Workshop on system based breeding with Sativa and GZPK and hosted by FiBL

Edith Lammerts van Bueren [1,2] & Edwin Nuijten [1,3]

[1]Louis Bolk Institute , NL

[2]Wageningen University, NL

[3]Beersche Hoeve, NL

Frick, 16 April 2019

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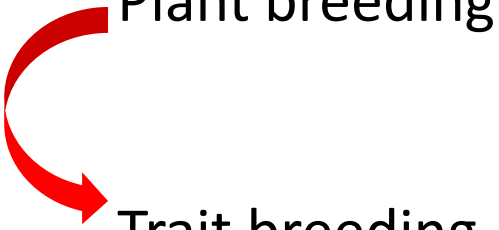
Trend 1:
increasing trait-based breeding

More and more plant breeding is becoming trait breeding



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Trend 1:
Trait breeding

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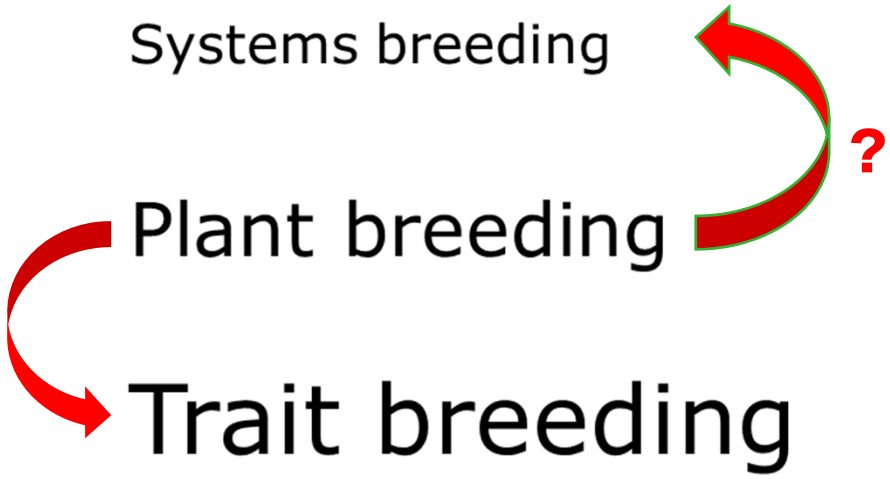

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Trend 1:
Trait breeding

More and more plant breeding is becoming trait [illegible]eding

Systems breeding

Plant br[illegible]g

Trait breeding

How to incorparte that into current breeding?

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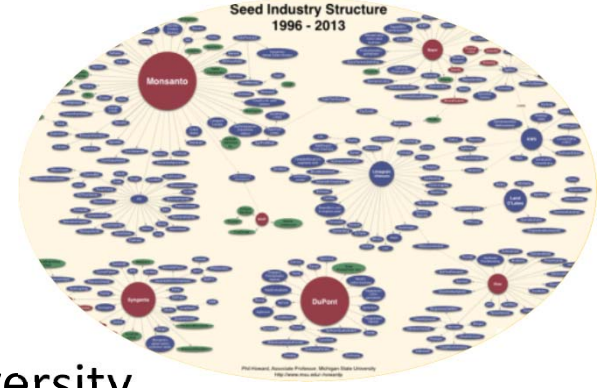
Trend 2:
Loss of small crops in breeding

- National diets are becoming more diverse, world wide diets are increasingly more similar
  (*Khoury et al. PNAS 2014).*
- Of the 30.000 edible species we grow only 150,
- 95% of our human food calories originate from 30 crop species
  (WHO & CBD, 2015)
- Mergers in the breeding sector
  - ►Loss of diversity in breeding programs
  - ►Small crops are orphans in breeding
  - ►Both commercial and public breeding programs are not focused on food diversity



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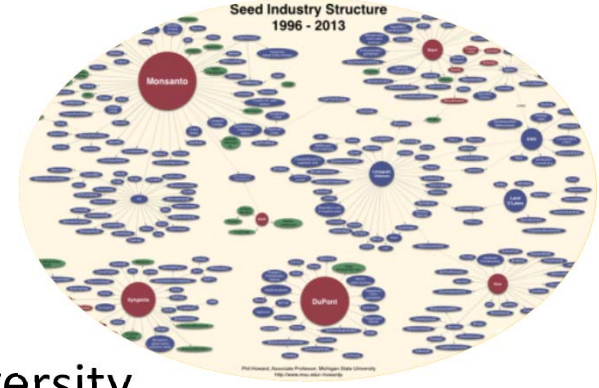
Who cares.....?



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Trend 3:
Breeding for (longterm) ecosystems 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

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- carbon … …n

…in turn contributing to food security and quality!

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Trend 3:
Breeding for (longterm) ecosystems services?

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- natural pest control
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Enhancing legume ecosystems services through plant-pollinator interplay.
Suso et al. 2016

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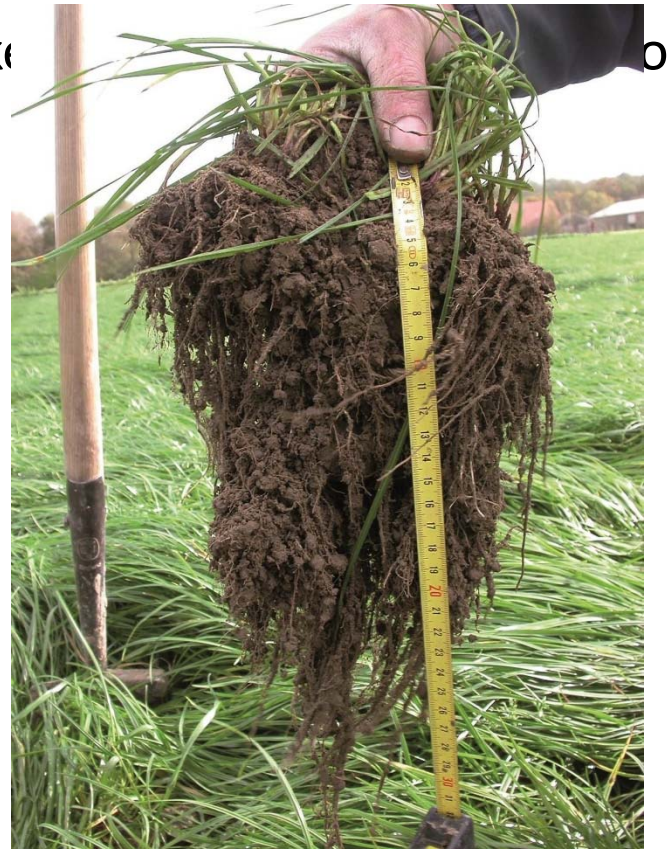

Genetic variation in root biomass in grass (Lolium multiflorum). Deru et al. Euphytica 2014

Trend 3:
Breeding for (longterm) ecosystems services?

Where is the breeding business?

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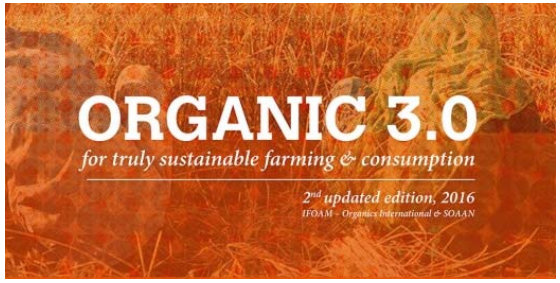
Trend 4:
Organic 3.0 (IFOAM 2015):
Broadening the organic scope for 2030



Five dimensions:

- Ecology
- Society
- Culture
- Accountability
- Economy

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Trend 4:
Organic 3.0 (IFOAM 201
Broadening the organic sc 2030

How to transform those criteria into breeding?

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Trend 5:
SDGs of UN (2015) - targets for ecological and societal resilience

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SDGs of UN (2015) - target
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How to transform those criteria into breeding?

