

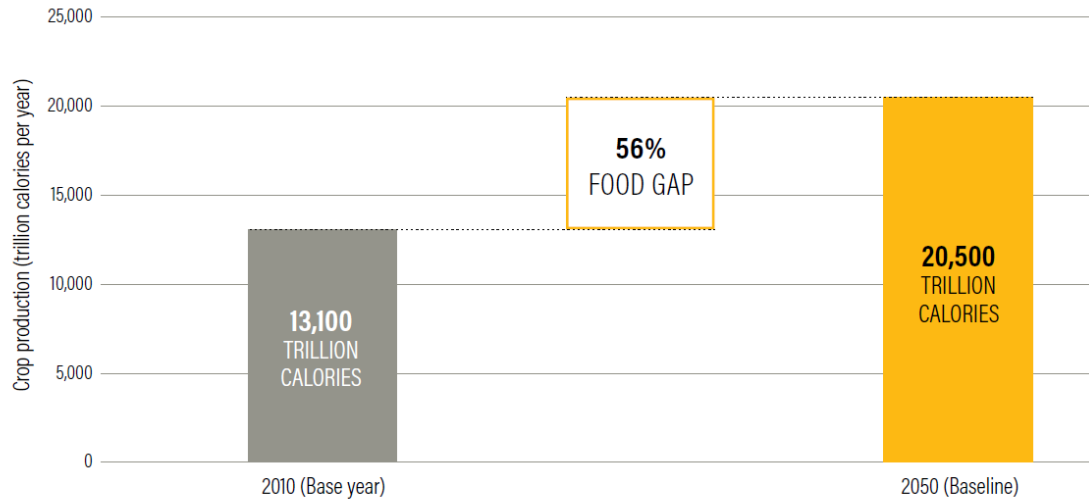
**Sustainable Food System Management:  
Organic Farming and Agroecology**  
*Prof Dr Urs Niggli*

Sponsored by:  
The OECD Co-operative Research Programme:  
Sustainable Agricultural and Food Systems

# Contents

- Global challenges.
- Organic farming as a strategy for greening and as a European path for empowered consumers.
- The role of innovation in sustainable food systems.
- Agroecology as a comprehensive, integrative and solution-oriented discourse between scientific knowledge and practice.
- Conclusions.

