APPLIED PLANT RESEARCH

Innovation of Farming Systems

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KTBL Fachgespräch

Systembewertung im Ökologischen Landbau

WAGENINGEN UR

Personal introduction

- Wijnand Sukkel
- Agronomist, Specialist organic plant production

Applied Plant Research (PPO)
Wageningen University and Research Centre (WUR),

Content

- Background
- System innovation
- Prototyping
- Some results and experiences

APPLIED PLANT RESEARCH

Organic Agriculture needs a specific approach in research and knowledge transfer

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Consequence values and intentions

- Low availability of monofactorial solutions
- Available methods and techniques have complex effects on the performance of a farm
- Improvements/solutions are often a sum of various effects

Conflicts

ecology ⟷ economy

diversity ⟷ homogeneity

Need for:

- farming methods designed to overcome these conflicts
- social and political solutions

Emphasis in farming strategies

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

Shift in approach

Shift from:

- Reductionism to holism
- Objectivism to subjectivism
- Knowledge transfer to knowledge circulation
- Description to development

- Need for general agronomists, T shaped skills

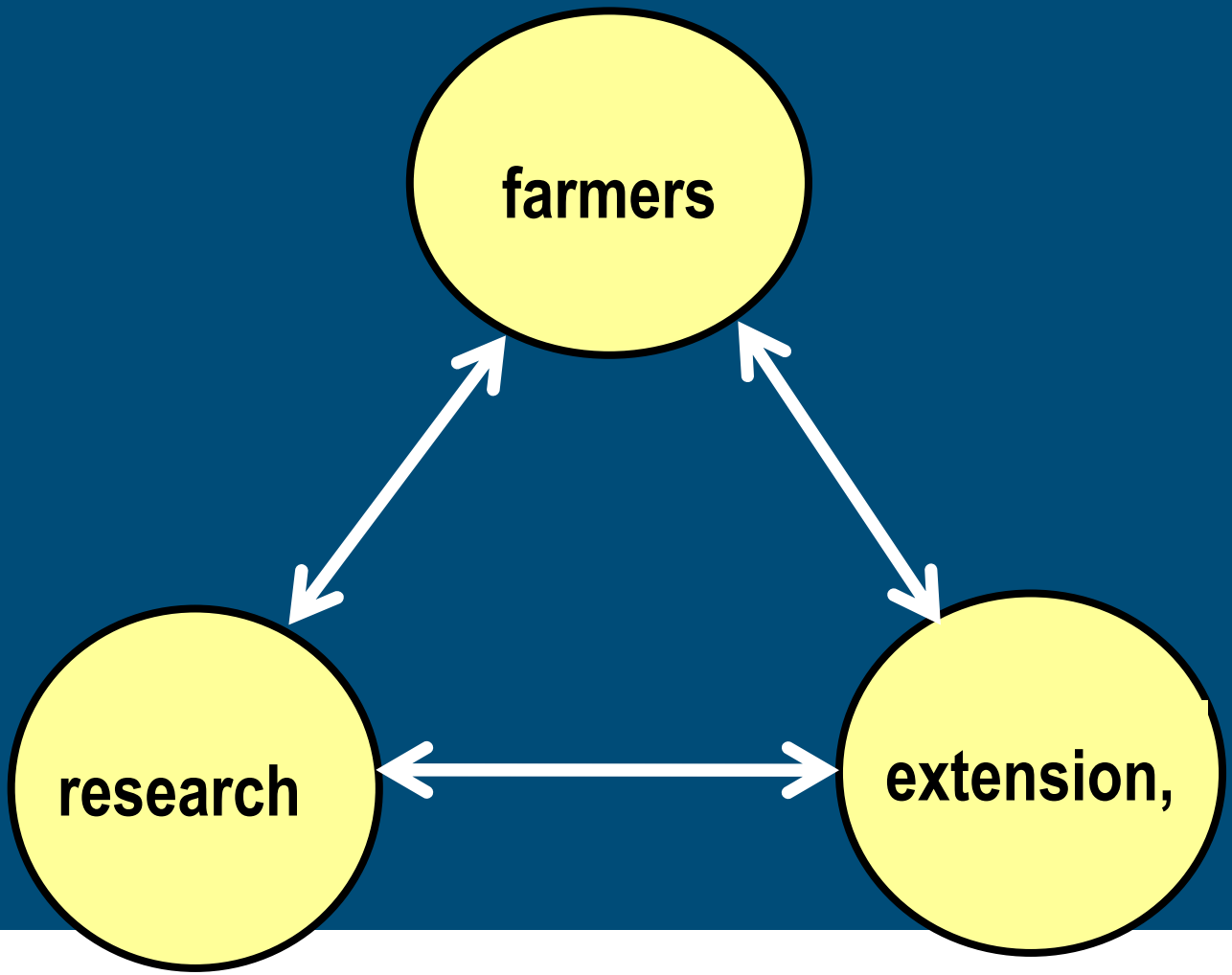
Ingredients for system innovation

- Hardware
- Software
- Orgware

Different approaches

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

Participatory approach

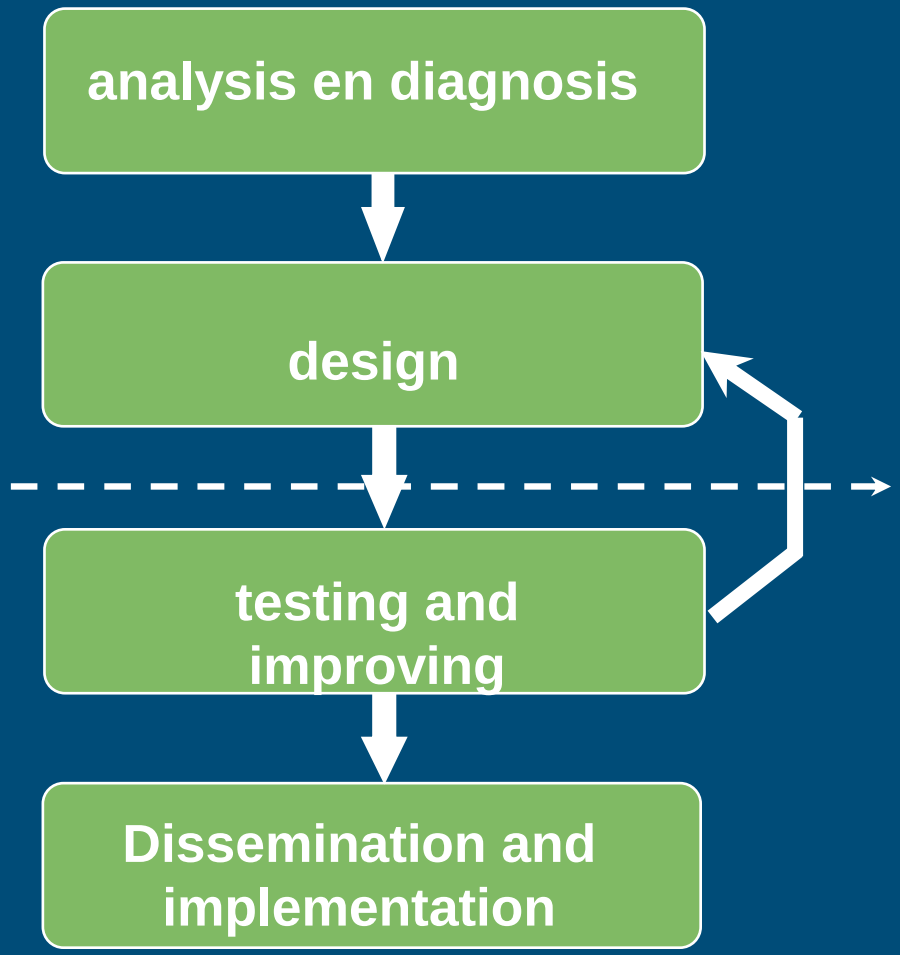


Farming systems research

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

Methodology: prototyping

- Methodical way to innovation from a technological perspective
- System level - system innovation



Analysis and diagnosis

- Regional farmstructure
- Constraints
- Policy and regulations
- Future developments

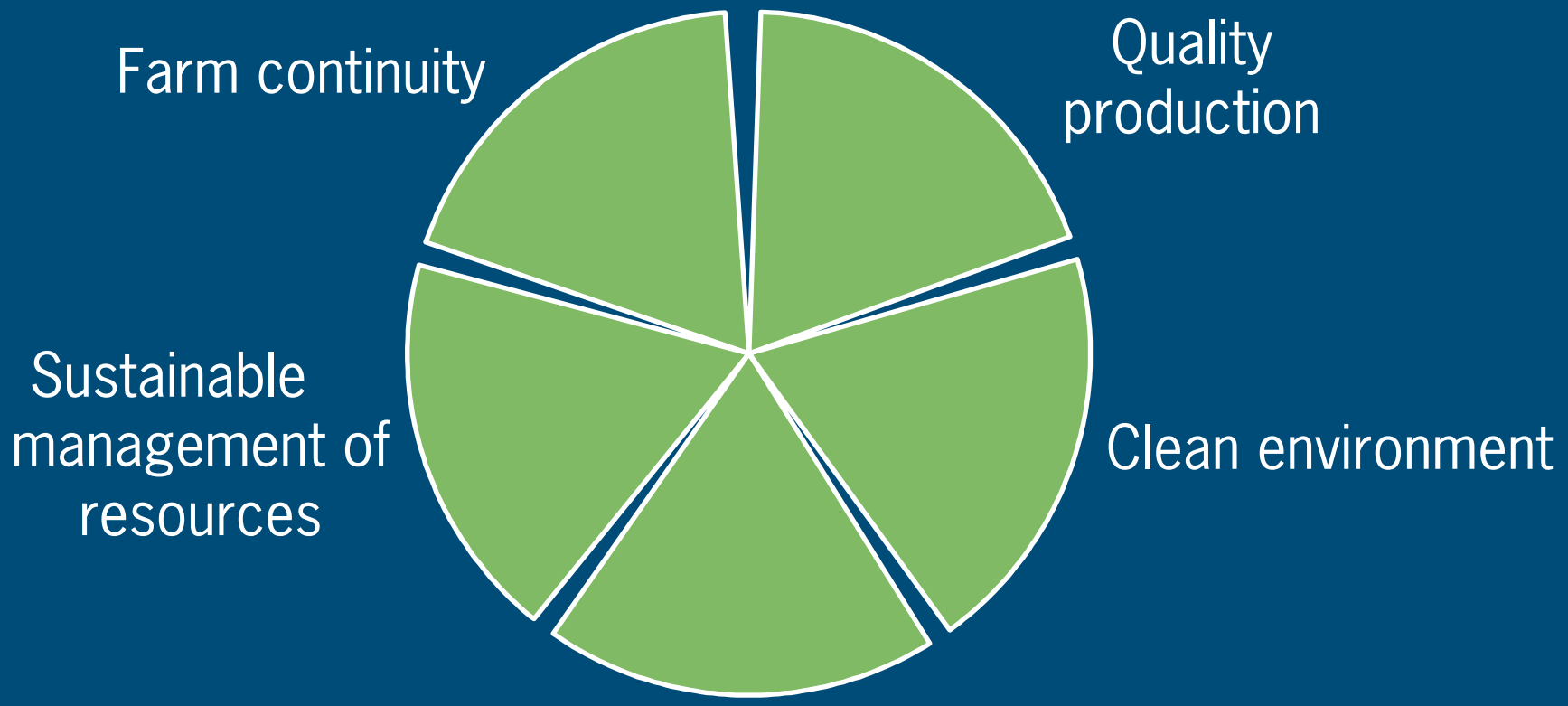
Design prototype

- Establish objectives
  - Measure them with Yardsticks (parameters) and
  - Quantify them with target values
- Design farming methods
- Design operational plan

