Sustainability and resilience of farming systems

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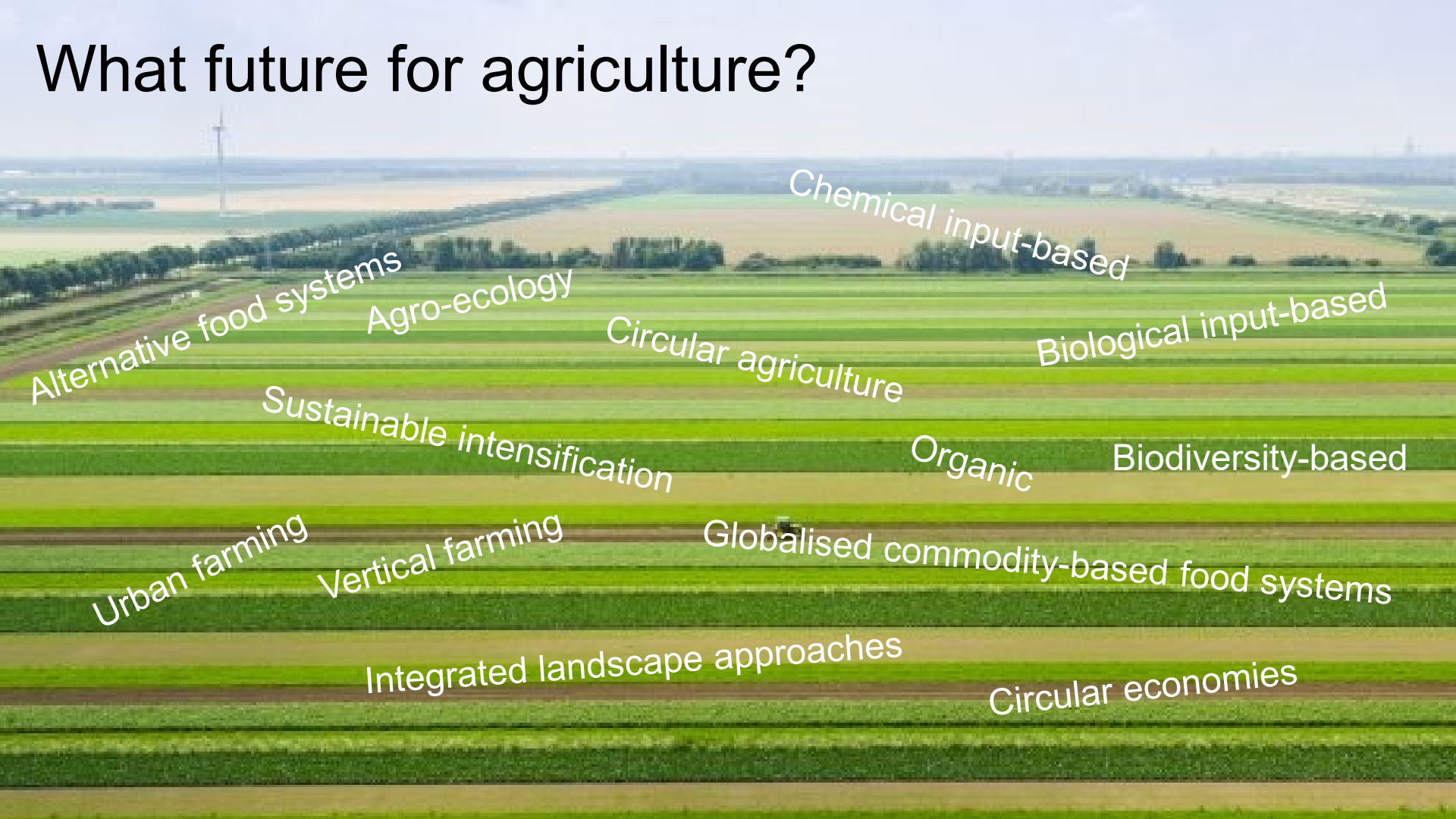
What future for agriculture?



Farm and farming system diversity

multiple drivers

Climate change
Technological development
Markets
Policy

farm diversity

Size
Intensity
Specialization
Orientation
⇩
Resources
Constraints
Objectives
⇩
Farm plans, inputs & outputs

