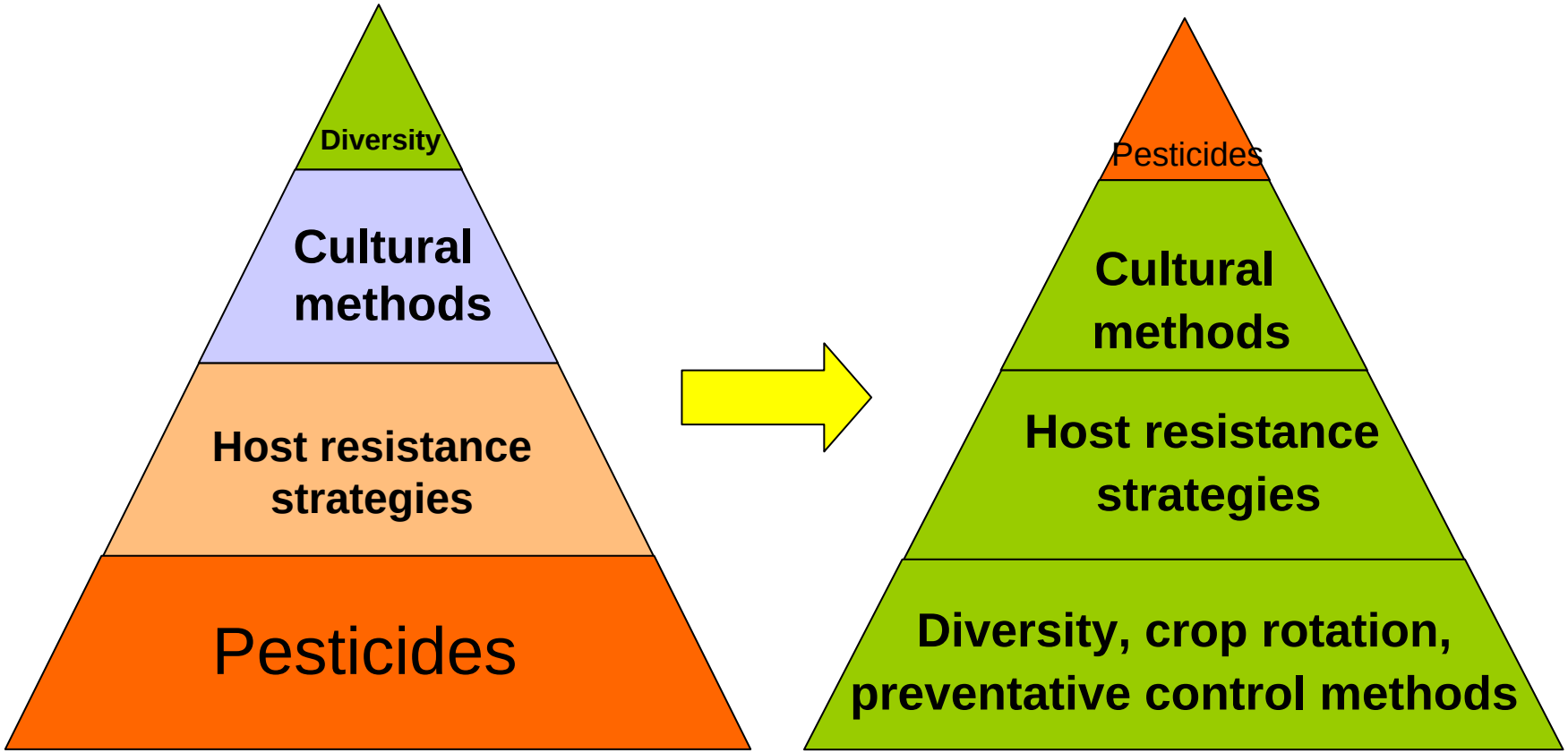
# A theoretical framework for cropping systems science




