APPLIED PLANT RESEARCH

Ecological crop protection in organic farming systems

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Agricultural problems

Agronomical

- soilfertility and soilhealth
- control of pests diseases and weeds
- high quality demands

Economical

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

Agricultural problems

Environmental/ecological

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

Society

- concern for food safety
- claim for multifunctional land use

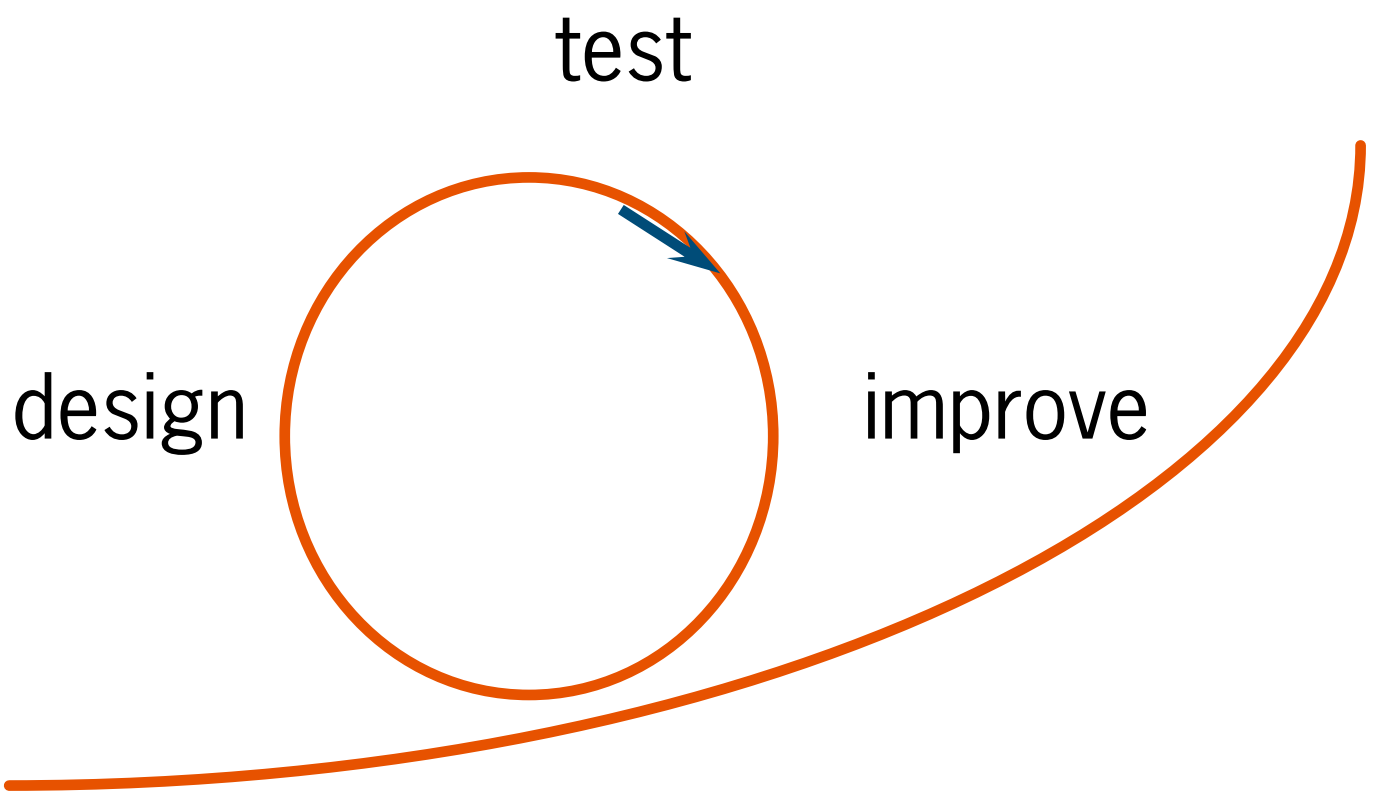
Themes new farming systems

- Abiotic environment
- Food Supply
- Nature and Landscape
- Basic income/profit
- Health wellbeing
- Employment
- Others??

Different approaches

- Socio-political oriented solutions
- Technological solutions
  - system innovation
  - process integrated solutions
    integrated technology
  - end of pipe solutions

System innovation

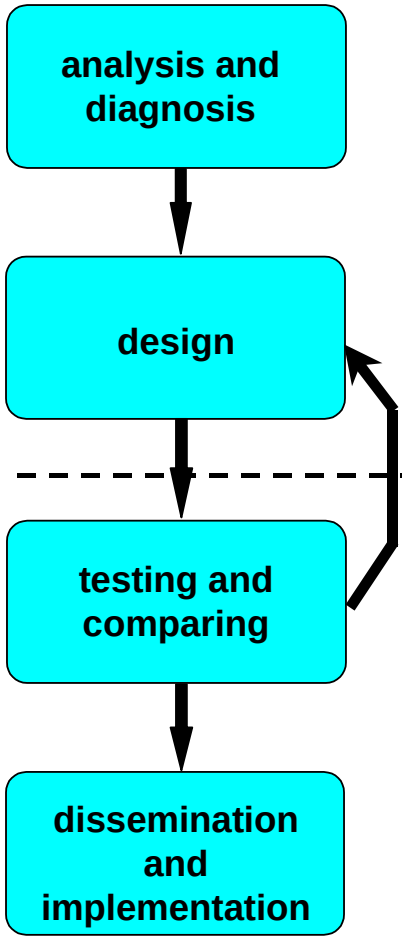


Main search directions

- system innovation
  - integrated production
  - organic production

- emphasis on total system approach and process integrated solutions
- organic production has few end of pipe solutions

Prototyping methodology



- regional farm structure
- constraints
- policy and regulations
- developments

- objectives
- parameters, target values
- farming methods
- operational plan

choice type and size project

- target ⇔ actual
- shortfall analysis
- improve methods

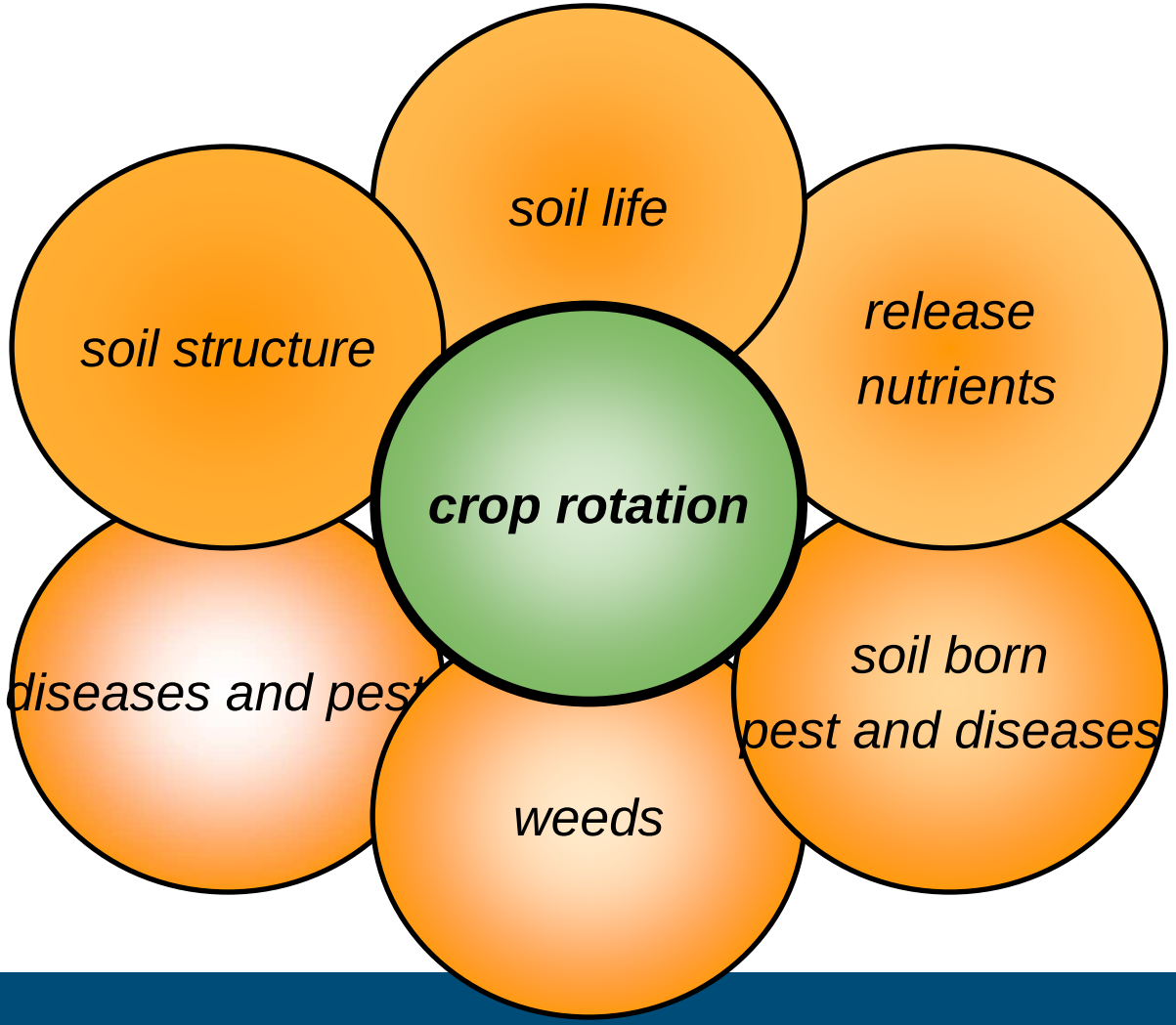
- introduction in practice
- cooperation research, extension and practice
- demonstration

Agronomic Toolbox

(farming methods)

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

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

Multifunctional crop rotation

- frequency
- sequence (lay-out in time)
- lay-out in space

Crop frequency

Of vital importance for

- specific non mobile soil born pests and diseases

classical example of crop rotation benefit

supported by cropping system (mainly cultivar resistance)

