



LIVESEED

SYSTEMS-BASED BREEDING APPROACH: HOW TO IMPLEMENT IT?

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Workshop program

15.30-16.00 Introduction

16.00-16.10 Questions

16.10-16.30 Personal exercise

16.30-16.50 Groupwork (in groups of two)

16.50-17.00 Discussion



Which steps are needed for implementing the systems-based breeding approach?

➤ Describe:

- current trends in breeding
- solution pathways: systems-based breeding
- all relevant aspects of breeding and seed systems

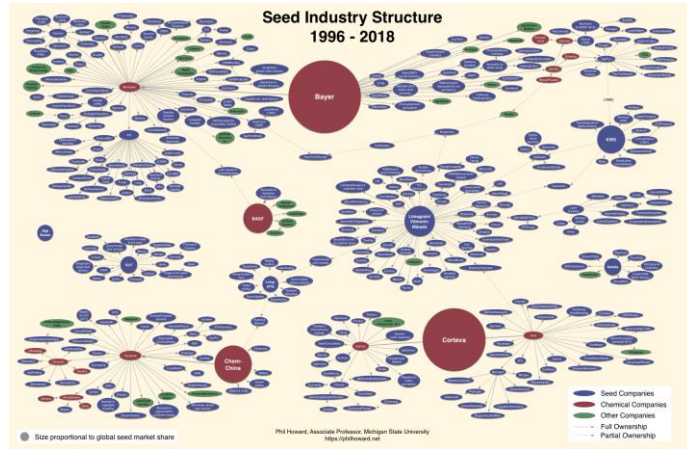
➤ Provide:

- methods for self-reflection
- methodology for group-reflection
- guidelines for other steps at value chain level



Current trends in agriculture and plant breeding

- Continuous focus on linear value chains
- More focus on molecular traits
- Loss of agro-biodiversity



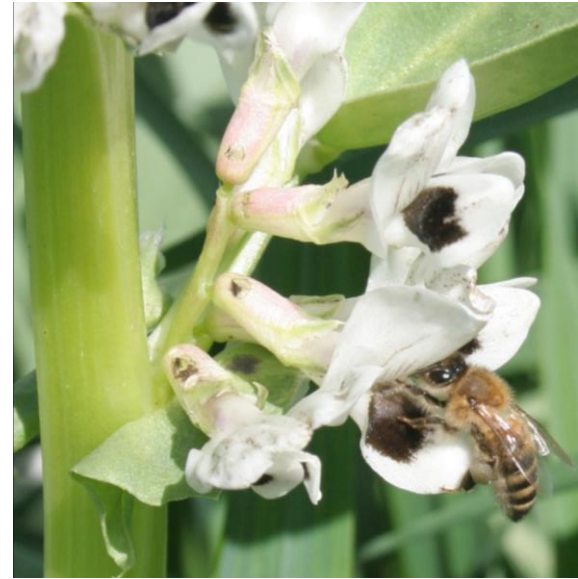
Summary of distribution of variety registration at CPVO in the period 2012-2016, according to crop, company and country (Annual report 2016)

	arable crops	vegetable crops	fruit crops
Top 5 crops	69,4	67,2	60,9
Top 10 crops	85,3	79,5	81,4
Top 5 companies	47,0	69,3	22,2
Top 15 companies	63,5	95,3	43,6
Top 5 countries	63,5	94,2	39,9

How to breed for long term ecosystem-services?

Biodiversity and ecosystems services are key factors that contribute to:

- natural pest control
- **pollination**
- nutrient (re)cycling
- soil conservation
(structure and fertility)
- water provision
(quality and quantity)
- carbon sequestration



*Enhancing legume ecosystems services through plant-pollinator interplay.
Suso et al. 2016*

How to breed for long term ecosystem-services?

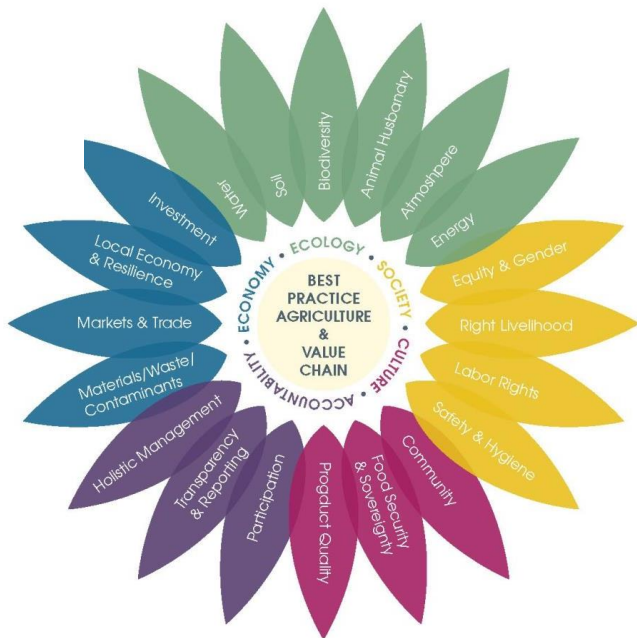
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- natural pest control
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(structure and fertility)
- water provision
(quality and quantity)
- carbon sequestration



