Design of Farming Systems

Transition to sustainable agriculture

May 7 2012, Derk van Balen

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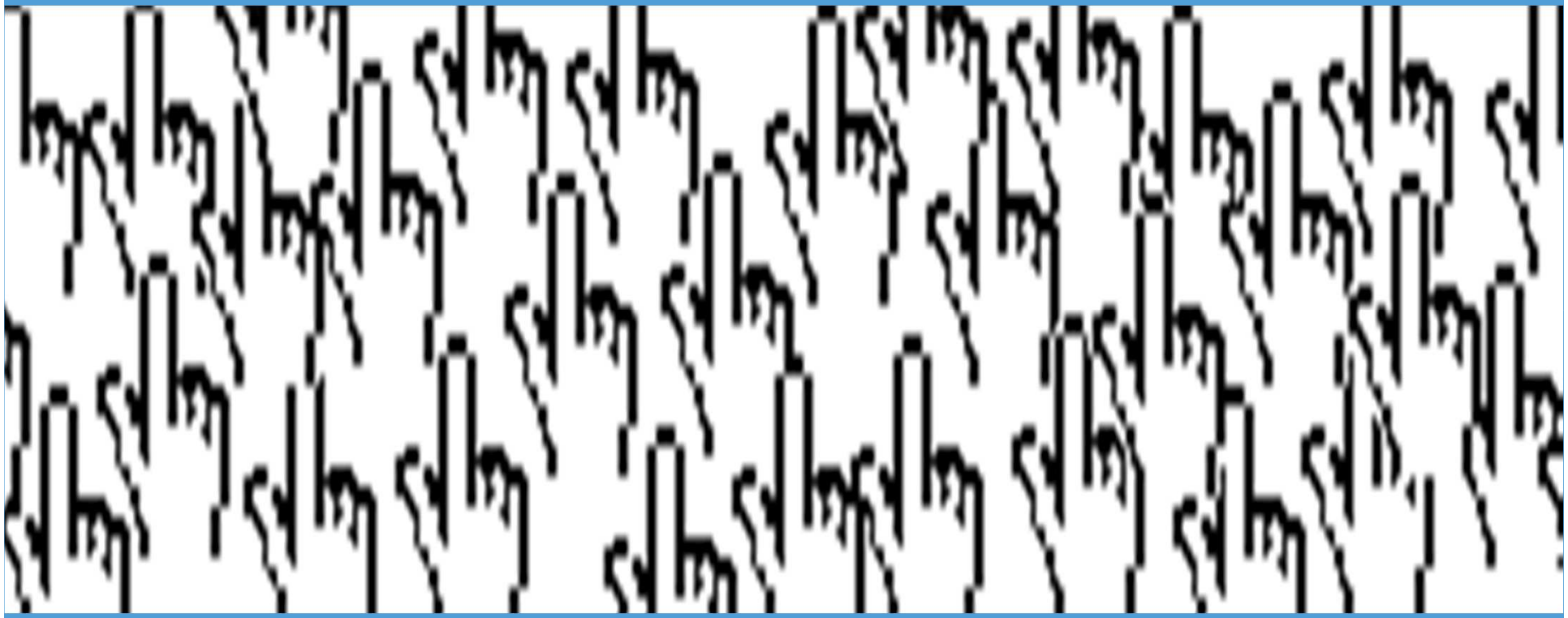
Personal introduction

- Derk van Balen
- Agronomist, Specialist farming systems, Organic plant production, Non inverse tillage.

Applied Plant Research (PPO)

Wageningen University and Research Centre (WUR),

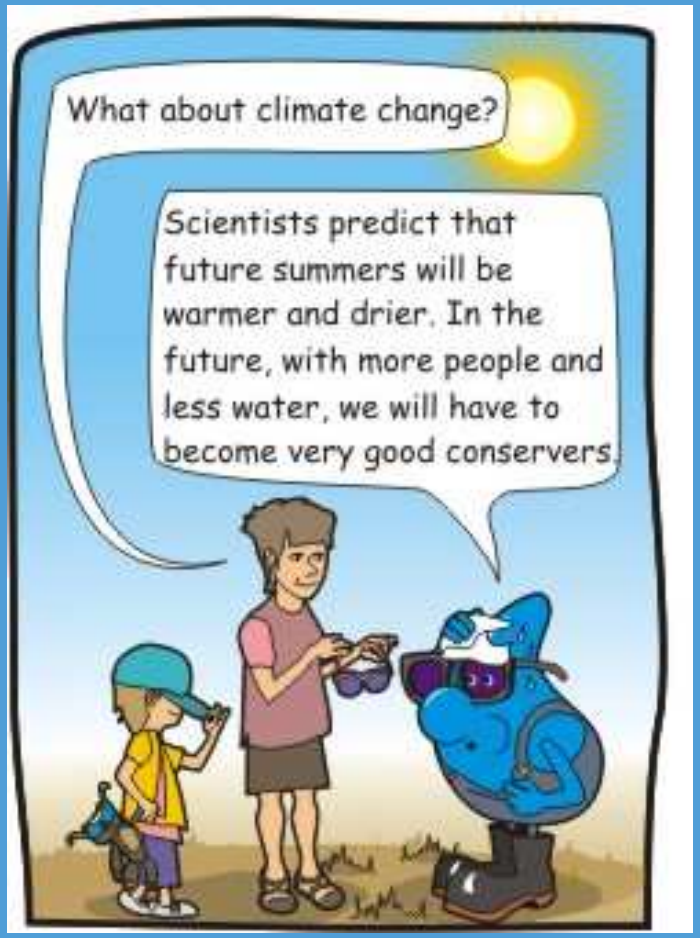
Questions?



