Leibniz Centre for Agricultural Landscape Research (ZALF)

Future Agricultural Management Conditions -
Pathways and Perceptions

Katharina Helming

Presented at EAAE – SUREFARM Seminar
"Future challenges and resilience of farming systems in Europe"

Date: 18.05.2021

Key messages

- The search for future sustainable pathways is **exciting**

- Scenario development is not only a **tool** for modelling, decision support and uncertainty management but also an interactive **learning process** and value by itself, in particular at regional levels

- Qualitative changes (what and **how** things are done) are as interesting as quantitative changes (intensification/extensification)

- **Diversification** is key

Multifunctional role of agriculture re societal challenges

Food Security

Biodiversity &
Ecosystem Services

Disaster Control

Health

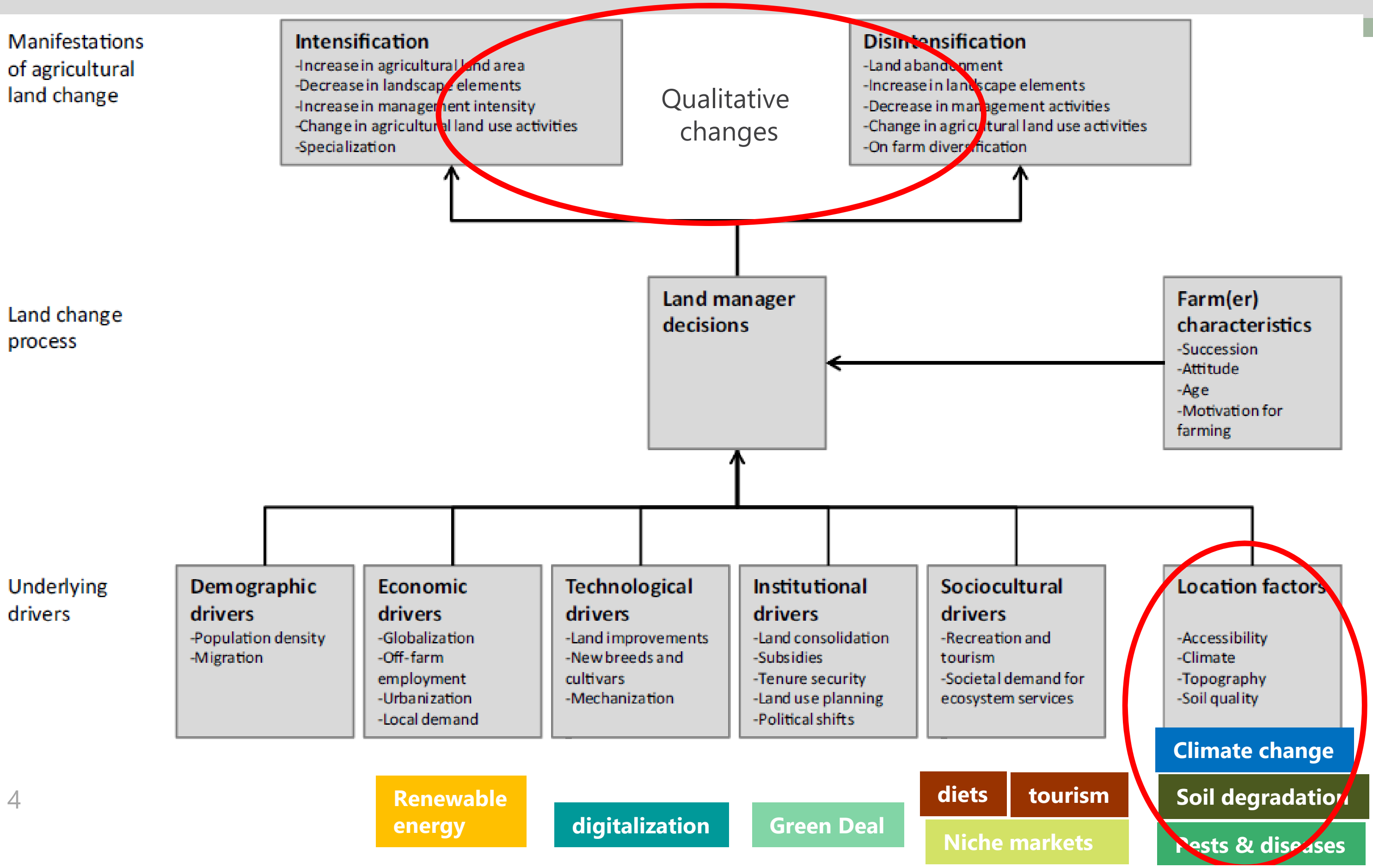
Climate Mitigation

Clean Energy

Rural Development

Agricultural policy indicators related to SDGs. Source: Scown and Nicholas, Global Sustainability 2020

External conditions and drivers of agricultural change



Vliet et al., 2015, doi: 10.1016/j.landurbplan.2014.09.001

Future Agriculture?
Uncertain, diverging visions

3 unsustainabale

https://upload.wikimedia.org/wikipedia/commons/thumb/2/26/Erosion_Verdichtung006.jpg/800px-Erosion_Verdichtung006.jpg

K. Helming

1 Local Initiatives

http://patrickwhitefield.co.uk/wp-content/uploads/2015/02/mulch-14-1024x682.jpg

2 High-tech

https://www.techiexpert.com/wp-content/uploads/2019/09/IOT-in-Agriculture.jpg

https://www.thomasnet.com/insights/will-agricultural-ai-become-the-future-of-farming/

4 Agroforestry

https://www.agroforestry.co.uk/wp-content/uploads/2018/05/silvoarable1.jpg

5 Large scale industrialised

https://www.bwagrar.de/Vorlagen/Webapp/Cache/CMS/10021/Case-Controlled-Traffic_NTgyODU0Nlo.JPG

https://iowaagliteracy.wordpress.com/2018/06/02/5-ways-technology-has-changed-farming/

6 care farming

https://www.sustainweb.org/resources/images/food_growing/community_supported_agriculture.jpg

Why think about and develop scenarios?