Genetic variation in root biomass in grass (Lolium multiflorum). Deru et al. 2014

Organic 3.0 (IFOAM 2015): Broadening the organic scope for 2030



Five dimensions:

- Ecology
- Society
- Culture
- Accountability
- Economy

SDGs of UN (2015) - targets for ecological and societal resilience

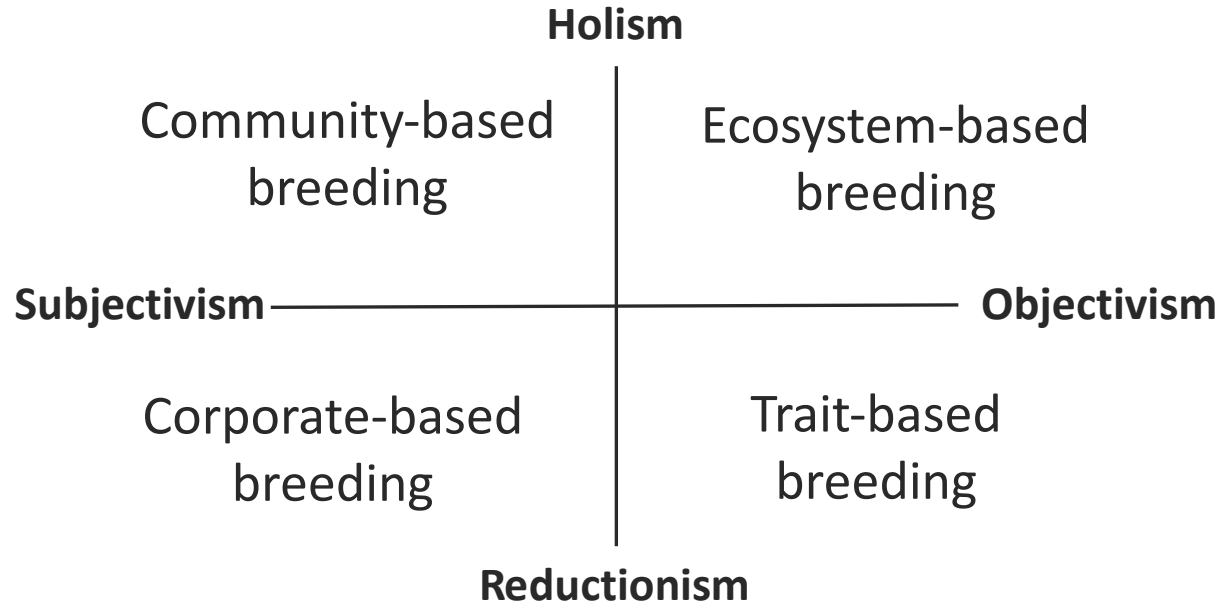