**Preceding effect**
**Sensibility of the following**
**Cumulative effect**

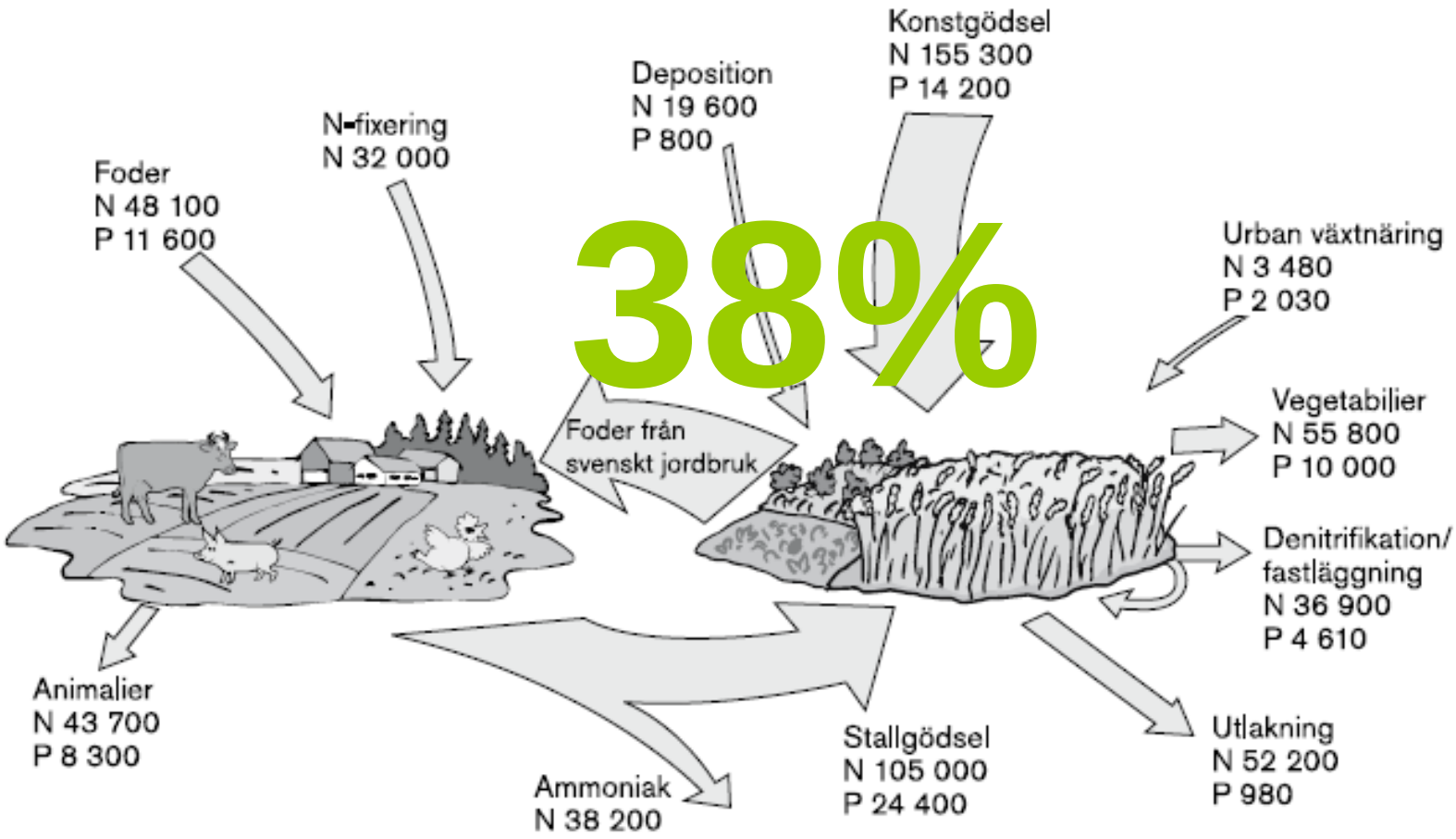
after Sebillotte, 1990

# Plant protection strategies for the future



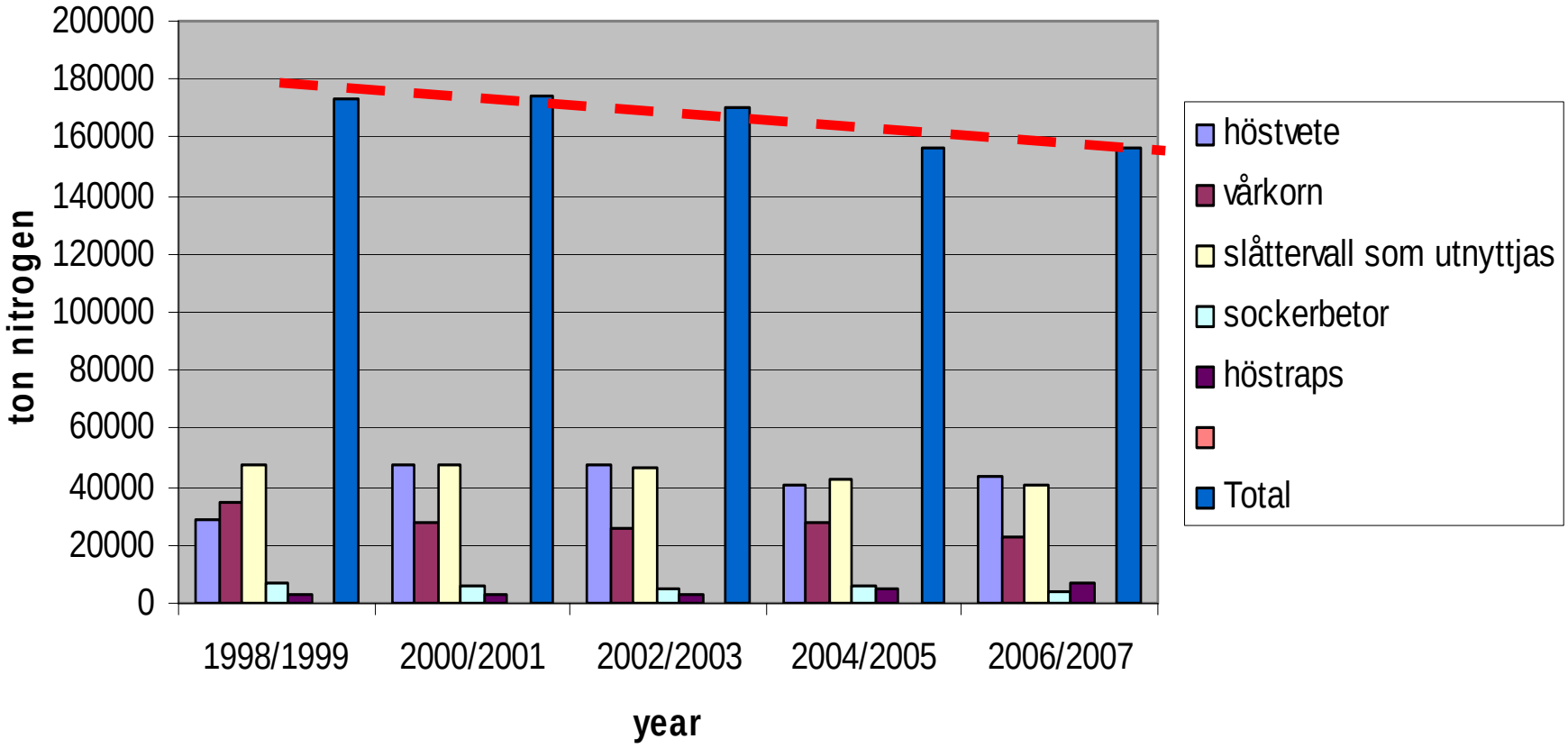