Future management scenarios

Intermediate purposes

Identify R&D priorities

Facilitate risk perceptions

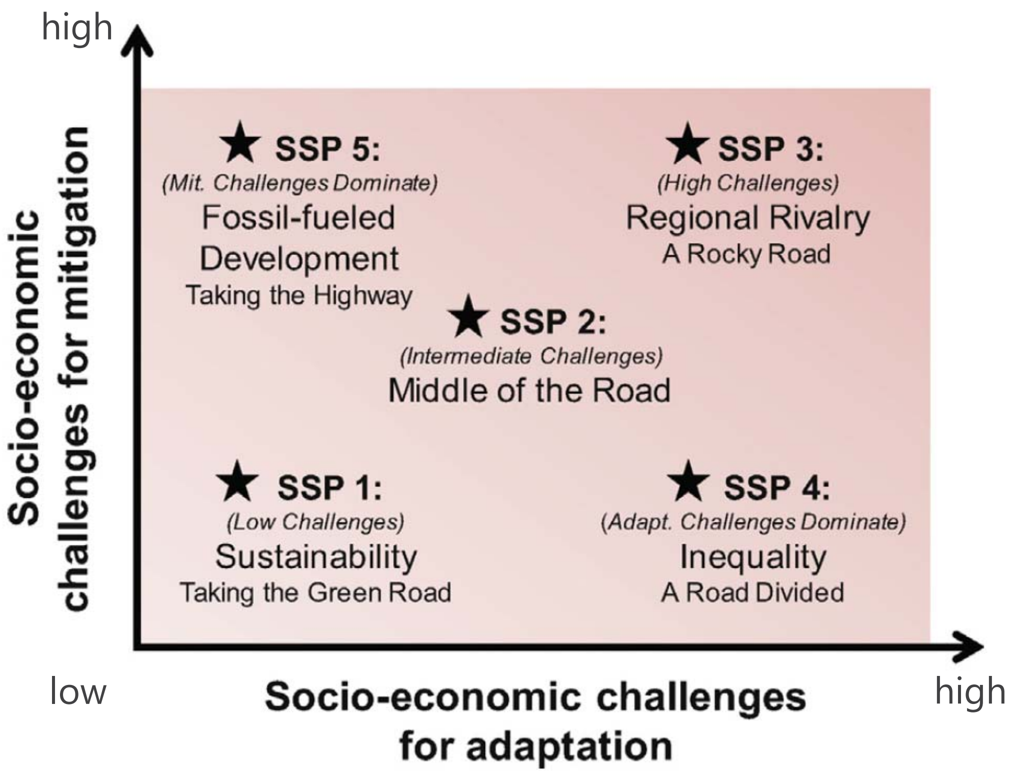
Integrate knowledge from different disciplines & sources

Inputs for modellig and assessment

Ultimate purpose

Support stakeholders in understanding dynamics, explicate alternative futures and better shape management strategies

Shared Socioeconomic Pathways



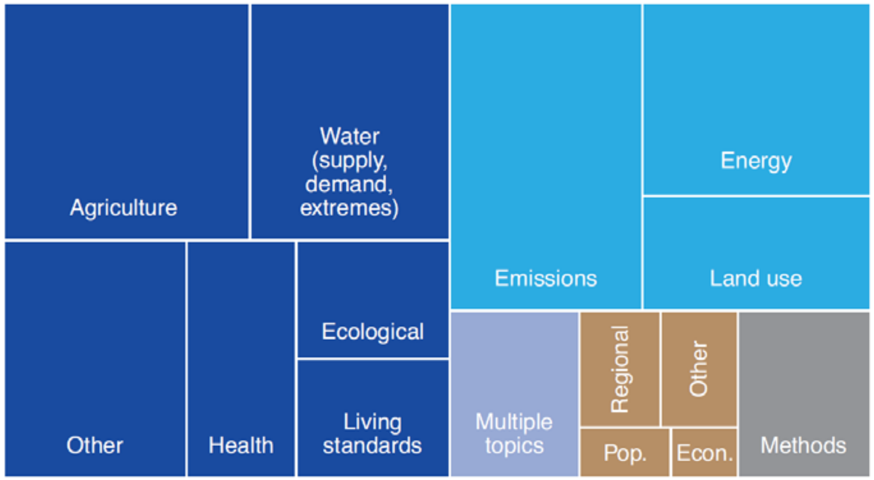
- Developed in the climate change research community (O'Neill et al. 2017)
- „Pathways in the 21st century"
- Combining alternative futures of climate and society
- SSP storylines, including specifications for land use, SSP public data base at IIASA (modelling results)
- Used in combination with greenhouse gas emmission trajectories (RCPs)

(O'Neill et al. 2017 in Global Environmental Change, doi: 10.1016/j.gloenvcha.2015.01.004)

- Widely adopted: used as framework in other settings
- Regional and sectoral specifications

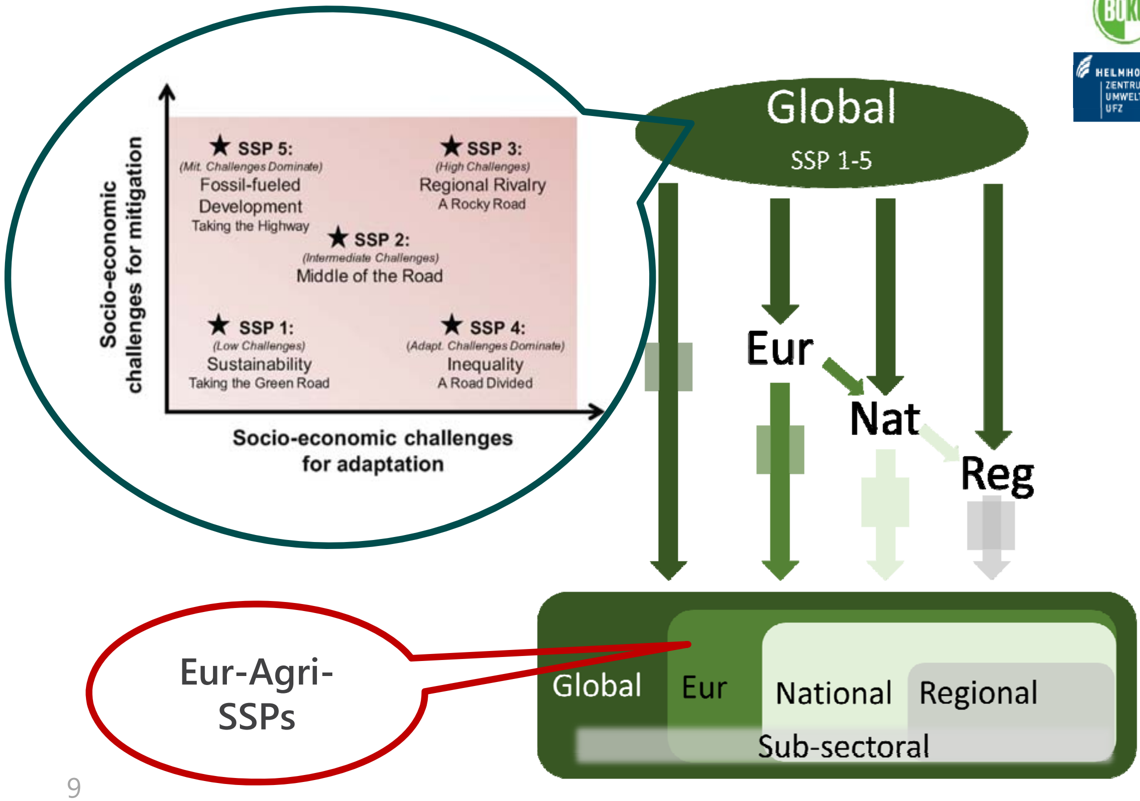
Pros:
- Consistency, Comparability, clarity
- Acceptance and visibility