# Food security and the carrying capacity of the planet: an escalating conflict

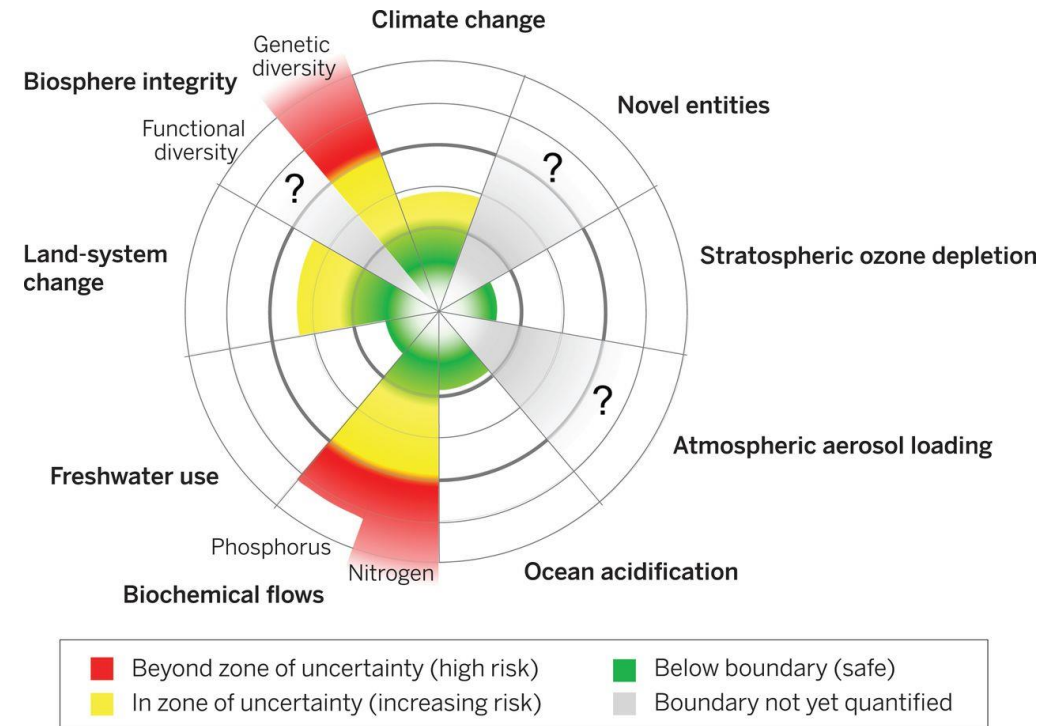


Note: Includes all crops intended for direct human consumption, animal feed, industrial uses, seeds, and biofuels.  
Source: WRI analysis based on FAO (2017a); UNDESA (2017); and Alexandratos and Bruinsma (2012).

## 593 million hectare additionally needed

- 401 million ha grassland
- 192 million ha arable cropland

Pollution of the planet in terms of nitrogen, phosphorus & loss of biodiversity in the **"high risk"** range. Climate and land-system change increasing risk.