After Wiik 2009

# Nitrogen and phosphorus supply in Swedish agriculture (ton N $yr^{-1}$)




SCB 2007

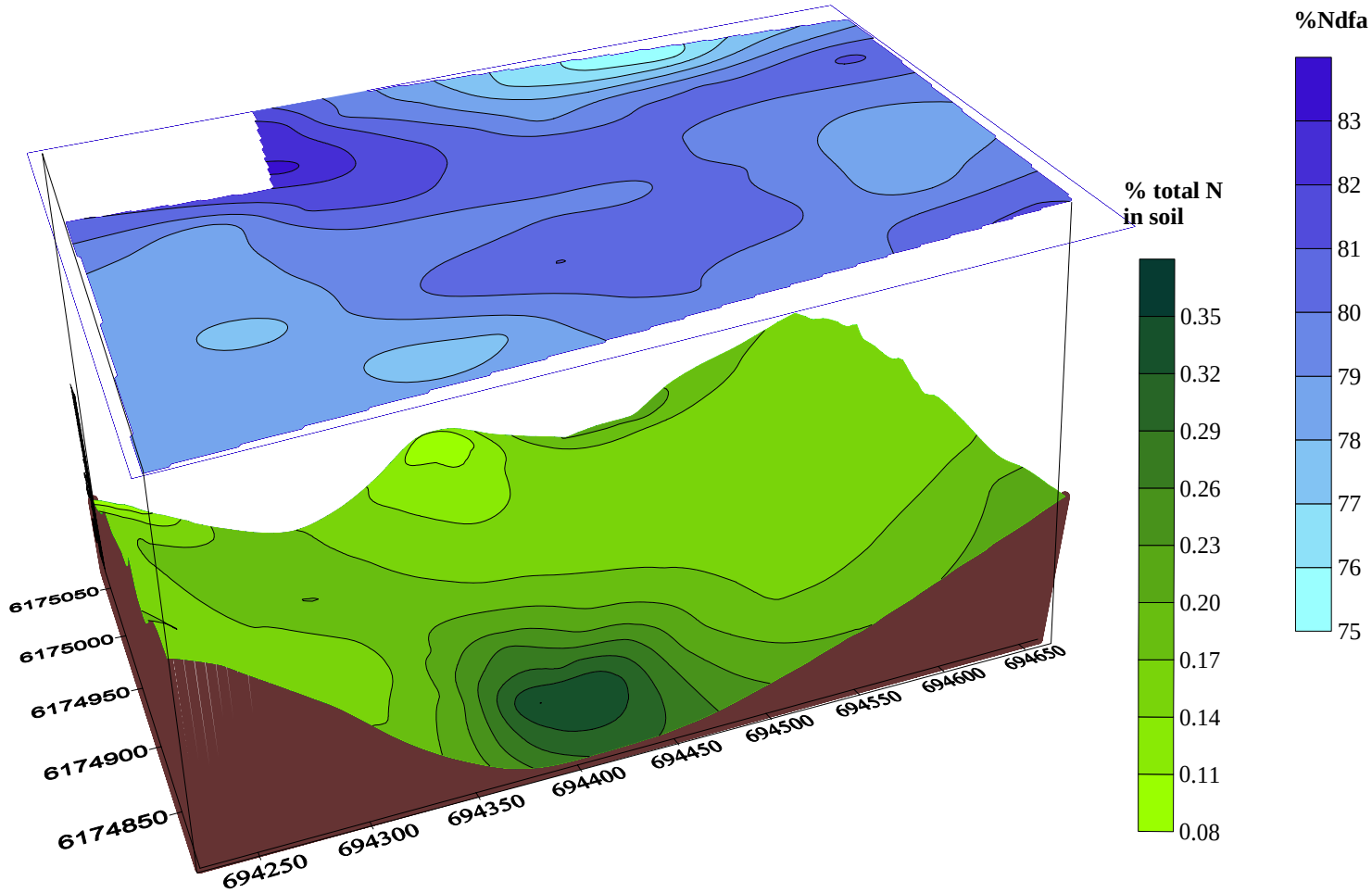
# Fertilizer N use in Sweden




**-2000 ton N year$^{-1}$**

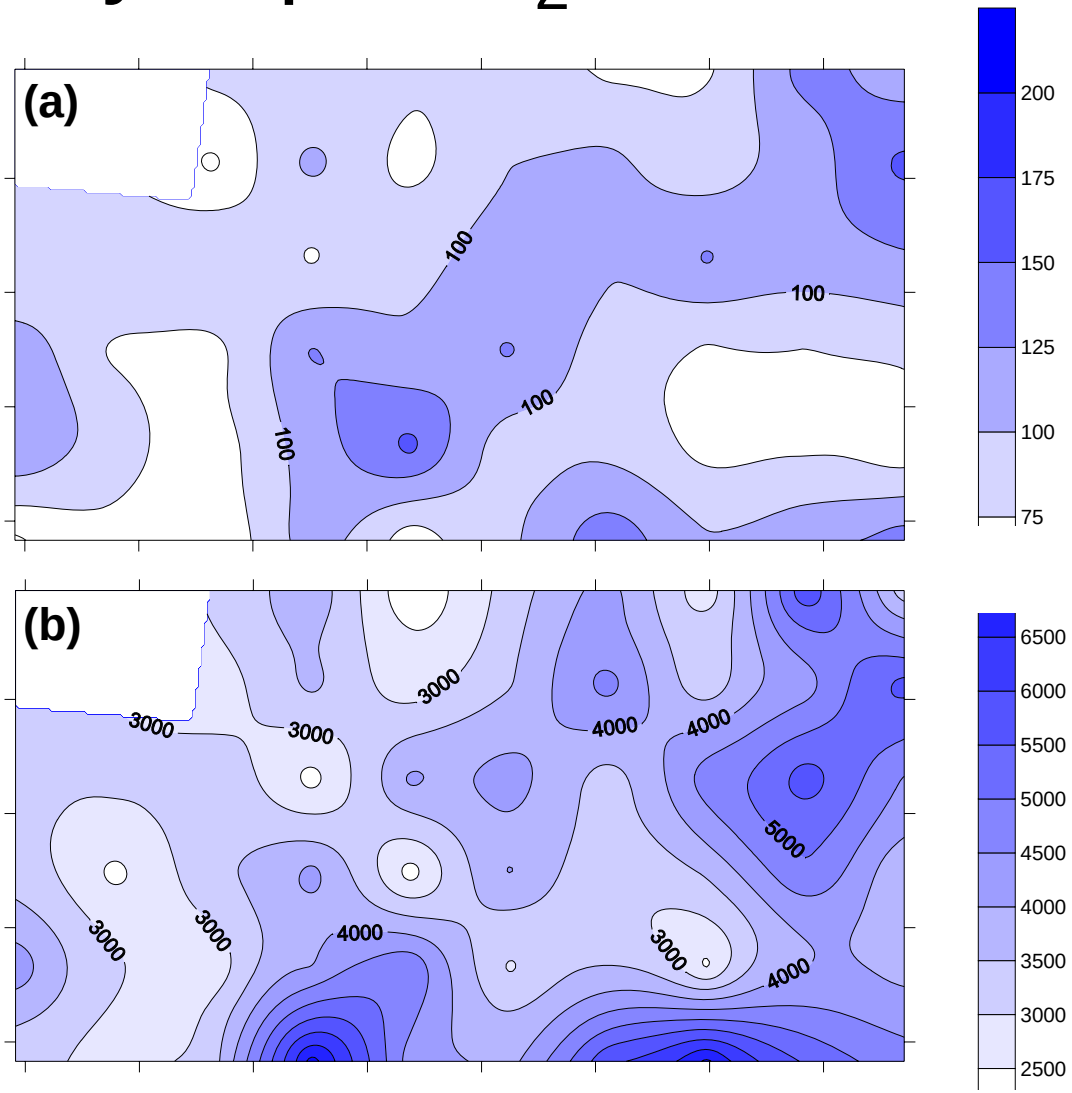