Crop sequence

Of vital importance for

- non specific soil born pests and diseases

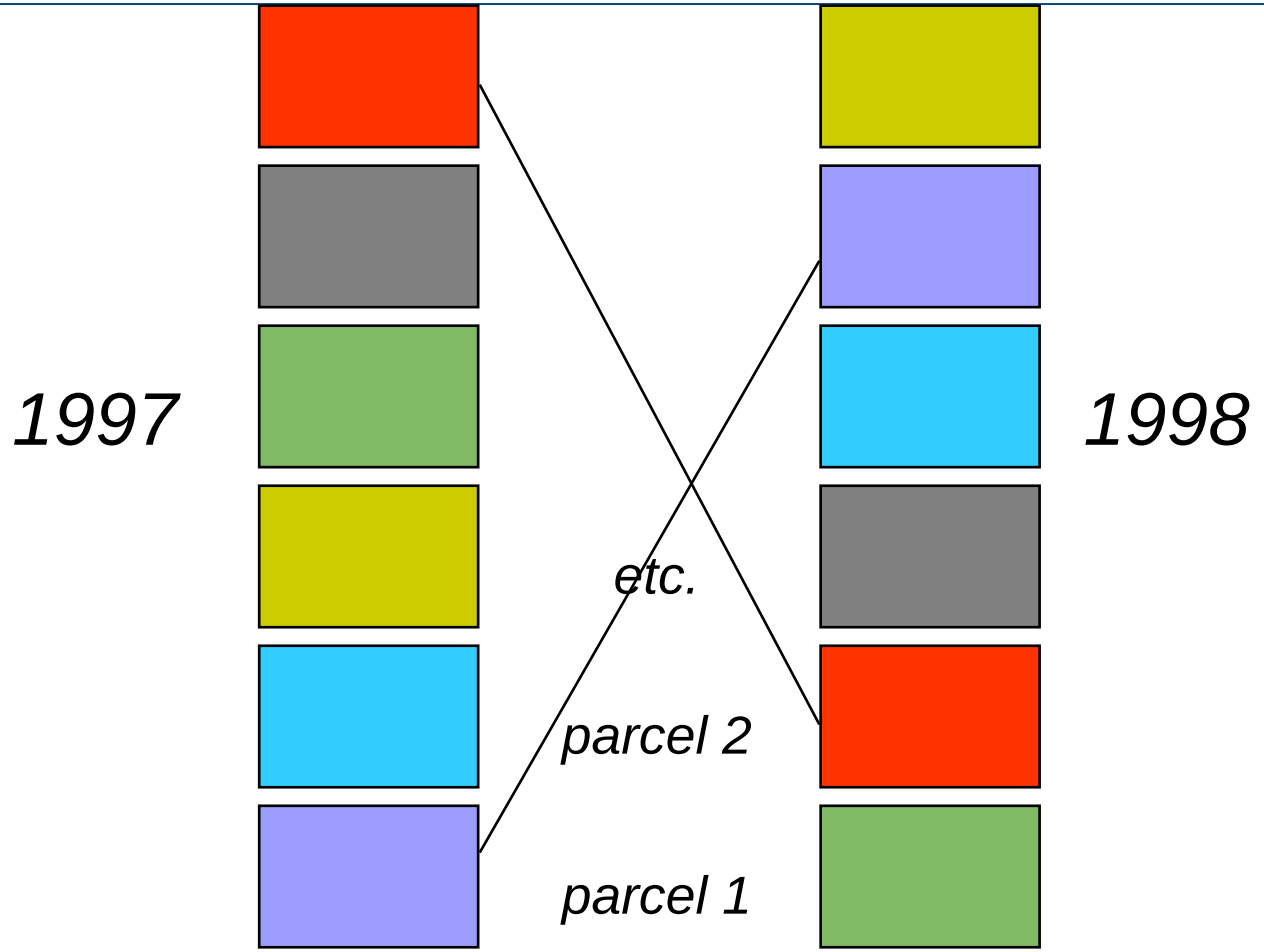
however also for (other non mobile aspects)

- weeds
- nitrogen availability
- soil fertility

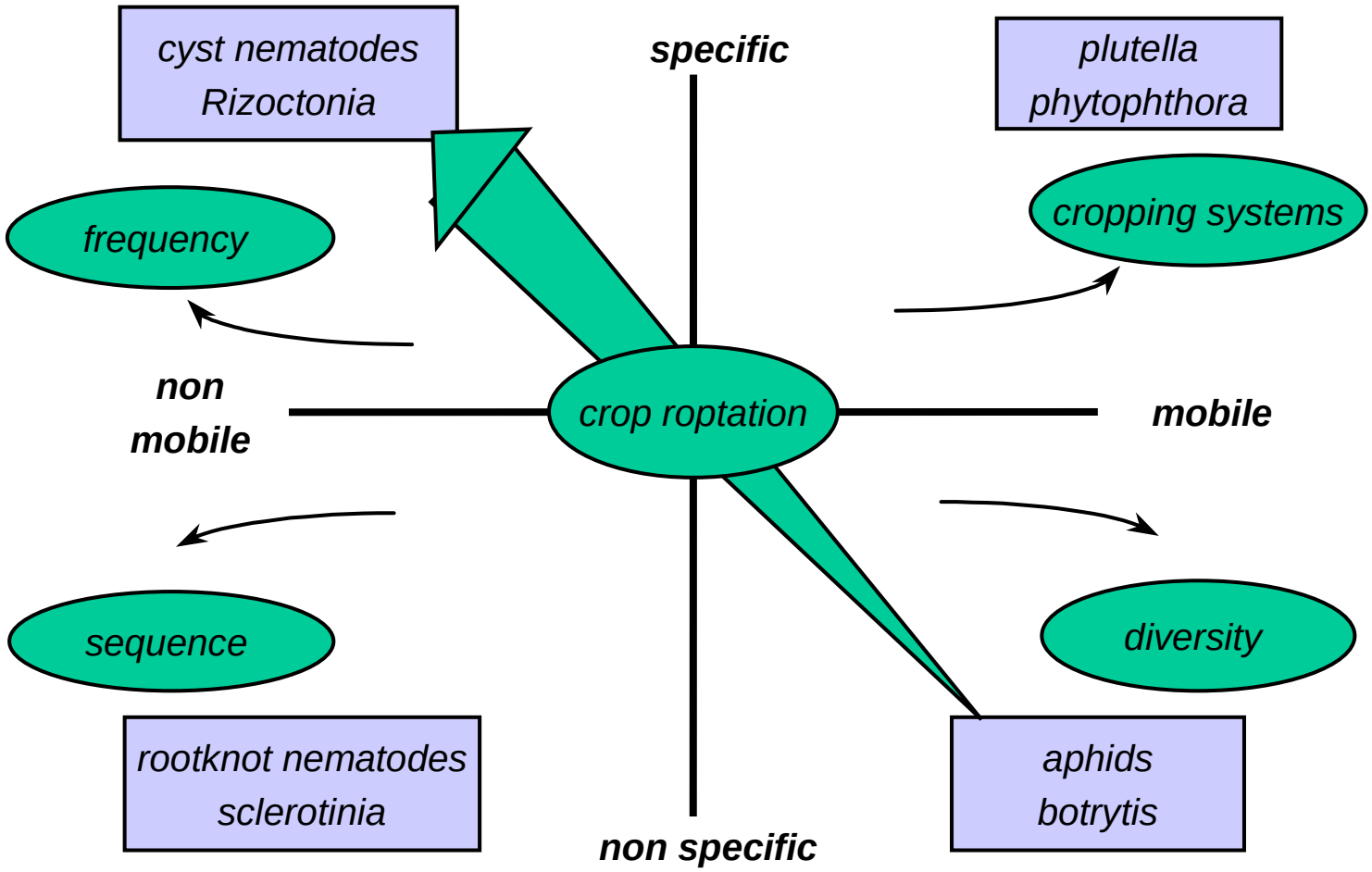
supported by cropping system (cultivar, sowing date, etc.)

Spatial crop rotation

Supports prevention of semi mobile, specific organisms as cabbage fly



Crop Rotation, prevention of pests and diseases



Strategy crop protection

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

Prevention

- **Strategic:**
  - farm hygiene and legal measures,
  - agro-ecological lay out and crop rotation,
  - stimulation of bio-diversity,
  - soil structure and water management.
- **Tactical:**
  - variety of choice,
  - healthy seeds and plant material,
  - adapted planting time or plant spacing,
  - optimal nutrient supply,
  - soil cultivation.

Prevention

- **Prevention of initial inoculum**:
  - • legal measures,
  - • farm hygiene and healthy seeds and plant material.
- **Enhancing (bio) diversity:**
  - • crop rotation and variety choice,
  - • design of the agro-ecological layout,
  - • other means of bio-diversification.
- **Creating unfavourable conditions for noxious organisms**:
  - • cultural methods,
  - • nutrient management.

Establishing need of control

- determine if organisms are harmful,
- monitor,
- prognosis of infestation or infection,
- prognosis of economic loss.