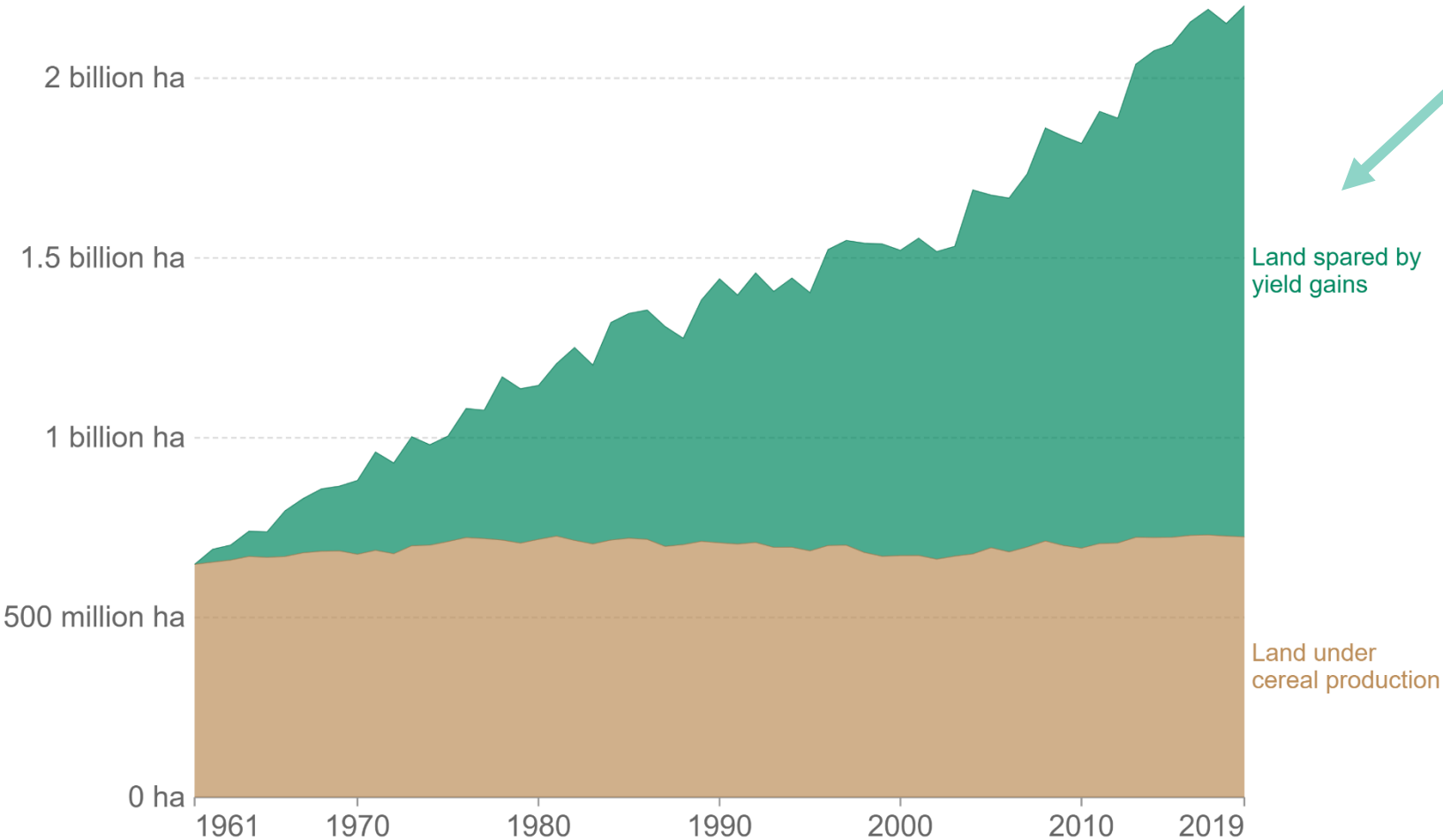




# Global land spared as a result of cereal yield improvements

Land sparing is calculated as the amount of additional land that would have been needed to meet global cereal production if average crop yields had not increased since 1961.

## Why productivity matters



Source: OWID based on UN Food and Agriculture Organization

OurWorldInData.org/land-use • CC BY

# Recommendation of the Scientific Group of the UN Food Systems Summit 2021

- Productive agricultural systems that harness - but do not consume - the natural resources of soil, water, air and biodiversity.
- For this, we need traditional knowledge (passed on by women in the countries of the Global South), agricultural experience, social and institutional innovations as well as scientific-technical innovation.

# Policy recommendations of the *foodpolicycoalition.eu* (1)

### Priority 1: Take a food systems approach

- Goal: environmentally-sound, fair and healthy food systems within planetary boundaries.
- Monitor and measure food systems sustainability in a holistic way (beyond LCAs).

### Priority 2: Set a new governance framework for the EU food system

- ...binding all food-related laws and policies.
- Support food **democracy** to address institutional power concentration in the food sector.
- Create a European Food Council.
- Encourage social innovation and experimentation.

## Policy recommendations of the *foodpolicycoalition.eu* (2)

### Priority 3: Develop enabling food environments

- Shifting consumption is key.
- Enabling consumers against dominance of the middle of the supply chain.
- EU with strong measures on public and private procurement and marketing.
- Require National Sustainable Food Plans.

### Priority 4: Strong accountability and fairness throughout the food chain

- A regime of corporate responsibility for traders, retailers and processors.
- Providing strong enforcement mechanisms for the EU food trade policy within a socially and environmentally safe operating space.

## Recommendations of the participatory process of experts (EU-JRC, 2022)

Action Plan of the Farm-to-Fork Strategy foresees a **legislative framework for sustainable food systems**. Possible building blocks could be:

1. A sustainability assessment framework
2. Transparency to **empower main actors** such as farmers, **consumers**, and most important other agents of change (large retailers, large food and drink manufacturers, finance and international traders).
3. Dealing with consequences of the transition (fair balance between winners and losers).
4. Policy coherence and multi-level governance.
5. International trade (reform WTO, trade agreements etc).



# Recommendations of the participatory process of the experts (EU-JRC, 2022)

## Overarching aspects:

- Paradigm shift away from short-term economic gains to a holistic sustainability orientation needed.
- Urgency of action.
- Mandatory approaches with ambitious and effective binding rules.
- Agency, empowerment and responsibility are a “package”.

# UNFSS 2021: Boost nature-positive production

Protect natural systems from  
new conversion  
for food production



«Cuvette Centrale» Democratic Republic of the Congo



Sustainably manage  
existing food  
production systems

Restore and rehabilitate  
degraded systems for food  
production & ES



## **Sustainable and productive management of existing agricultural land. All kinds of innovations are needed.**

- **Social and institutional innovations**, e.g. farmer-consumer partnerships, living labs, food hubs, on-line food shops, urban agriculture, farmer-farmer coops.
- **Ecological innovations** (or optimizations), e.g. better understand and sustainably manage soil fertility and (functional) biodiversity.
- **Technological innovations** , e.g. plant and livestock breeding, digitalization, material science and engineering.