SCB, 2009

# Spatial variabilitity in soil N and % N derived from symbiotic $N_2$ fixation within 10 ha dry pea




Plant and Soil: Hauggaard-Nielsen et al 2010

# Variability in pea $N_2$ fixation and yield




$N_2$ fixation
Kg N/ha

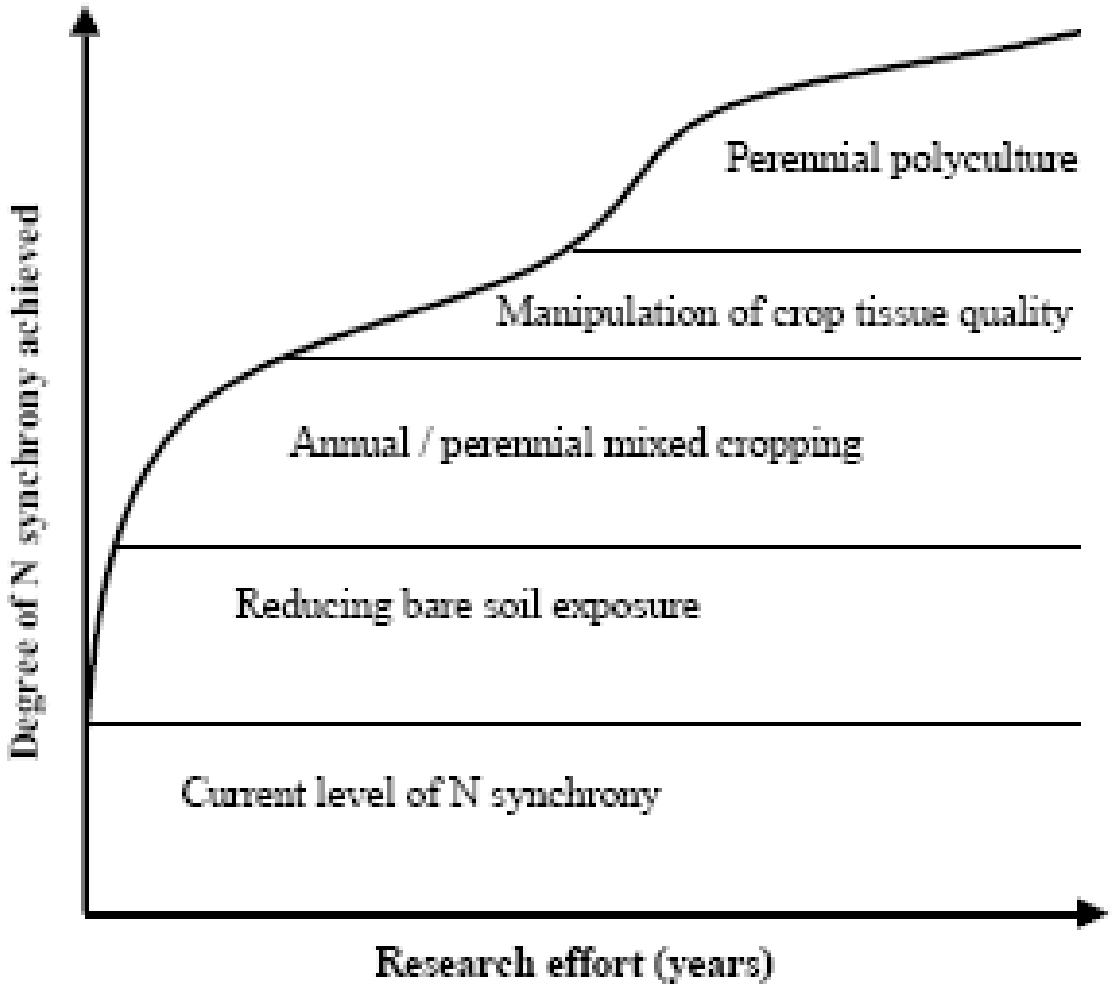
Pea grain
Ton DM/ha

Plant and Soil: Hauggaard-Nielsen et al 2010

# Synchronization of nutrient supply and crop demand

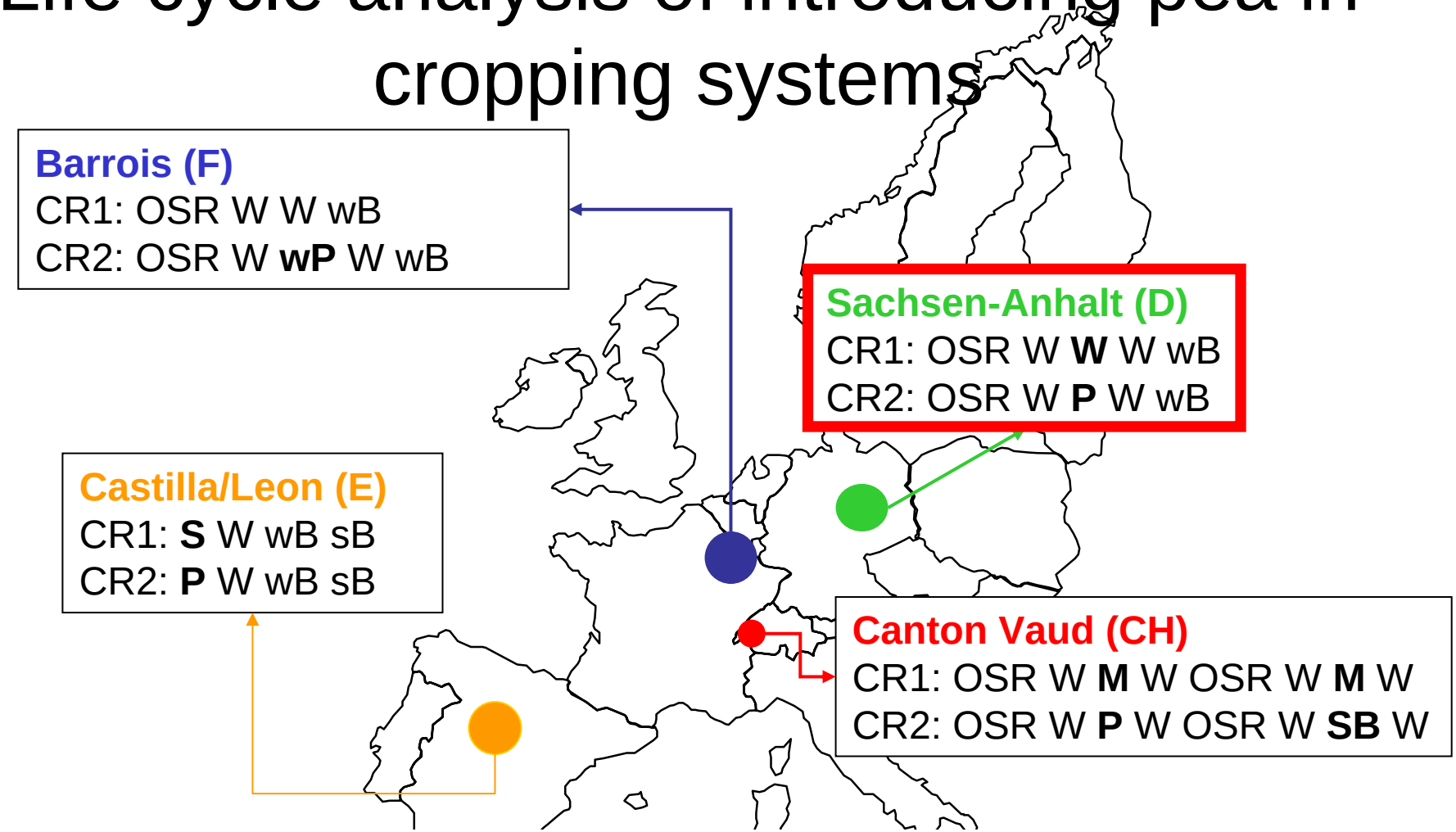
- On-farm nutrient management research and extension
- Knowledge intensive technologies at the field level (cultivar, species and cultivar mixturre, equipment)
- NUE increase by matching temporal and spatial nutrient supply with plant demand.