Six goals for future plant breeding for ecological AND societal resilience

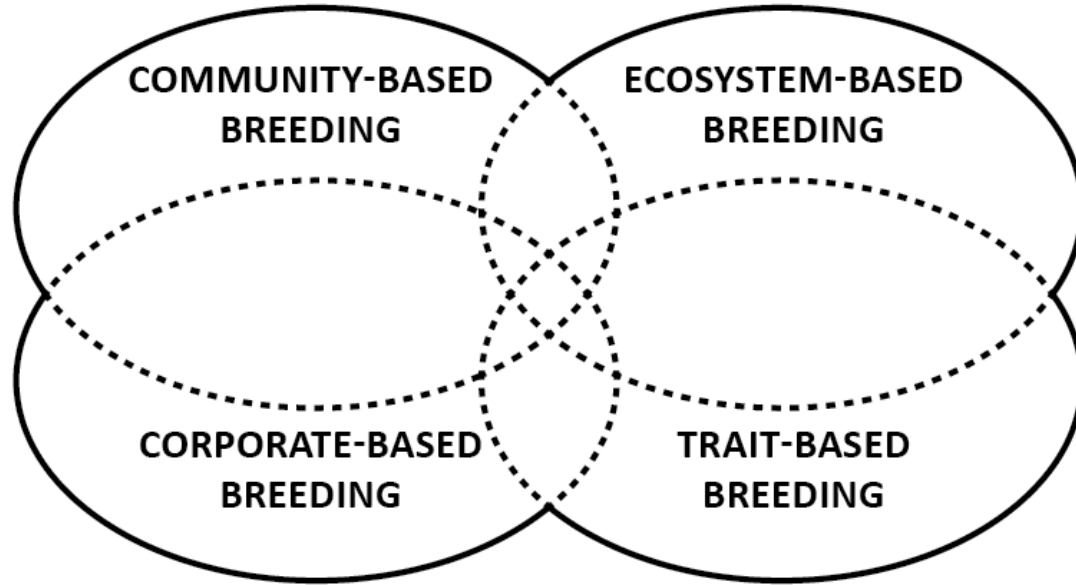
1. Social justice
2. Food security, food quality and safety
3. Food and seed sovereignty
4. Agro-biodiversity
5. Ecosystem services
6. Climate robustness



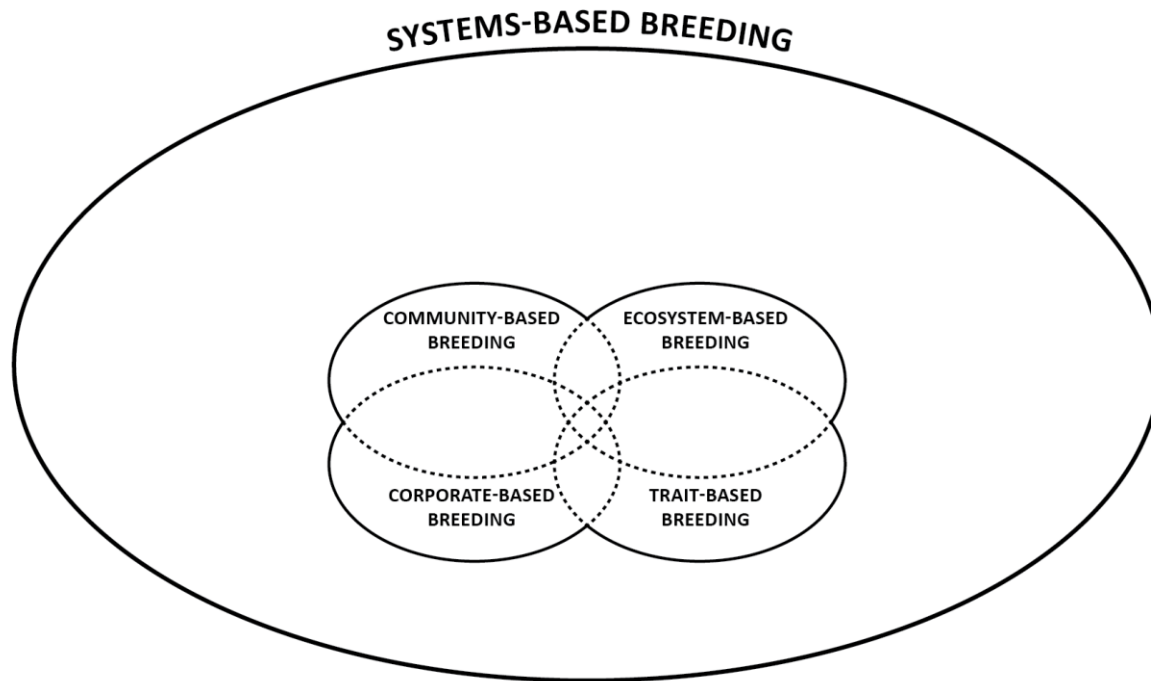
Current state of the art: Four breeding orientations (‘paradigm positions’, styles of thought)