Design: Objectives

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

Thematic approach



Quantifying objectives

Demands for parameters/yardsticks

- 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

Parameter targets value's based on:

- analysis policy and legislation
- systeem specific values
- scientific state of the art
- dialogue with stakeholders

- target value has to be ambitious and relevant

Examples parameters

- soil fertility
- quantity and quality production
- nitrate leaching
- economic farm result

Example parameters and targets

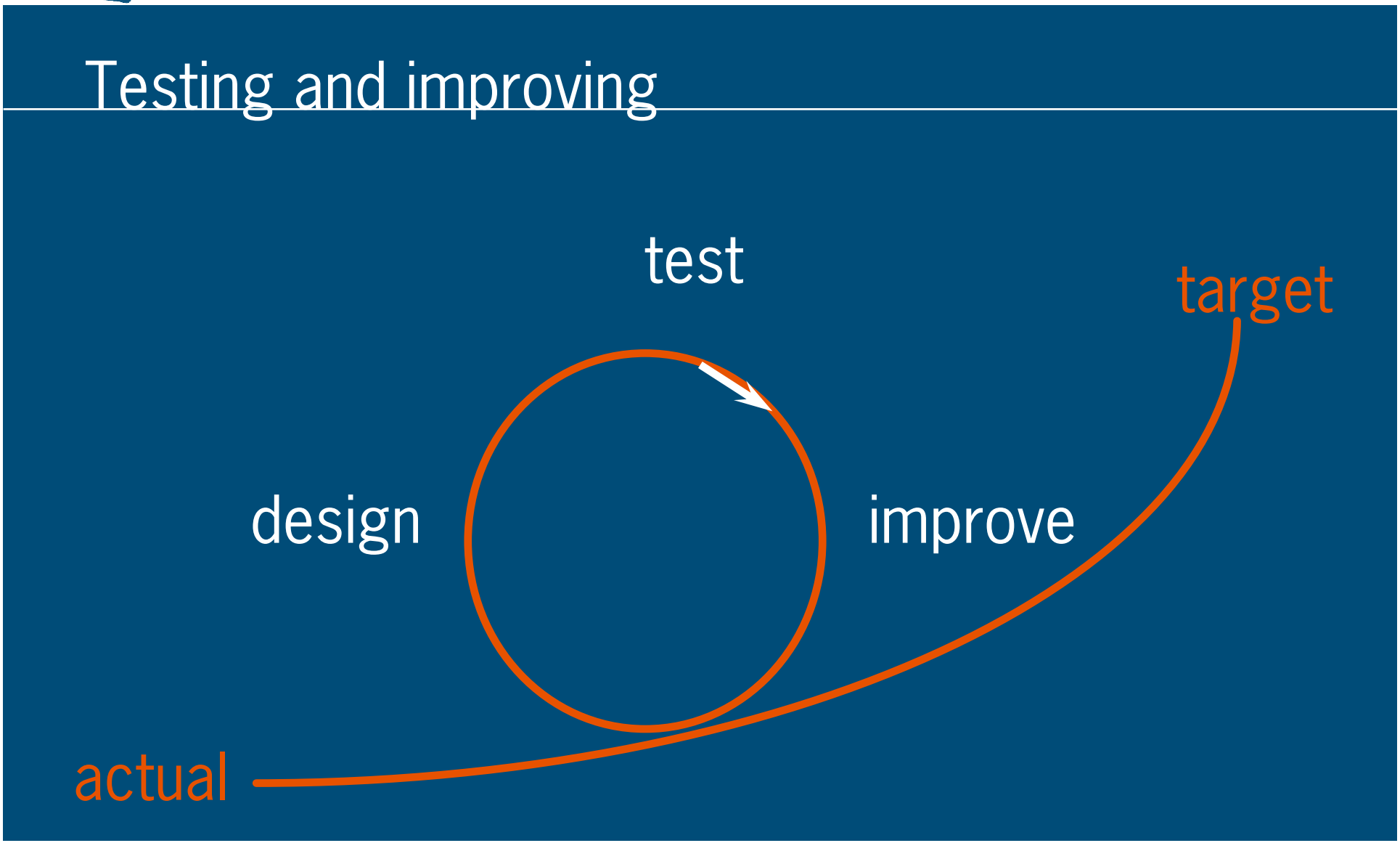
Theme	nr	Parameter	Dimension	Target	Result BD
quality production	1	**quantity**		1	0,89
	2	**quality**		1	0,94
Clean environment	3	Nmin autumn	Nmin (0-100cm)	70	43,2
	4	N-leaching	mg/l	50	42,0
	5	N-surplus	kg/ha	100	139
	6	K20-surplus	kg/ha	40	101
	7	P2O5-surplus	kg/ha	20	24
	8	A.I. input	kg/ha	ALARA	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 res	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

Agronomic Toolbox

(farming methods)