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Six goals for plant breeding for ecological AND societal resilience

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

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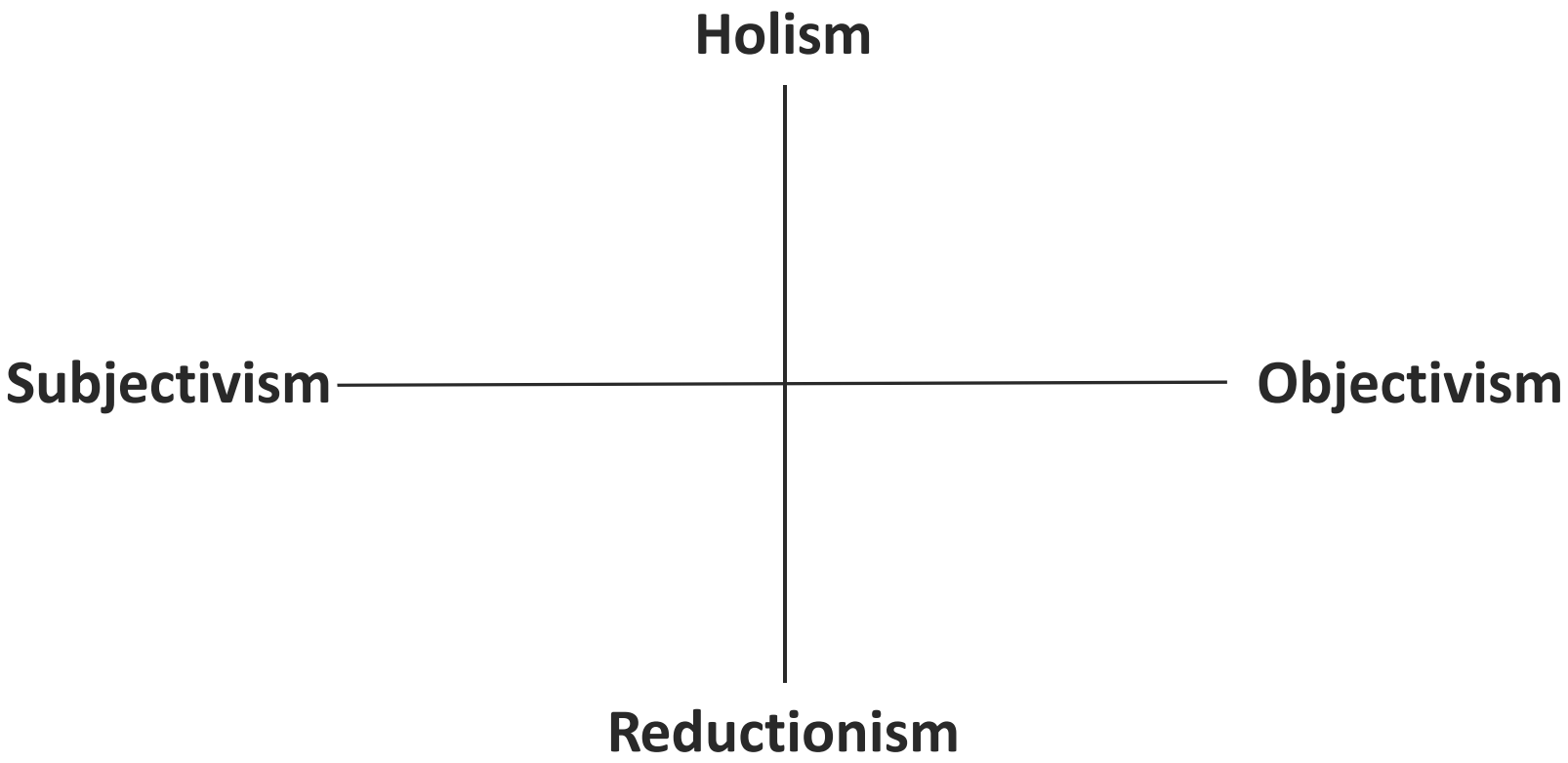
Framework of analysis
(adapted after Bawden, 2010)



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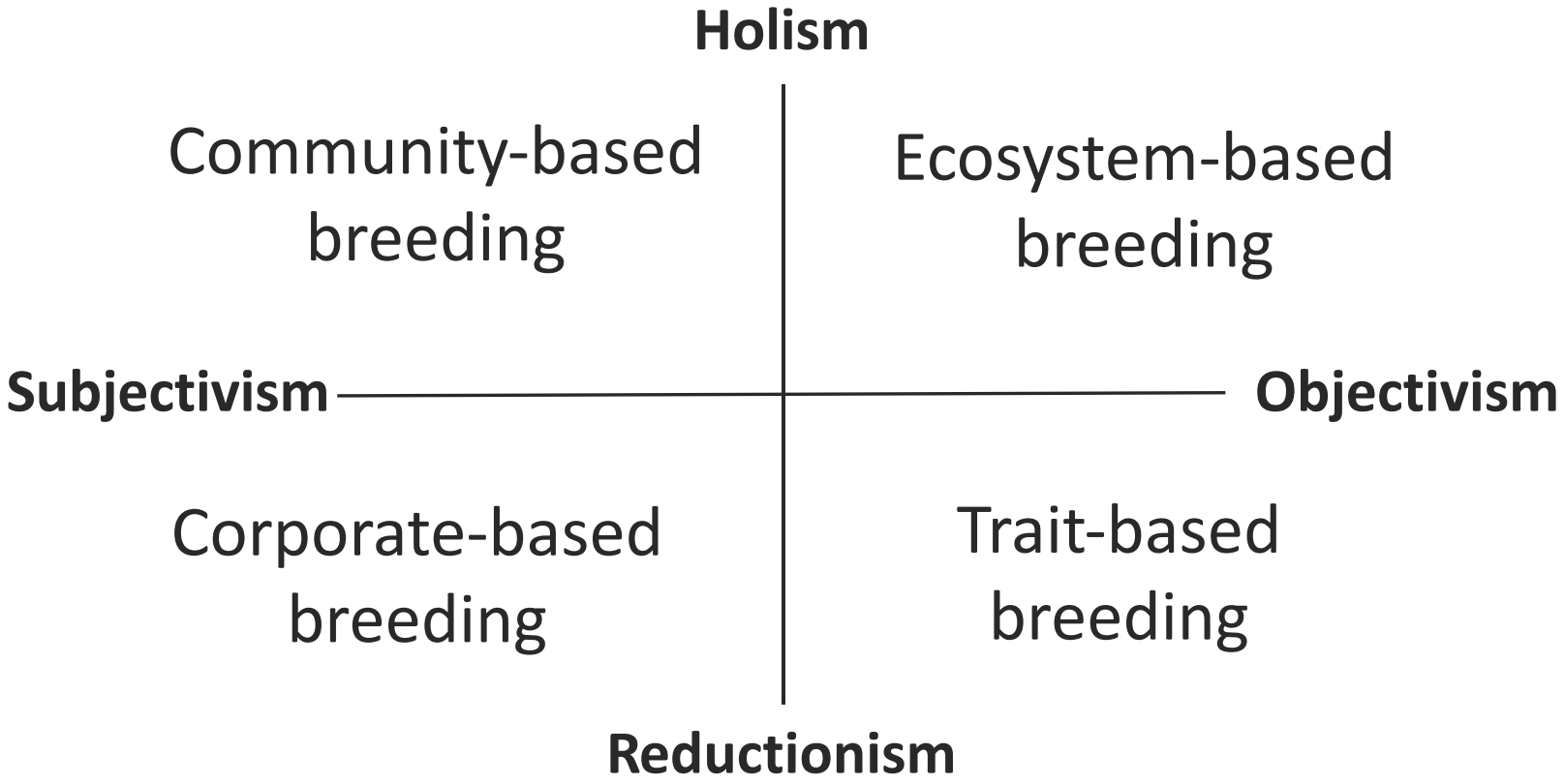
Current state of the art: Four breeding orientations ('paradigm positions' or 'styles of thinking')