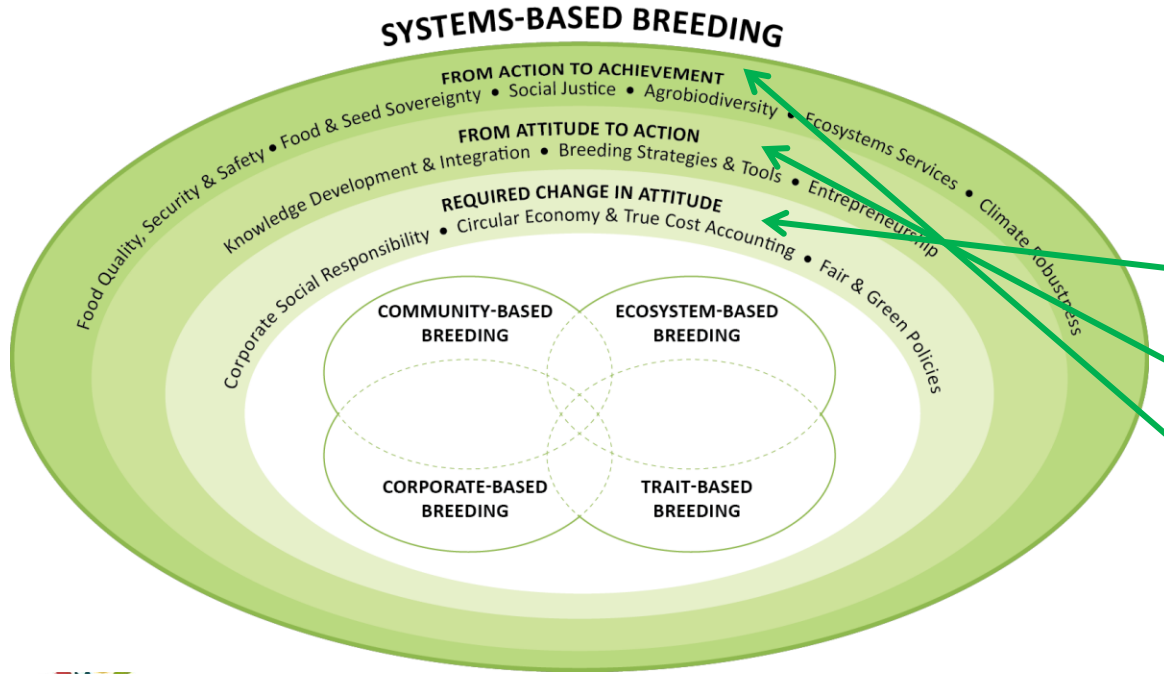
Need for balance, optimal interaction and synergy



Hence, a need for systems-based breeding approaches



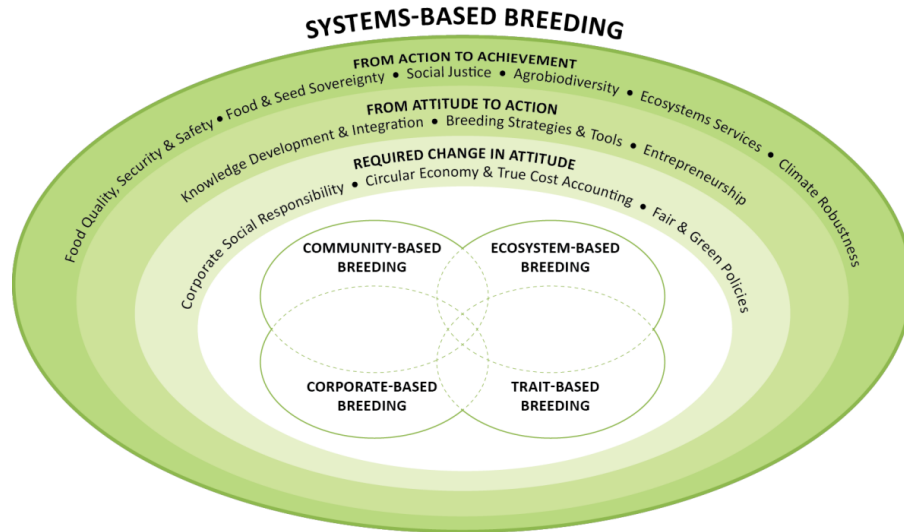
Steps needed towards systems-based breeding:



Three categories of steps:

1. Required change in attitude
2. From attitude to action
3. From actions to achievements

Required change in attitude



Three key-elements:

1. Corporate Social Responsibility
2. Circular Economy & True Cost accounting
3. Fair & Green Policy

Example 1:

Required change in attitude



10% of turn-over of Frank's free varieties to Seed Company High Mowing



Organic farmer breeder Frank
Morton Oregon-USA

Three key-elements

1. **Corporate Social Responsibility**
2. Circular Economy & True Cost accounting
3. Fair & Green Policy

Example 2:

Required change in attitude

- ❑ New resistant potato varieties were not adopted by the market and continuous (in NL illegal) copper use and harvest failures
- ❑ In 2017, in NL full commitment of all supermarkets achieved to sell only resistant cultivars for organic potato by 2020