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

Testing and improving



Testing and improving

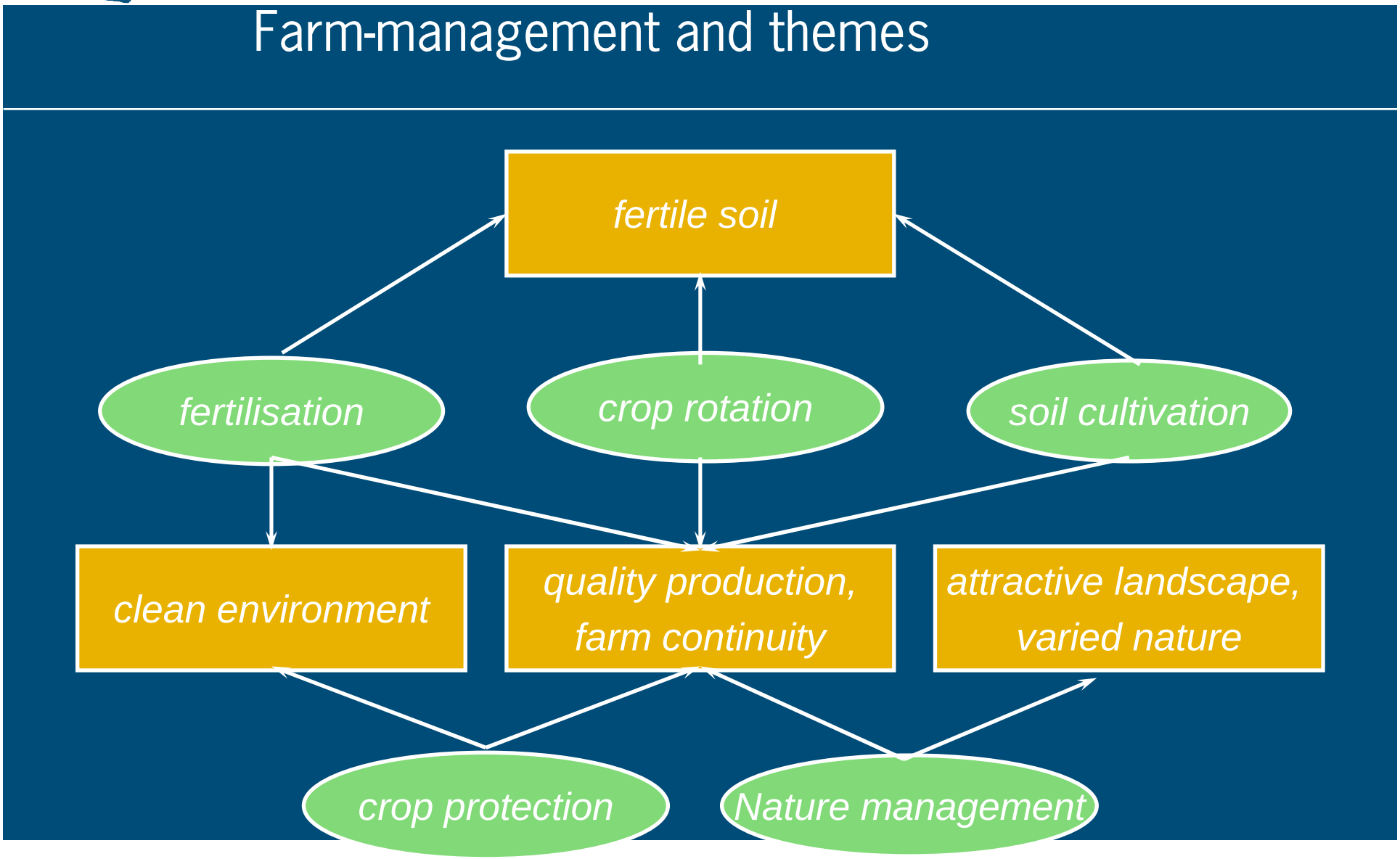
- Lay out of prototype in practice
- Measure performance (yardsticks)
- Comparison actual - target
- Analyse shortfall
- analyse cause in relation with methods
- Improve farming methods/design

Testing and Improving

Where:

- experimental farms, lay out as agro-ecological unit
- practising farms
  - Participatory approach

Farm-management and themes



Dissimination and implementation

- Coöperation
  - research, extension and practice
- Testing and improving systems in practice
  - manage ability
  - acceptability
- Demonstration
- Participatory learning
  - farmer field schools, joint innovation

Products

- Farming methods suited to reach the targets (allround farming system)
- Insight in underlying processes
- Insight in remaining bottlenecks
- Food for research agenda

Characteristics prototyping

- Targeted development
- Total system approach
- Multi objective
- Participatory development

Dissemination, practice implementation

- Translation into practicable concepts
- Testing on Pilot farms
- Software and Orgware
- Study groups, demonstration etc.