# Prospective advances in cropping systems research for increased N use efficiency




Crews. T.E. and Peoples, M.B. 2004. Agriculture, Ecosystems and Environment, 102, 279-97

# Life cycle analysis of introducing pea in cropping systems

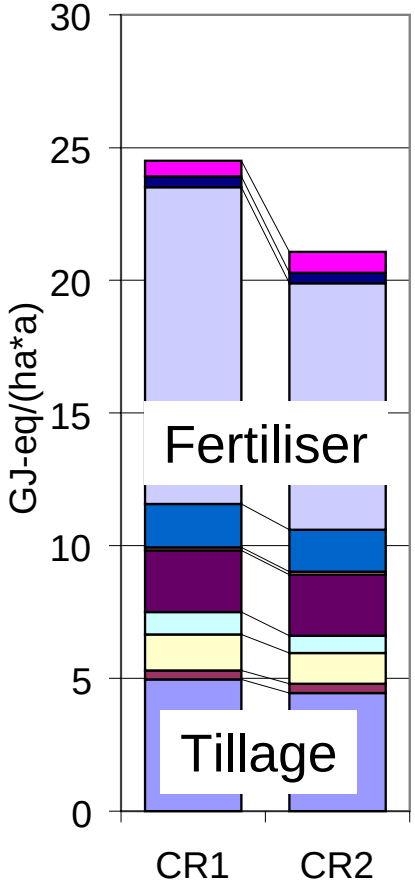



Legend: OSR: Winter rapeseed, W: Winter wheat, wB: Winter barley, sB: Spring barley
P: Spring pea, wP: Winter pea, M: Grain maize, S: Sunflower

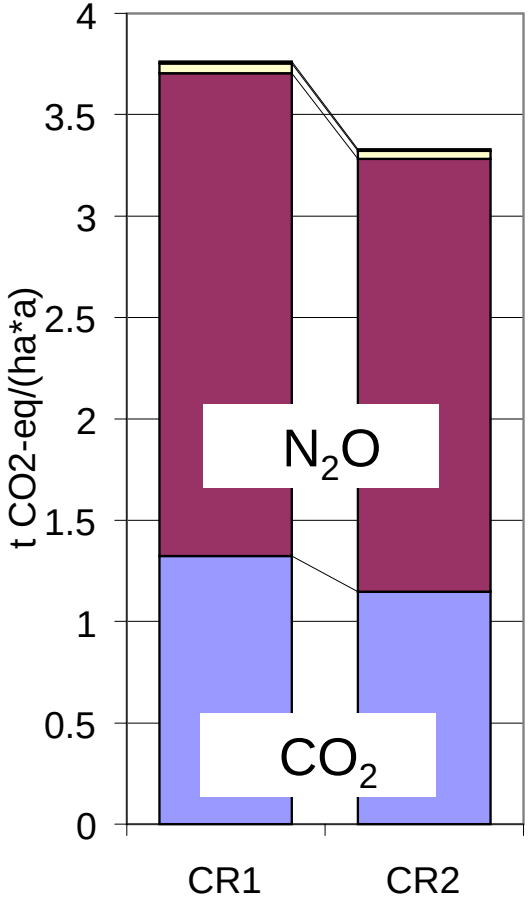
*Source: http://www.grainlegumes.com/aep/r_d_projects/gl_pro*

# Crop rotation (Saxony-Anhalt, Germany)

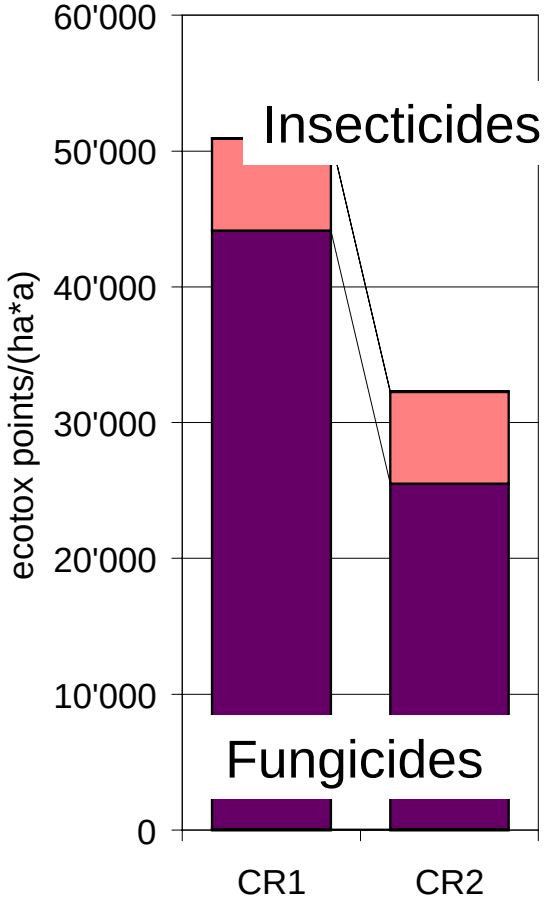
Non-renewable energy consumption




Global warming potential (~100yr)