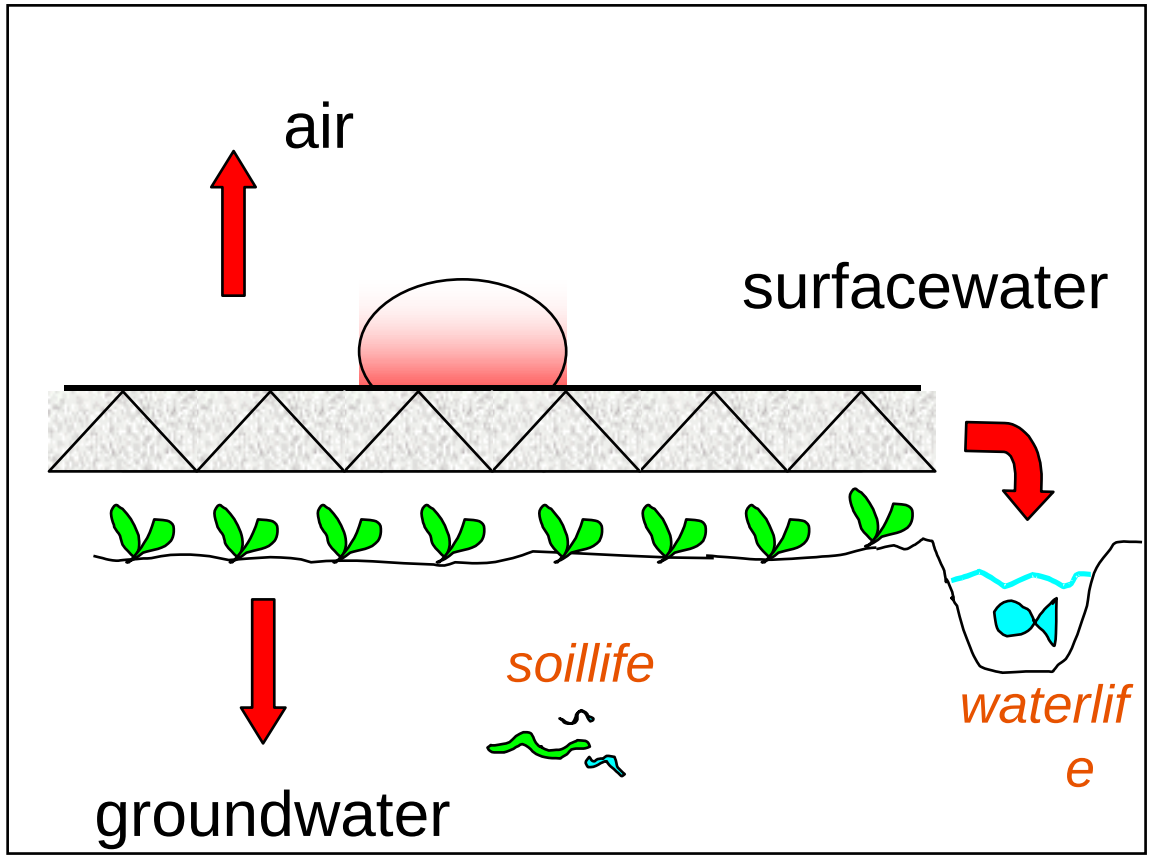
Control

- Physical
- Biological
- Chemical
  - pesticide choice
  - dose, timing and technique

Chemical control

- Choice of pesticides
  - selectivity
  - resistance development
  - emission and damage risks, DT50
- Application
  - timing, weather conditions
  - application technique
  - dose

Environmental effects pesticides



parameters

use

emission

damage

Location PPO-Nagele

PPO-Nagele

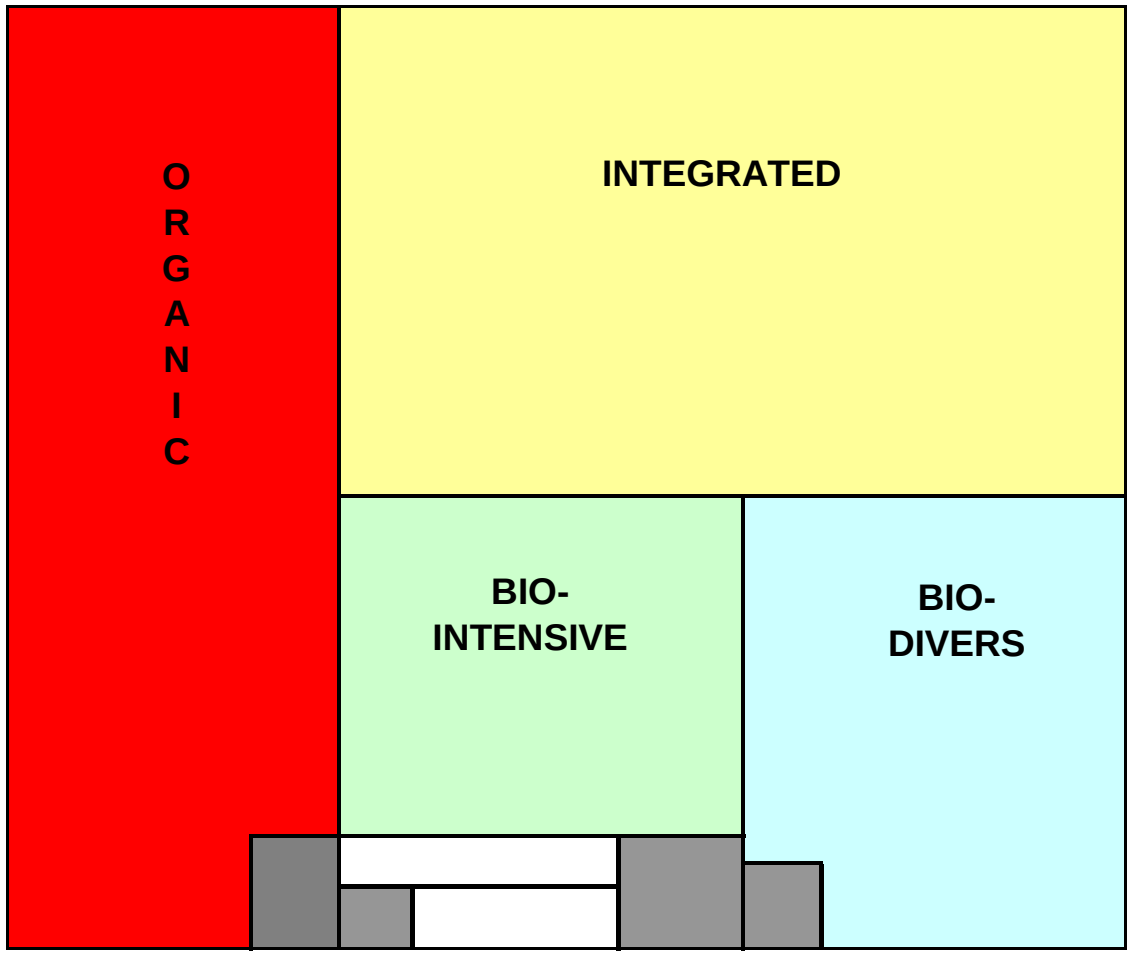
- Northeast polder, Flevoland
- Farm size 72 ha
- Soil type heavy sandy marine clay (24% lutum)
- 4 farming systems

History PPO-Nagele

- Development of farming systems since 1979

- Period 1 (1979 until 1991)
  - Conventional, Integrated, Organic
- Period 2 (1992 until 1999)
  - Integrated, Experimental, Organic
- Period 3 (from 2000)
  - Experimental, Organic, Bio-divers, Bio-intensive

Current situation



Rotation

Organic 1

1. seed potatoes
2. grass-clover
3. sown onions/sugar beets
4. spring wheat
5. winter carrot/chicory
6. processing peas

Organic 2

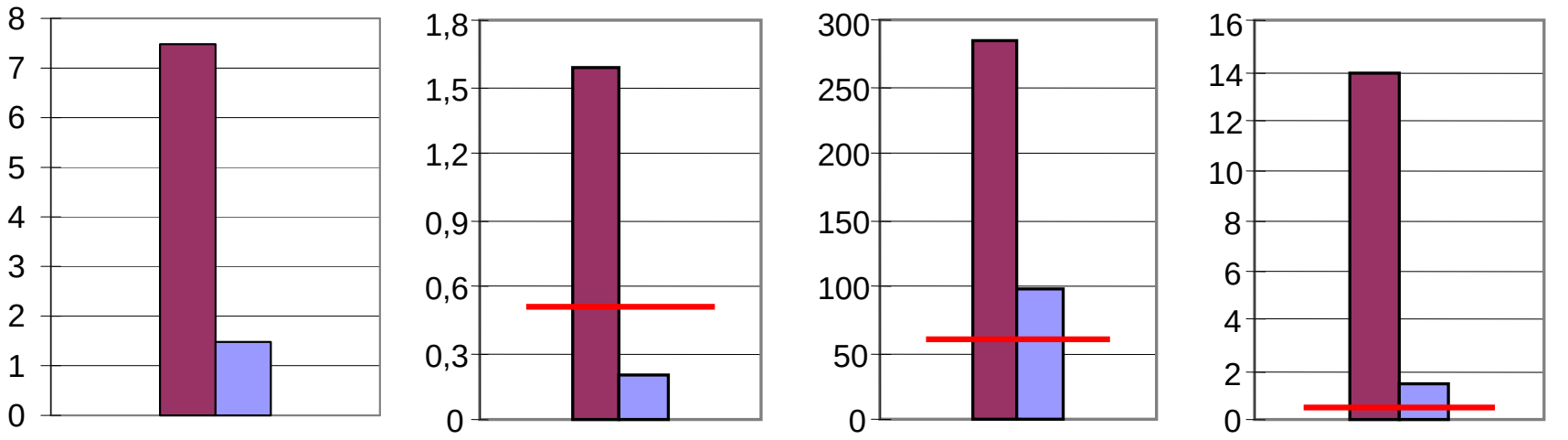
1. seed potatoes
2. Grass clover
3. Brussels sprouts
4. peas
5. Spring wheat
6. I. lettuce/spinach