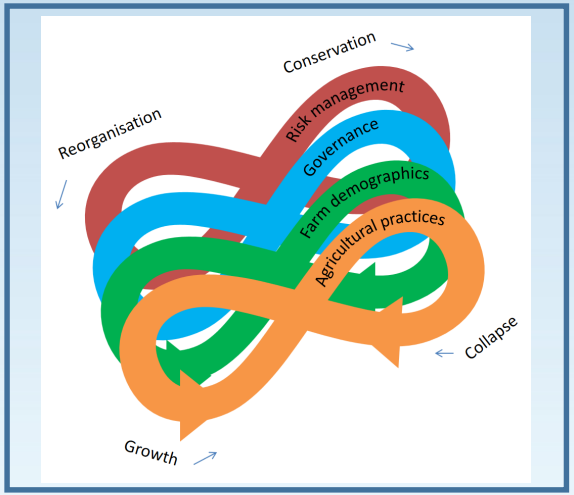
multiple indicators

Economic
Environmental
Social

Reidsma et al., 2015; Environmental Research Letters

Adaptive cycles in agriculture

Challenges
- Economic
- Environmental
- Social
- Institutional



Functions
- Private goods
- Public goods

Meuwissen et al., 2019; Agricultural Systems

SURE Farm
SUSTAINABLE RESILIENT EU FARMING SYSTEMS

WHY THE CAP SHOULD WIDEN ITS APPROACH TO RESILIENCE

TOWARDS A RESILIENT CAP FOR RESILIENT FARMING SYSTEMS

RESILIENCE IS MORE THAN ROBUSTNESS

www.surefarmproject.eu / #FutureofCAP

ESA 2020

Framework to assess resilience of farming systems

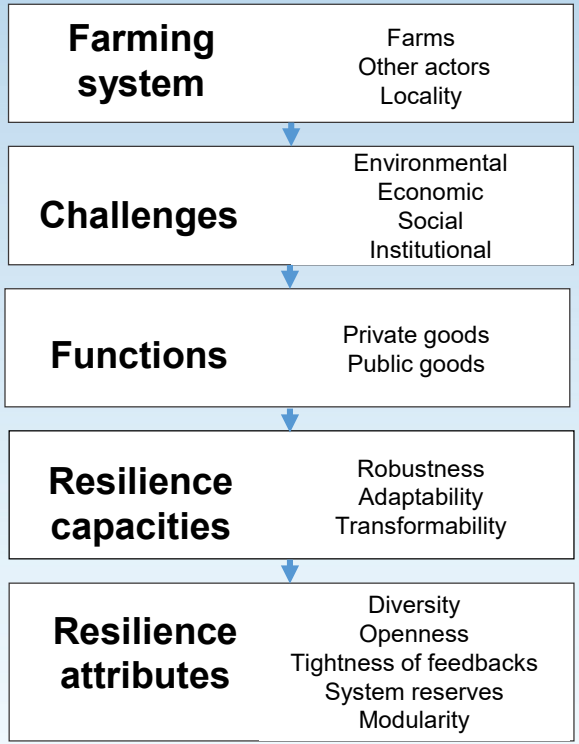
1. Resilience *of what*?

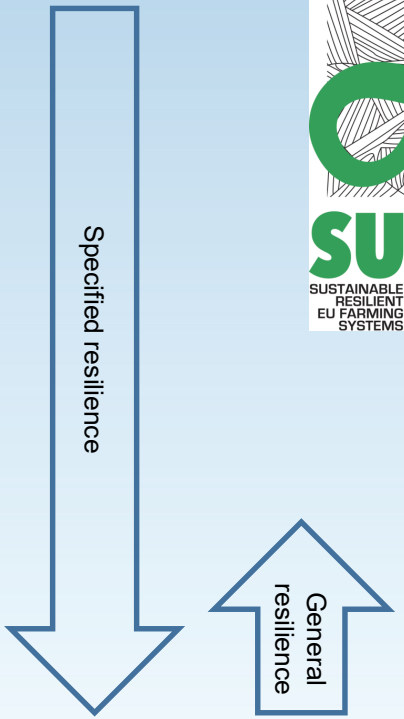
2. Resilience *to what*?

3. Resilience *for what purpose*?

4. What *resilience capacities?*

5. *What enhances* resilience?

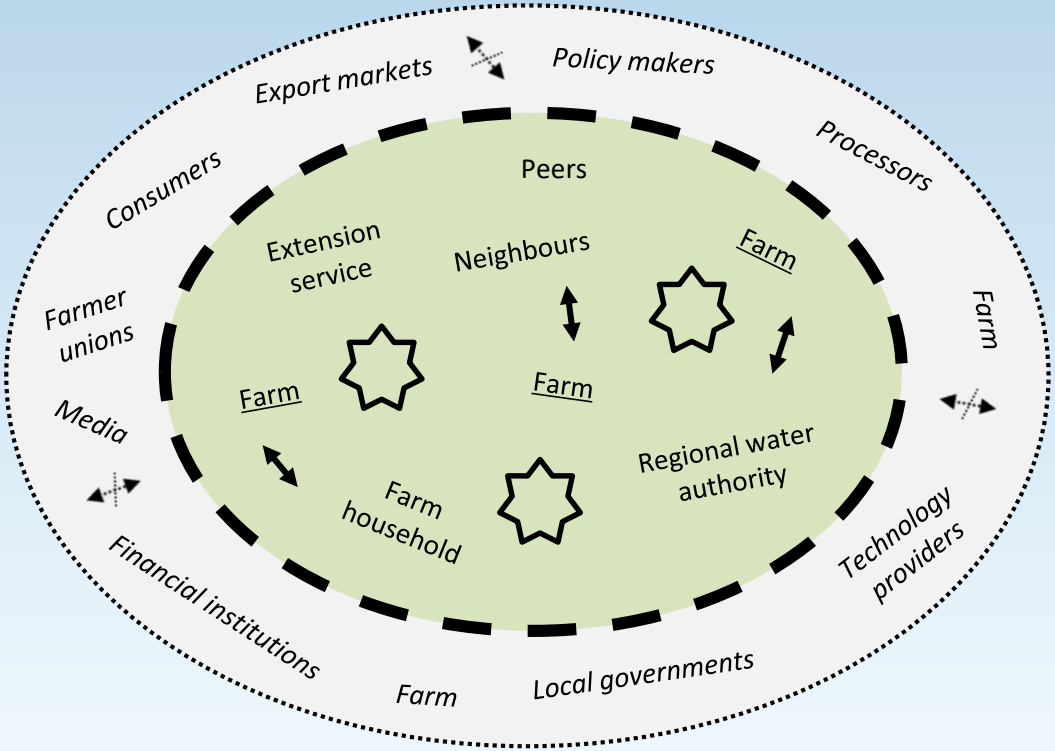




SURE Farm
SUSTAINABLE RESILIENT EU FARMING SYSTEMS

Meuwissen et al., 2019; Agricultural Systems

Step 1. Resilience of what? Farming system



Farming system (FS)

Farm — Main farms in analysis

Actors — Other FS actors

Locality (agro-ecological context, infrastructure, public goods, identity, ..)

Context

Actors — Context actors

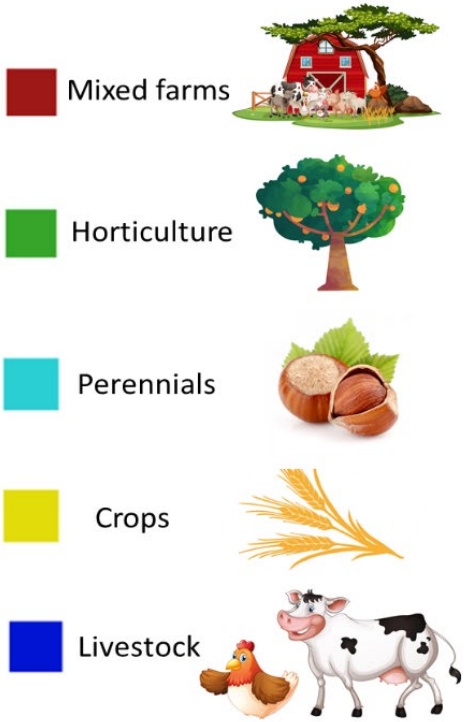
Distinction between 'other FS actors' and 'context actors':