Three key-elements:

1. Corporate Social Responsibility
2. **Circular Economy** & True Cost accounting
3. Fair & Green Policy

Example 3: Required change in attitude

Composite cross populations versus pure line varieties



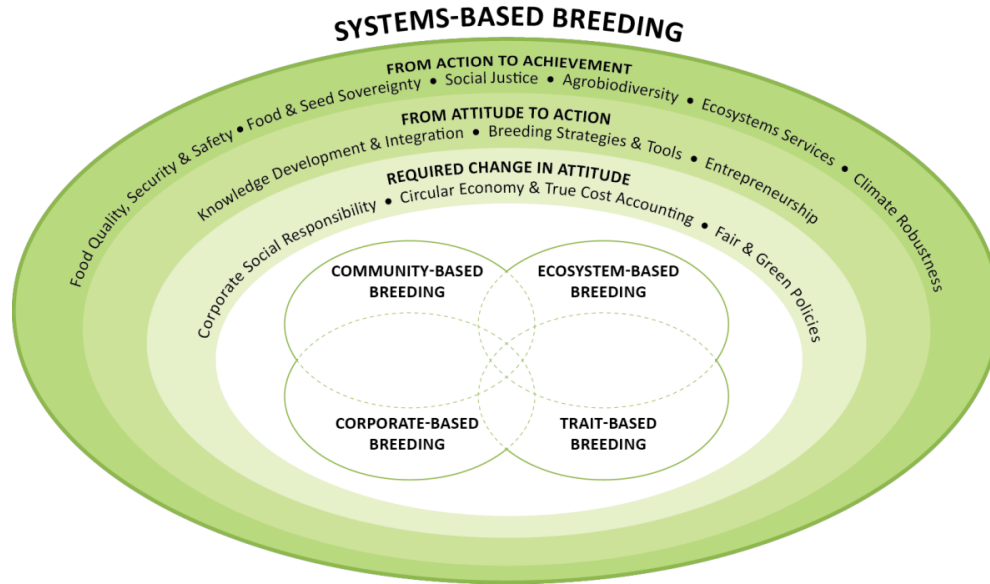
(1) EU experiment (2014-2021) to allow heterogeneous material to be described and marketed

(2) Allowing changes in official Variety Testing protocols (VCU)

Three key-elements

1. Corporate Social Responsibility
2. Circular Economy & True Cost accounting
3. **Fair & Green Policy**

From attitude to action



Three key-elements:

1. Knowledge development & Integration of knowledge
2. Breeding strategies & tools
3. Entrepreneurship

Example 2

From attitude to action

Breeding for diversity e.g. 'heterogeneous material' and crop mixtures



Composite cross populations:

- ▶ Multiple crosses



Crop mixtures (e.g. lupine/wheat):

- ▶ breeding for combinability

Three key-elements:

1. Knowledge development & Integration of knowledge
2. **Breeding strategies** & tools
3. Entrepreneurship

Example 3: From attitude to action



100% employee owned

Three key-elements:

1. Knowledge development & knowledge integration
2. Breeding strategies & tools
3. **New entrepreneurial models**



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Example 3: From attitude to action

De Beersche Hoeve 



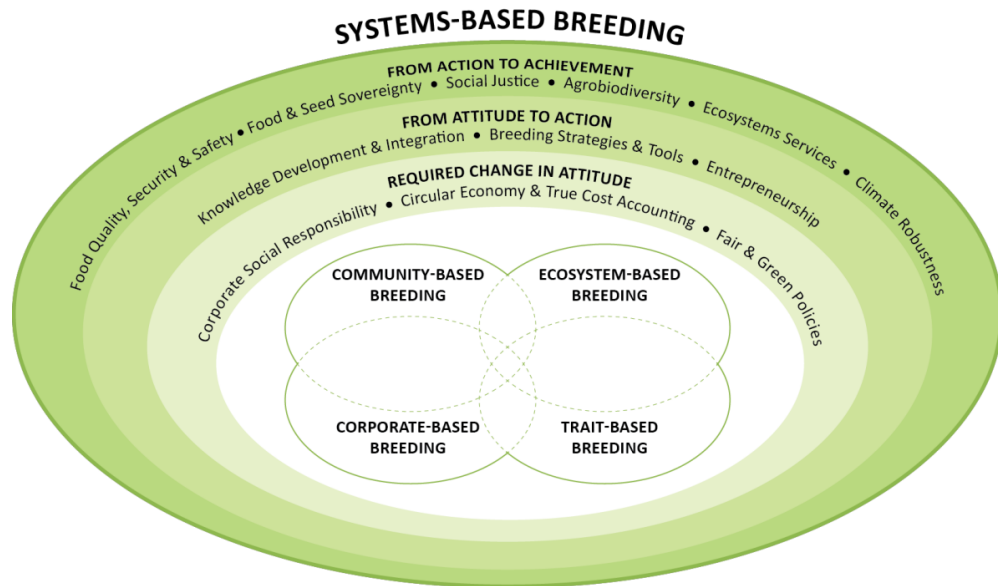
Biodynamic Seed & Vegetable Farm
100% daughter of
Food Cooperative Odin