Bio divers system: Functioning of biodiversity

Some Results

Period 1992-2000

Use and Emission of pesticides



Use
kg a.i/ha

EEP-air
kg a.i/ha

EEP-soil
kg days/ha

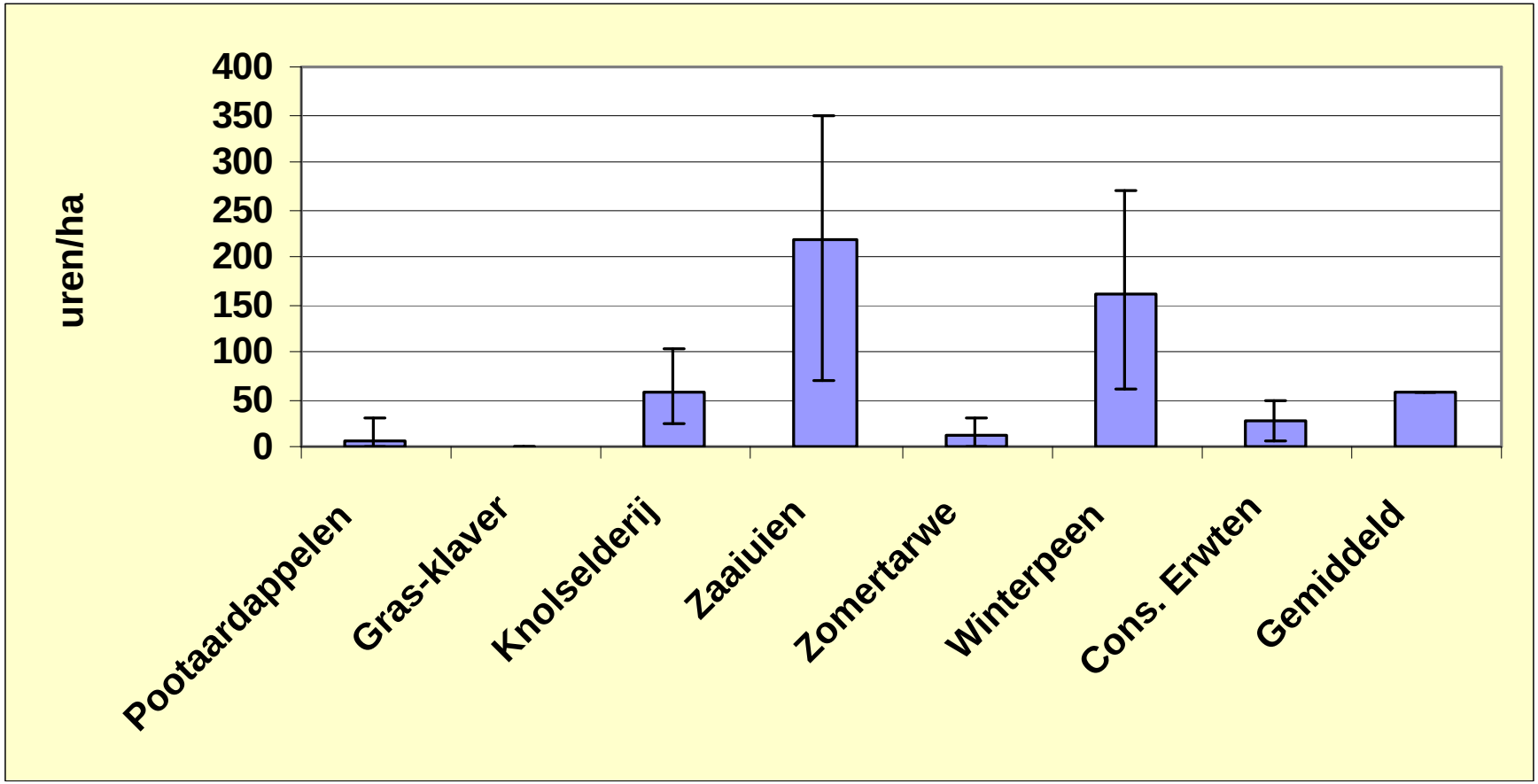
EEP-groundwater
ppm

conventional **OBS** **target value**

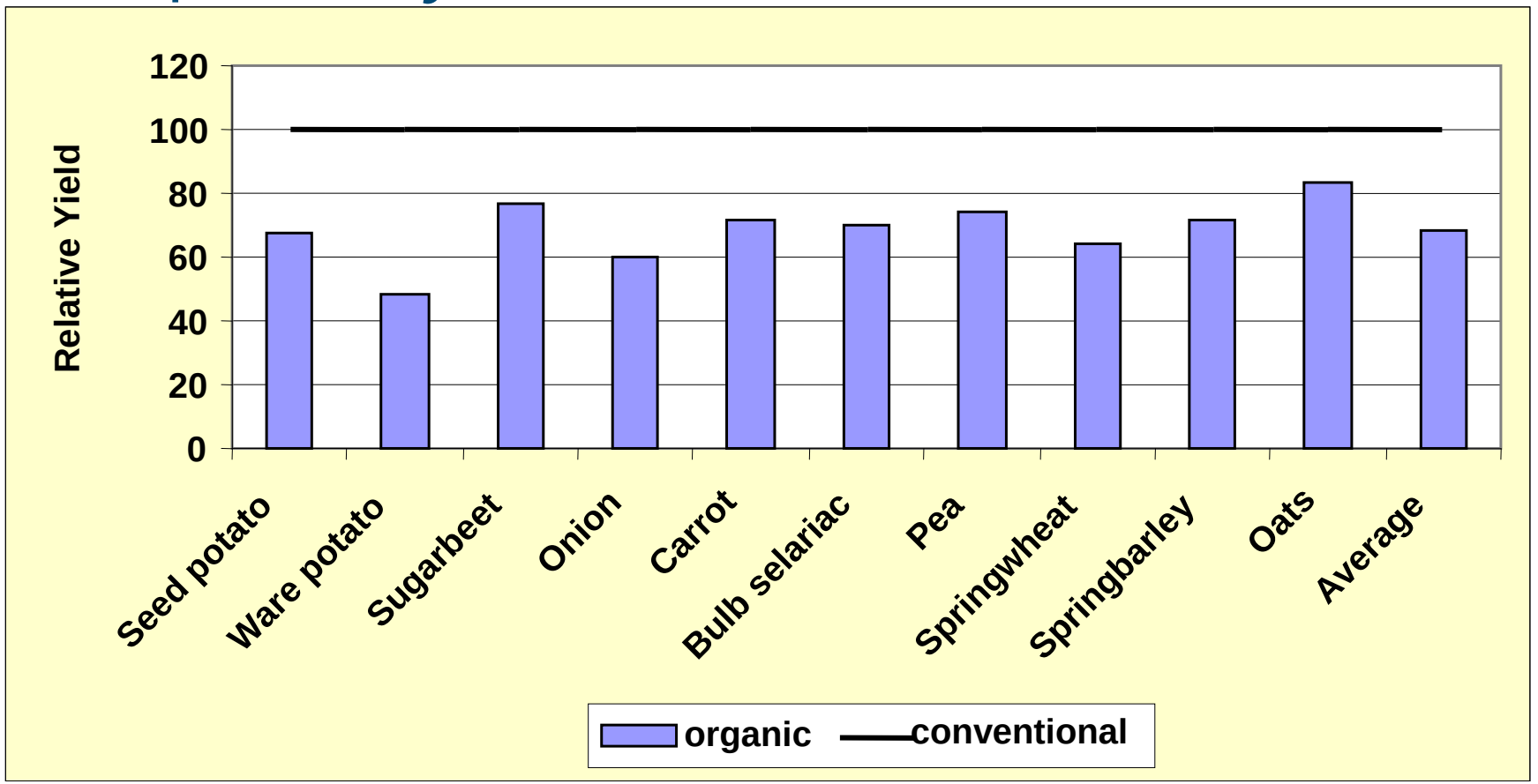
Production organic system

Parameter	Dimension	Target	Result BD
seed potato	ton/ha	30	21,263
grass-clover	d.s. ton/ha	10	9,521
selariac	ton/ha	45	40,902
sown onions	ton/ha	50	42,15
spring wheat	ton/ha	6	5,239
B-carrots	ton/ha	65	62,27
juice carrots	ton/ha	80	75,146
peas for caning	ton/ha	5	5,525

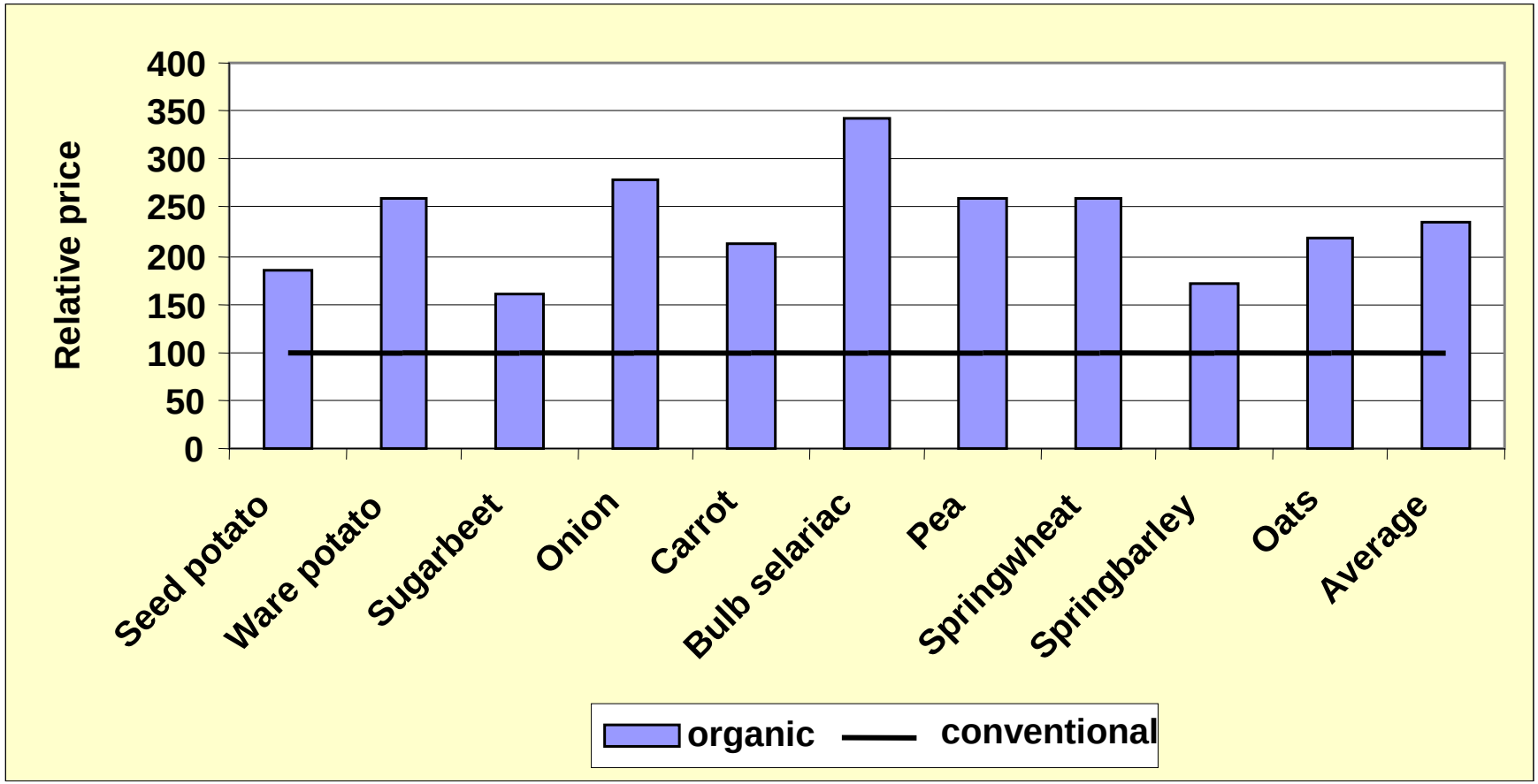
Hours of handweeding per ha (organic)