Current Agriculture: What's Wrong? Whats Right?

Adverse effects modern agriculture

- Agricultural tredmill
- Pollution
- Depletion, accumulation
- Decrease biodiversity and landscape
- Ending resources
- Climate change (partly caused by agriculture)
- .....



(Dutch) agricultural problems

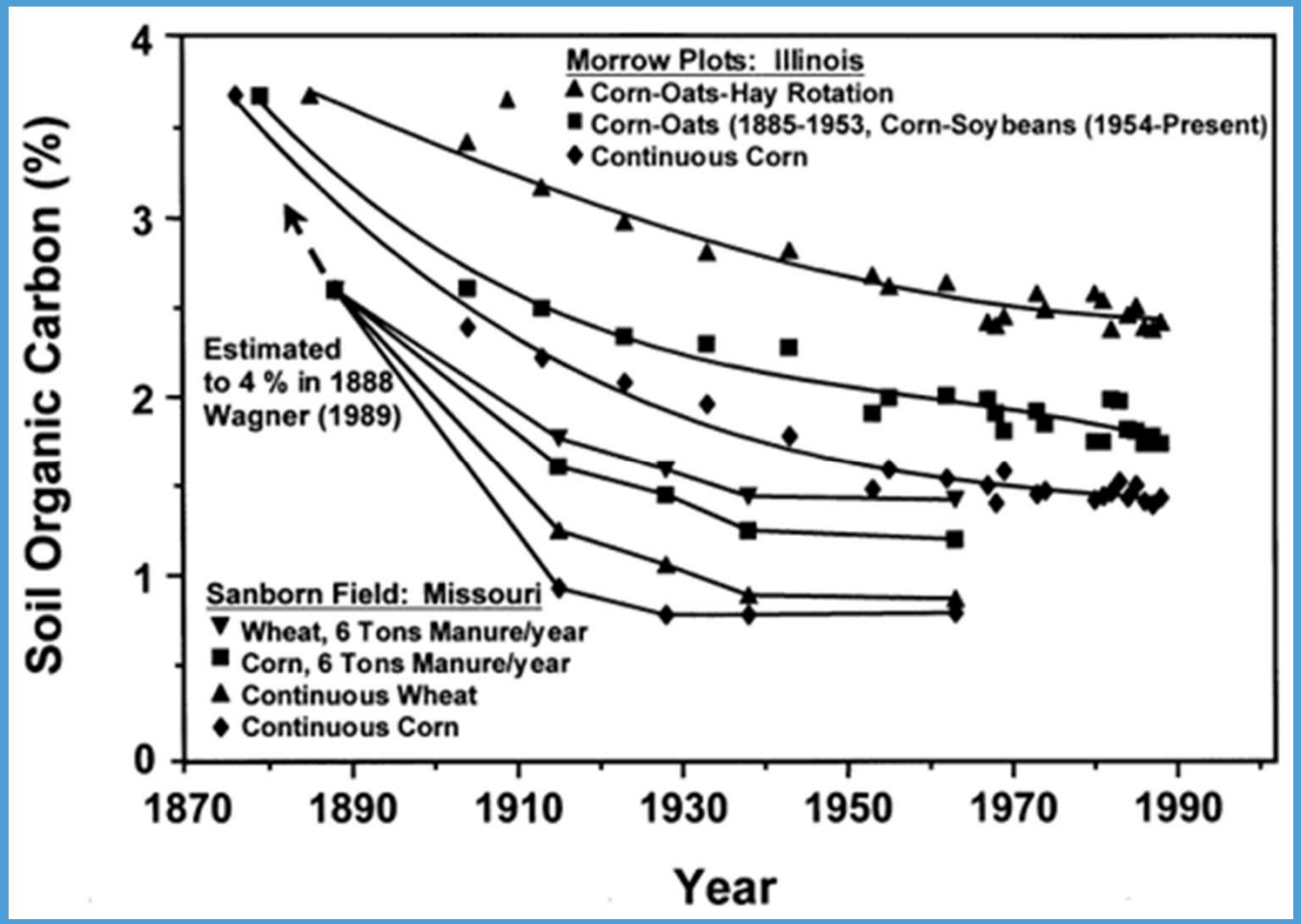
Agronomical

- Soil fertility and soil health
- control of pests diseases and weeds
- high quality demands