**Odin**

Three key-elements:

1. Knowledge Development & knowledge integration
2. Breeding strategies & Tools
3. **New entrepreneurial models**

From action to achievement: six goals for ecological and social resilience

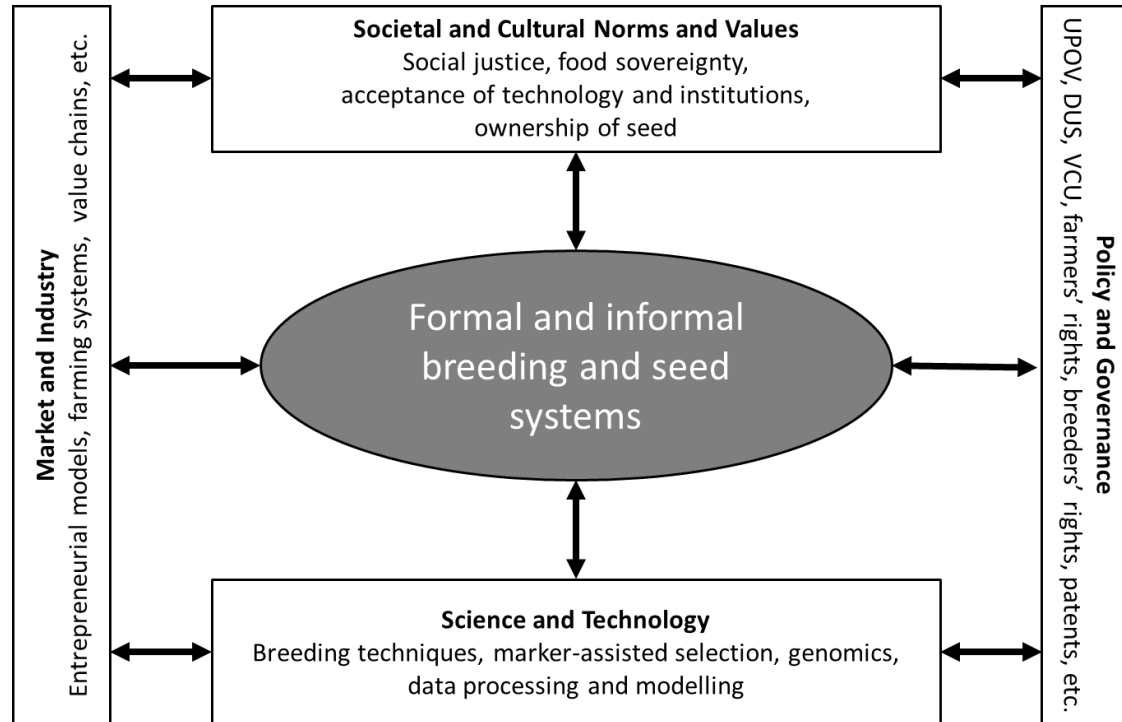


Six key-elements (goals):

1. Social justice
2. Food security, quality and safety
3. Food and seed sovereignty
4. Agro-biodiversity
5. Ecosystem services
6. Climate robustness

(Lammerts van Bueren et al. 2018. **Towards resilience through systems-based plant breeding. A review.** Agronomy for Sustainable Development.)

Roles and positioning of breeding and seed systems within their economic, scientific, institutional and cultural environment (Figure 3, Lammerts van Bueren et al. 2018)