Design: Themes and parameters

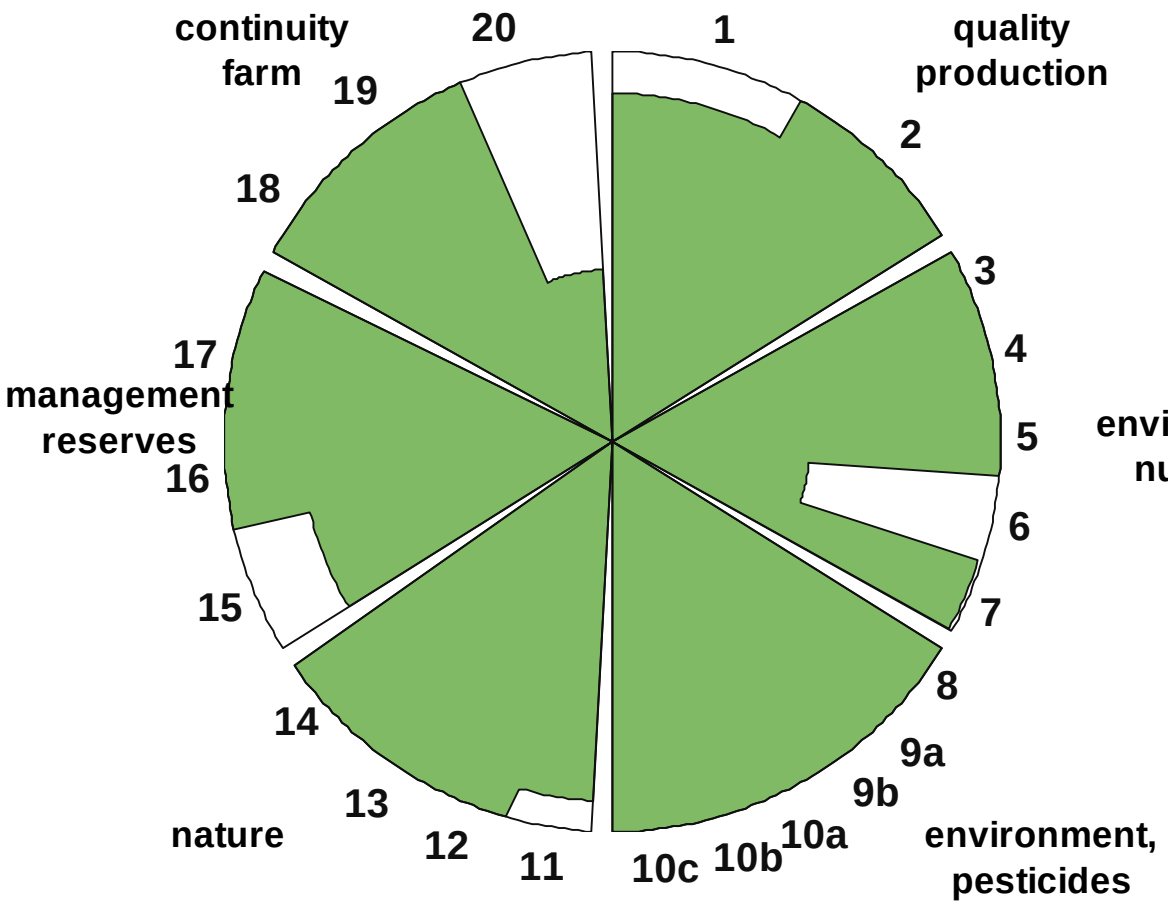
- Farm continuity
  - Net profit
  - labour input (specified topics)
- Quality production
  - quantity and quality of produce
- Multifunctionality (in relation to on farm nature)
  - no of target species, no of target biotopes
  - infrastructure, area, connectivity, circuitry

Design: Themes and parameters

- Sustainable use of resources
  - use of (fossil) energy and mineral P and K
  - soil fertility, soil cover, soil health
- Clean environment
  - use, emission and damage risk pesticides
  - use, surplus and emission nutrients
  - gas emissions

Locations in the Netherlands (2003)

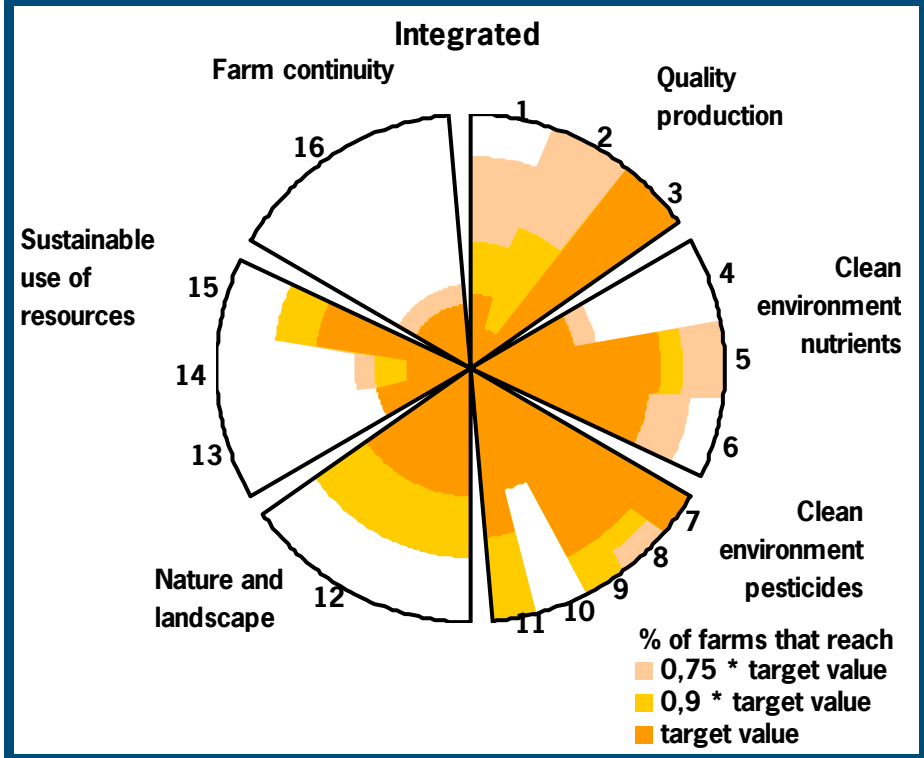
- Experimental locations
- Pilot farms organic
- Pilot farms integrated