Mutual influence with farms

Unilateral influence with farms

Meuwissen et al., 2019; Agricultural Systems

11 farming systems in the EU



France	Spain	Sweden	Belgium	Germany	Bulgaria	Netherlands	England	Italy	Poland	Romania
Extensive beef cattle systems	Extensive bovine and ovine farms	High-value egg and broiler farms	Intensifying dairy farming	Large-scale corporate farms	Large-scale corporate farms	Arable farming	Large-scale corporate farms	Small scale Hazelnut production	Private family fruit and vegetable farms	Small scale farms

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SUSTAINABLE RESILIENT EU FARMING SYSTEMS

Mixed methods approach

Qualitative

- Narratives
- Interviews
- Participatory workshops
- Focus group discussions
- Policy document analysis

Quantitative

- Farm surveys
- Statistical analyses
- System dynamics modelling
- Agent-based modelling
- Ecosystem services modelling

SURE Farm
SUSTAINABLE RESILIENT EU FARMING SYSTEMS

Reidsma et al., 2019 - D5.3; Accatino et al., 2020 – D5.5; surefarmproject.eu

Step 2. Resilience to what? Challenges

Farm survey responses: institutional > environmental > economic > social

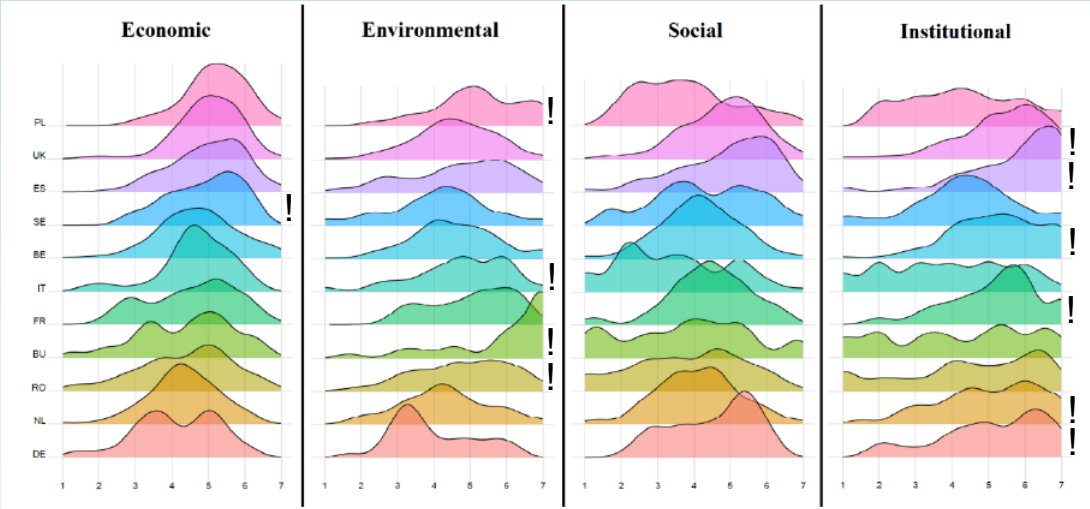


Figure 5. Distribution of perceived relevance of different categories of challenges. The relevance was assessed based on a 7-point-Likert-type item: 1 – not challenging at all for my farm ... 7 – very challenging for my farm.

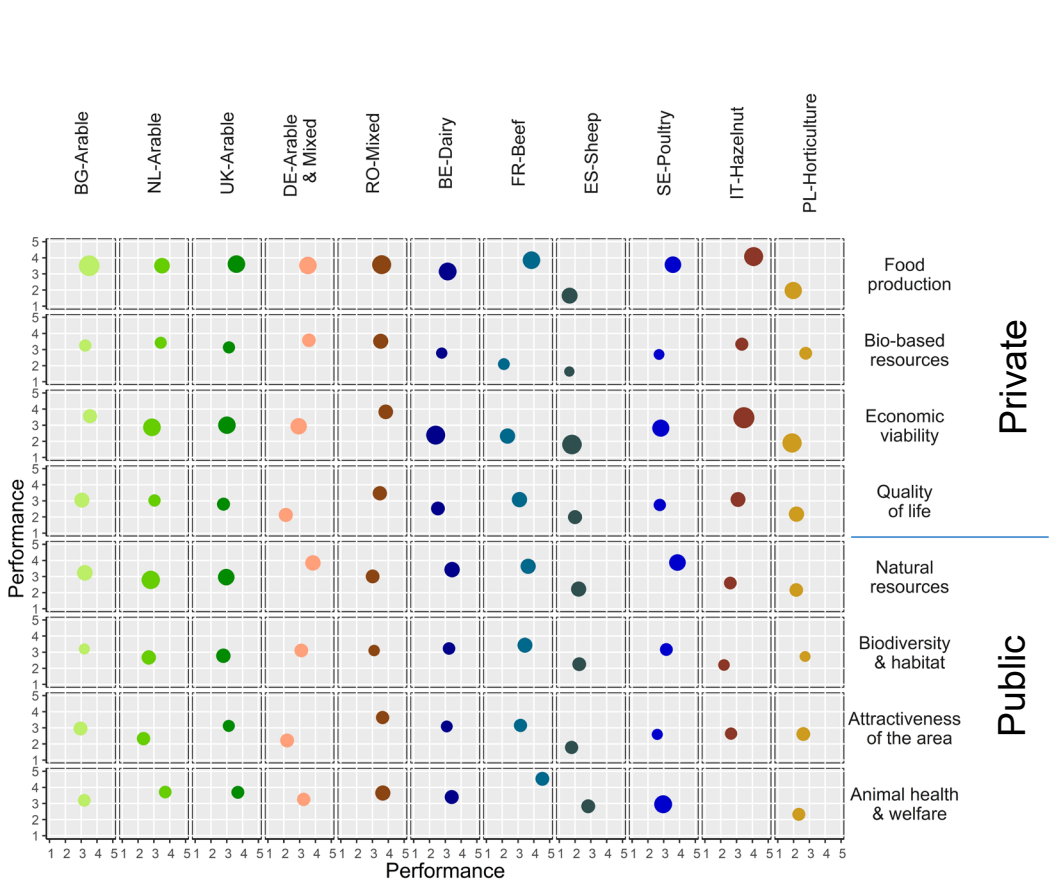
Spiegel et al., 2019; D2.1

Main challenges identified in participatory workshops

Low prices and price fluctuations
Extreme weather
Continuous change of laws and regulations
Economic laws & regulations
High production costs
Environmental laws & regulations
Low labor availability
Pests & diseases
Changes in consumer preferences
Change in technology
Wildlife attacks
Lack of infrastructure
Low attractiveness