**Also in organic farming: breakthrough thanks to resistant varieties (ex. Apple scab, *Venturia inaequalis*)**





# Importance of breeding and variety testing paramount (e.g.: potatoes: *Phytophthora infestans*)



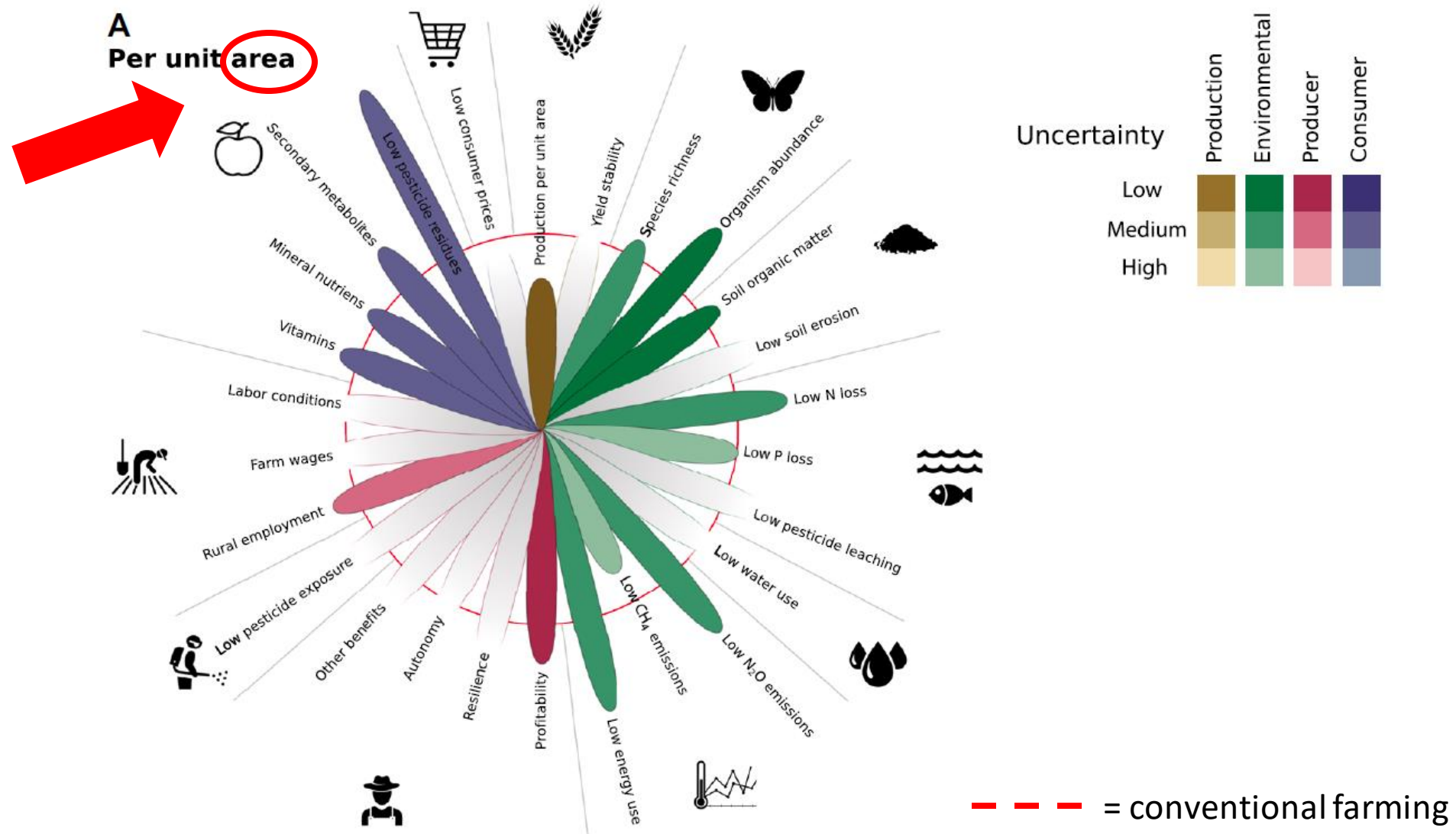
On biodynamic field plots with different soil fertility management:

- Factor cultivars highly significant.
- Factor soil fertility management n.s.
- Interactions cultivars x soil fertility management n.s.