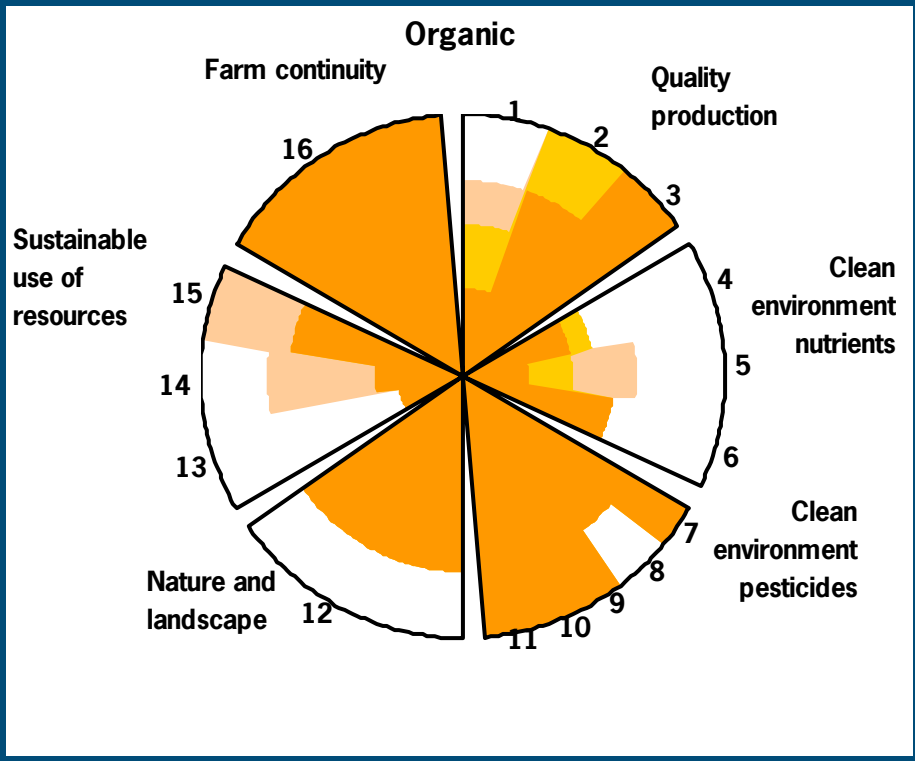


1. quantity
2. quality
3. N leaching
4. N min November
5. N surplus
6. K surplus
7. P surplus
8. use active ingredient
9. Ecological Damage Index
10. Environment Exposure to Pesti
11. plant species diversity
12. plant species distribution
13. flower density
14. % ecological infrastructure
15. P soil reserves
16. K soil reserves
17. organic matter balance
18. net surplus
19. utilisation available labour
20. hours hand weeding

Comparison between integrated and organic systems

EU project Vegineco 1997-2002 (experimental farms)





Causes shortfall

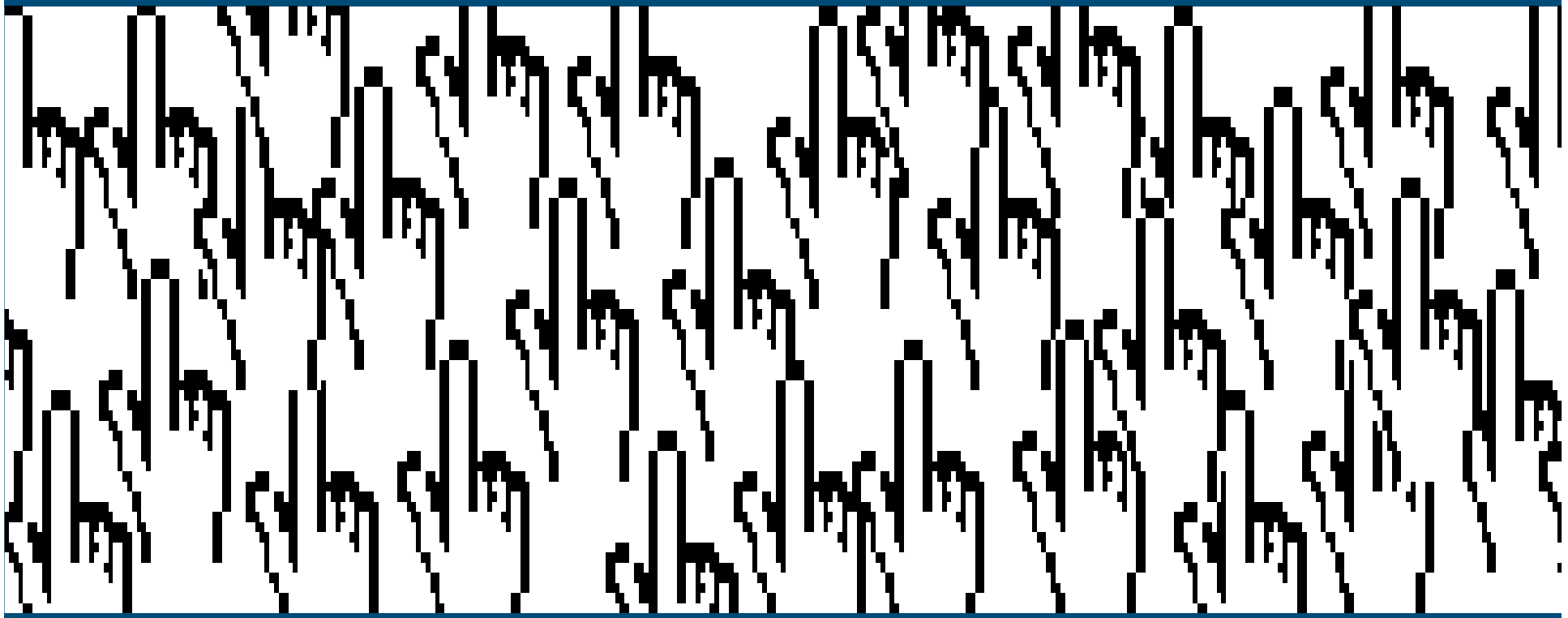
- nutrients manure ≠ plant uptake
- N-mineralisation ≠ crop demand and growth period
- pest and diseases