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Four breeding orientations

Holism

Community-based breeding

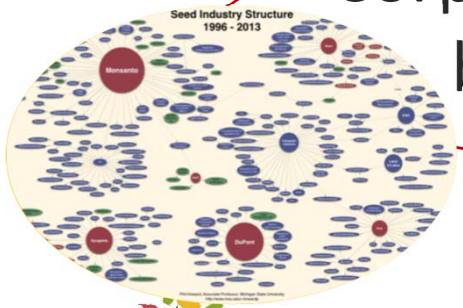
Ecosystem-based breeding

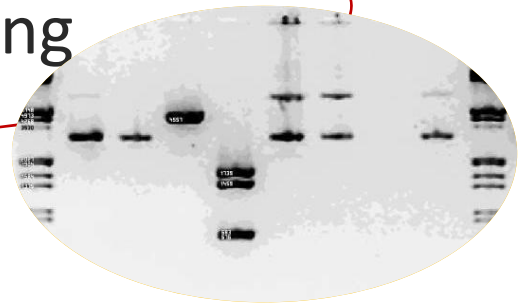
Subjectivism — **Objectivism**

Corporate-based breeding

Trait-based breeding

Reductionism





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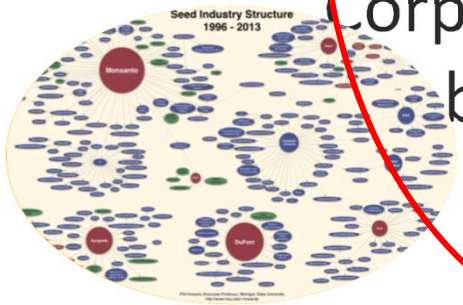

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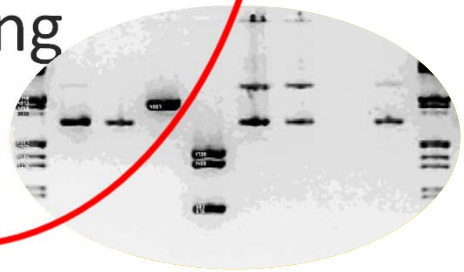

Reductionism

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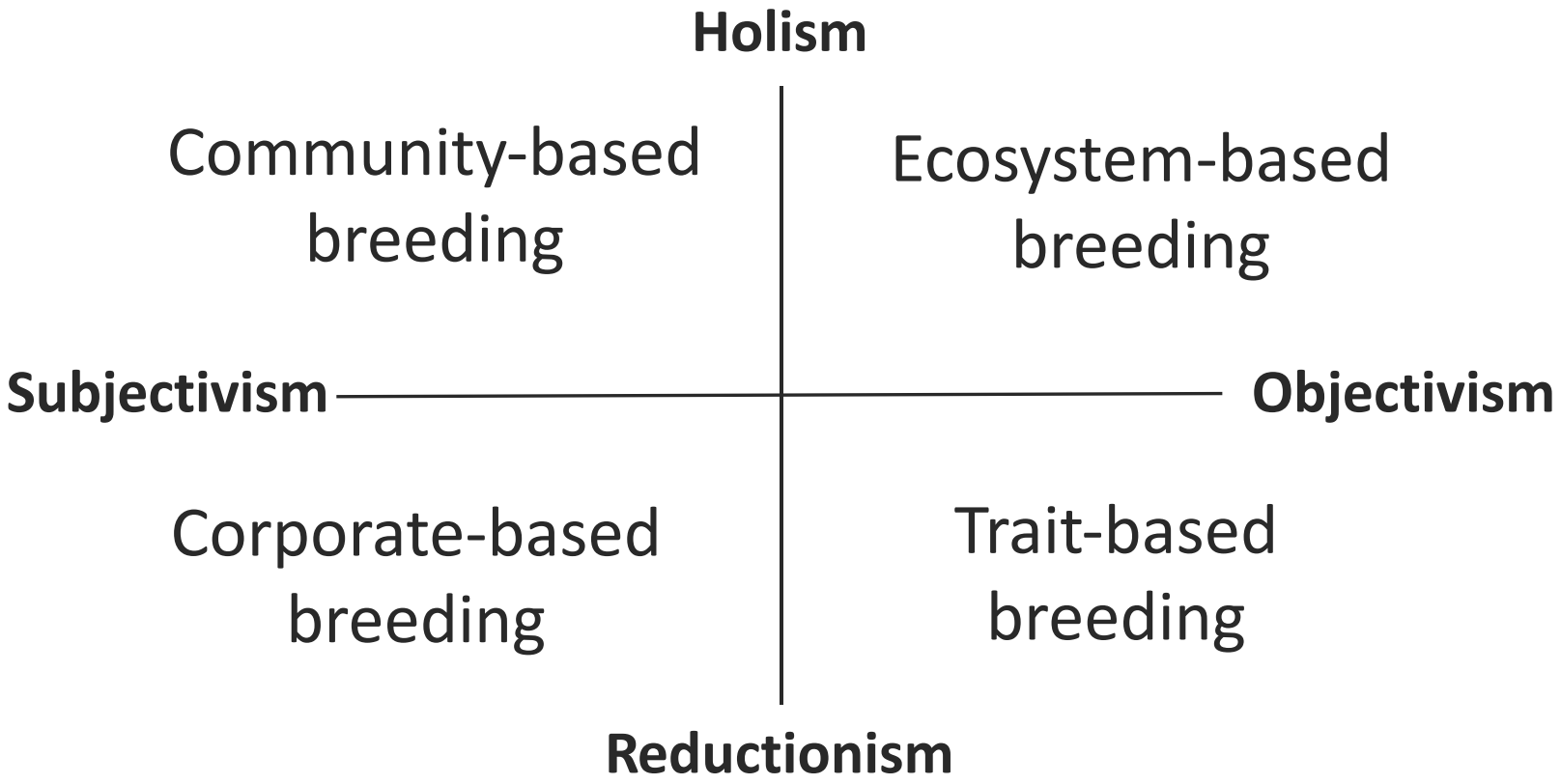
Each have strengths and weaknesses