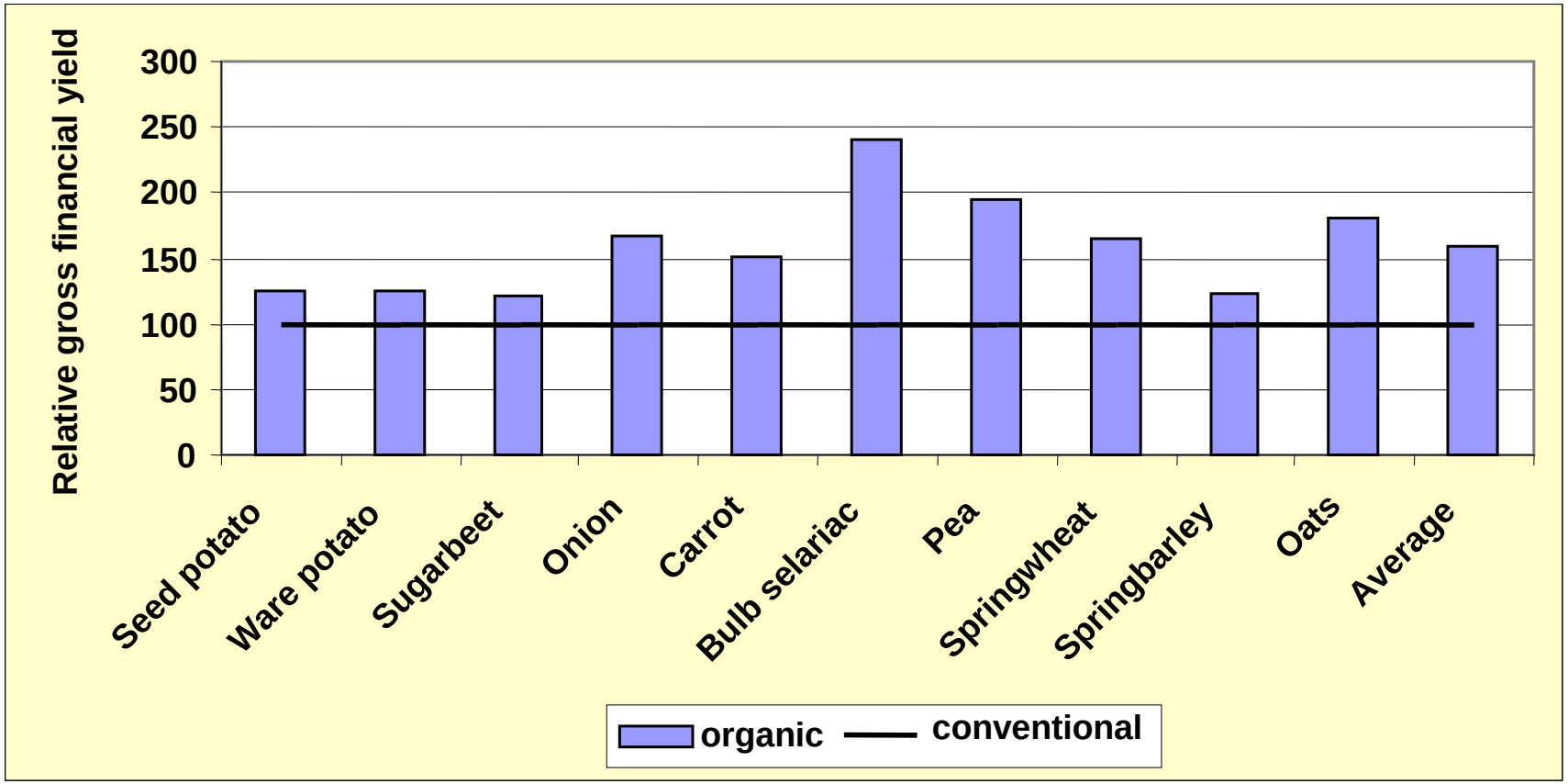
Comparison yield (Conventional = 100)



Comparison prices (Conventional = 100)



Relative financial yield (conventional= 100)



Dissemination projects

- Integrated pilot farms
  - integrated arable farming 1990-1993
  - arable farming 2000 1994-1998
  - vegetable farming 1996-1999
  - ‘Farming for the future’: arable and vegetable farming 2000-2003
- Organic pilot farms
  - ‘BIOM’: arable and vegetable farming 1998-2002