- awareness, knowledge
- conflicting objectives

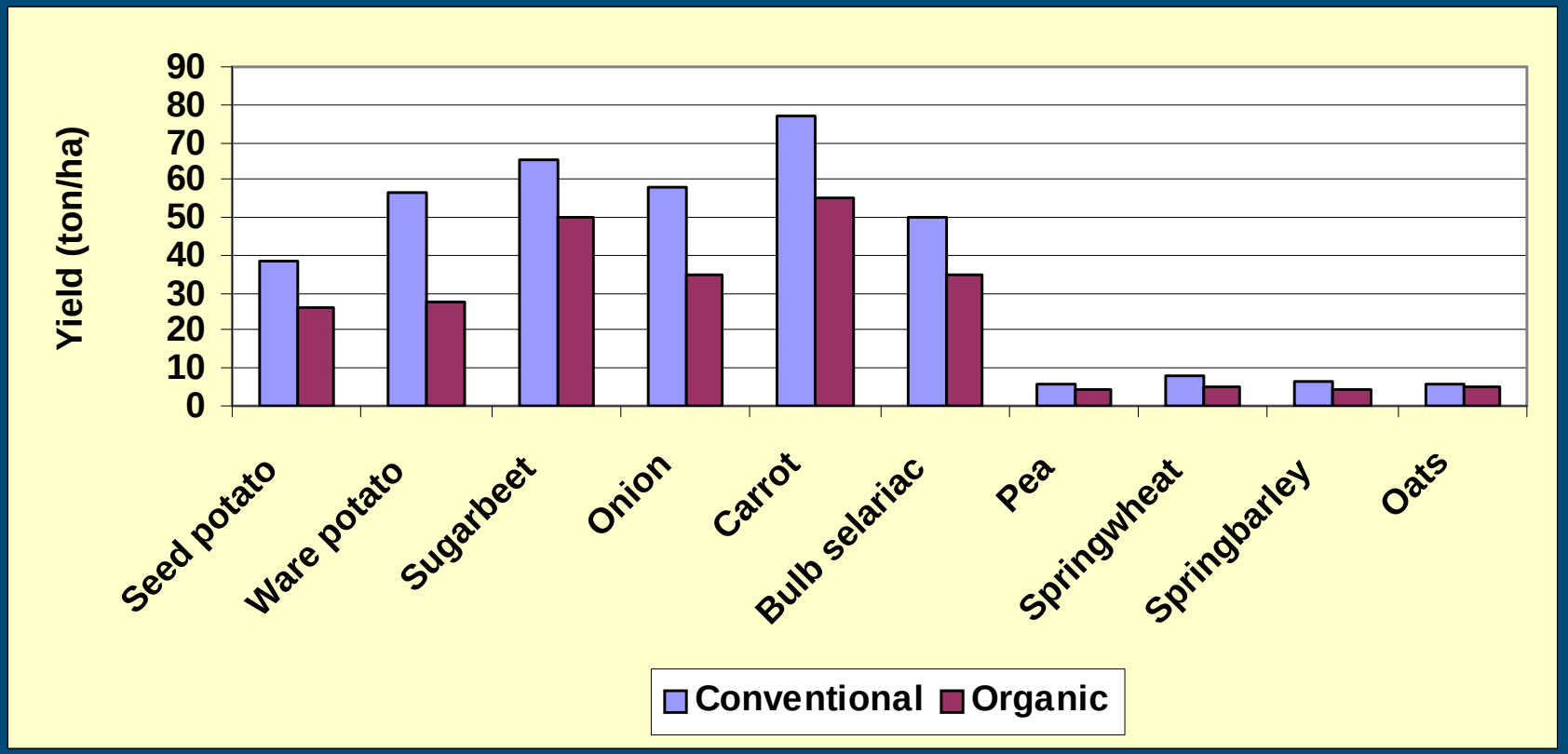
Total system approach and partipatory development are crucial steps towards organic agriculture that makes true its intentions

Thank you very much for your attention

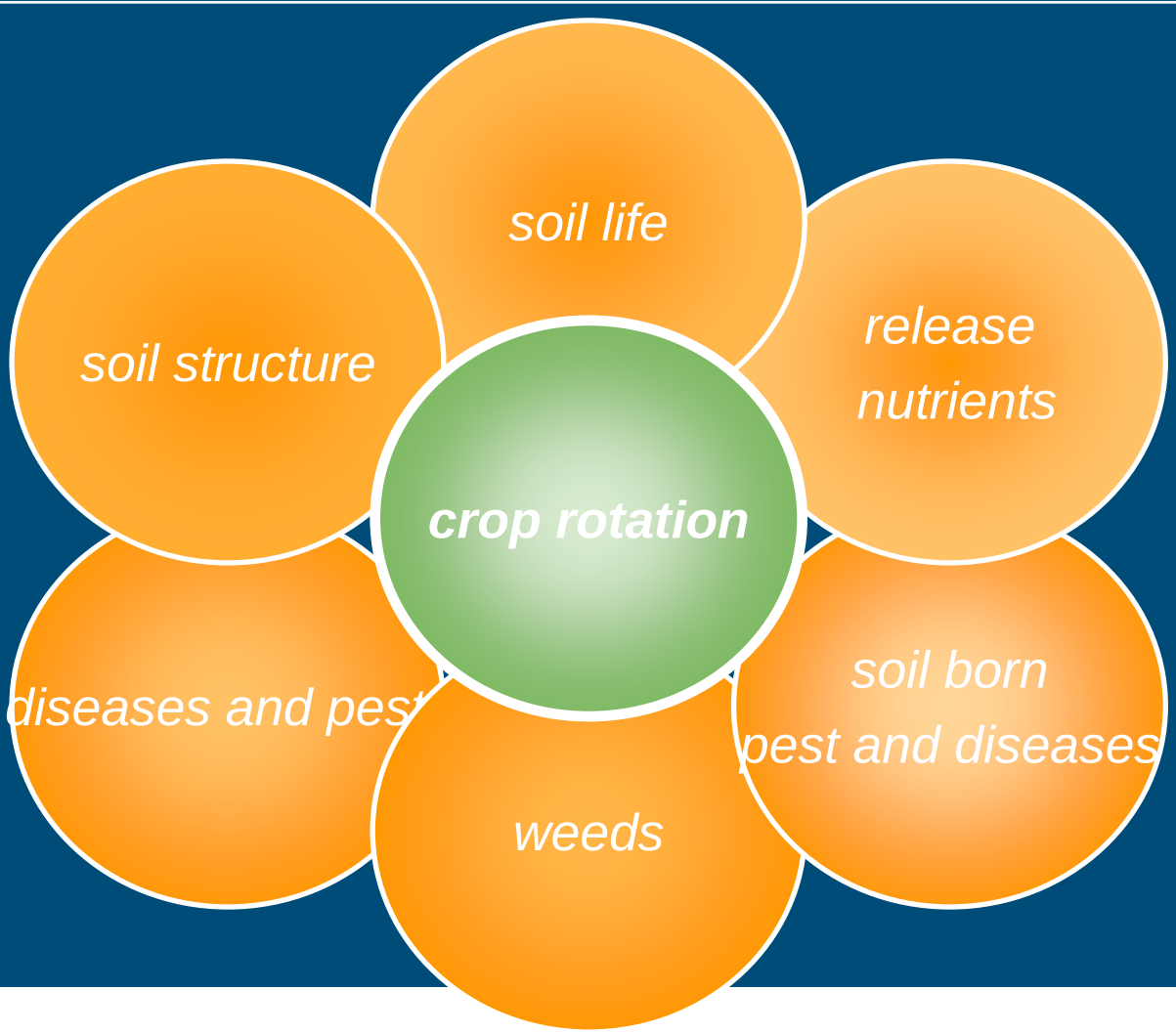
Questions?