Challenges:
- Applicability at regional and local scales
- Capture relevant perspectives and uncertainties
- Keep scenarios up to date
- Improve relevancy: capacity building, communication, accessibility, stakeholder involvements



(O'Neill et al. 2020 Nature Climate Change)

Eur-Agri-SSPs: Shared Socio-economic Pathways for European agriculture and food systems



Hermine Mitter
Martin Schönhart

Mitter et.al. 2019. J Env. Mangement

Aims and focus of scenario development for European Agriculture

Thematic:
- Extending and enriching global SSPs
- Providing a basis for integrated assessments of agriculture and food systems
- Increasing consistency and comparability of research results
- Providing a basis for policy and decision-making

Scientific
- Develop protocols for extending and refining the SSPs
- Operationalizing the protocol for European agriculture


Journal of Environmental Management 252 (2019) 109701
Contents lists available at ScienceDirect
Journal of Environmental Management
journal homepage: http://www.elsevier.com/locate/jenvman

Research article

A protocol to develop Shared Socio-economic Pathways for European agriculture

Hermine Mitter, Anja-K. Techen, Franz Sinabell, Katharina Helming, Kasper Kok, Jörg A. Priess, Erwin Schmid, Benjamin L. Bodirsky, Ian Holman, Heikki Lehtonen, Adrian Leip, Chantal Le Mouël, Erik Mathijs, Bano Mehdi, Melania Michetti, Klaus Mittenzwei, Olivier Mora, Lillian Øygarden, Pytrik Reidsma, Rüdiger Schaldach, Martin Schönhart

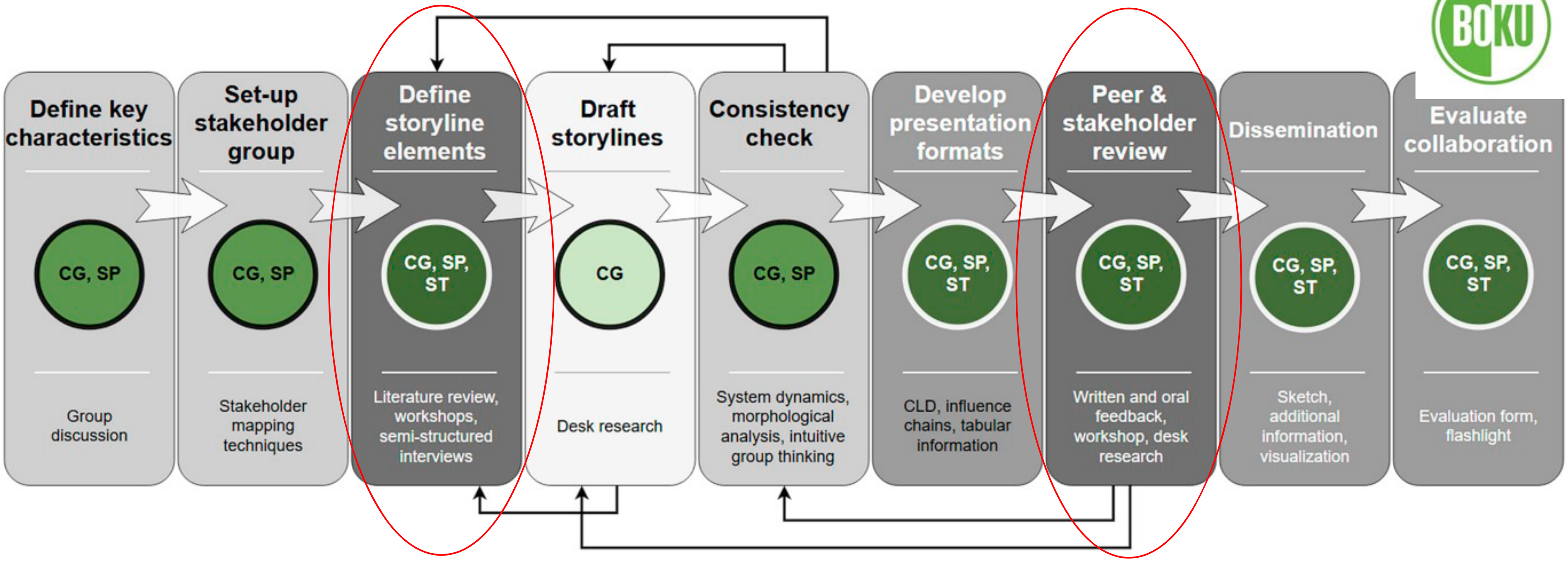
- **Thematic:** alternative future developments of agriculture and food systems
- **Spatial scale:** Europe
- **Time scale:** 2050
- **Scenario type:** problem-focused, qualitative storylines, semi-quantitative specifications of plausible futures


Global Environmental Change 65 (2020) 102159
Contents lists available at ScienceDirect
Global Environmental Change
journal homepage: www.elsevier.com/locate/gloenvcha

Shared Socio-economic Pathways for European agriculture and food systems: The Eur-Agri-SSPs

Hermine Mitter, Anja-K. Techen, Franz Sinabell, Katharina Helming, Erwin Schmid, Benjamin L. Bodirsky, Ian Holman, Kasper Kok, Heikki Lehtonen, Adrian Leip, Chantal Le Mouël, Erik Mathijs, Bano Mehdi, Klaus Mittenzwei, Olivier Mora, Knut Øistad, Lillian Øygarden, Jörg A. Priess, Pytrik Reidsma, Rüdiger Schaldach, Martin Schönhart

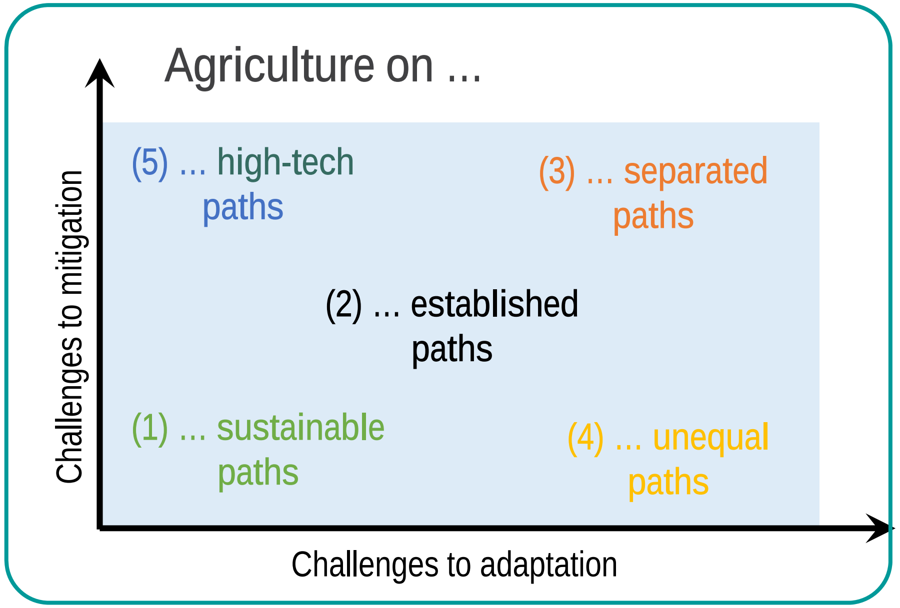
Protocol for developing Eur-Agri-SSPs summarizing resource needs and methodological requirements