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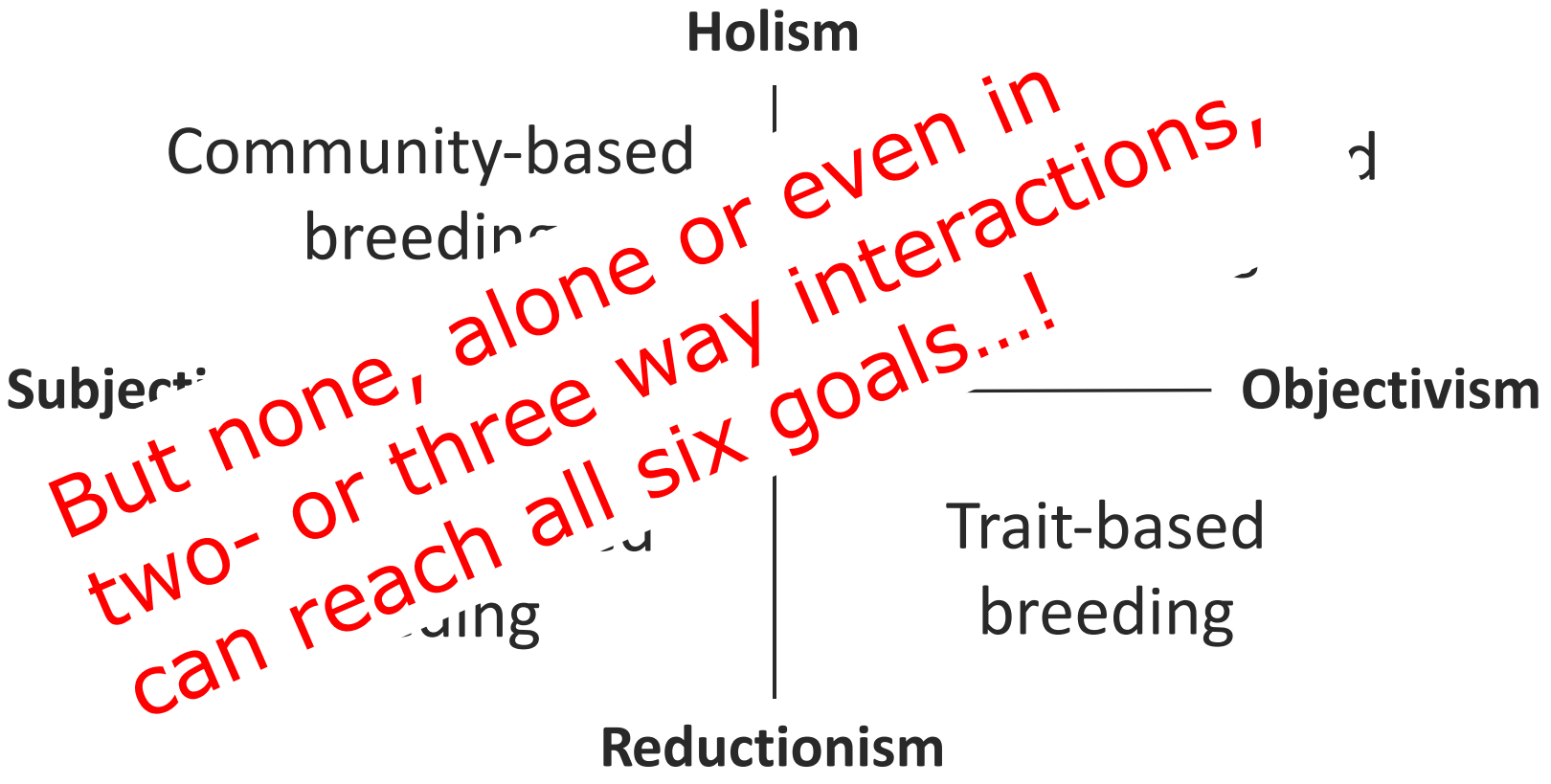

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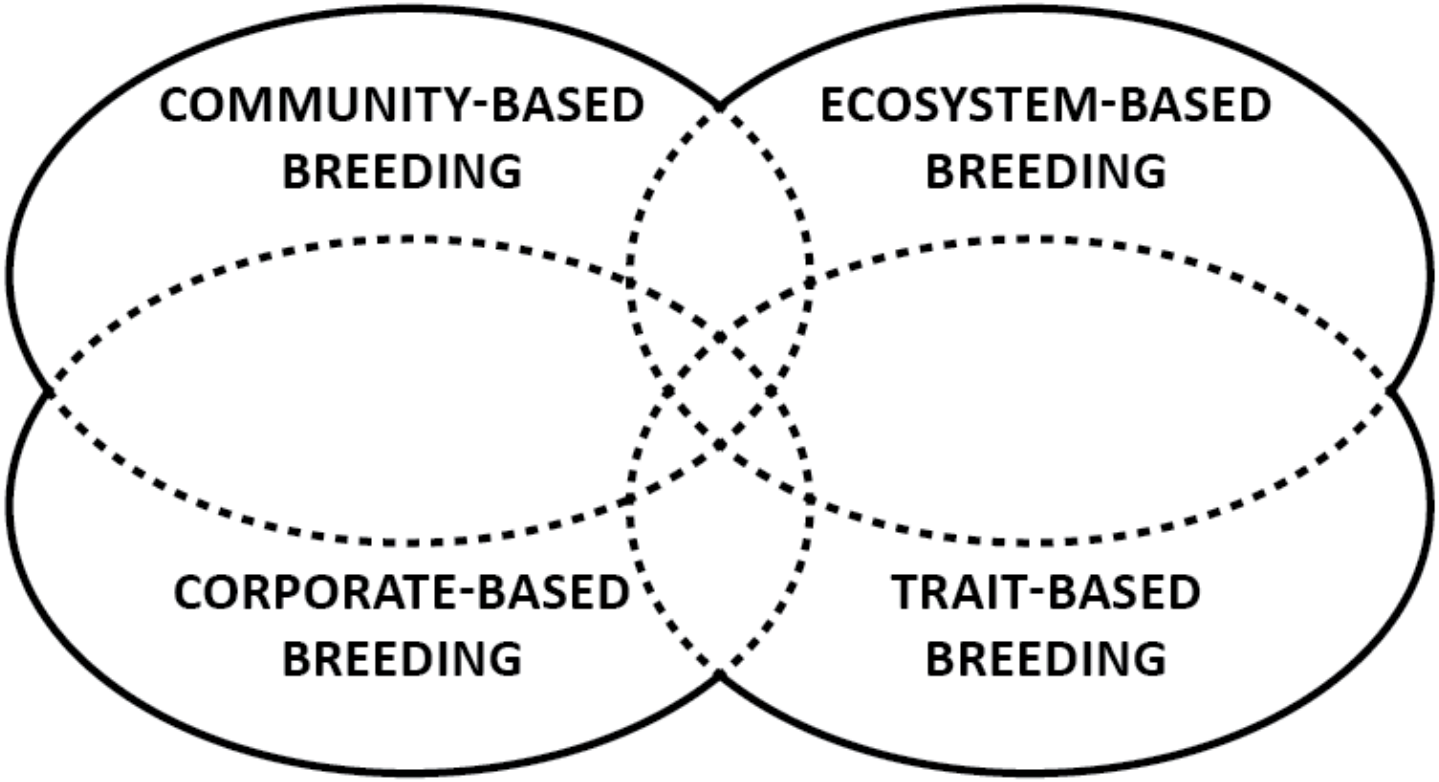
Need for optimal interaction and synergy



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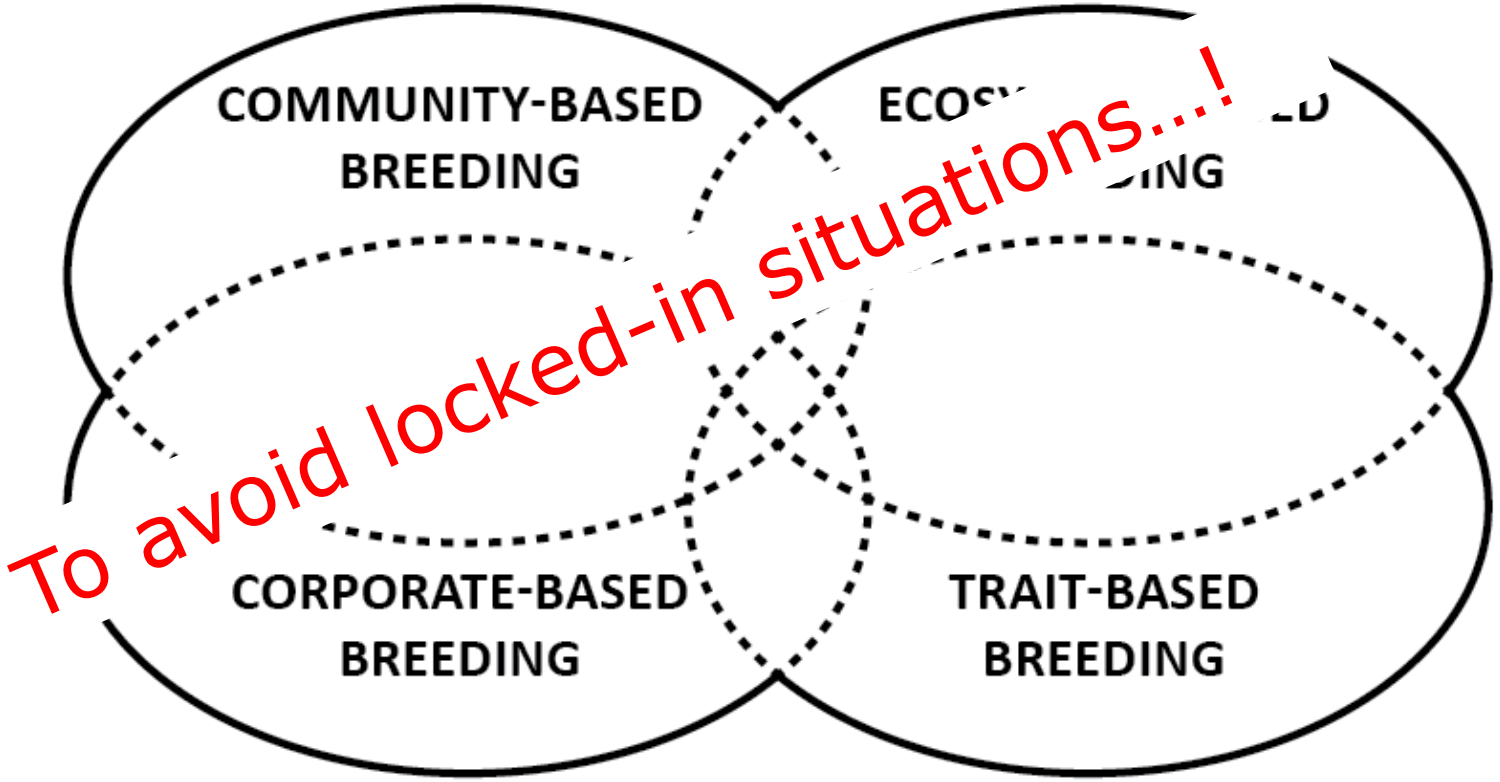