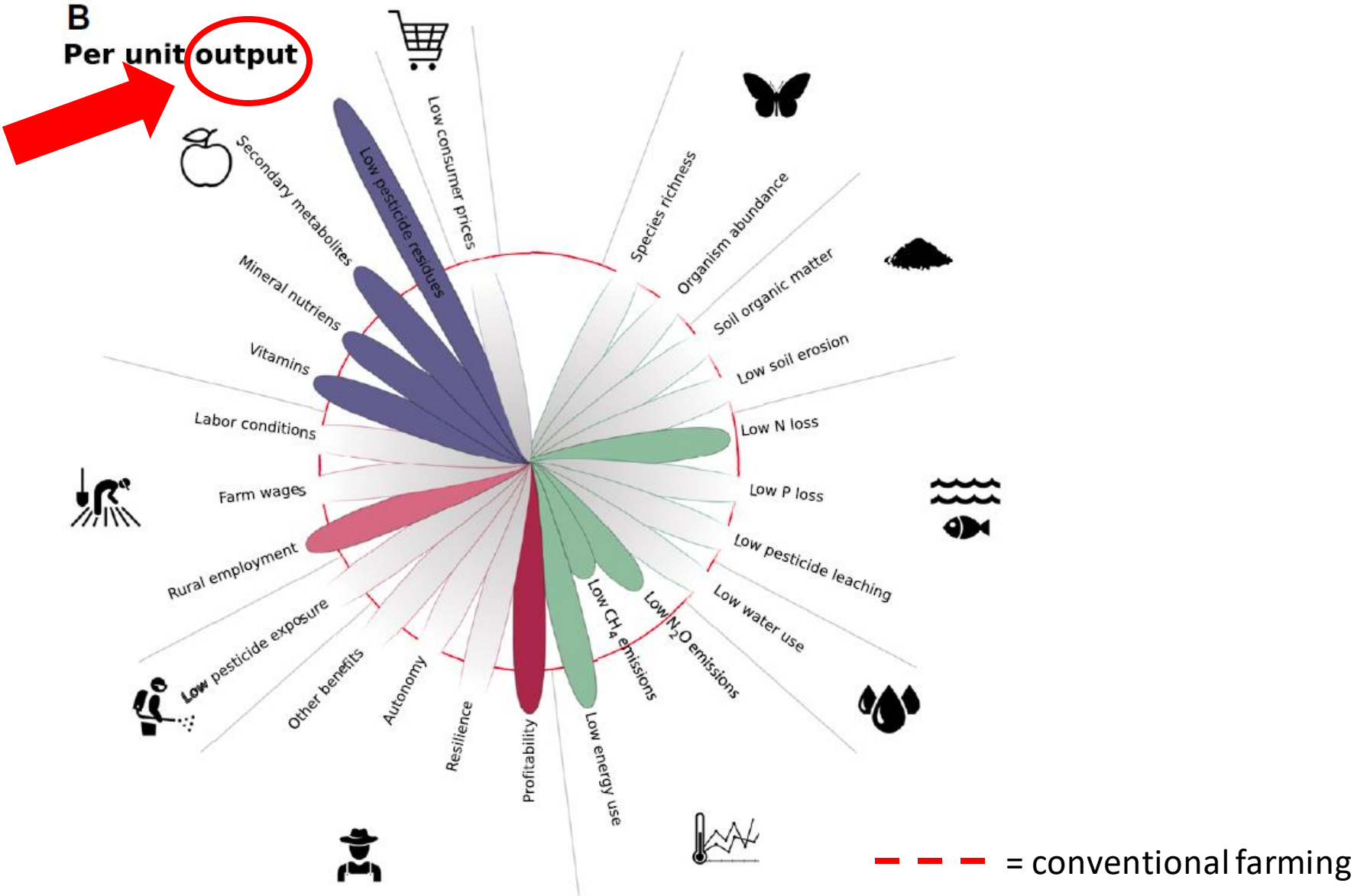
Speiser, FiBL, 2004-2009, EU-QLIF



# Performance of organic farming compared to conventional per area



# Performance of organic farming compared to conventional per output



# FAO: 10 elements of agroecology



Diversity



Co-creation and sharing  
of knowledge



Synergies



Efficiency



Recycling



Resilience



Human and social values



Culture and food  
traditions



Responsible governance



Circular and solidarity  
economy



# Hypothesis of Agroecology „ There is sufficient scientific evidence that agricultural diversification positively correlates productivity with ecosystem and natural resource maintenance, thereby reducing trade-offs.”