Paas et al., 2020; in D5.5

Step 3. Resilience for what purpose? Functions



Participatory assessment of

- Importance (size of bubbles; 100 points distributed)
- Performance (1= very low, 5 = very high)

Importance

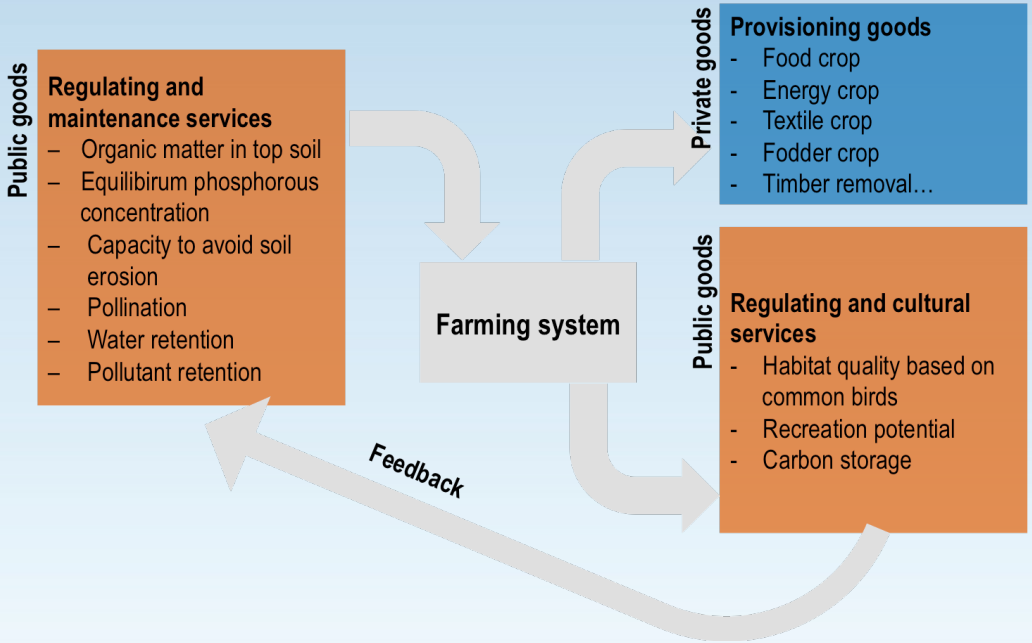
- Food production
- Economic viability
- Natural resources

Performance

- Moderate on average
- Food production relatively high
- Variability between case studies

Reidsma et al., 2020; Eurochoices

Step 3. Resilience for what purpose? Functions: ES

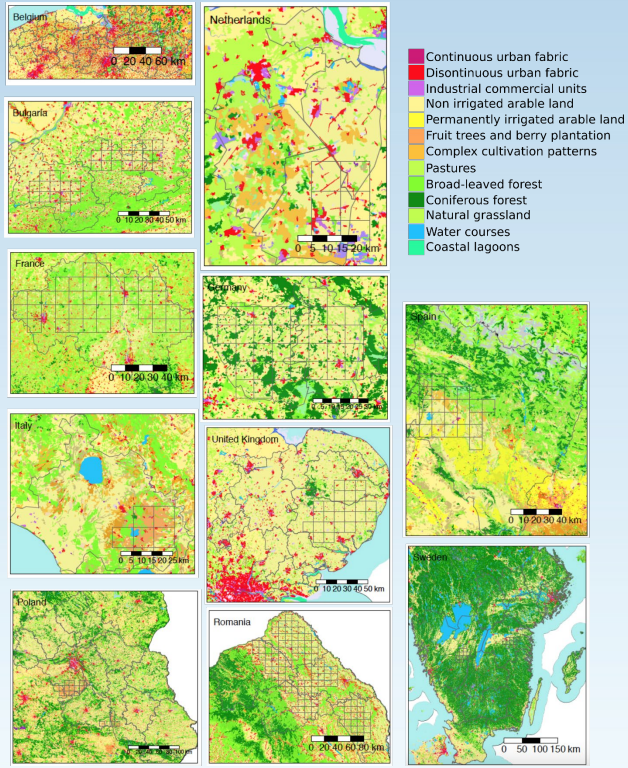


Quantitative assessment of ability to provide private and public goods

- Selection of ecosystem services
- All 11 case studies
- Provision by administrative region
- Decrease or increase of multifunctionality by FS?

Accatino et al. 2019 in Reidsma et al., 2019; D5.3

Step 3. Resilience for what purpose? Functions: ES



+	Median in the FS is **higher** than the median of the rest of the NUTS3
-	Median in the FS is **lower** than the median of the rest of the NUTS3
~	Median in the FS is similar than the median of the rest of the NUTS3

Accatino et al. 2019 in Reidsma et al., 2019; D5.3

Step 3. Resilience for what purpose? Functions: ES

		RO	IT	PL	UK	NL	DE	BG	FR	ES	SE
Private goods	Food crop prod.	~	+	~	~		+	+	~	+	+
	Fodder crop prod.	~	~							+	~
	Energy crop prod.	+	~							-	+
	Graz. livestock dens.	~	~							~	~
	Timber removal	~	-							~	~
Public goods	Carbon storage	-	+							-	-
	Habitat (birds)	-	+							+	~
	NOx deposition	-	+	~	~	~	~	+	~	~	~
	Org. matter topsoil	~	+	~	+	+	~	~	~	~	~
	Rel. Pollination Pot.	~	+	~	~	~	~	~	~	~	-
	Recreation potential	~	+	-	~	~	-	+	+	-	-
	Soil erosion control	~	~	~	+	-	-	~	~	~	-
	Water reten. index	~	~	~	~	-	~	~	~	~	~