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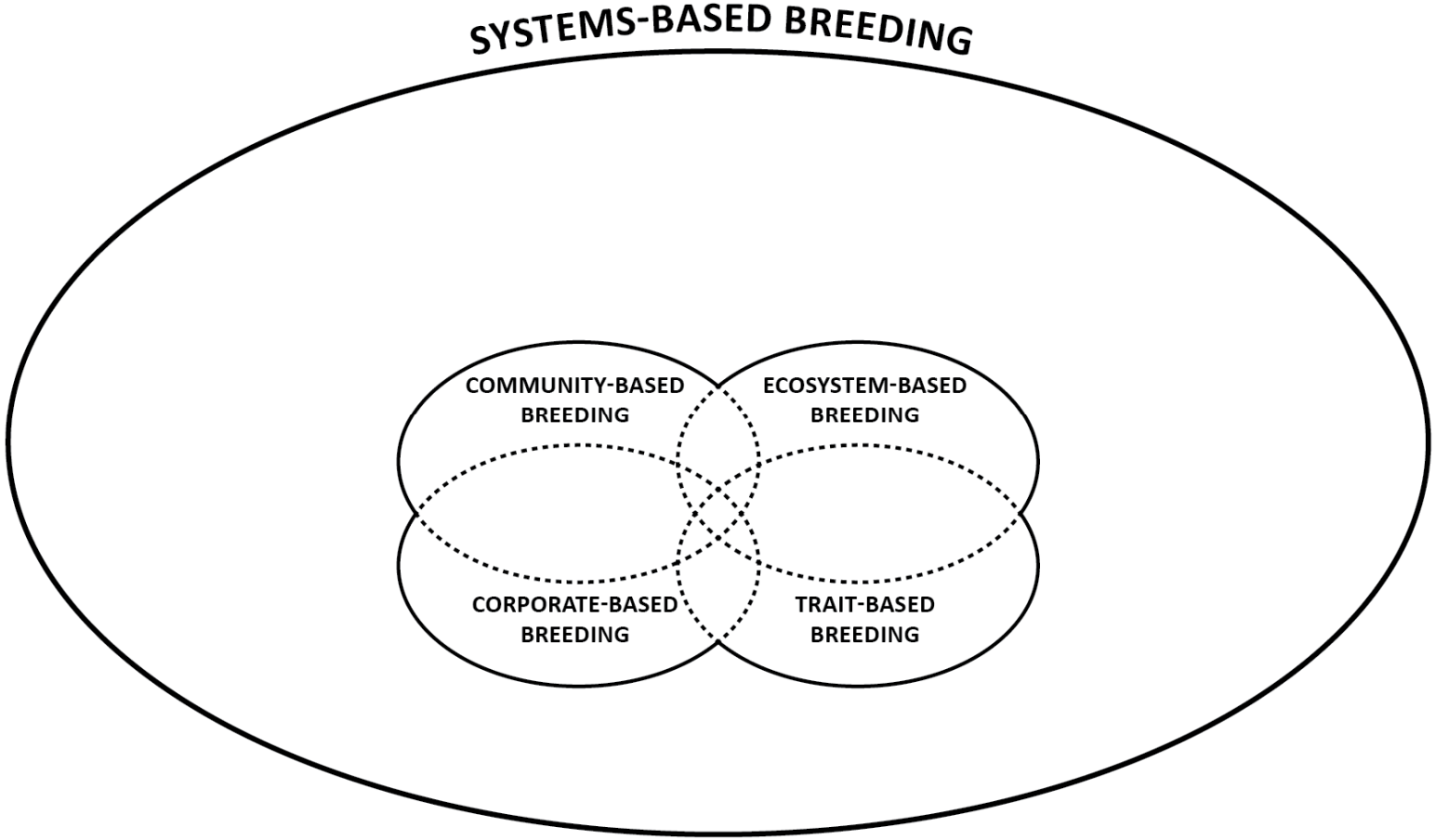
5th breeding orientation needed: systems-based breeding



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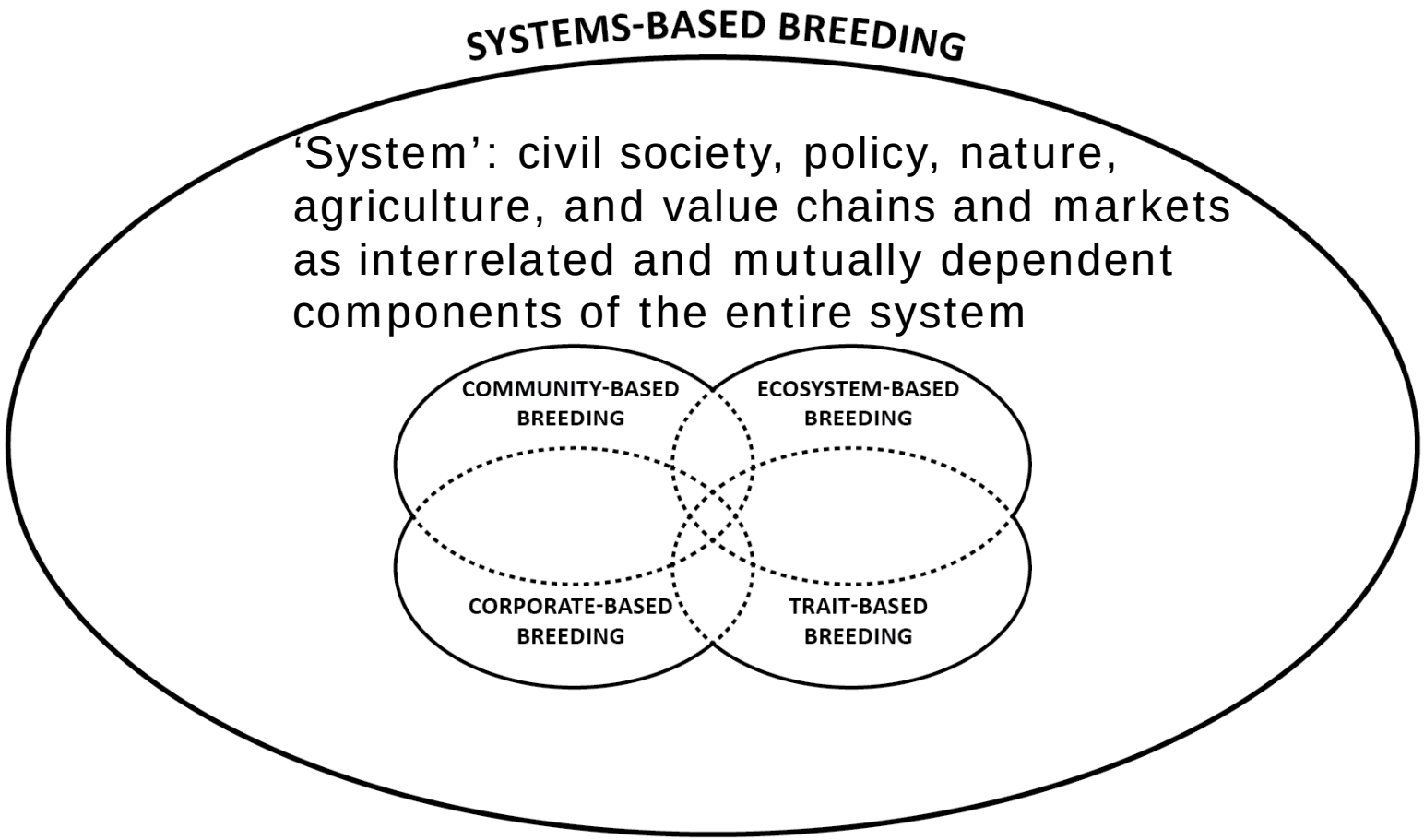
5th orientation: systems-based breeding