Economical

- lower prices, basic income under pressure
- availability and costs of labour

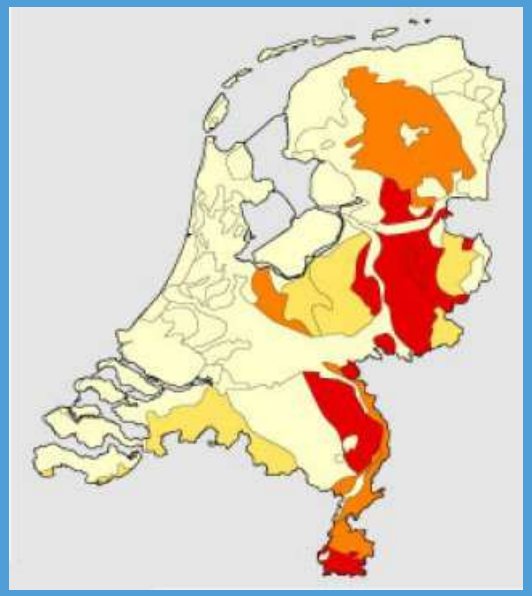
Soil organic matter



(Dutch) agricultural problems

Environmental/ecological

- pollution of air water and soil with nutriënts and pesticides
- decline of nature and landscape



Society

- concern for food safety
- claim for multifunctional land use

?

Something has got to change!

Turn around in front of

an abyss is also progress

How to get a sustainable way of farming?

Conventional	Organic intentional
Uniformity	Diversity
Recipy	Concept
Reductionism	Holism
General	Situational
Control	Cooperation
Specialist	Universalist
Reaction	Precaution
Economy	Ecology
Global	Regional

Conflicts

Ecology ⟷ **Economy**

Diversity ⟷ **Homogeneity**

Need for:

- Farming systems and methods designed to overcome these conflicts
- Social and political solutions

Market demands

- Product uniformity
  - Shape, size, taste, color, quality, price
- High cosmetic quality
- Large volumes
- Supply certainty
- Certified

- Low price

Consequences pressure on costprice

- Mechanisation (crop uniformity)
- Specialisation
- Large Scale
- Capital intensive
- Intensive land use
- Recipy farming

Consequences product demands

- Genetic uniformity
- Phenotype uniformity
- Field and farm uniformity

Which leads to a

- high vulnerability to pests and diseases
- Low tolerance for spots and deformations

causing high dependancy of pesticide input

- Non marketable qualities

Agricultural tredmill

- Market demands and low costprice
- Uniformity and high production
- Scale enlargement
- More vulnerability
- Higher protection (sterile conditions)