Farming Systems Research

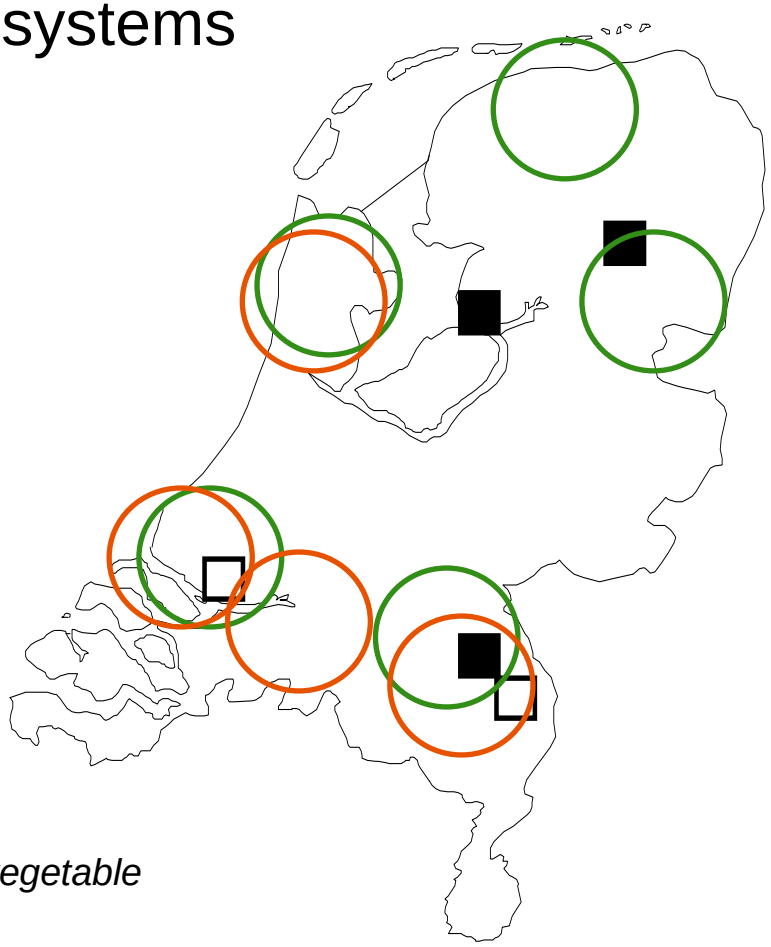
Integrated and organic farming systems

research

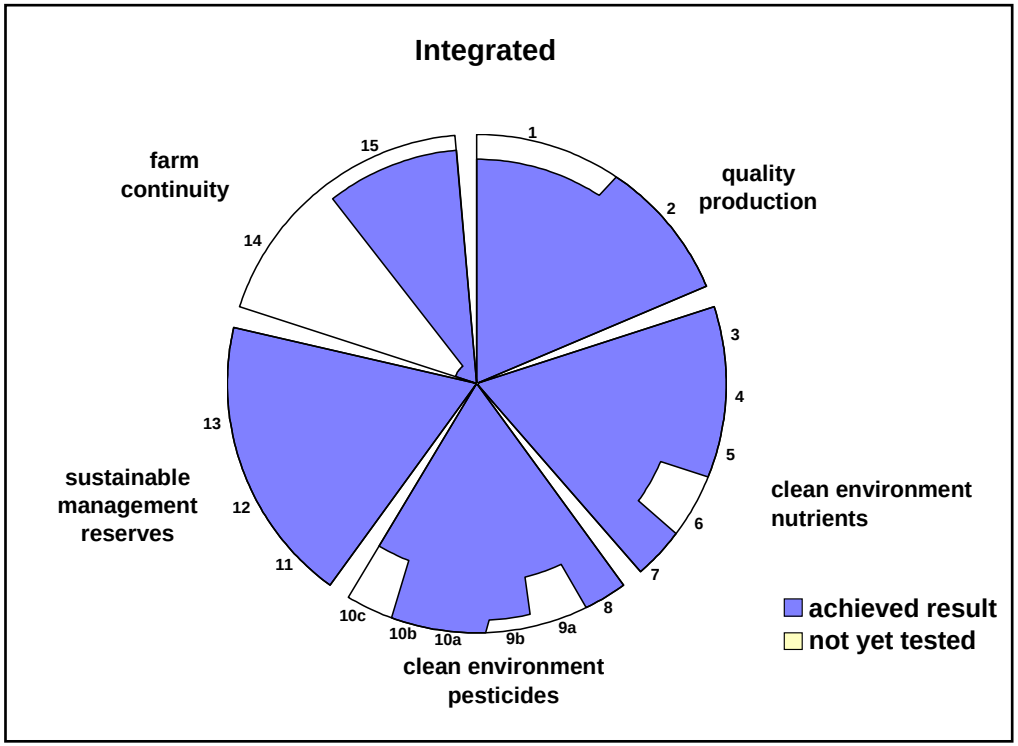
design
testing
improving

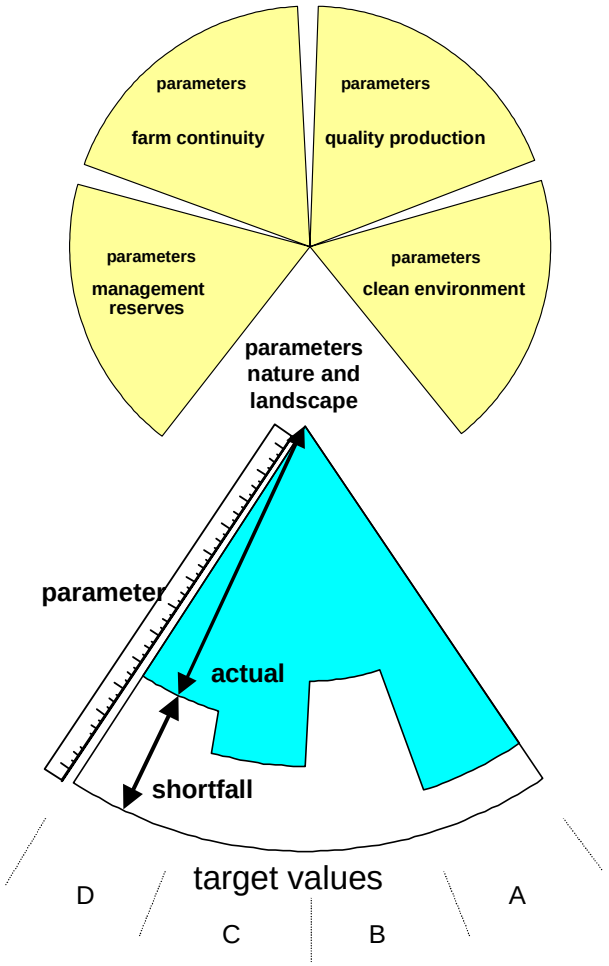
practice

introduction
testing
optimising



Methodology of presentation





Theme and parameters

- Clean environment
  - emissions and damage risks of

    pesticides, nutrients and greenhouse gasses (CO2 NOx etc.)
- Parameters
  - use, emission and damage risk pesticides
  - use, surplus and emission nutrients
  - gas emissions (or indirect fossil energy use)

Theme and parameters

- Multifunctionality
  - on farm nature management
  - agrotourism, health and care, etc.
- Parameters
  - in relation to on farm nature,
    - no of target species, no of biotopes
    - infrastructure, area, connectivity, circuitry

Theme and parameters

- Sustainable use of resources
  - energy
  - soil fertility
  - non renewable resources
- Parameters
  - use of energy and mineral P
  - soil fertility, erosion, soil cover, soil health

Theme and parameters

- Farm continuity
  - income, savings, profit etc,
  - “strategic” management, labour organisation
  - embedding in market and society
- Parameters
  - farm economic parameters
  - labour input (specified topics)

Parameter requirements

- Relative easy to access (costs, labour)
- Descriptive for system characteristics
  - internal: sustainability and production
  - external: ecology, environment, landscape, market, society
- Parameters must be influenced by farming methods
- Total set of parameters must be limited

Demands on parameters

- Relative easy to access (costs, labour)
- Descriptive: system characteristics:
  - internal: sustainability and production
  - external: ecology, environment, landscape
    market, society
- Steering variables influenced by the methods

Target values derived from

- Policy and legislation
- System specific values
- Scientific state of the art
- Dialogue with stake holders

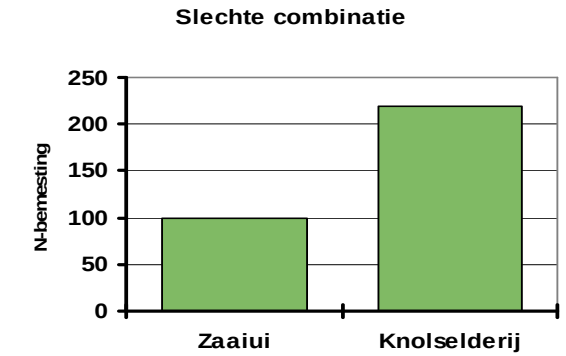
Target values must be ambitious and relevant

Parameters based on

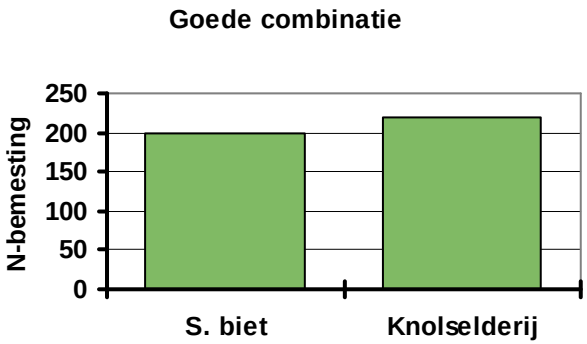
- Analysis policy and legislation
- System specific values
- Scientific state of the art
- Dialogue with stake holders

- target value: ambitious and relevant

Wrong combinations of crops create differences in soil fertility



differences in N demand will create differences in soil fertility



a good combination prevents these problems

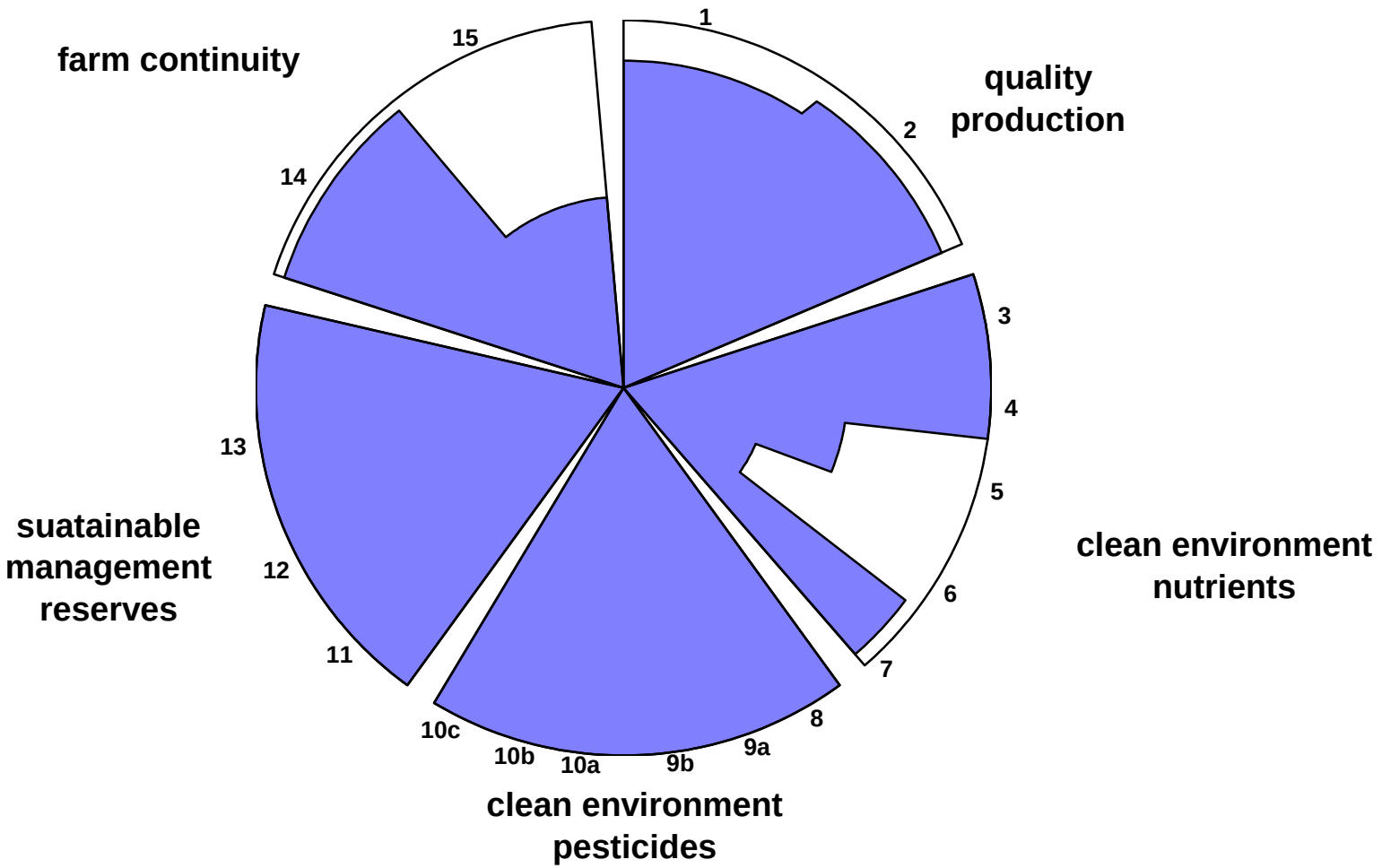
Epilogue

- Farm System approach an indispensable step towards a sustainable agriculture
- Consider not only inputs and economic output but also “potential” losses and damage
- Dissemination and implementation is a vital follow up
- Need for general agronomists

Rotation, green manures and fertilisation (org)

	Crop	**Green manure**	**Animal Manure**
1.	seed potato	grass-clover	22 ton solid goat manure
2.	grass-clover	grass-clover	30 m^3 leak water
3.	sown onions/sugar beet	white mustard / -	30 ton solid goat manure
4.	spring wheat	Persian clover	12 ton solid goat manure
5.	winter carrot / chicory	- / -	-
6.	processing peas	Italian ryegrass	-