## Meta-Analyses (excerpt):

- Tamburini, G et al. (2020) Agricultural diversification promotes multiple ecosystem services without compromising yield. *Science Advances* 6.
- Agroecological transformation for sustainable food systems. Insight on France-CGIAR Research. Number 26, September 2021. [www.agropolis.org/publications/thematic-files-agropolis.php](http://www.agropolis.org/publications/thematic-files-agropolis.php)
- Niggli U., Sonneveld M. and Kummer S. (2023): Ways to promote agroecology for a successful transformation to sustainable food systems. In: Von Braun J., Afsana K., Fresco L. O., Hassan M.H.A. and Torero M. (eds.) (2023): Science and Innovations for Food Systems Transformation, Springer Open Access. [https://doi.org/10.1007/978-3-031-15703-5\\_2](https://doi.org/10.1007/978-3-031-15703-5_2)
- Davis, A.S., Hill, J.D., Chase, C.A., Johanns, A.M. & Liebman, M. (2012). Increasing Cropping System Diversity Balances Productivity, Profitability and Environmental Health. *PLoS ONE* 7(10): e47149.
- Jalli M, Huusela E, Jalli H, Kauppi K, Niemi M, Himanen S and Jauhiainen L (2021) Effects of Crop Rotation on Spring Wheat Yield and Pest Occurrence in Different Tillage Systems: A Multi-Year Experiment in Finnish Growing Conditions. *Front. Sustain. Food Syst.* 5:647335. doi: 10.3389/fsufs.2021.647335
- Competitive dynamics in two- and three-component intercrops METTE KLINDT ANDERSEN, HENRIK HAUGGAARD-NIELSEN, JACOB WEINER and ERIK STEEN JENSEN (2007) *Journal of Applied Ecology* 44, 545–551

### Oats and White Lupine



### Intercropping Mais und Inkarnatklee



# Farming methods and standards

## Agro-ecological farming

- Many excellent principles and recommendations, vaguely worded.
- No mandatory standards.
- No bans and detailed restrictions.
- Basically open to technologies.
- No inspection.
- Social learning process.

## Organic farming

- 4 principles of health, ecology, fairness and care, more bindingly worded.
- Mandatory standards.
- Bans and detailed restrictions.
- General technology bans.
- Inspection and certification (3<sup>rd</sup> party, group certification, PGS).
- Jump in, accept it or forget it



# Use of digitization for system diversification while maintaining yields



Strip and contour farming (3000 ha organic Farm Laguna Blanca in Argentina).

*(Photo: Tompkins Conservation Foundation)*



Precision farming  
for clever people

.... for "dummies"