- ✓ 9 steps
- ✓ Partly iterative
- ✓ 3 actor groups: CG Core Group; SP Supporting Group, ST Stakeholders
- ✓ level of stakeholder engagement (grey shading)

Mitter et al. 2019, Journal of Environmental Management, doi: 10.1016/j.jenvman.2019.109701

The Eur-Agri-SSPs

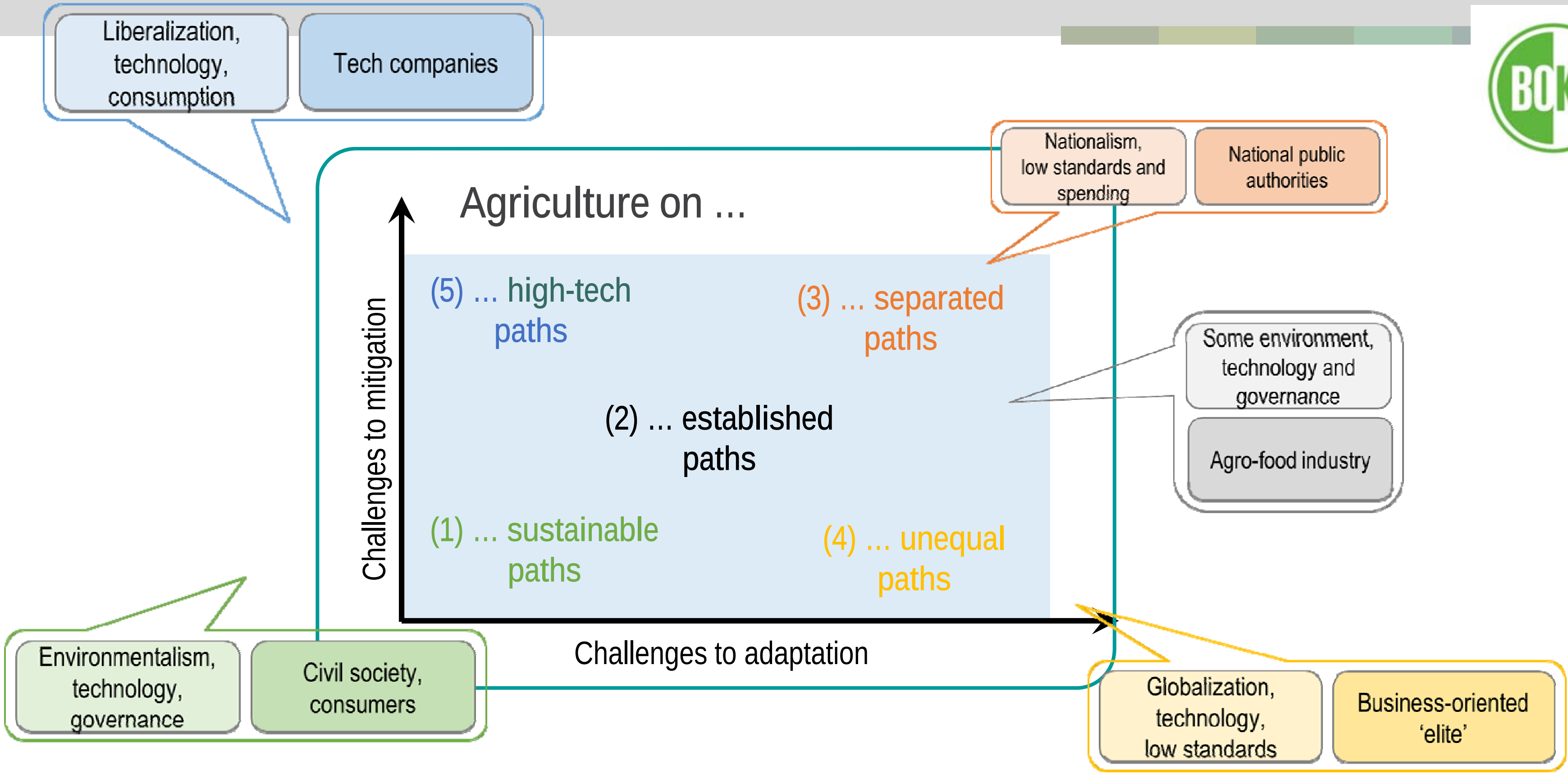


5 Topics

- Population and urbanization
- Economy
- Policies and institutions
- Technology
- Environment and natural resources

Mitter et al. 2020, Global Environmental Change, doi: 10.1016/j.gloenvcha.2020.102159;
Concept based on O'Neill et al. 2014, 2017

The Eur-Agri-SSPs



Mitter et al. 2020, Global Environmental Change, doi: 10.1016/j.gloenvcha.2020.102159;
Concept based on O'Neill et al. 2014, 2017