Group 1: *bringing multifunctionality* to surrounding regions

Hazelnut farming in central Italy brought functions intrinsically connected to the presence of permanent crops (e.g., habitat quality, recreation potential)

Step 3. Resilience for what purpose? Functions: ES

		RO	IT	PL	UK	NL	DE	BG	FR	ES	SE
Private goods	Food crop prod.	~	+	~	~	-	+	+	~	+	+
	Fodder crop prod.	~	~							+	~
	Energy crop prod.	+	~							-	+
	Graz. livestock dens.	~	~							~	~
	Timber removal	~	-							~	~
Public goods	Carbon storage	-	+							-	-
	Habitat (birds)	-	+	-						+	~
	NOx deposition	-	+	~	~	~	~	+	~	~	~
	Org. matter topsoil	~	+	~	+	+	~	~	~	~	~
	Rel. Pollination Pot.	~	+	~	~	~	~	~	~	~	-
	Recreation potential	~	+	-	~	~	-	+	+	-	-
	Soil erosion control	~	~	~	+	-	-	~	~	~	-
	Water reten. index	~	~	~	~	-	~	~	~	~	~

Group 2: *removing public goods* from the region to focus on the delivery of private goods

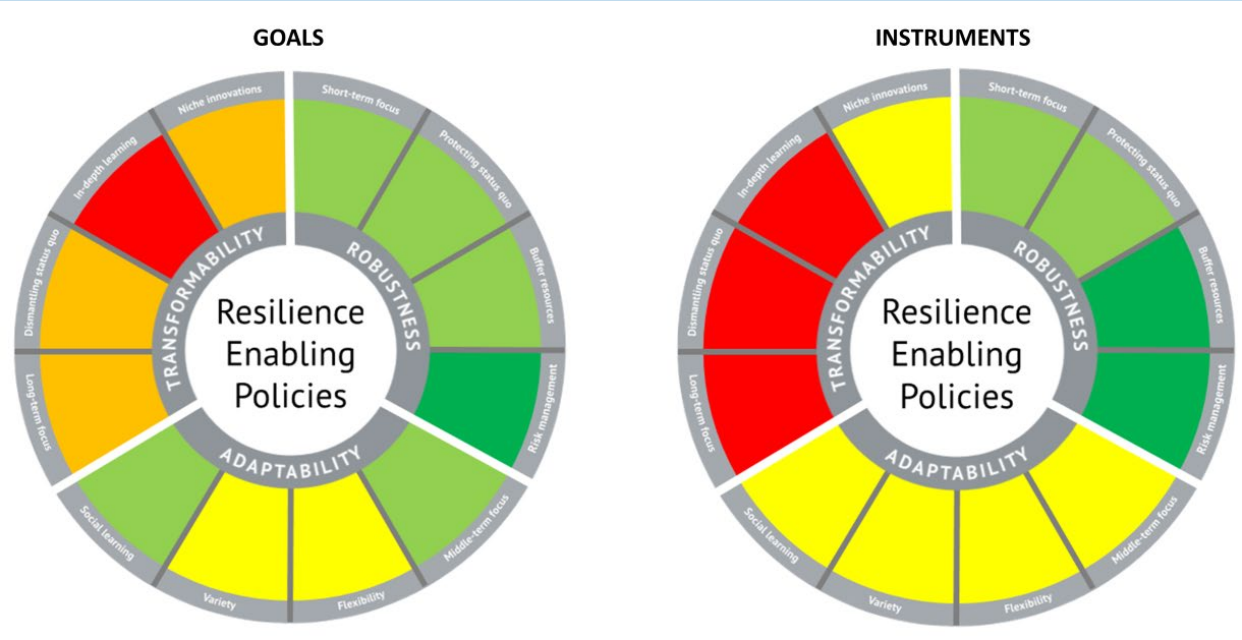
Mixed farming in north-east Romania decreased almost all the public goods of the region

Step 4. What resilience capacities?

Meuwissen et al., 2019; Agricultural Systems

Step 4. What resilience capacities? Policy level

Example RESilience ASsessment Tool: Veenkoloniën, the Netherlands



Feindt et al., 2019; D4.2

Policy document analysis:

- Robustness-enhancing policy in most (6) FS (see fig.)
- Adaptability-enhancing policy in IT-Hazelnut and SE-Eggs
- Resilience-constraining policy in ES-Sheep
- Transformability-oriented policy in UK-Arable

Reidsma et al., 2019 - D5.3; Accatino et al., 2020 – D5.5; surefarmproject.eu

Step 4. What resilience capacities? Farming system level

Participatory assessment:

- Past strategies (S) to cope with main challenges for main indicators (I)
- Contribution of S to capacities: scoring -3 to +3

- Past strategies mainly contributed to robustness, less to adaptability, least to transformability
  - E.g. Investment of cooperatives (S) > labour income (I)

- In some cases negative contribution to transformability
  - E.g. Investment in buildings and technology (S) > market pressure for eco eggs (I)

Paas et al., 2019 - D5.2; Reidsma et al., 2020

Step 4. What resilience capacities? Farming system level

Most studied systems: close to at least one critical threshold for

- system challenges
- functions related to food production and economic viability