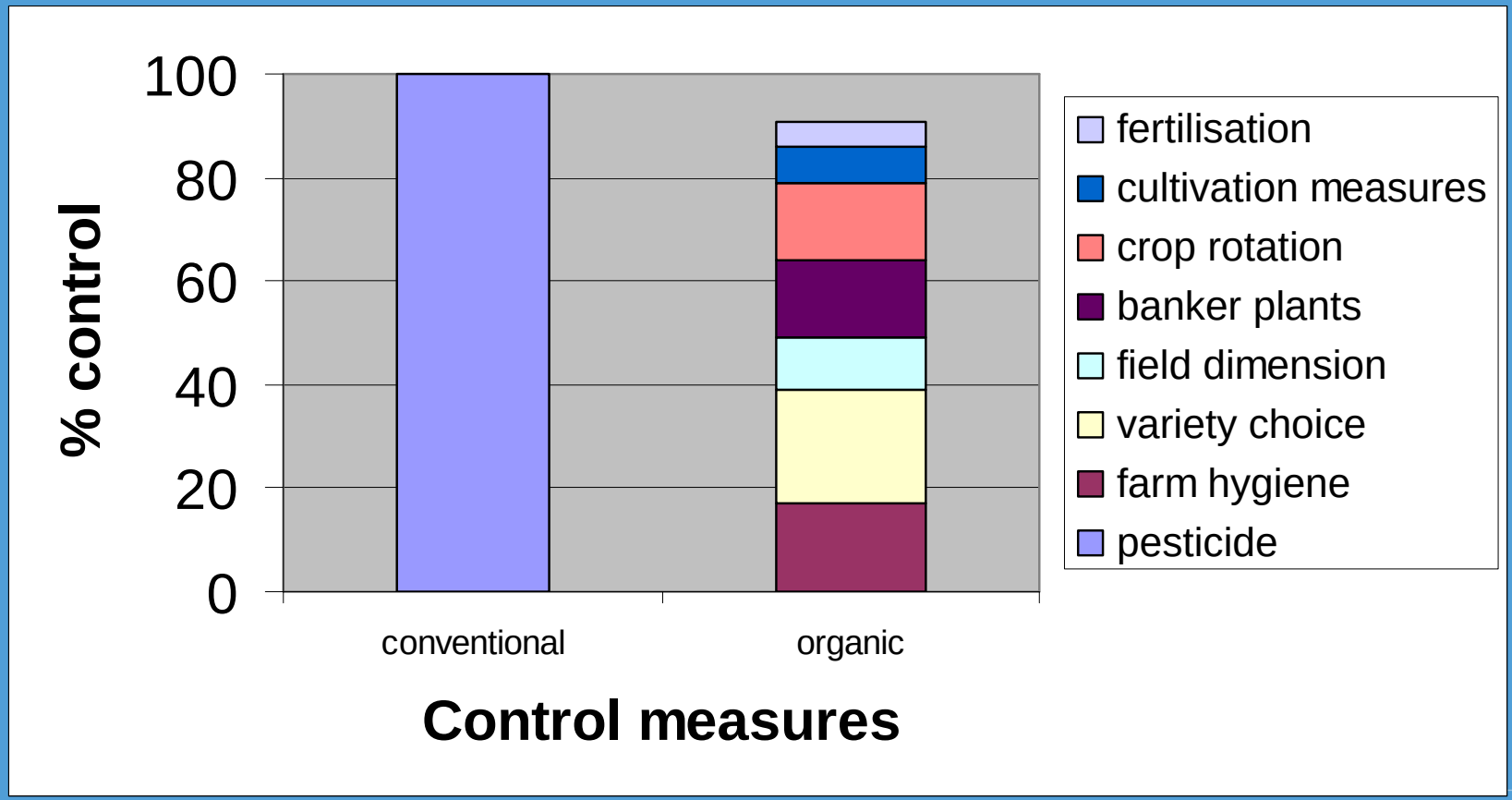
(free interpretation Cochrane)

Coping with the conflict

- Social
- Organisational
- Political
- Technical

How to make use of diversity instead of excluding it?

Complex and multi-objective methods



Control pest x (+ landscape + biodiversity + …)

Agronomic consequences uniformity

Examples

- (inter)National: T plasm maize
- Regional: pest and diseases leek
- Farm or Field level: soil born pests and diseases
- Within plant: vertical resistance

Agronomic demands (organic)

- (Bio)Diversity → stability, resilience, prevention
  - Time
  - Space (plant, field, farm, region)
- Crop rotation
- Farm lay out
  - Dimensions
  - Ecological infrastructure
- Mixed cropping, mixed varieties

Different approaches

- Socio-political oriented solutions
- Technological solutions
  - system innovation
  - process integrated solutions

    integrated technology
  - end of pipe solutions
- Participatory innovation or progress

Farming systems research

- System innovation: coherent overall concept, multi-objective
  - Agronomical
  - Ecological
  - Economical
- Integrated technology
  - agro-ecological principles, agronomy and technology Whole farm

Design: Objectives/values

- Abiotic environment
- Food Supply
- Nature and Landscape
- Basic income/profit
- Health well-being
- Integrity of life
- Employment
- Others??

Our technical toolbox: Farming methods

Agronomic Toolbox to realise values

- Crop rotation
- Soil cultivation
- Fertilisation/Nutrient management
- Crop protection
- On farm nature (biodiversity) management

Farming methods

- General strategy (concept)
- Toolbox of methods and techniques
- Flexible integration into approach
- Region and farm specific interpretation of these strategies