# Agroecological transformation of farms (and society)

**Level 1:** Increasing efficiency

**Level 2:** Replacing industrial/conventional inputs and practices with alternative practices.

**Level 3:** Transforming the agroecosystem so that it becomes self-regulating, regenerative, and resilient.



**Level 4:** Restoring farmer-consumer exchanges and creating shorter value chains.

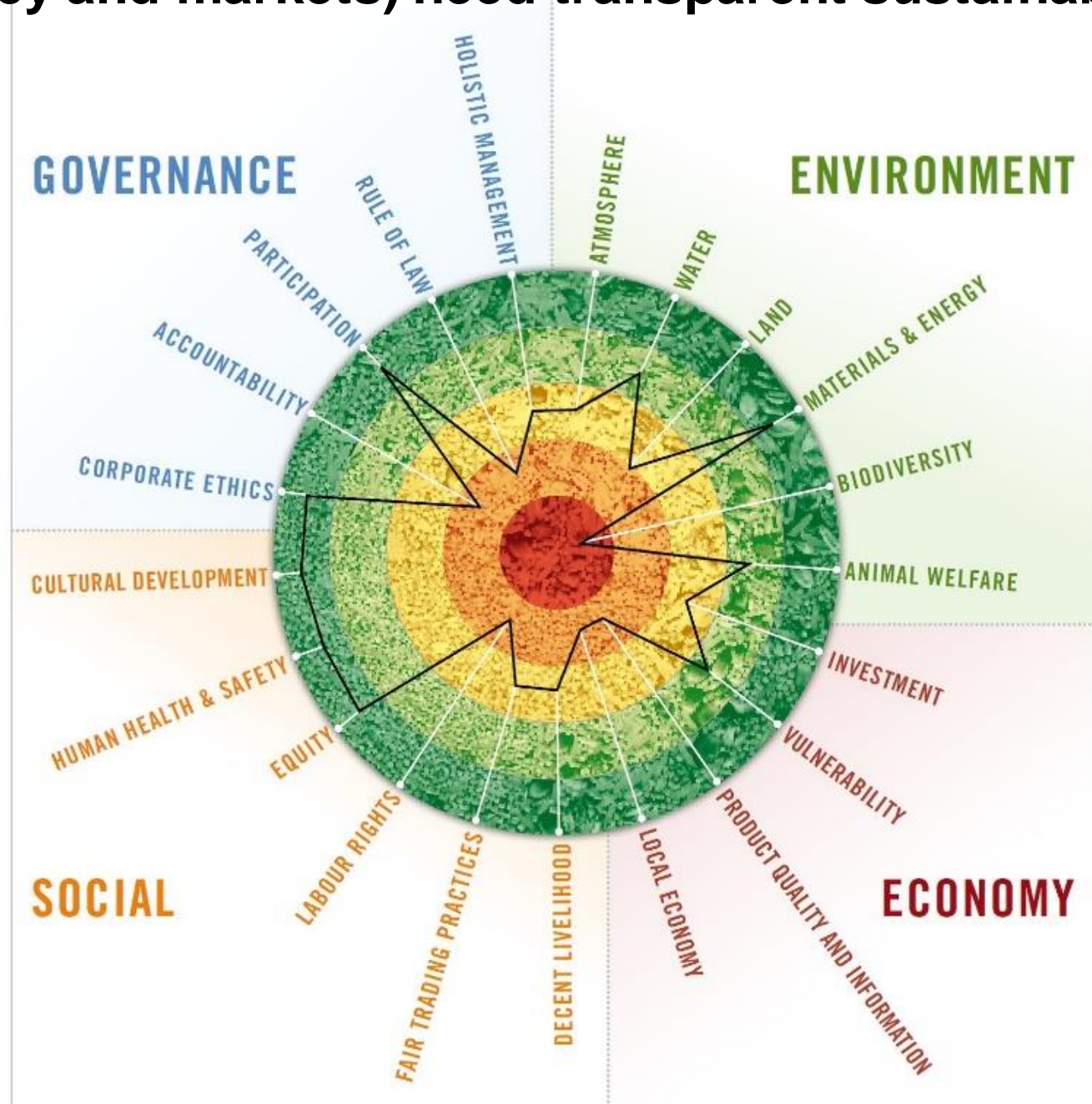
**Level 5:** Societal paradigm shift in terms of consumption, policy and trade.



# Transformation (and policy and markets) need transparent sustainability assessment.

## The SAFA guidelines (FAO)

- 4 dimensions
- 21 themes
- 58 sub-themes with sustainability goals defined.
- > 300 indicators with metrics



## We need: New, more appropriate narratives

“A system approach is much more effective for addressing multiple challenges than a ‘silver bullet’ technology like precision farming, novel breeding technologies”.