Limitations

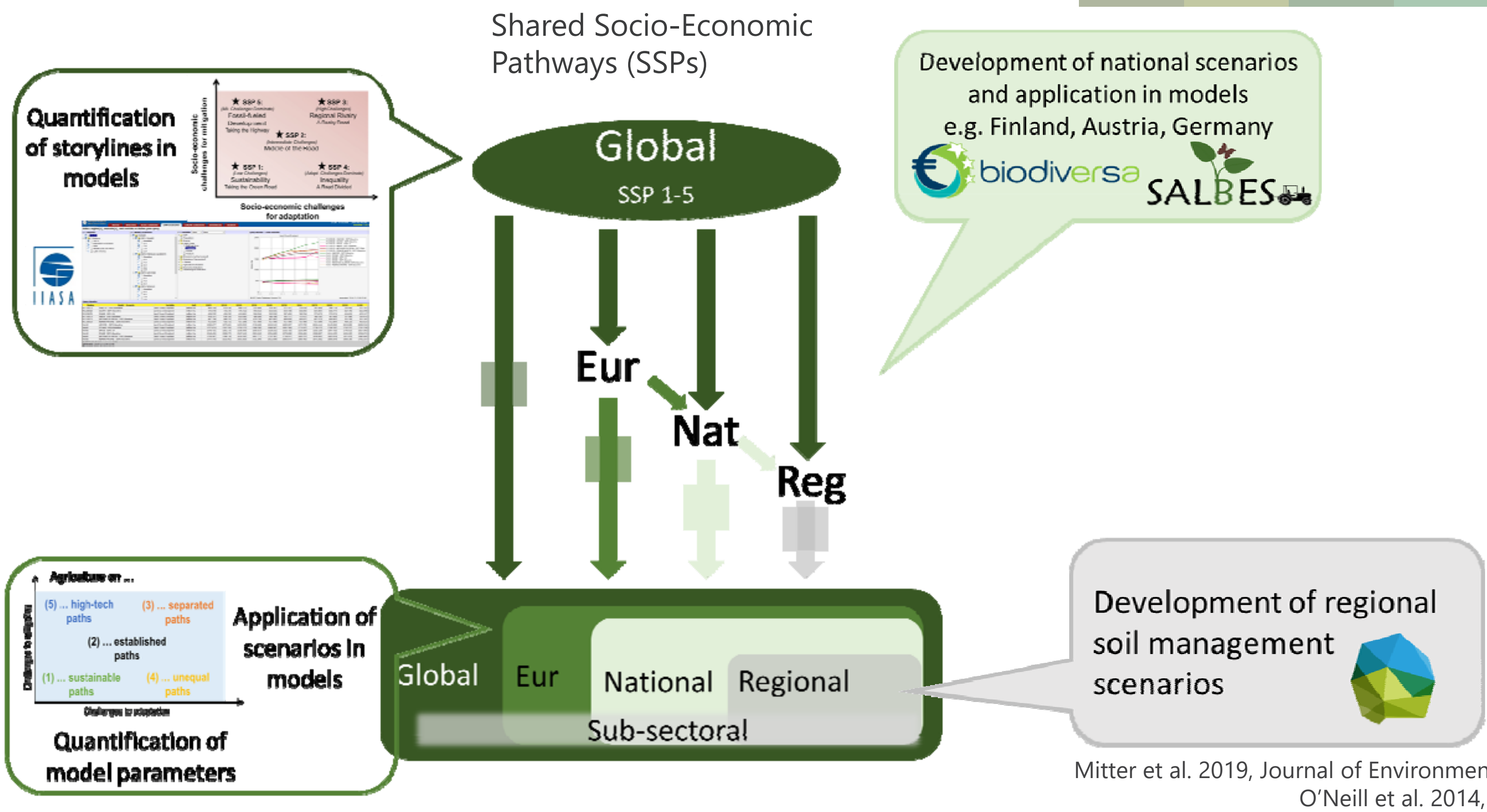
- Few details for European regions
- Few details for sub-sectors of agriculture and food in Europe
- → **Allows for spatial and sub-sectoral extensions**

- Semi-quantitative
- → **Allows for systematic quantifications**

- Limited flexibility for updates
- → **Long-term maintenance and networking activities**

Mitter et al. 2020, Global Environmental Change, doi: 10.1016/j.gloenvcha.2020.102159;
Concept based on O'Neill et al. 2014, 2017

Ongoing activities with use of the Eur-Agri SSPs



Mitter et al. 2019, Journal of Environmental Management
O'Neill et al. 2014, Climatic Change
O'Neill et al. 2017, Global Environmental Change
Lehtonen et al. 2021 Regional Environmental Change

Soil Functions

Biomass production

Habitat for biological activity

Filtering and storage of water

Carbon sequestration

Storage and recycling of nutrients

Soil management: what the farmers can do on the ground

Foresight on future **soil** management

Multiple Drivers

- Demand / Product prices
- Factor costs
- Policies
- Education and training
- Research and Development

Socio-economic

- Available agricultural land
- Soil degradation
- Climate change
- Natural resources (water, P)