- Objective: excellent agronomy

Emphasis in farming methods

conventional *organic*

soil structure

- crop rotation
- organic manure
- green manure
- soil cultivation

nutrient supply

- crop rotation
- organic manure
- green manure
- mineral fertiliser

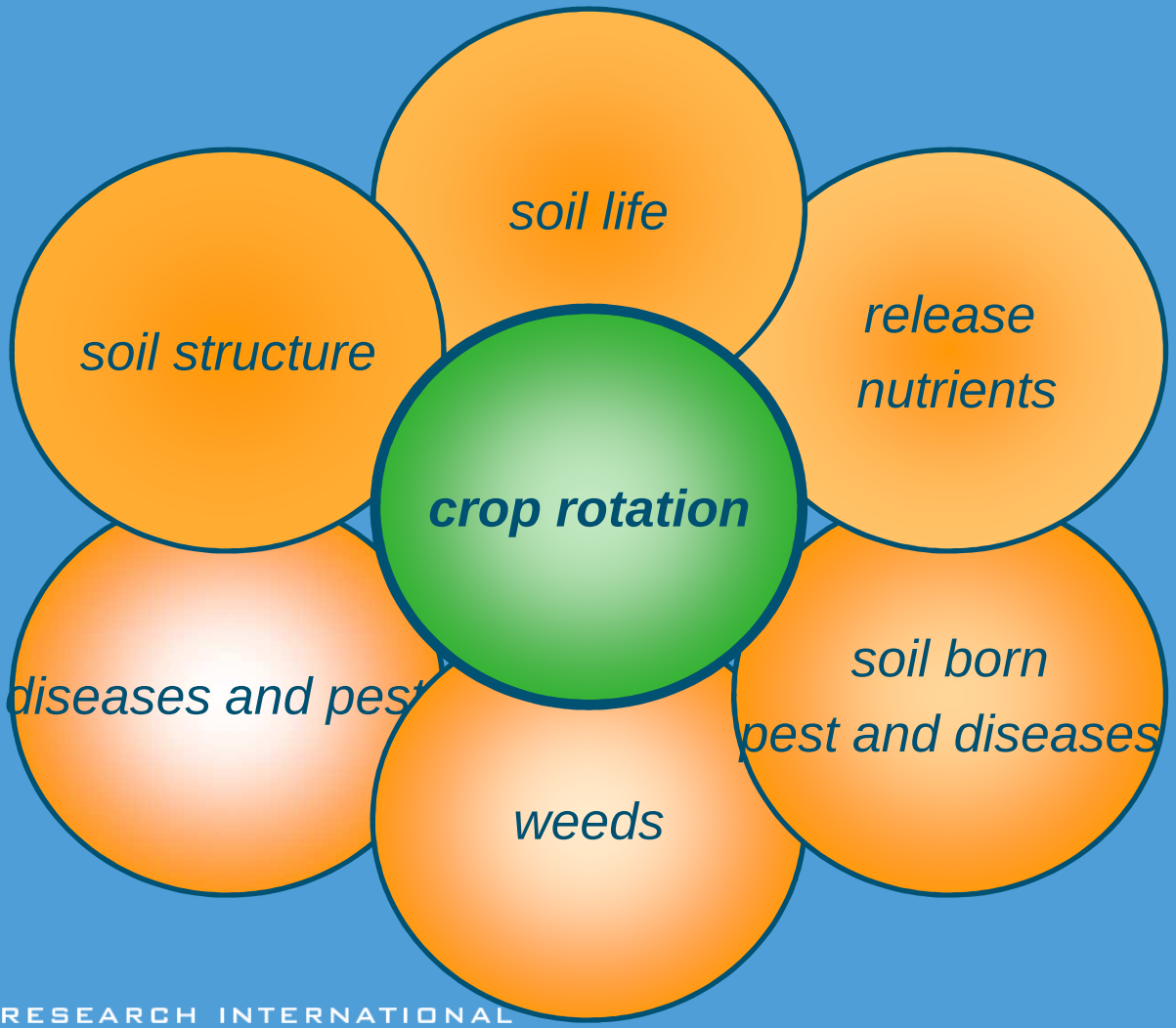
weeds

- crop rotation
- cropping system
- mech. control
- pesticides

pests and diseases

- crop rotation
- cropping system/ resistant varieties
- pesticides

Influence crop rotation



Multifunctional crop rotation

basis for quality production

supported by:

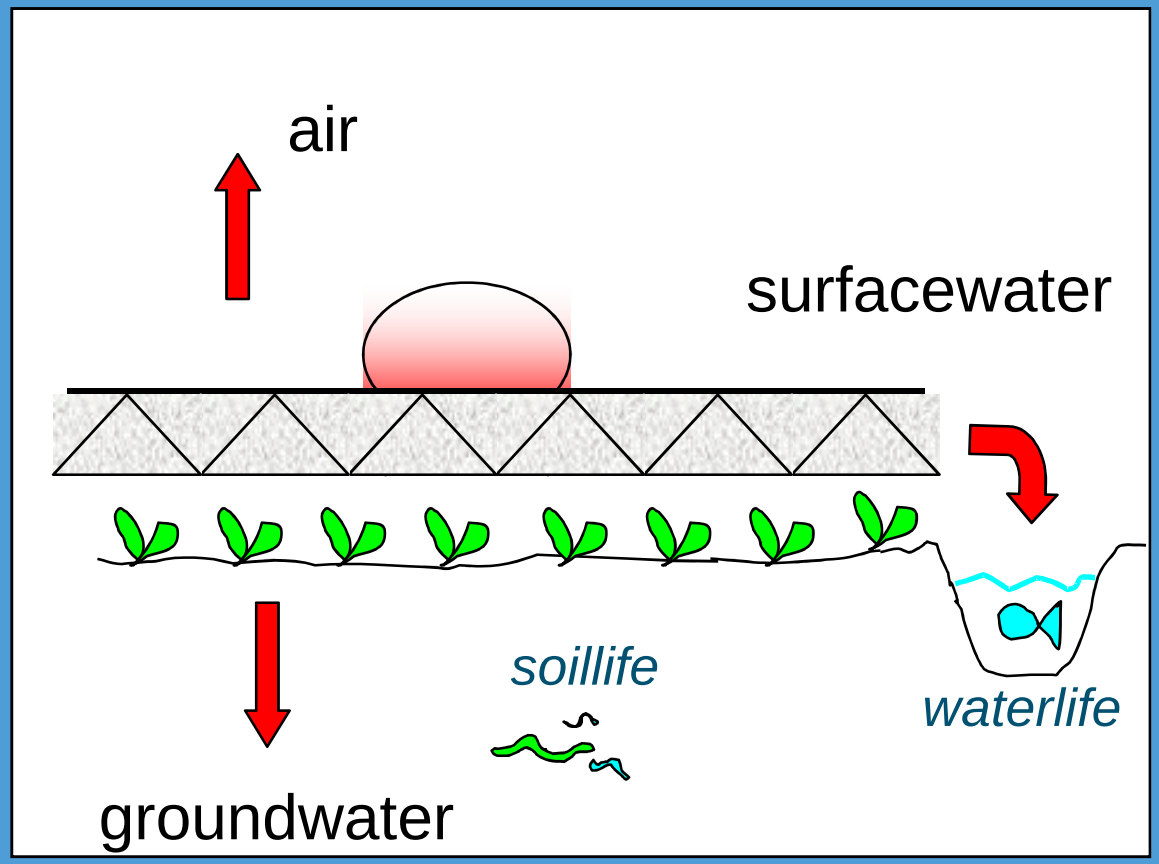
- cropping systems
- crop protection
- on farm nature management and farm design
- fertilisation
- soil cultivation

- crop rotation is a team of players

Strategy crop protection

- Prevention
  - crop rotation, farm hygiene,...
- Need of control
  - asses if control is necessary
- Control
  - non-chemical control (mechanical, biological)
  - chemical,
    - pesticide selection
    - application technique