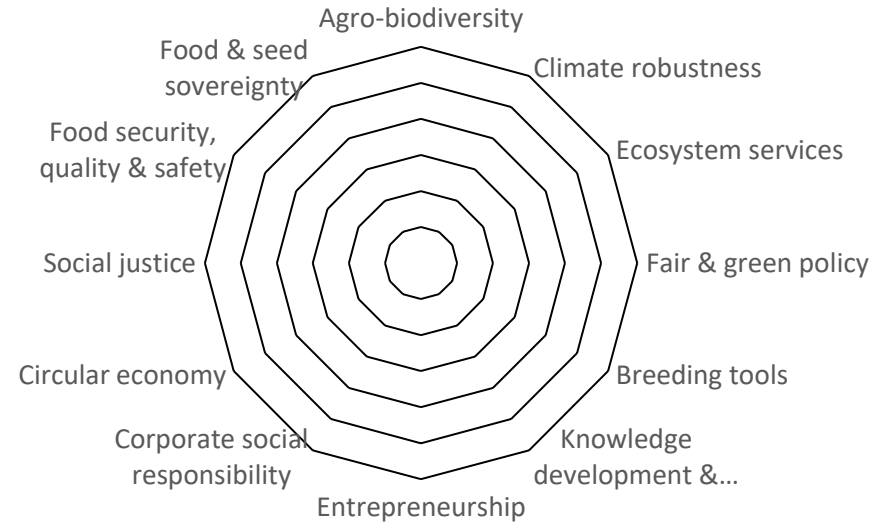
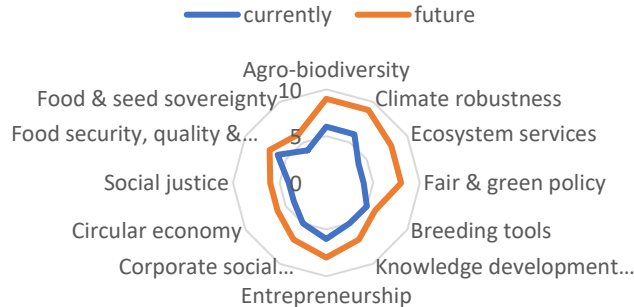
Witzenhausen workshop 2018: workshop outcomes organised according to the four categories as described in Figure 3 (Lammerts van Bueren et al. 2018)

Category		Solutions (in %)	Obstacles (in %)	Examples (in %)
	N =	85	68	39
Market and Industry	69	27%	37%	54%
Policy and Governance	43	18%	32%	15%
Science and Technology	51	33%	18%	28%
Societal and Cultural Norms and Values	29	22%	13%	3%

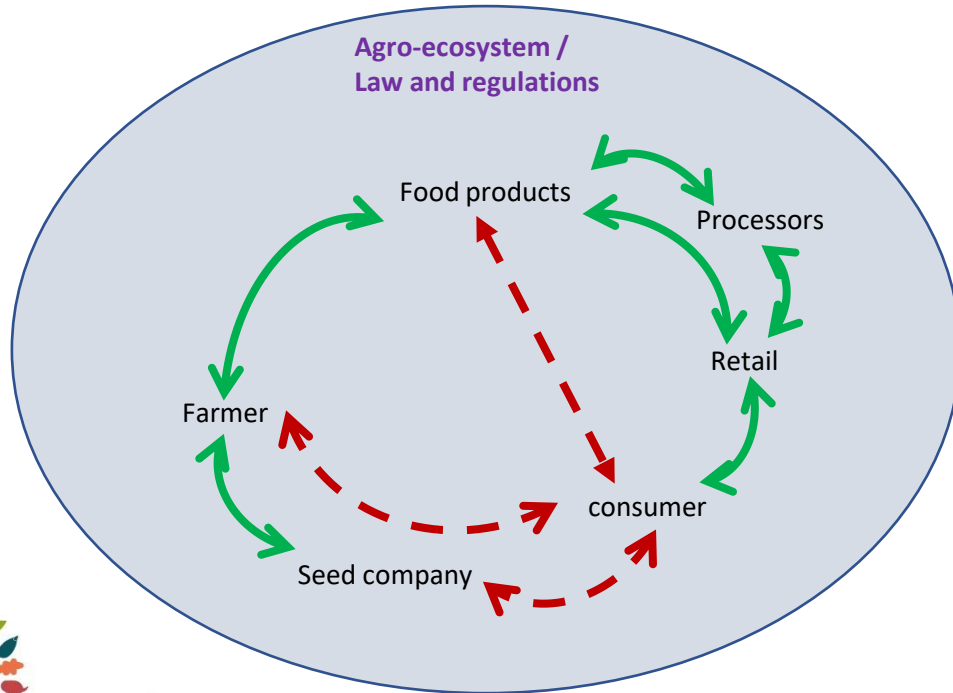
	Key elements
Required change in attitude	Corporate social responsibility
	Circular economy & True cost accounting
	Fair & green policy
From attitude to action	Knowledge development and integration
	Breeding strategies and tools
	Entrepreneurship
From action to achievement	Food security, safety & quality
	Food & seed sovereignty
	Social justice
	Agrobiodiversity
	Ecosystem services
	Climate robustness