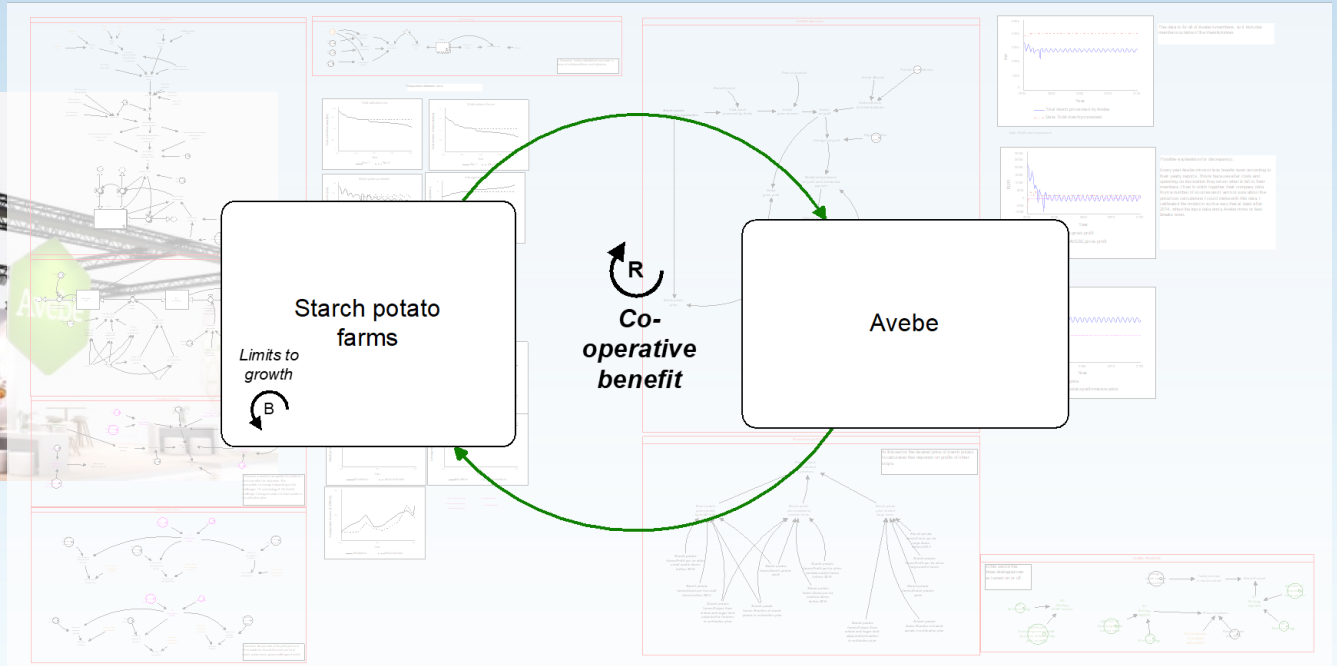
14.15 room 2: Wim Paas
PARTICIPATORY ASSESSMENT OF FUTURE SUSTAINABILITY AND RESILIENCE OF EUROPEAN FARMING SYSTEMS

Paas et al., 2020 in Accatino et al. 2020; D5.5

Step 4. What resilience capacities? Farming system level

System dynamics:

- Quantitative model
- Case study ‘starch potato farming’ in the Veenkoloniën, NL



Schuetz, 2019; Herrera et al., 2020 in Accatino et al., 2020 – D5.5

Step 4. What resilience capacities? Farming system level

Environmental challenges

Droughts and flooding

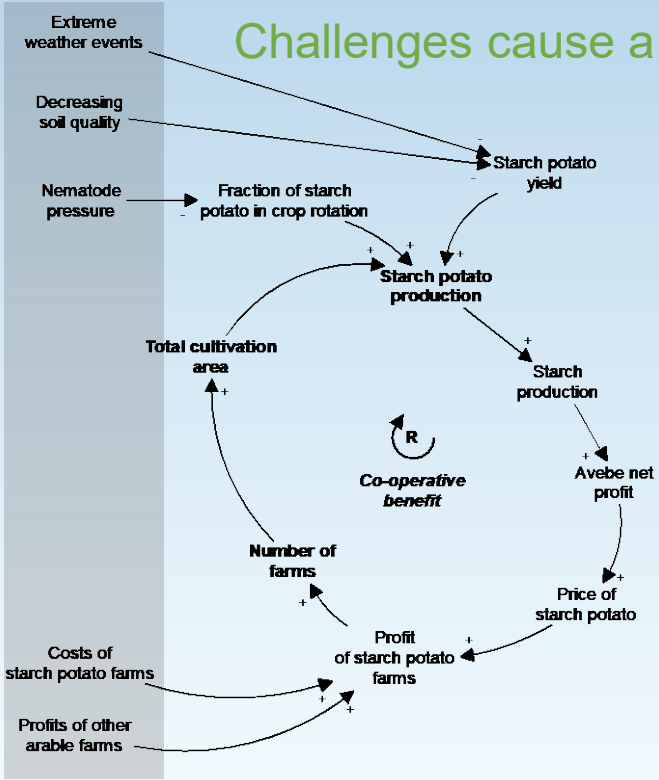
Decreasing soil quality

Potato cyst nematodes

Economic challenges

Increasing costs

Fluctuating crop prices



Schuetz, 2019; Herrera et al., 2020 in Accatino et al., 2020 – D5.5

Step 4. What resilience capacities? Farming system level

	Model variable	Threshold
Environmental challenges		
Droughts and flooding	Starch potato yield:	**- 3.5%**
Decreasing soil quality	Fraction starch potato in rotation:	**- 5.5%**
Potato cyst nematodes		
Economic challenges		
Increasing costs	Costs of s.p. farms:	+ 11.5%
Fluctuating crop prices	Profits of other farms:	+ 8.5%

The system is close to all challenge thresholds

Schuetz, 2019; Herrera et al., 2020 in Accatino et al., 2020 – D5.5

Step 4. What resilience capacities? Farming system level

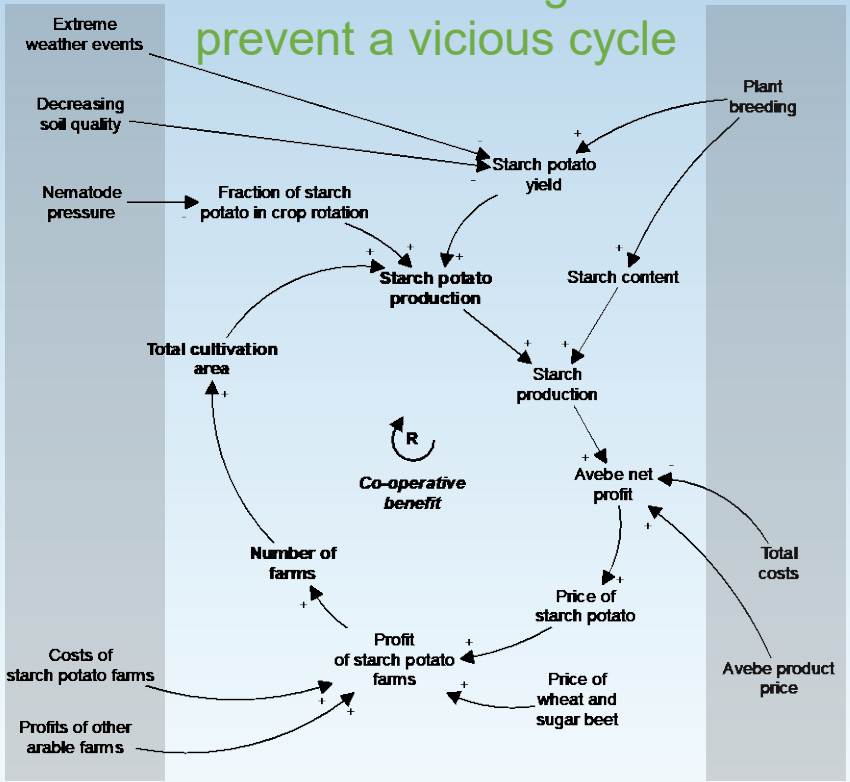
Avebe's strategies prevent a vicious cycle