Environmental effects pesticides



parameters

use

emission

damage

Legislation and stimulation

- Legislation (manure and pesticides)
  - Application of P2O5 in kg/ha

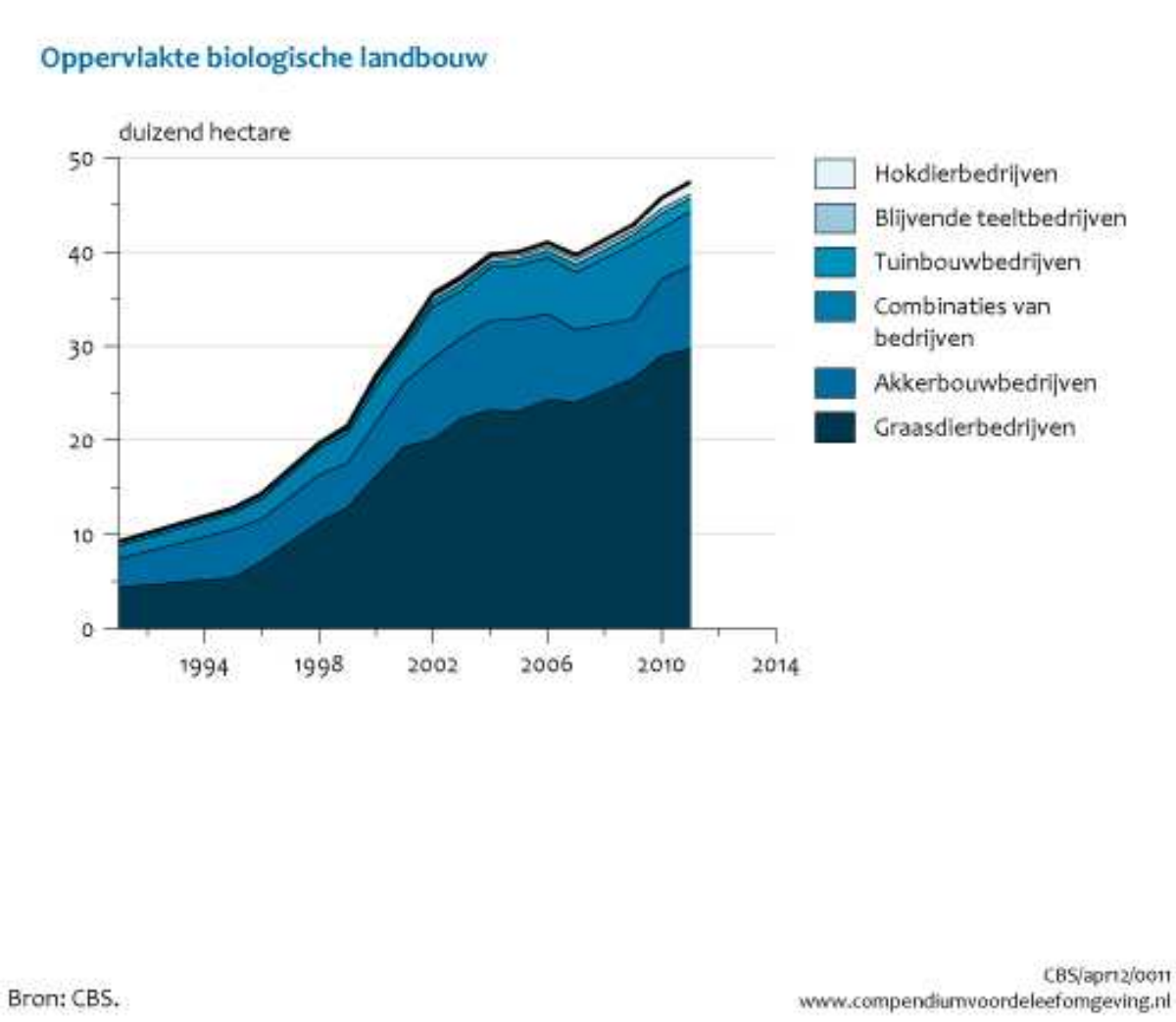
P2O5 content	2011	2012	2013	2014	2015
Low	85	85	85	80	75
Neutral	75	70	65	65	60
High	70	65	55	55	50

  - Screening of pesticides and application techniques

Stimulation

- Development of farming systems
- Certification of products
- Field days for organic agriculture
- Subsidy for conversion to organic agriculture (until 2010)
- Task force Marketing Organic agriculture

Area organic agriculture x 1000 ha



Influence of organic agriculture

- Importance of crop rotation
- Cereal crops, cover crops
- Natural enemies
- Mechanical weed control
- Controlled traffic farming and Conservation agriculture

Case

- 3 reasons **to convert** to organic agriculture
- 3 reasons **not to convert** to organic agriculture

PPO farming systems research

PPO farming system research

- (semi) practical scale
- no replications
- development path towards ‘all round’ farm
- until 1985 comparison conventional-integrated-organic
- later comparison with targets and average practice
- combination with pilot farm networks

Locations in the Netherlands (2010)

Experimental locations

Pilot farms organic

Pilot farms integrated

Results

- Performance in terms of yardsticks
- Set of farming methods

Results clean environment pesticides 2001

Experimental locations

Parameter	Target value	OBS	Westmaas	Meterik
EEP-air	< 0.7 kg/ha	0.3	0.6	0.4
EYP-water life	0% app. > 10 points	0	72	0
EEP-ground water	< 0.50 ppb	0.15	0.22	0.3
EEP-soil	< 200 kg days/ha	101	193	284
EYP-soil life	0% app. > 100 points	0	9	9
Active ingredients	kg/ha	1.5	2.1	3.8

Percentage reduction pesticides

(OBS 1978-2000)

Yardstick	Percentage reduction
emission air	92
damage waterlife	99
emission groundwater	99
emission soil	83
damage soillife	81
active ingredient input	95