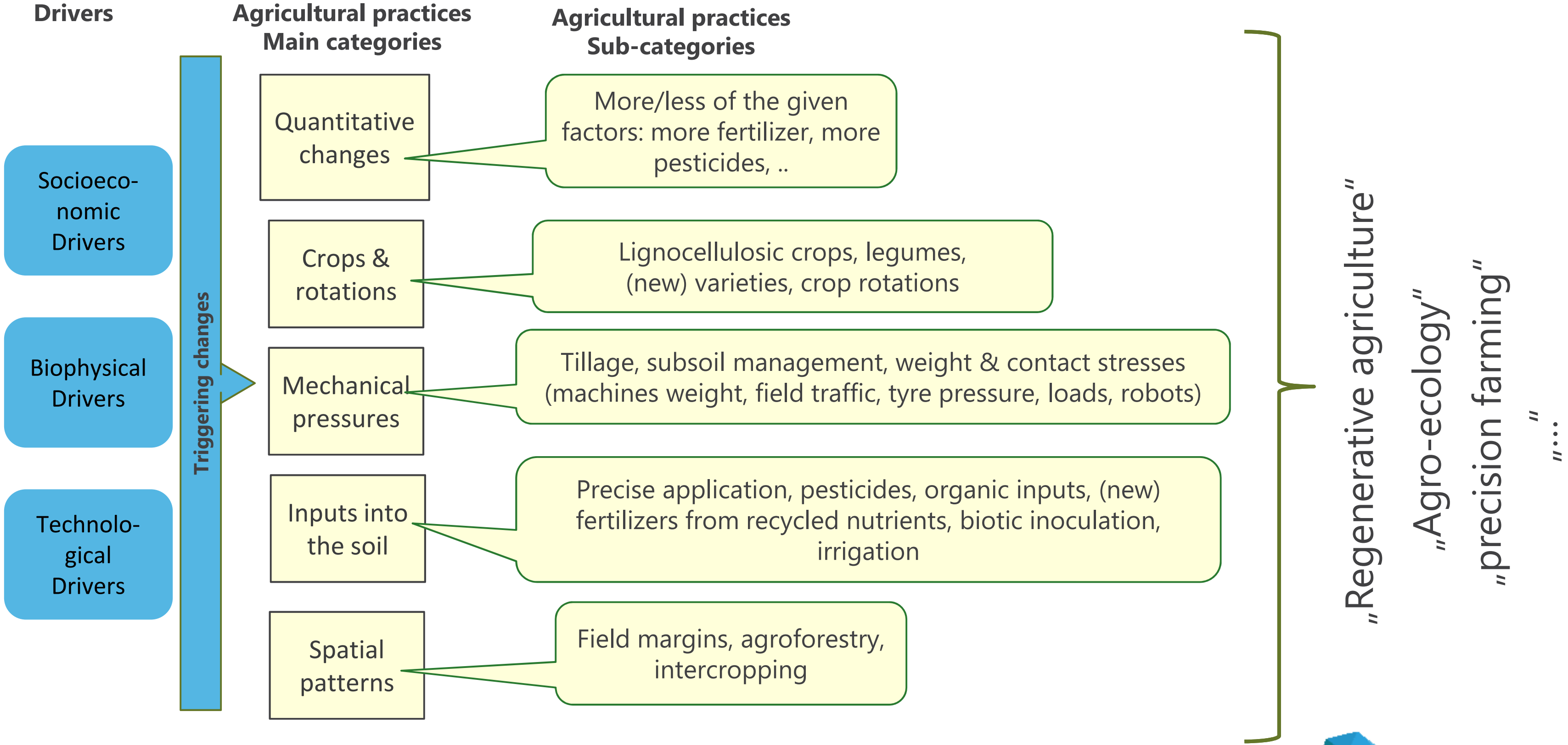
Biophysical

- Digitalization
- Data management
- Robotics
- Biomass technology

Techno-logical

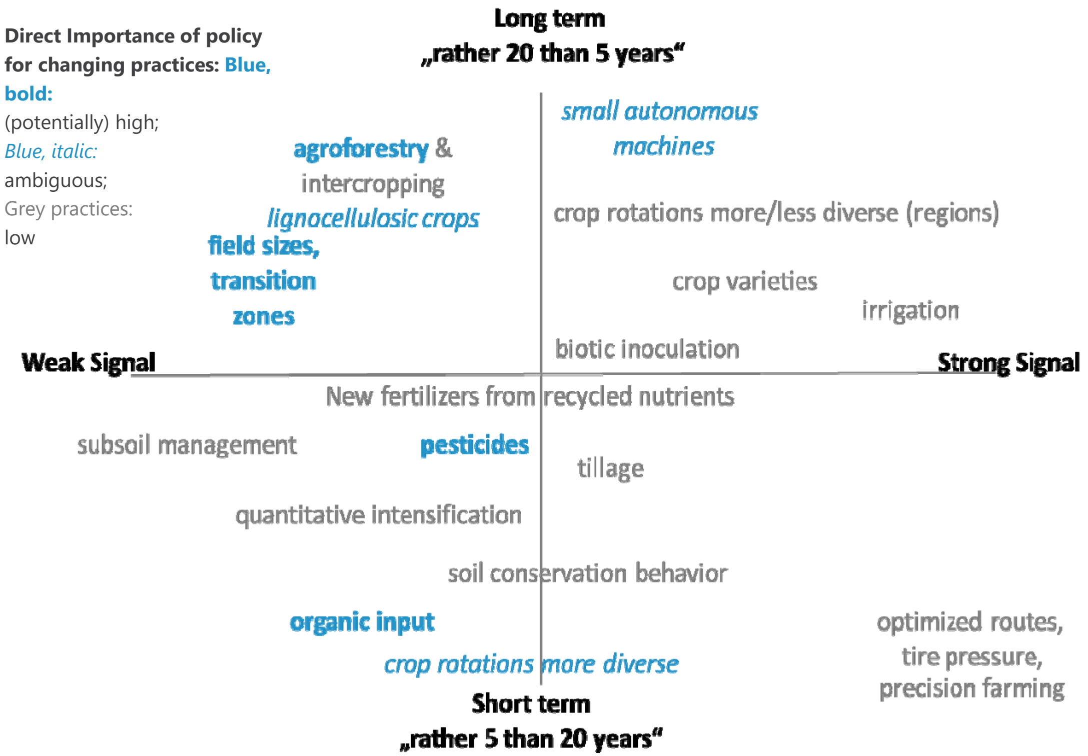
Techen & Helming 2017. Agronomy for Sustainable Development

Categories of emerging soil management practices



Techen & Helming 2017. Agronomy for Sustainable Development

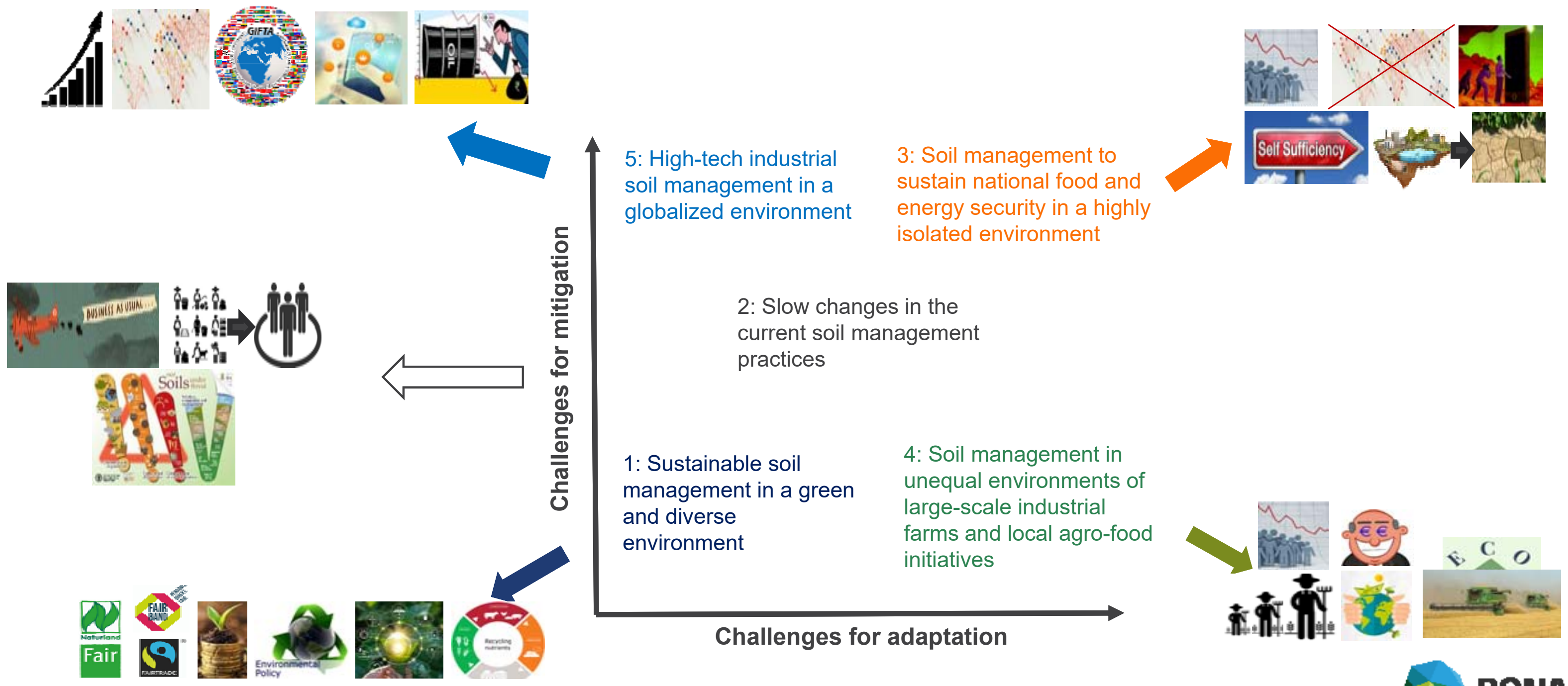
Foresight on emerging soil management: signal strength and time frame



Techen & Helming 2017. Agronomy for Sustainable Development

German Soil Management Pathways (DE-SMPs):

- ✓ Opportunities and barriers for sustainable soil management solutions
- ✓ Impacts and feasibility of innovative solutions using participatory impact assessment



Evgrafova et al.; in prep.