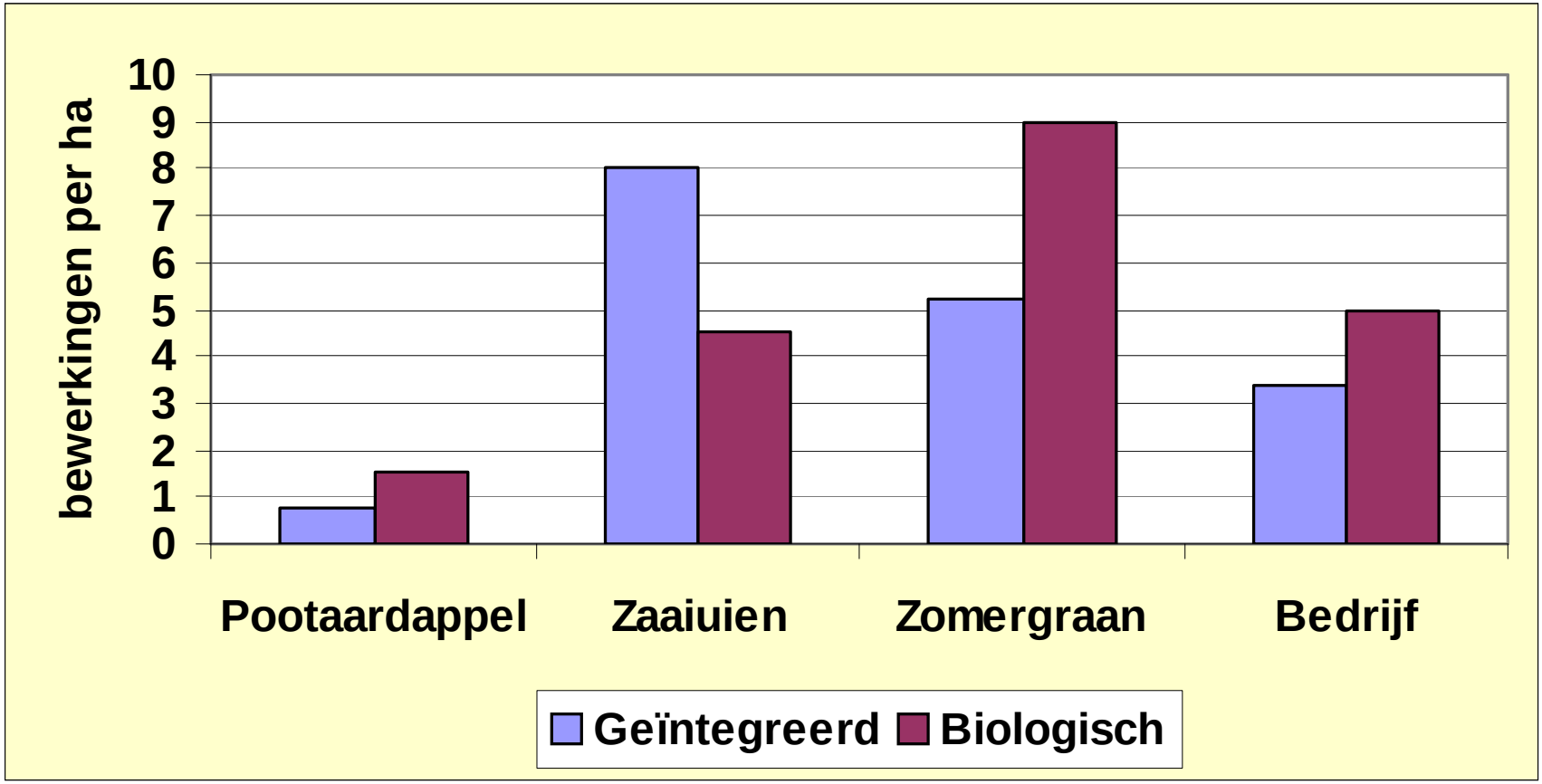
Results Organic (1)



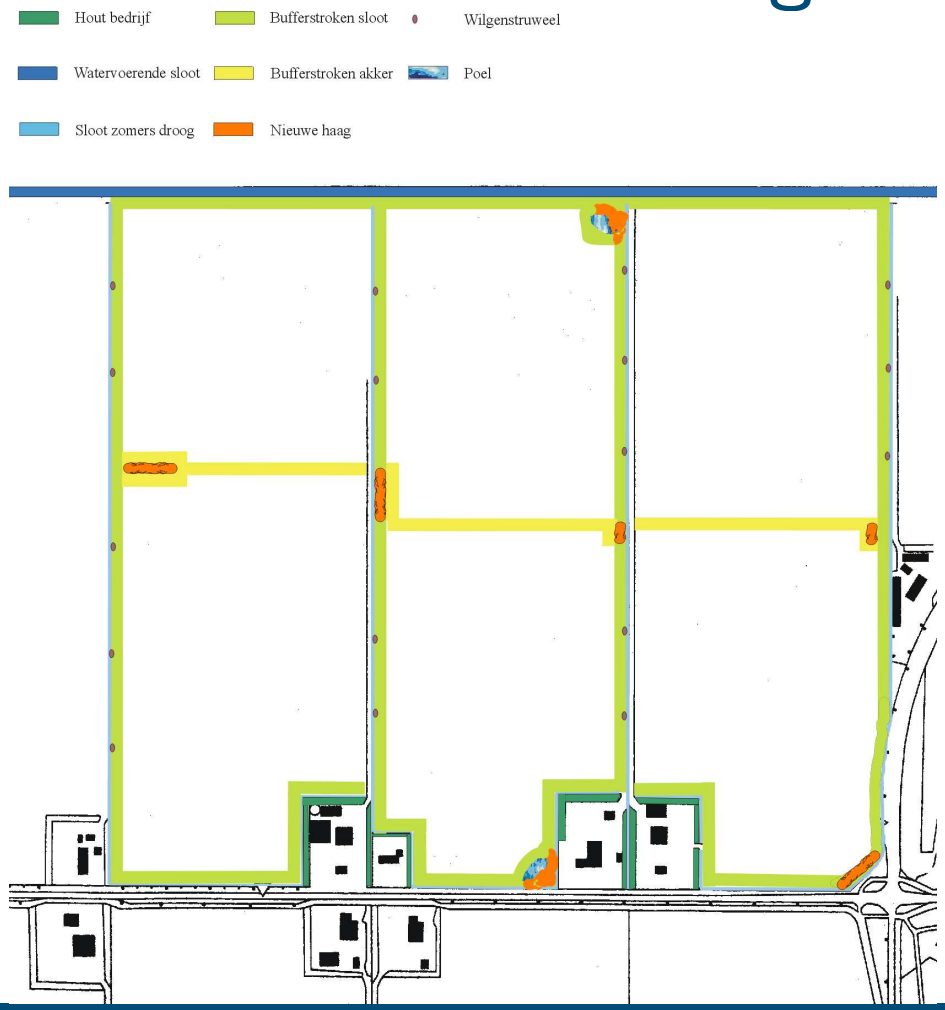
Results Organic (2)

Theme	nr	Parameter	Dimension	Target	Result BD
quality production	1	**quantity**		1	0,89
	2	**quality**		1	0,94
Clean environment	3	Nmin autumn	Nmin (0-100cm)	70	43,2
	4	N-leaching	mg/l	50	42,0
	5	N-surplus	kg/ha	100	139
	6	K20-surplus	kg/ha	40	101
	7	P2O5-surplus	kg/ha	20	24
	8	A.I. input	kg/ha	ALARA	0
	9a	EYP waterlive	% apl.>10	0 % apl.>10	0
	9b	EYP soillive	% apl.>100	0 % apl.>100	0
	10a	EEP air	kg a.i. per ha	0,7	0
	10b	EEP soil	kg days/ha	200	0
	10c	EEP groundwater	PPM	0,5	0
suatainable management re	11	P available reserves	PW	20-30	20
	12	K available reserves	K-count	18-29	21
	13	O.S-balance		>1	1
farm continuity	14	Nett surplus	hfl	>0	-3240
	15	Ours handweeding	our/ha	10	58

Number of treatments weed control (int-org)