Comparison yield organic-conventional



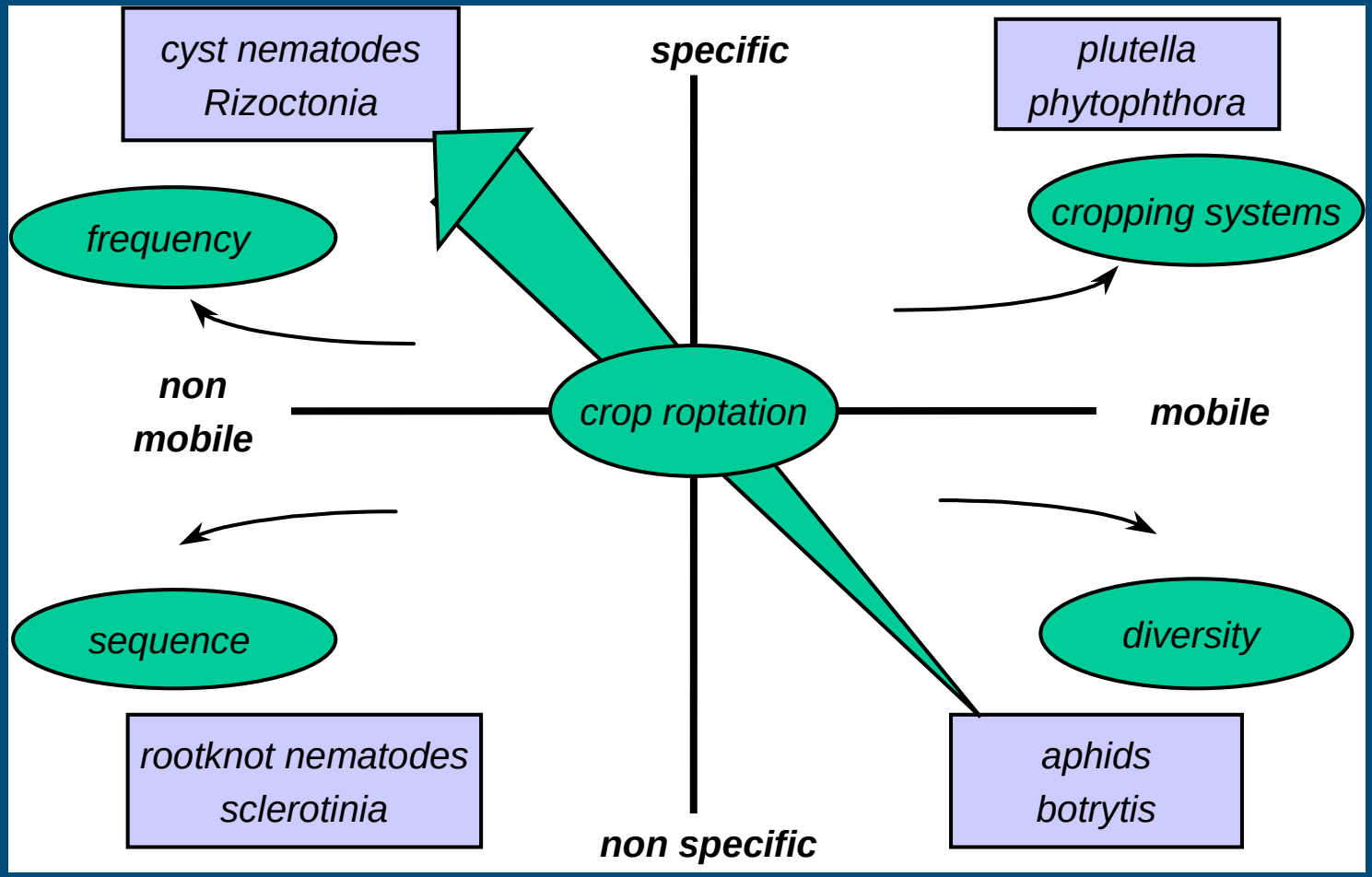
Influence crop rotation



Multifunctional Crop Rotation (MCR)

- basis for
  - soil fertility
  - healthy and vital crops
- optimise positive and minimise negative interaction
  - pest and diseases,
  - nutrient recovery etc.
- well balanced team of players
  - Sequence, frequence, spacial

Crop Rotation, prevention of pests and diseases



Strategy crop protection

- Prevention
  - crop rotation, farm hygiene, farm lay-out
- Need of control
  - asses if control is necessary
- Control
  - non-chemical control (mechanical, biological)
  - Chemical (bio-toxins),
    - bio pesticide selection
    - application technique, timing

Nutriënt management

Principles:

- maintenance of soil reserves in agronomic desired and ecologically acceptable range
- input = oftake (+ unavoidable losses)
- minimising losses
- optimising quality production

Tools nutriënt management

- crop rotation,
- soil cultivation
- organic fertilisers
- green manure, catch crops
- nitrogen fixation