Stakeholder Workshops for specifying SSP storyline elements for soil management

- Apply SSP protocol of Eur-Agri SSPs
- 5 online participatory scenario workshops, Dec 2020 to March 2021
  - 2 English workshops + outreach/international collaboration
  - 3 German workshops
- **90** participants from 6 stakeholder groups:
  - State/Policy
  - Civil societies
  - Agricultural associations
  - Enterprises
  - Farmers
  - Academia

Focus on technology and environment

1. Population and urbanization*
2. Economy*
3. Policies and institutions*
4. **Technology**
5. **Environment and natural resources**

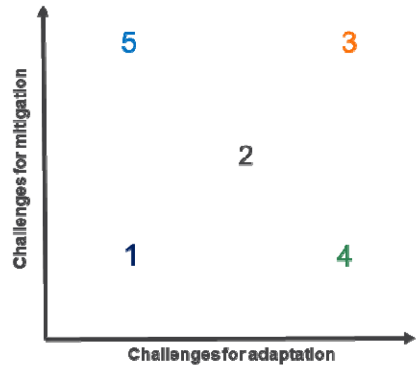
Evgrafova et al.; in prep.

Workshop Results: Technology storyline elements

Strong decrease	Tendency to decrease	Remains	Tendency to increase	Strong increase

Storyline elements			SMP1	SMP2	SMP3	SMP4	SMP5
	Technology uptake: Farm operationalization & management	Information and communications technologies (incl. Internet of Things) (Tzounis *et al.*, 2017; Villa-Henriksen *et al.*, 2020)	Strong increase	Strong increase	Remains	Strong increase	Strong increase
		Artificial intelligence (incl. machine and deep learning, language analytics, and computer vision)	Strong increase	Strong increase	Remains	Strong increase	Strong increase
		Agricultural automated robotics (incl. unmanned aircraft systems, sensors, e.g. precise 3D maps) (Foldager *et al.*, 2019)	Strong increase	Strong increase	Remains	Strong increase	Strong increase
		Controlled agricultural chemical inputs	Strong increase	Strong increase	Remains	Tendency to increase	Strong increase
		Biodegradable & bio-based cover materials	Strong increase	Strong increase	Tendency to increase	Tendency to increase	Strong increase
		Crop bioengineering and bioinformatics	Strong increase	Tendency to increase	Tendency to decrease	Strong increase	Strong increase
		Big data, blockchain and smart contracts	Strong increase	Strong increase	Tendency to decrease	Tendency to increase	Strong increase
		Photovoltaic and solar thermal technologies	Strong increase	Tendency to increase	Tendency to increase	Tendency to increase	Strong increase
	Social innovations	Cooperation between farmers (e.g. networks)	Strong increase	Tendency to increase	Strong increase	Tendency to decrease	Remains
		Participation in the national/regional landscape design program	Strong increase	Remains	Strong increase	Tendency to decrease	Tendency to decrease
		Certification (incl. tracking and tracing)	Strong increase	Strong increase	Tendency to increase	Tendency to increase	Strong increase
		Cooperation between farmers and consumers (incl. food sharing and crowdfarming)	Strong increase	Tendency to increase	Strong increase	Tendency to increase	Remains
	Technology acceptance by producers and consumers	Development of information sharing tools, e.g. platforms, apps, networks	Strong increase	Strong increase	Tendency to increase	Tendency to increase	Strong increase
		Policy regulations on agriculture-related technologies and data rights	Strong increase	Tendency to increase	Remains	Tendency to increase	Tendency to increase
	Speed of agricultural technology development	Research and development	Strong increase	Remains	Tendency to decrease	Strong increase	Strong increase
		Government support (recycling, e-commerce, green technologies etc.)	Strong increase	Remains	Tendency to increase	Remains	Strong increase
		Management of data rights	Strong increase	Remains	Remains	Tendency to increase	Strong increase
		Trainings for farmers (institutional and private)	Strong increase	Remains	Remains	Remains	Strong increase

SMP1 – Sustainable path
SMP2 – Slow change path
SMP3 – Nationwide path
SMP4 – Divided path
SMP5 – High-tech path

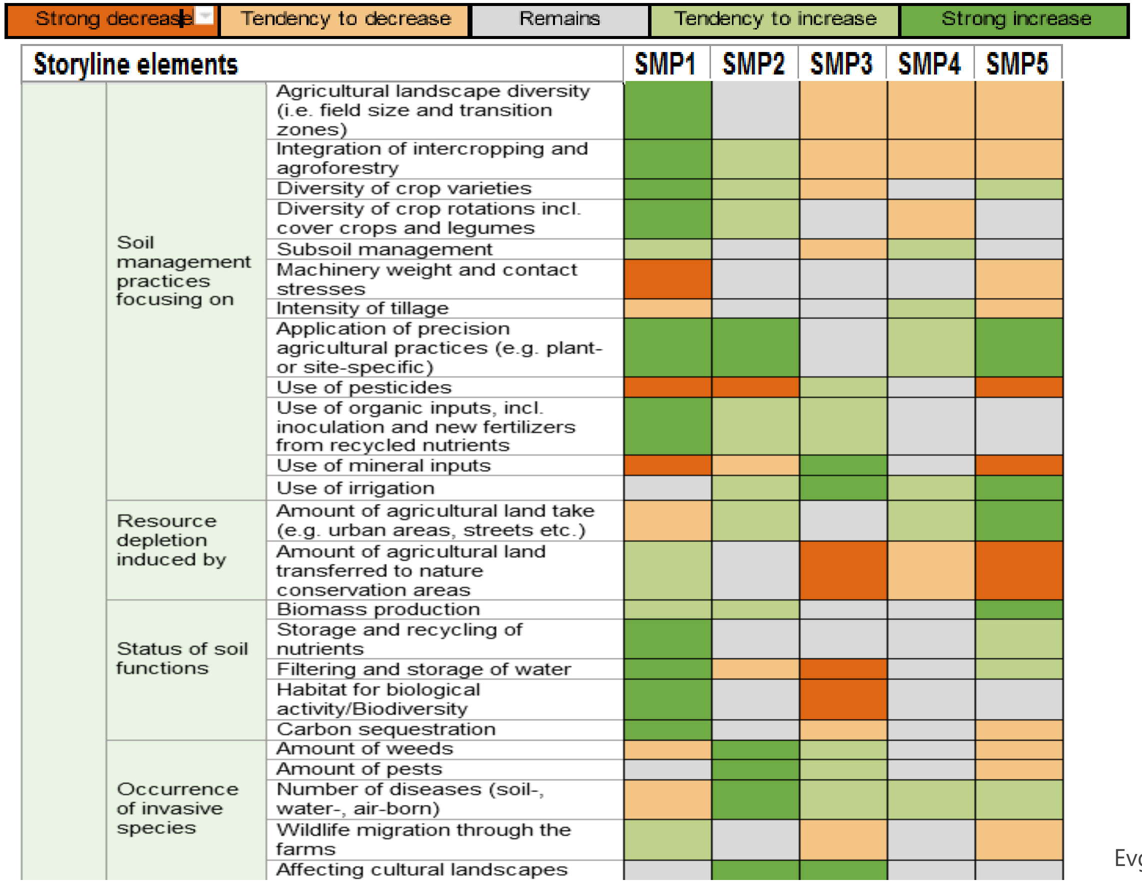


Evgrafova et al.; in prep.