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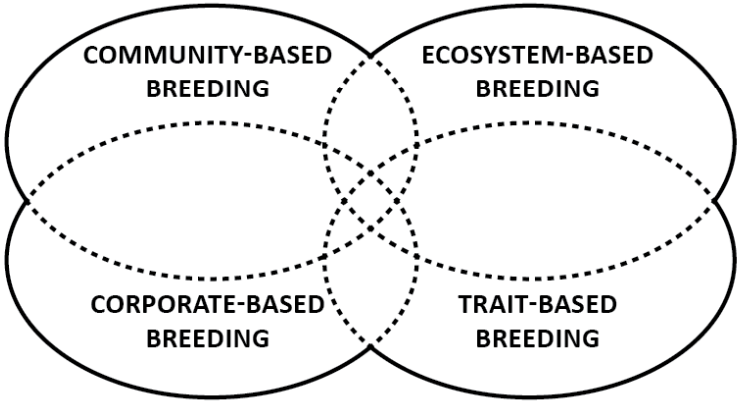
5th orientation: systems-based breeding

SYSTEMS-BASED BREEDING

This style of thought is systems-centric by its focus and by its methodology; requires system thinking of all actors; all parts are interrelated and affecting each other.



All partners should commit themselves to a collective learning process to achieve this shift!

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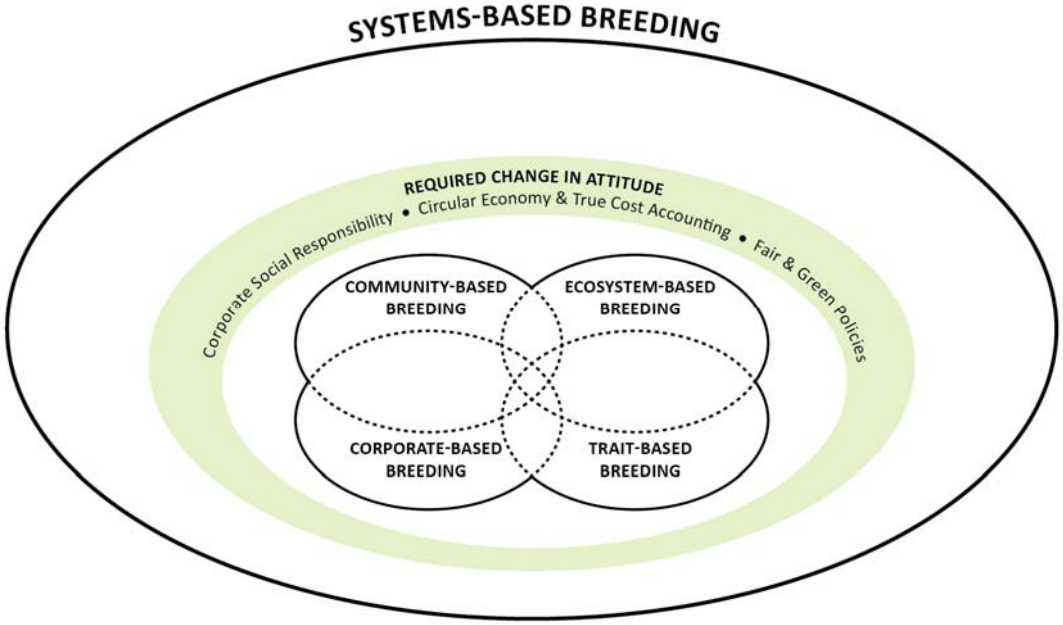
Required change in attitude



Three key-elements for a change in attitude:

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

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Example 1:
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

Three key-elements:

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

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

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Example 2:
Required change in attitude

In 2017, in NL full commitment of all supermarkets achieved to sell only resistant cultivars for organic potato by 2020

Three key-elements:

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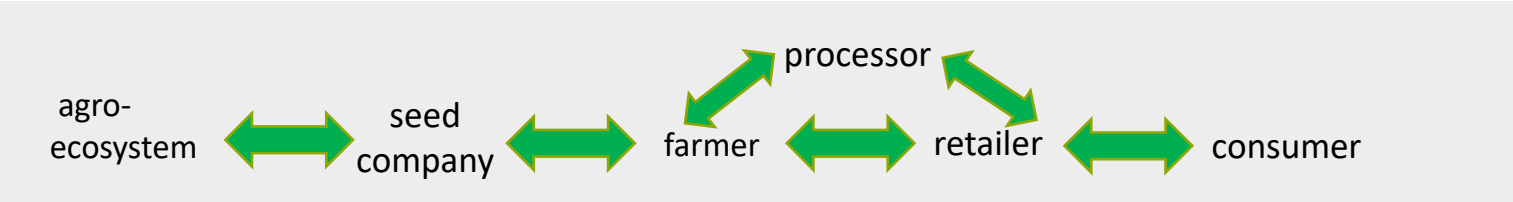
From linear to circular organised value chains or food communities

- More and more specialisation in the value chain.
- Even when each partner would do it's ultimate best to become sustainable,
- Still it is easy to throw aspects over the fence,
- And then we get 'organised irresponsibility'……



- Even organic value chains are still traditionally linear organised….!