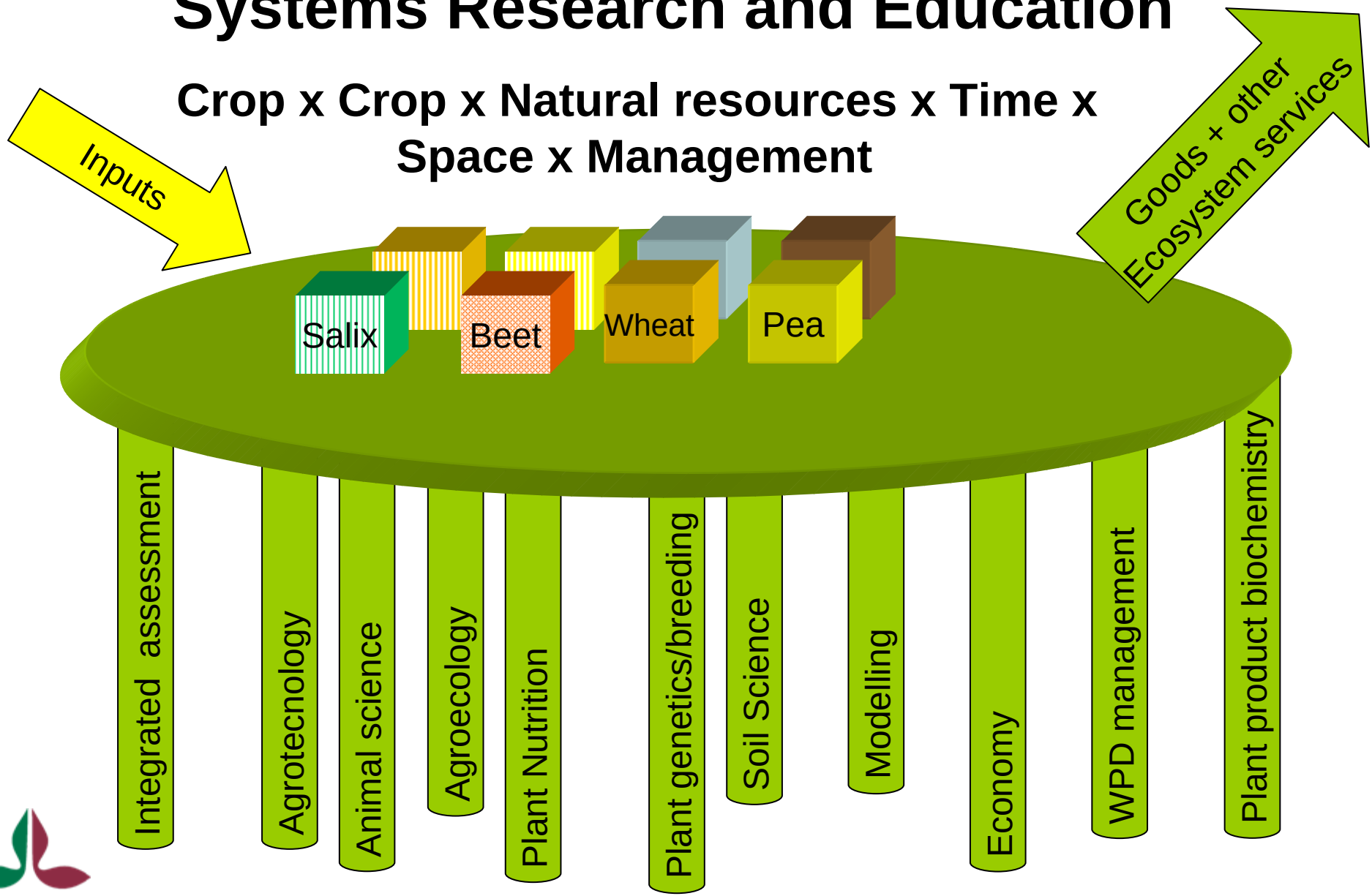

Terrestrial ecotoxicity potential




*Source: Nemecek et al., 2008*

# Platform for Sustainable Cropping Systems Research and Education

## Crop x Crop x Natural resources x Time x Space x Management

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# Conclusions

- More knowledge about rotation effects to give farmers tools to enhance diversity of systems
- Multidisciplinary research teams are requried to design, develop, test, model and assess cropping system on farms – integrating especially ecological and agricultural sciences
- Fundamental understanding of agro-ecology, biogeochemistry and biotechnology linked to breeding programmes will be essential for future sustainable crop production
- User friendly tools and assessment methods for economy, environmental impacts and quality of goods are required for assisting the farmer and the society in valuation of ecosystem services.