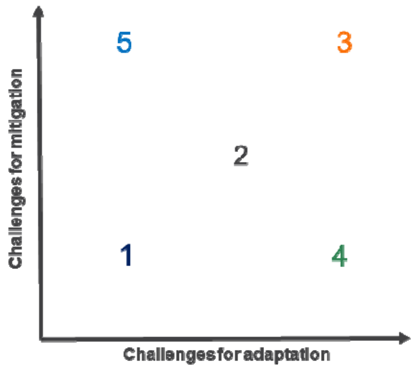
BONARES Centre for Soil Research

Sponsored by the Federal Ministry of Education and Research

Workshop Results: Environment and Natural Resources storyline elements



SMP1 – Sustainable path
SMP2 – Slow change path
SMP3 – Nationwide path
SMP4 – Divided path
SMP5 – High-tech path

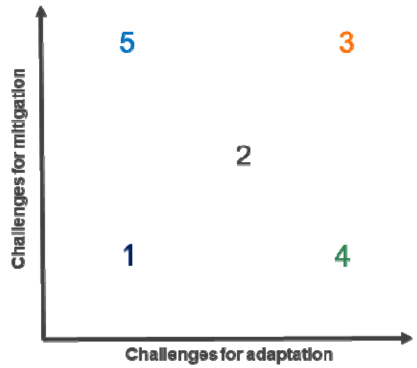


Evgrafova et al.; in prep.

Key messages from the Soil Management Pathways Workshops

- BAU (SMP2) was not a desired future;
- Divided path (SMP4) was often seen as representation of the current state
- Nationwide path (SMP3) scored worst on environmental health
- High-tech path (SMP5) mostly ignored diversification
- Sustainable path (SMP1) integrated technological with societal innovation
- Diversification key point (integration of high-tech with biological methods)

SMP1 – Sustainable path
SMP2 – Slow change path
SMP3 – Nationwide path
SMP4 – Divided path
SMP5 – High-tech path



Evgrafova et al.; in prep.

Key messages from the stakeholder interaction on Soil Management Pathways

MA2

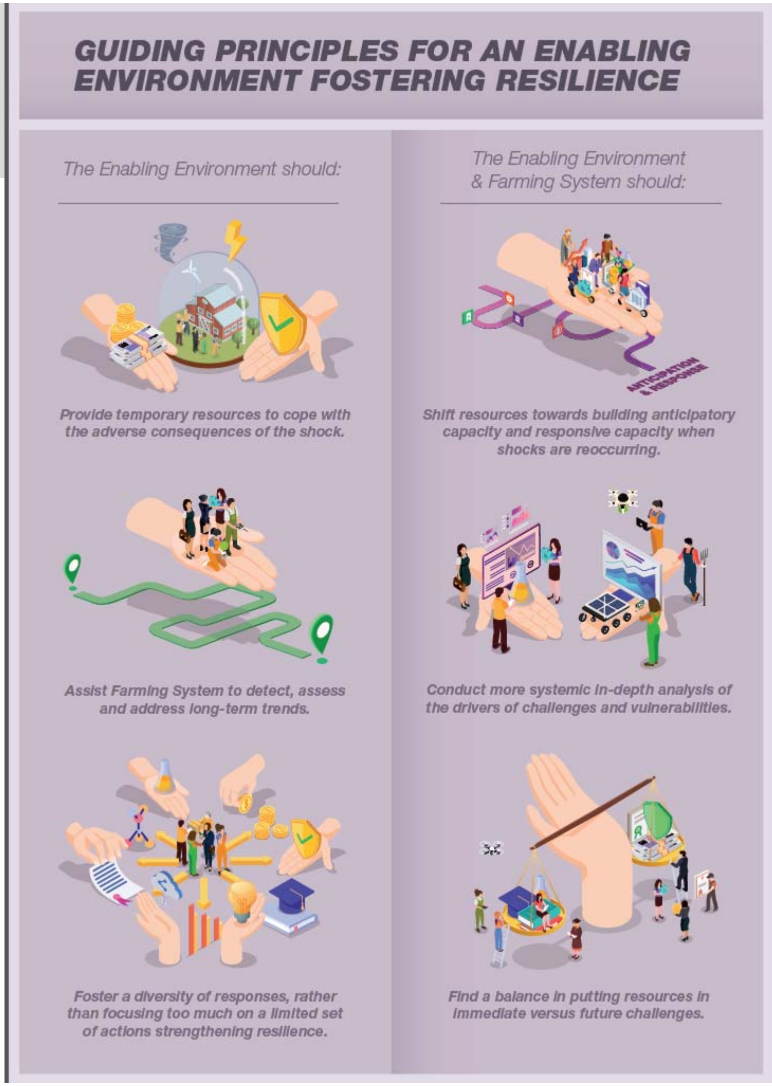
- Stakeholders were open for dialogues and collaboration. Only a few participants used the workshop to lobby their opinions, while the majority of participants were eager to learn and exchange ideas.
- Most stakeholder have very little opportunities and experience in foresight/scenarios development: they appreciated the learning exercise and possibility to share their opinions and knowledge
- At first, natural scientists experienced some skepticism on the added value of the such scenarios due to interdisciplinary complexity, afterwards, the relevance and necessity was recognized.
- Mock-up exercise within the institute (with soil experts) allowed to gain useful experience on team building and interdisciplinary thinking

Evgrafova et al.; in prep.

SPONSORED BY THE Federal Ministry of Education and Research

SUREFARM Infographic

Learn about long-term trends



Anticipatory capacity

Future challenges

Conclusions

Earthworms perspective on the future of agriculture:

- Integrate high-tech with biological measures and societal innovations
- diversify
- Exchange on future options

ONSORED BY THE
ederal Ministry
Education
d Research

Landscape 2021 - Diversity for Sustainable and Resilient Agriculture

20-22 September 2021

--- ONLINE CONFERENCE ---

Registration opened yesterday!

27 **sessions** that have been selected and are organised in six clusters:

- Cropping and grassland systems
- Farming systems
- Landscape management systems
- Public and private governance systems
- Food systems
- Cross scale systems
- Additional sessions

Sessions highlight the state of the art in agricultural landscape research and promote critical exchange pathways to more resilient and sustainable agriculture. Each session will last 90 minutes and include 3-presentations (decided by session organisers).

11 **Masterclasses** are organised, each will last 3 hours and host about 15-40 participants (prior

Leibniz Association

zalf

BONARES Centre for Soil Research

SPONSORED BY THE Federal Ministry of Education and Research

Thank you for your attention.

Leibniz Centre for
Agricultural Landscape Research
(ZALF)

Contact: Katharina Helming, helming@zalf.de