On farm nature management

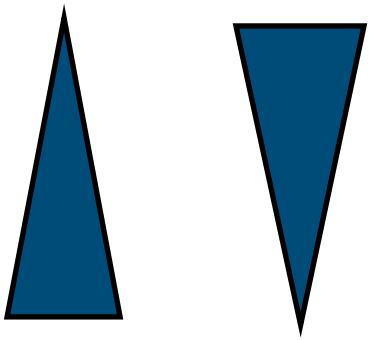


Quality production

conventional *organic*

soil structure

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

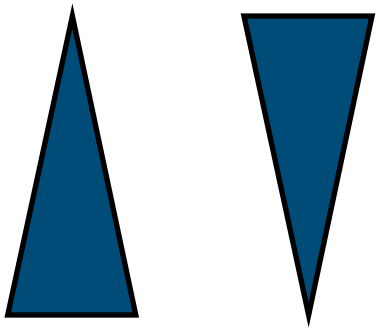


nutrient supply

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

weeds

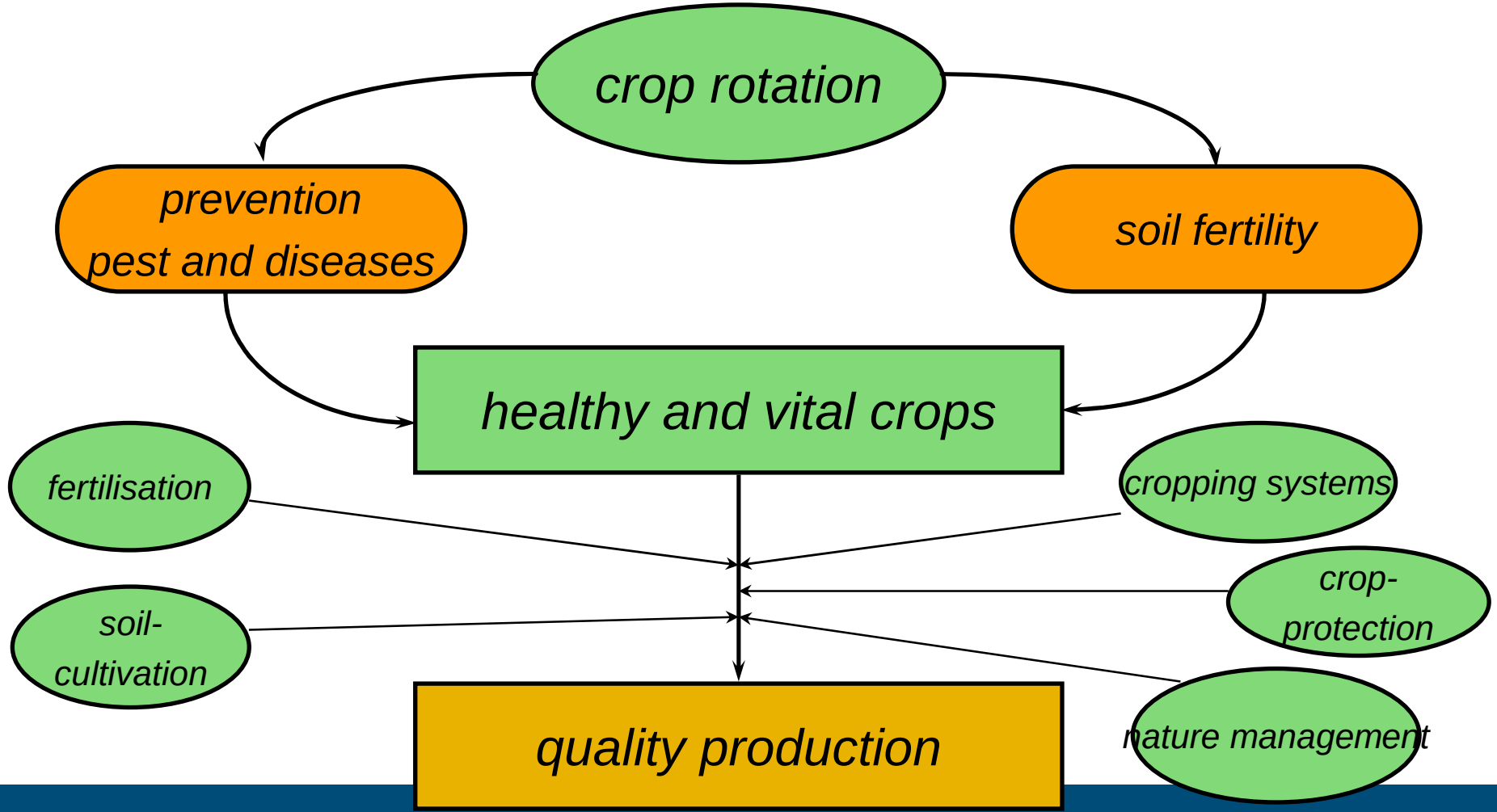
- crop rotation
- cropping system
- mech.. control
- pesticiden



pests and diseases

- crop rotation
- cropping system/ resistent varieties
- pesticides

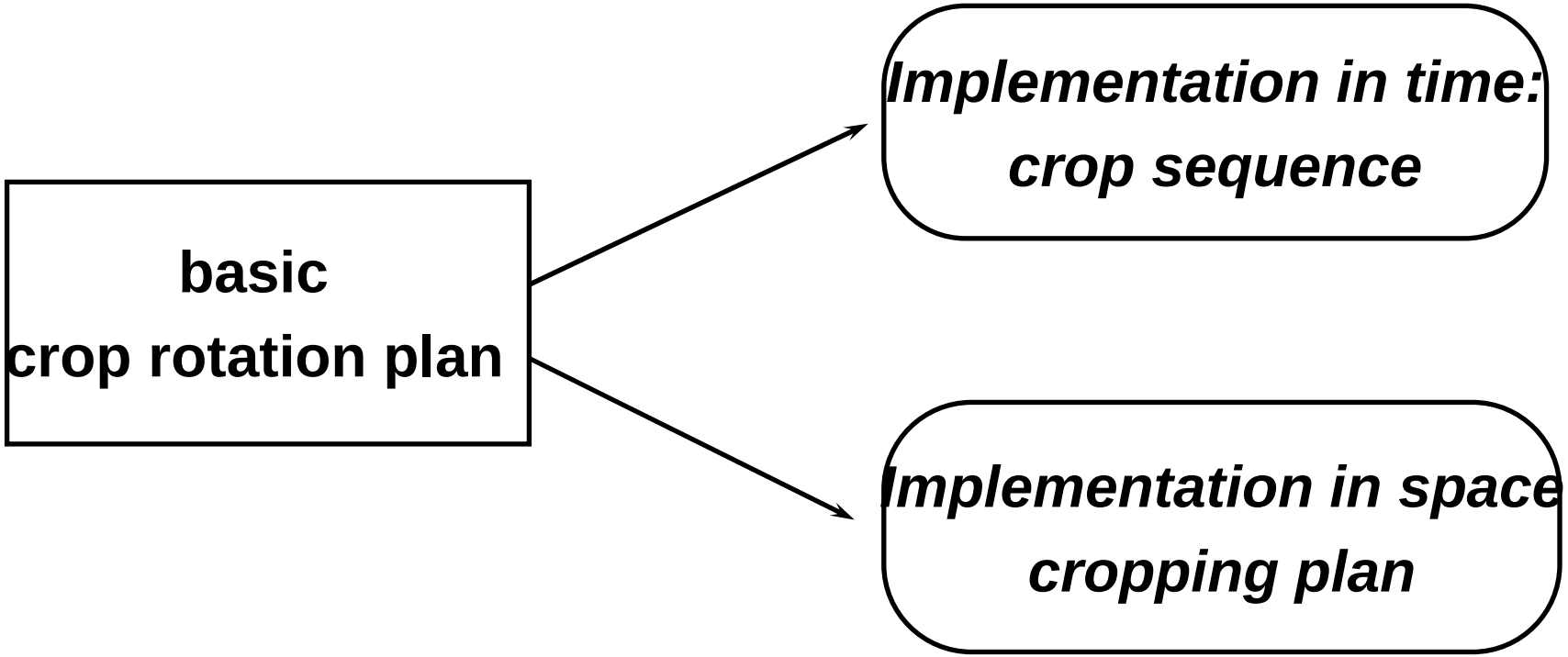
Crop rotation and quality production



Healthy and vital crops

- prevention of
  - (soilborne) diseases and pests
  - weeds
- soil fertility
  - physical (soil structure, air- and watersupply)
  - chemical (especially N)
  - biological (active soil life)

Crop rotation



Crop diversity and ecological infrastructure

Of vital importance for:

- mobile non specific organisms
- supported by cropping systems
- direct, in crop control or prevention becomes important
  - crop cover
  - natural enemies

diversity on a regional scale limits risks

Cropping systems

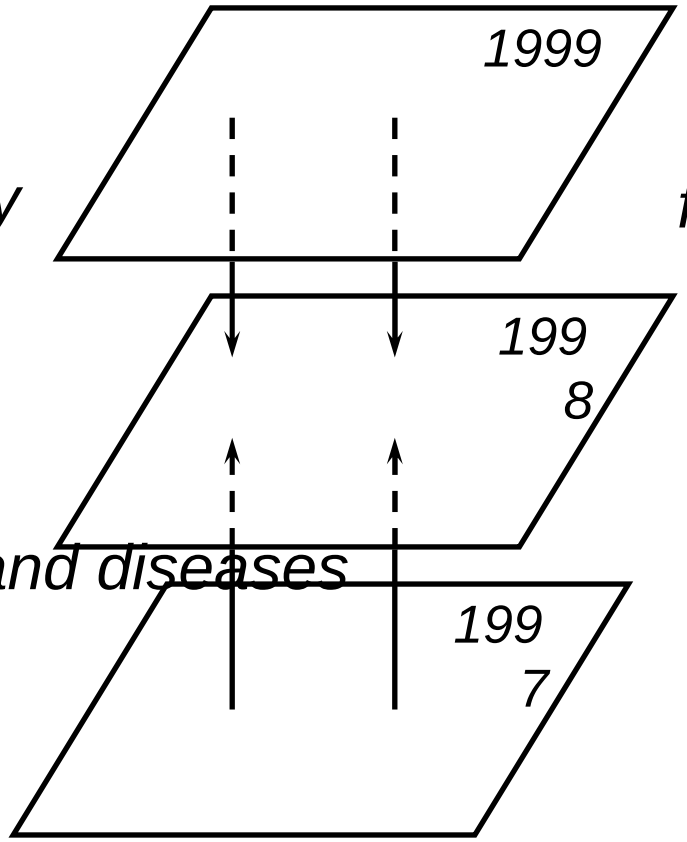
Of vital importance for

- specific, mobile organisms
  - cultivar choice
  - plant density
  - sowing/planting time
- eventually in crop control or prevention necessary
  - crop cover

Crop sequence

Target: homogenity

- *N supply*
- *soil structure*
- *soil fertility*
- *soil born pests and diseases*
- *weeds*



fine tuning on future

making plans

fine tuning on past

Crop rotation design 1

1. Selection crops and green manure
2. Characterising role and potential
   - pests, diseases, weeds
   - soil structure
   - N need, oftake, residual, transfer
   - gross margin, cropping period

Crop rotation design 2

3. Design rotation

- frequence, sequence and spacial
- maximising + and minimising - interaction
  - soil fertility (N dynamics and soil structure)
  - soil health

Design cropping plan 3: guidelines

- crops 1 to 6
- green manures 1 to 3
- crop groups 1 to 3

  (incl. gr. manure excl. perennial crops)
- no green manure from same crop group before or after main crop

Crop rotation design 4: guidelines

- alternate combinable and root crops
- synchronise N need and supply
- agro ecological identity (infrastructure and spatial crop rotation)

Comparison yield (KWIN 2002)