Environmental challenges

Droughts and flooding

Decreasing soil quality

Potato cyst nematodes



Crop productivity strategies

Plant breeding

> yield

> starch content

Economic challenges

Increasing costs

Fluctuating crop prices

Economic strategies

Avebe cost reduction

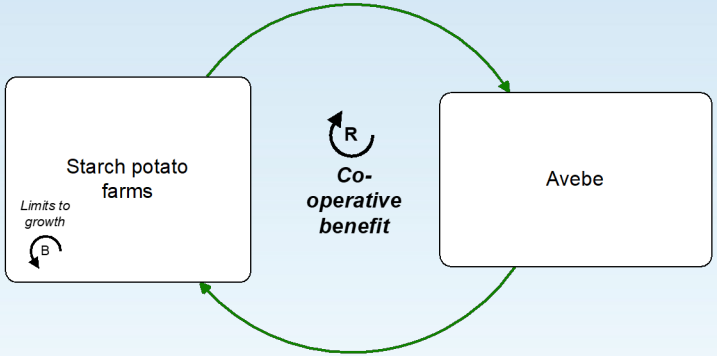
Avebe product price

Schuetz, 2019; Herrera et al., 2020 in Accatino et al., 2020 – D5.5

Step 4. What resilience capacities? Farming system level

System dynamics:
- Quantitative model
- Case study ‘starch potato farming’ in the Veenkolonien, NL

- Interdependence farmers and cooperative Avebe explains robustness in the past
- Avebe has shown adaptability in the past by developing new cultivars, new products and new markets
- Transformabilty is limited because of interdependence and high dependence on starch potato production



Schuetz, 2019; Herrera et al., 2020 in Accatino et al., 2020 – D5.5

Step 5. What enhances resilience? Resilience attributes

- Past strategies
  - were often geared towards making the system more profitable
  - to a lesser extent towards coupling production with local and natural resources, social self-organization, enhancing functional diversity, and facilitating infrastructure for innovation
- Overall resilience of the FS was perceived as low to moderate, with robustness and adaptability often dominant over transformability
- To allow for transformability, being reasonably profitable and having access to infrastructure for innovation were viewed as essential

Paas et al., 2019 - D5.2; Reidsma et al., 2020

Step 5. What enhances resilience? Resilience attributes

Participatory assessment: presence and contribution to capacities	1 to 5	Contribution to (-3 to +3)			
Resilience attribute	Presence	robustness	adaptability	transformability	number of strategies linked to attribute
Reasonably profitable	2.2	1.8	1.5	0.9	54
Coupled with local and natural capital (production)	2.9	1.8	1.6	1.1	22
Functional diversity	2.2	1.4	1.3	1.2	15
Response diversity	2.4	1.3	1.4	1.0	8
Exposed to disturbance	2.5	0.6	0.7	0.3	4
Spatial and temporal heterogeneity (farm types)	3.1	1.5	1.4	1.2	3
Optimally redundant (farms)	2.5	1.0	1.1	0.9	1
Supports rural life	2.6	1.2	1.1	0.8	12
Socially self-organized	3.0	1.6	1.6	1.2	21
Appropriately connected with actors outside the farming system	2.3	1.1	1.0	0.8	5
Coupled with local and natural capital (legislation)	2.8	0.7	0.6	0.4	12
Infrastructure for innovation	2.1	1.6	1.6	1.7	13
Diverse policies	2.1	1.2	1.1	0.9	3

Cabell and Oelofse, 2012; Paas et al., 2019 - D5.2; Reidsma et al., 2020

Step 5. What enhances resilience? Resilience attributes

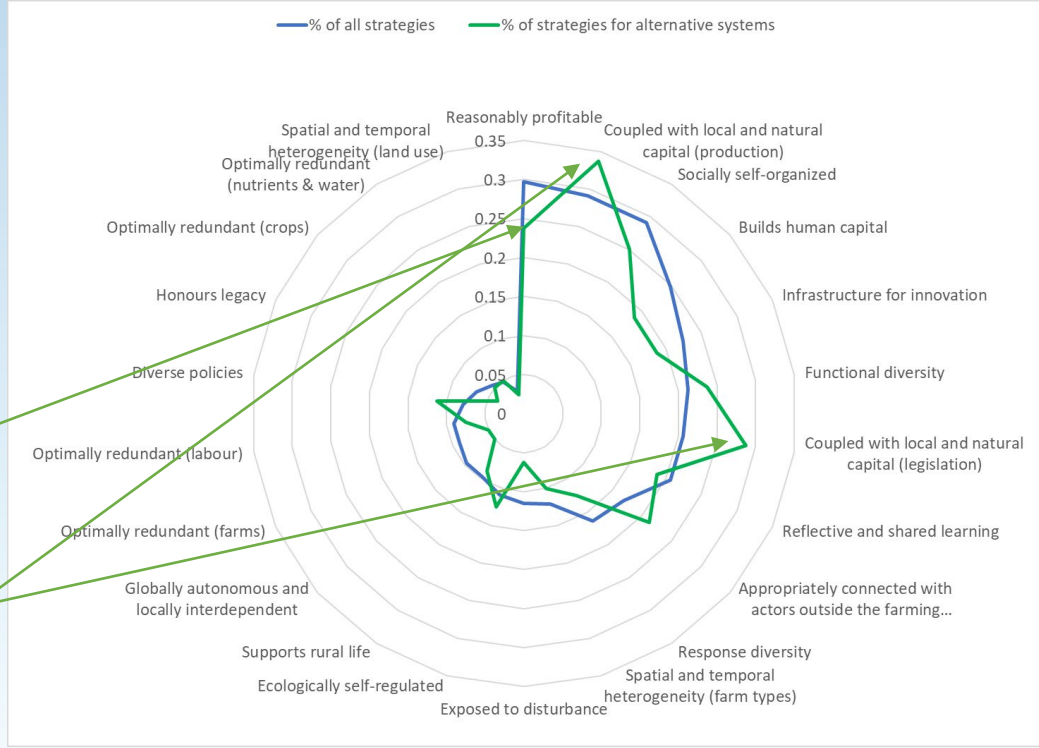
- Alternatives to improve main functions and attributes?