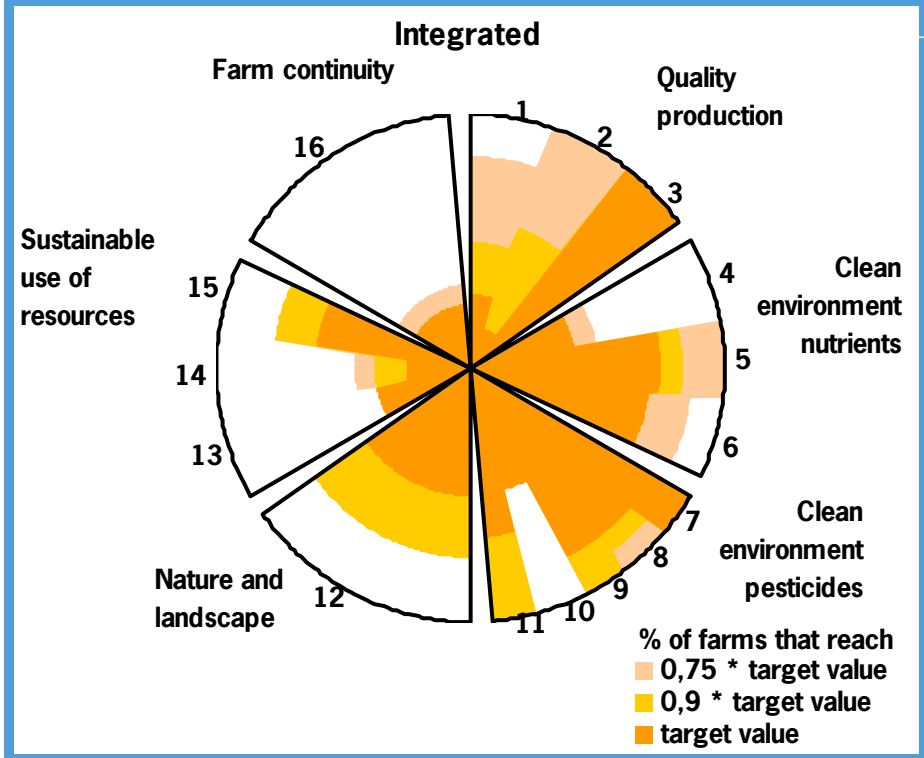
Results clean environment pesticides 2001

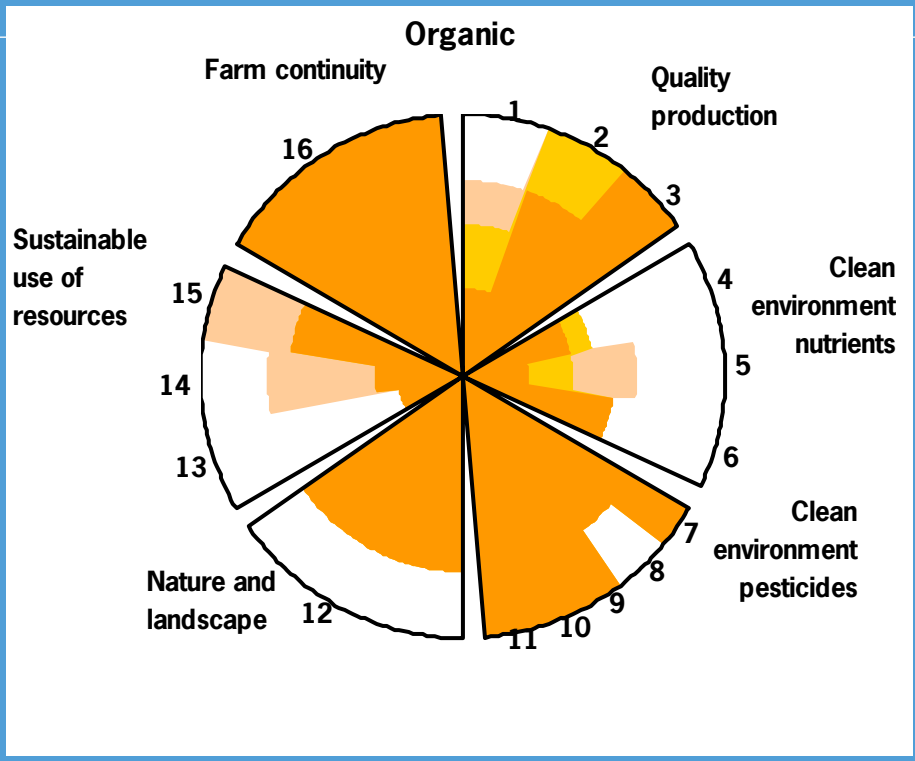
Pilot farms, vegetable farming

		Limburg		Brabant	
		97-99	2001	99-97	2001
EEP-air	< 0.7 kg/ha	2.1	1.2	1.0	0.4
EYP-water life	0% app. > 10 points		26		38
EEP-ground water	< 0.50 ppb	30.3	1.7	3.7	1.5
EEP-soil	< 200 kg days/ha	1646	653	681	340
EYP-soil life	0% app. > 100 points		7		29
Active ingredients	kg/ha	16.4	8.2	4.4	2.9

Comparison between integrated and organic systems

EU project Vegineco 1997-2002 (experimental farms)





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Potential Organic farming

- Multifunctionality (production, recreation, care, nature and landscape)
- Sustainable and environment friendly
- Food safety (pesticide residues, allergies)
- Consumers preference (natural, healthy and tastefull)
- Biodiversity
- Employment
- Low input costs

End slide or section heading

Thank you for your attention