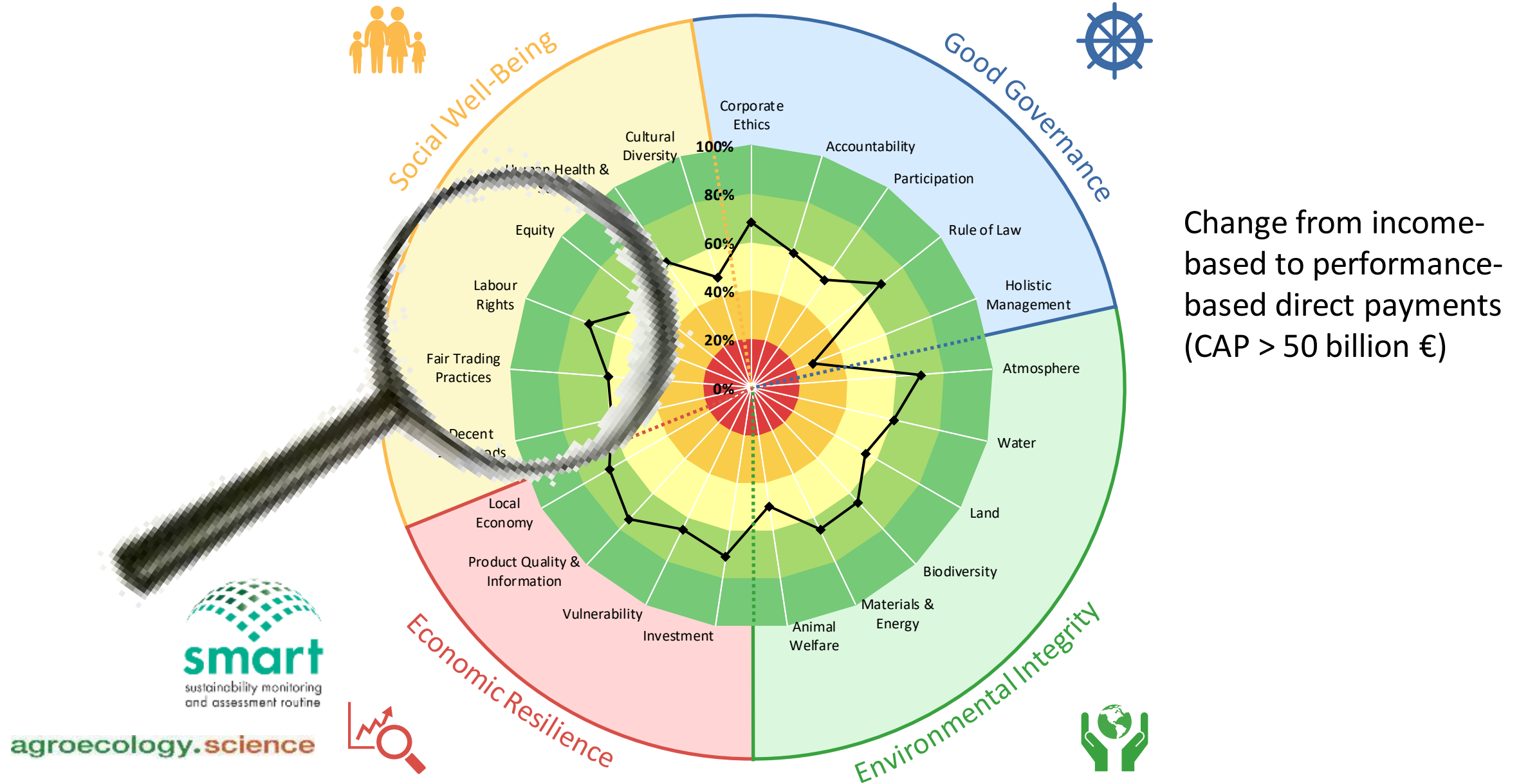


“There is no basic contradiction between sustainable and diversified production systems and best modern science-based technologies.”

Examples:

- Cultivars with agronomically and ecologically best functional traits”\*
- Landscape and farm system design with precision agriculture.
- Very targeted application of fertilizers and pesticides with GPS, sensors and cameras.

# We need: Innovation through a transparent sustainability assessment





## Conclusions:

- A sustainable framework for food systems is urgently needed and needs to be made operational.
- Empowerment of actors.
- Diversification is the key to sustainably increasing yields.
- The most effective on-farm measures are diversified crop rotations, alley cropping, and to a lesser extent intercropping and mixed cropping.
- Digitization offers techniques for diversifying cropping systems and landscapes and reducing pesticides and fertilizers.
- Agroecological agriculture offers a holistic innovation strategy with *social, institutional, environmental, and technological* elements.