Tool for self reflection: applying 12 key elements in an assessment

Spider chart per company/initiative



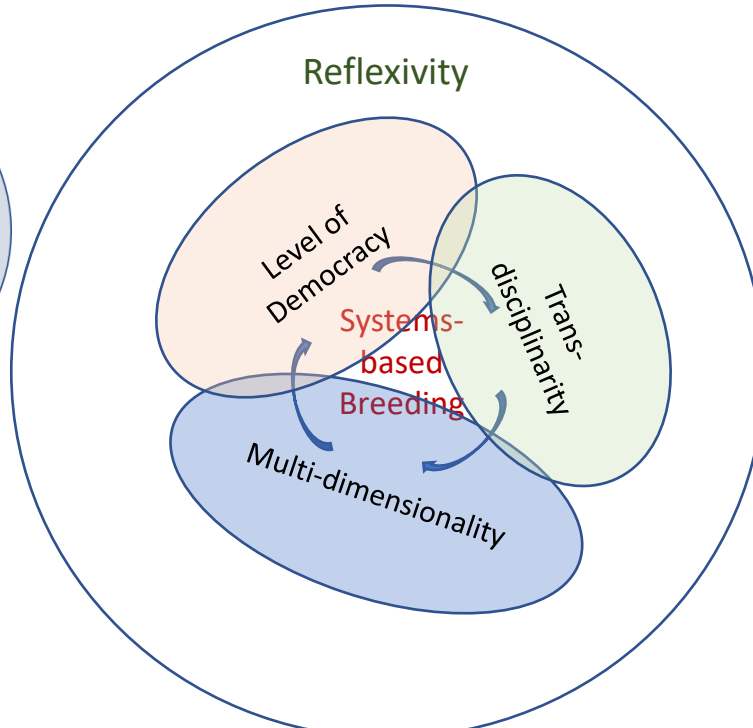
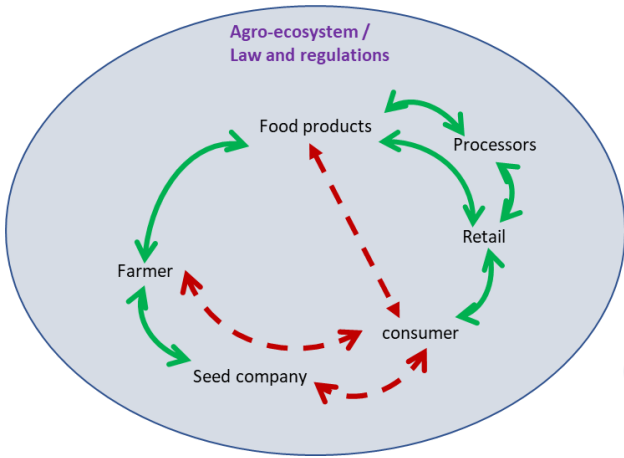
For circular economy we need rebuilding of linear value chains: towards circular organised food systems



.....including breeders as partners in new 'food communities'
.....including shared risk taking to overcome individualism.

Lessons learned from DIVERSIFOOD on multi-actor processes: reflection in a group process

especially with respect to technical and social aspects



Reflection in a group process

- Involve various actors of the value chain;
- Make the implicit explicit;
- What are our assumptions?
 - We are often unaware of them
 - The perspectives of each actor can be different;

Biofach workshop 2019: systems-based approach in organic plant breeding: integration into value chain partnerships

- Main questions remained to address collectively:
 - Why should different value chain actors support organic plant breeding?
 - The advantage of organic plant breeding for value chain (farmer, processors, traders)
 - The advantage of organic plant breeding for consumers and society (local and global)
- Tailor-made approaches are needed
 - Needs to include **new** approaches for: knowledge exchange, communication, marketing, education, etc



The importance of a systems-based approach

- Fostering diversity in breeding approaches and breeding initiatives helps:
 - maintain agrobiodiversity
 - make agriculture more climate robust
 - foster the development and maintenance of knowledge
 - develop new types of relationships
 - keep an open mind on what seeds are: part of our common heritage



- Thank you for your attention!
- Time for questions



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16.30-17.10 Groupwork (in groups of two)

- Guiding questions:
 - What is necessary in order to achieve the goals set in year 10 (departing in year 0, the current situation?)
 - Can you do that alone, and if not, which other chain actors need to act as well?
- Question for homework:
 - What will I do when I go home?
 - You can put it on a post-it





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