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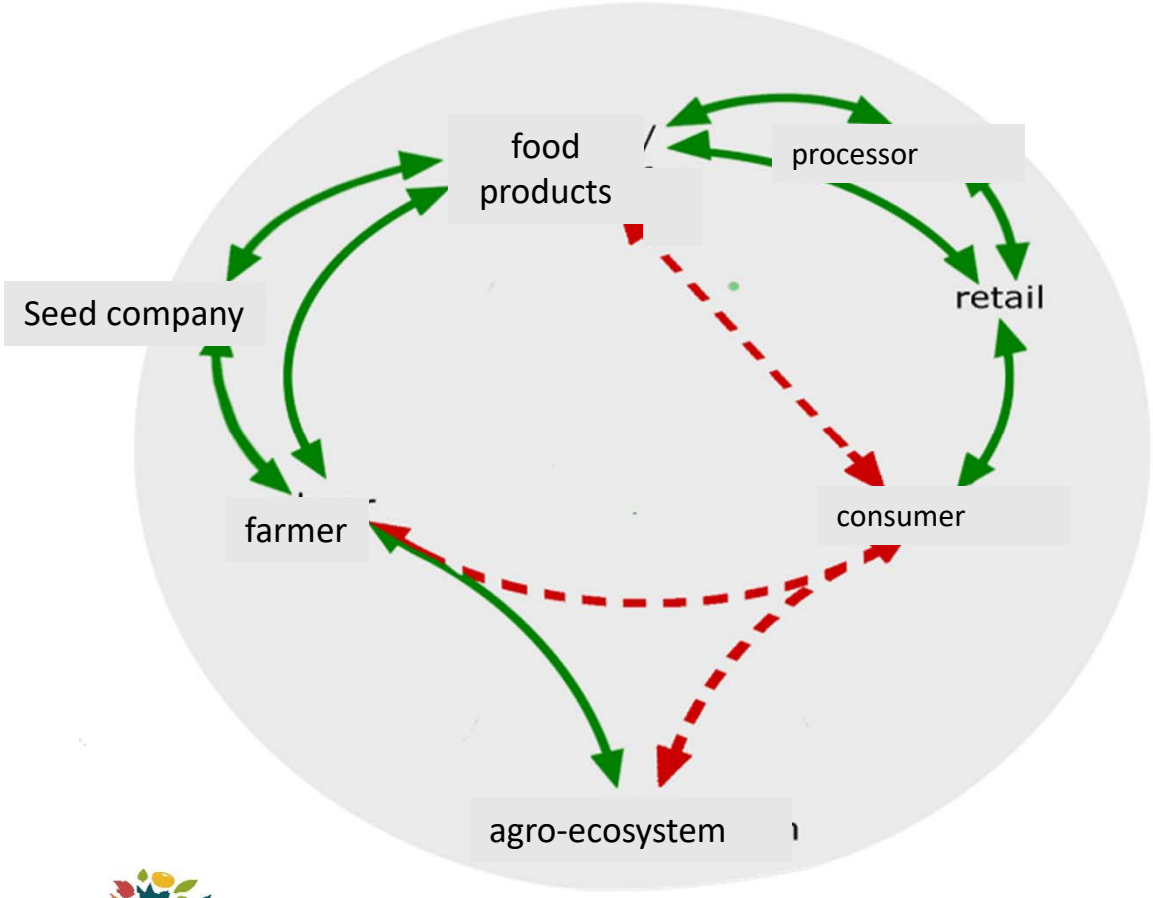
How can we build true relationships?



Towards circular organised value chains:

.....including breeders as partners in food communities.

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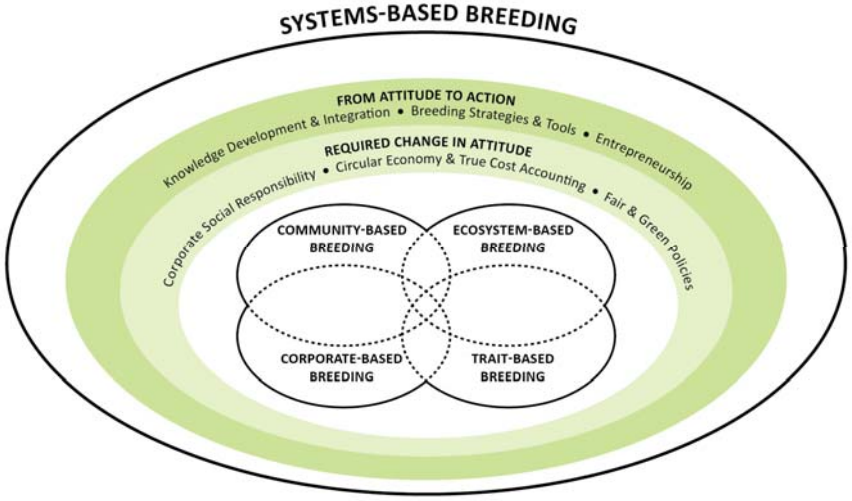
From attitude to action



Three key-elements form attitude to action:

1. Knowledge Development & Integration
2. Breeding strategies & Tools
3. Entrepreneurship

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Example 1:
From attitude to action

10% turn over of Frank's free varieties

Organic farmer breeder Frank Morton Oregon-USA

Three key-elements form attitude to action:

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Example 2:
From attitude to action

Johnny's Selected Seeds

100% employee owned

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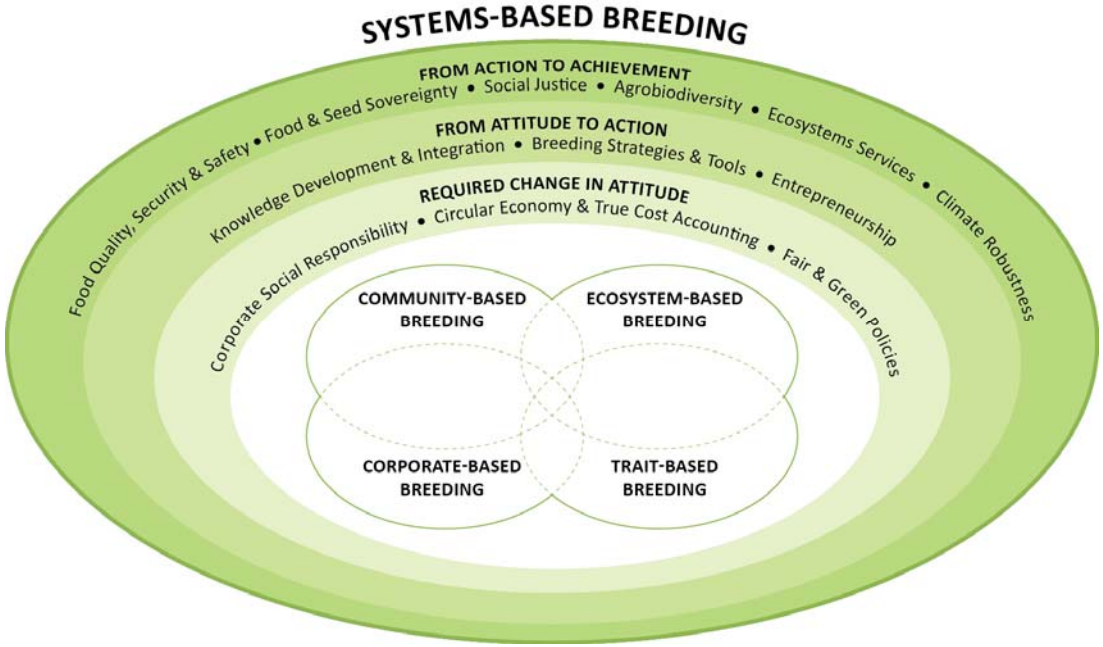
From action to achievement: 6 goals



Six key-elements (goals):

1. Social justice
2. Food security, quality and safety
3. Food and seed sovereignty
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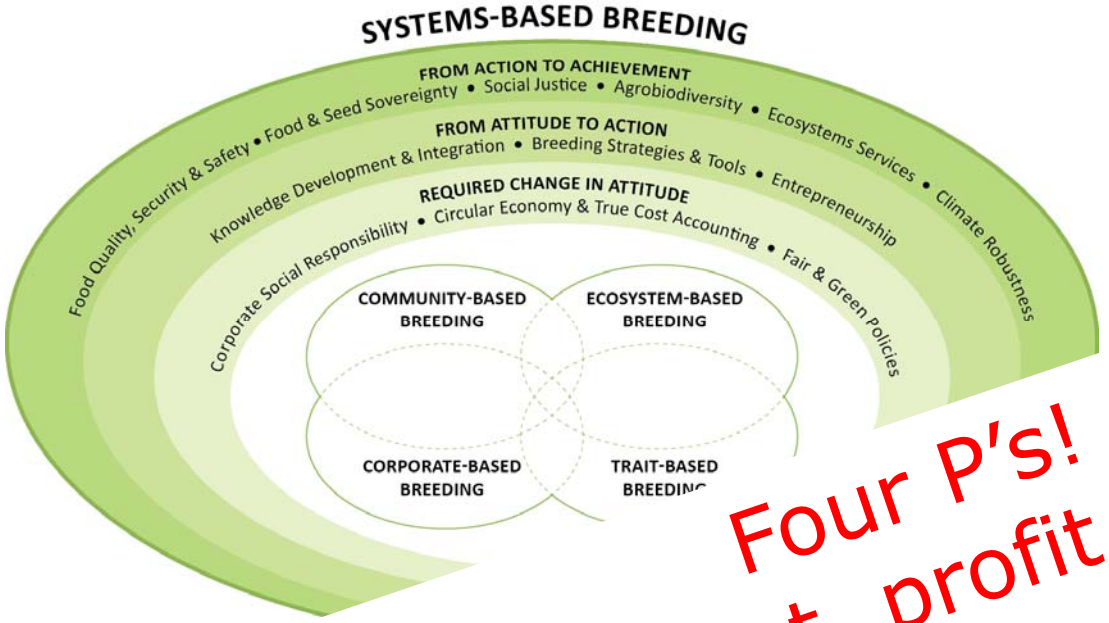