Innovation & technology

Product valorization

Collaboration

Nature inclusive



- Which strategies needed?
- Link to attributes?
- Still much attention for ‘reasonably profitable’
- More attention for ‘coupling local and natural capital’

Reidsma et al., 2020; D5.6

3 main mis-matches

1. Delivery of public goods is major concern ⟺ Most future strategies focused on delivery of private goods
2. FS comprise many non-farm actors ⟺ Future strategies focused on farms and their robustness, neglecting other options and opportunities
3. Majority of FS was at start of period in which transformation is required ⟺ FS capacity to transform was low

   Policy instruments largely focused on maintaining the status quo

Meuwissen et al., 2020; Eurochoices

Conclusions

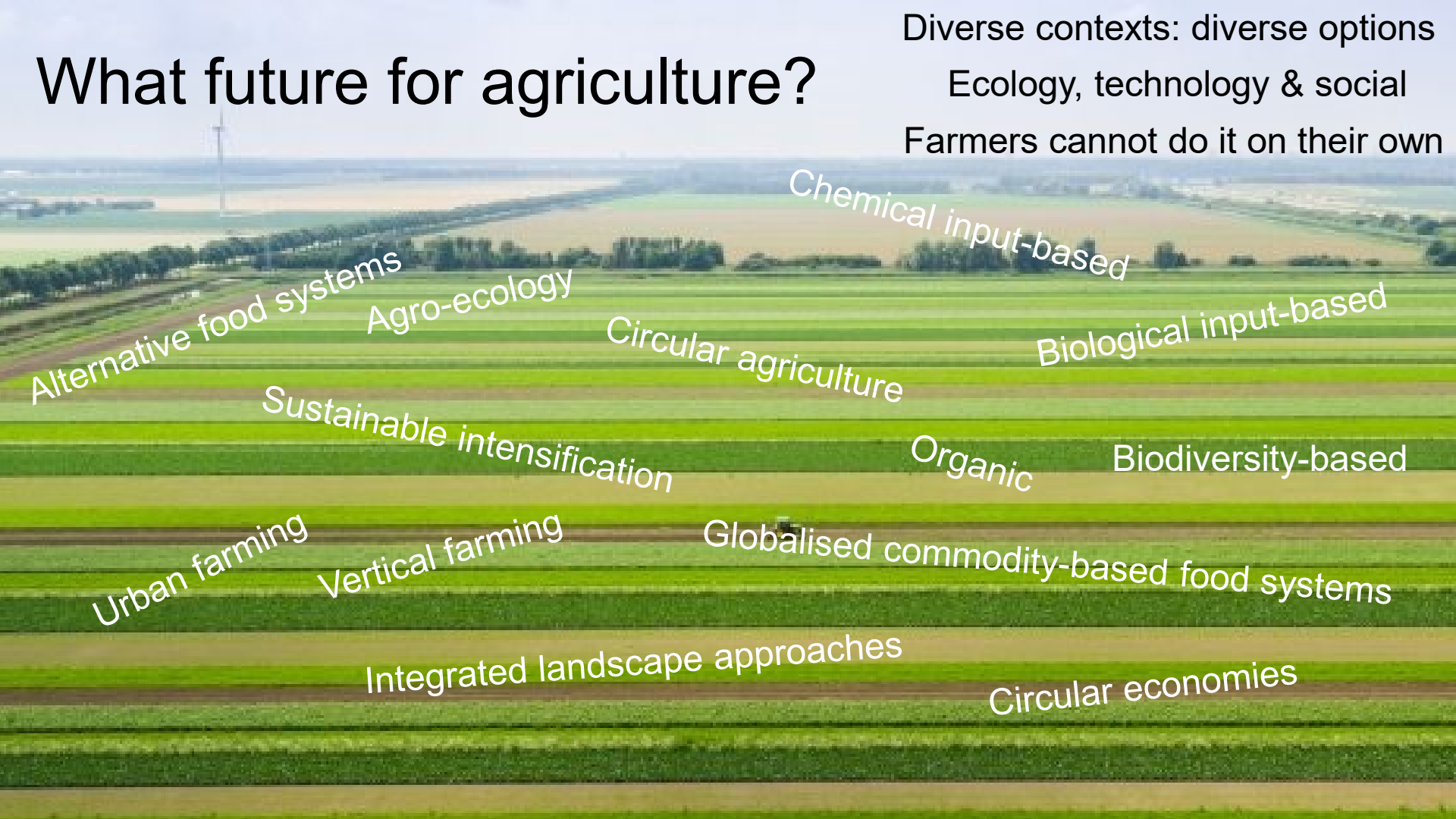
- Researchers, business and policy need to
  - account for the delivery of public goods more explicitly
  - develop new business models
  - address the role of actors beyond the farm
  - propose instruments and tools to enhance, not to constrain, system level capacity to adapt and transform
- A shift is required from responses to short-term processes to strategies that deal with long-term processes
- Ecological (e.g., coupling to natural capital), technological (e.g., innovation) as well as social (self-organization) solutions are needed
- Alternatives differ depending on the context, and multiple directions are possible

What future for agriculture?

Diverse contexts: diverse options

Ecology, technology & social

Farmers cannot do it on their own



Thank you

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