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Four P's!
People, planet, profit and purpose

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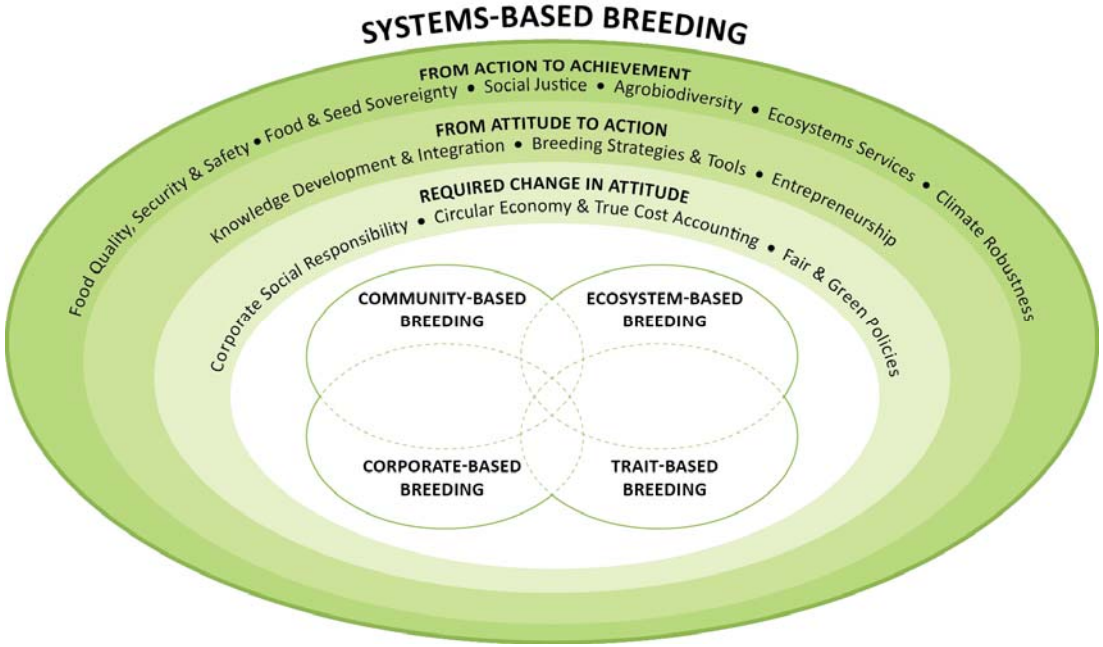
From action to achievement: 6 goals



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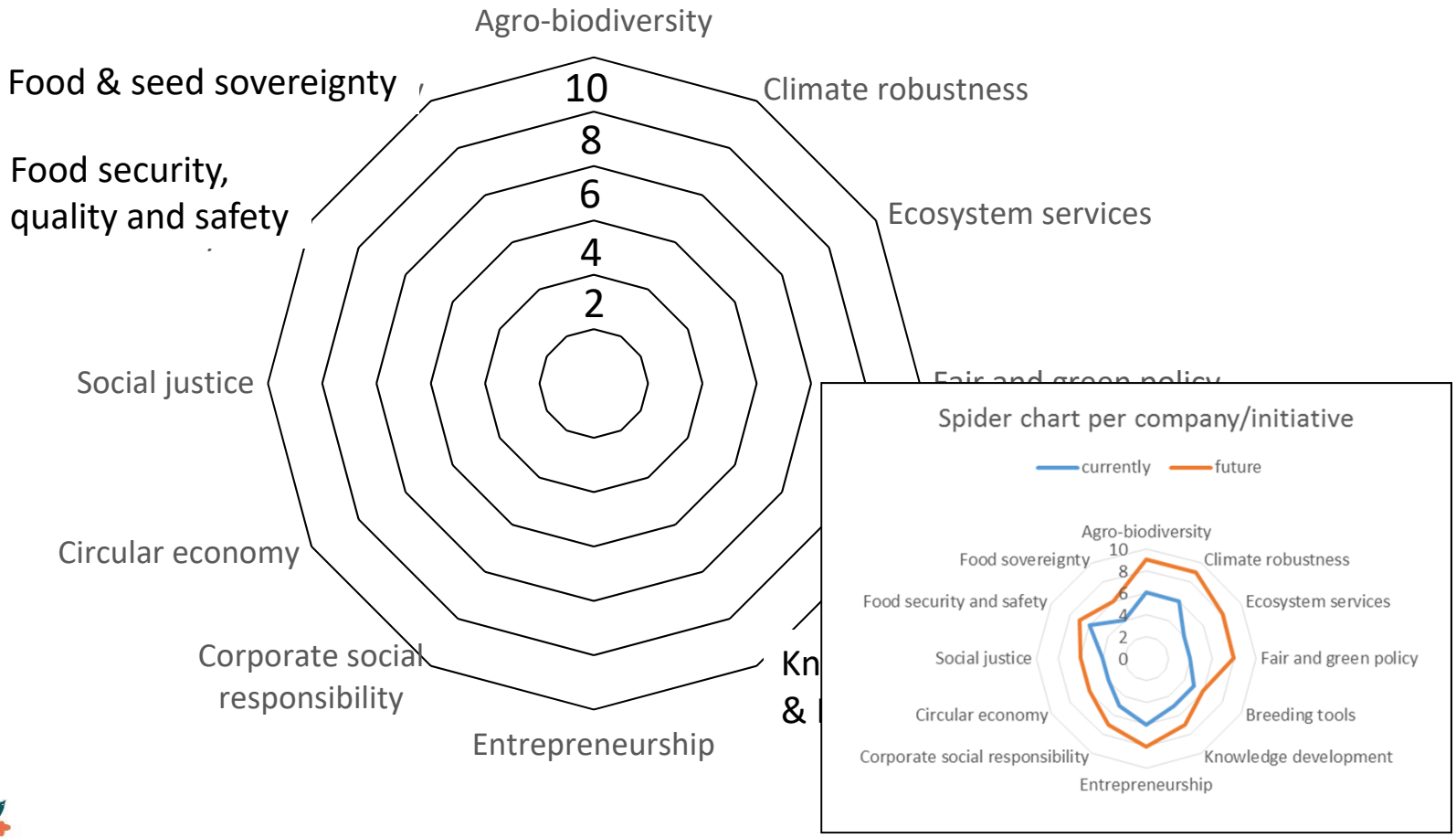
12 Key-elements of systems-based breeding: as an assessment tool



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Acknowledgements

- The scientific paper underlying this concept is:

  Lammerts van Bueren E.T., Struik P.C., Van Eekeren N., Nuijten E. Towards resilience through systems-based plant breeding. A review. Journal of Agronomy for Sustainable Development (2018) 38: 42 (open access)

- This concept is developed under EU project LIVESEED (2017-2021) and will be further elaborated!

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