

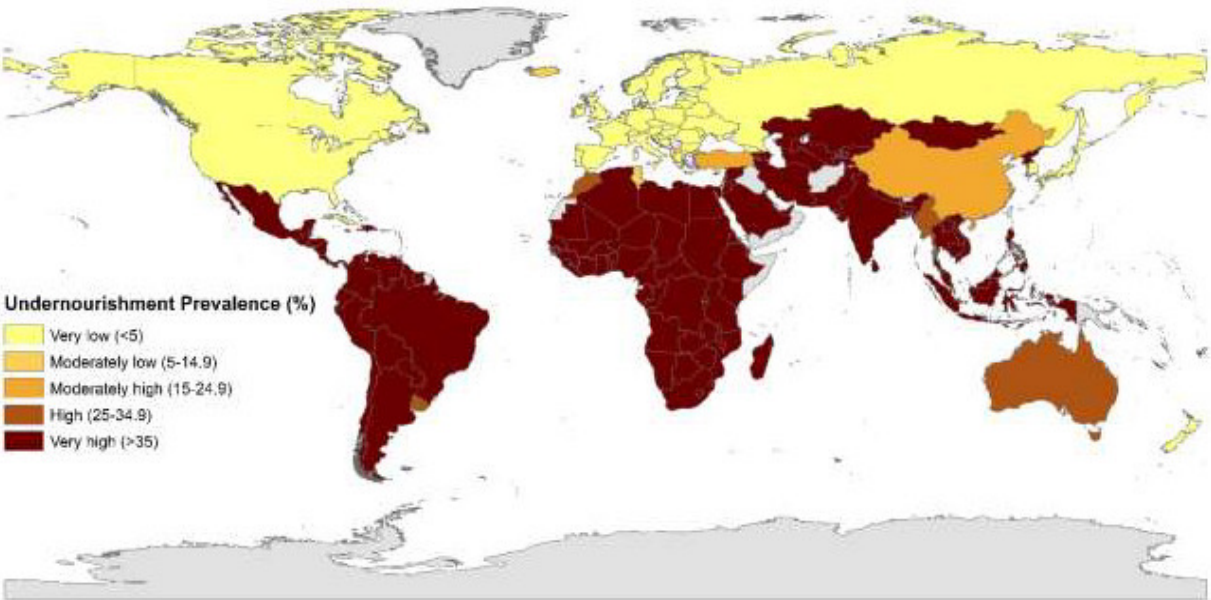
Enhancing Resilience in Agricultural Production Systems with Technology Development

Global Summit of Women- Luncheon session
"FOOD SECURITY AND TECHNOLOGY"

Dr. Kathrin Grahmann

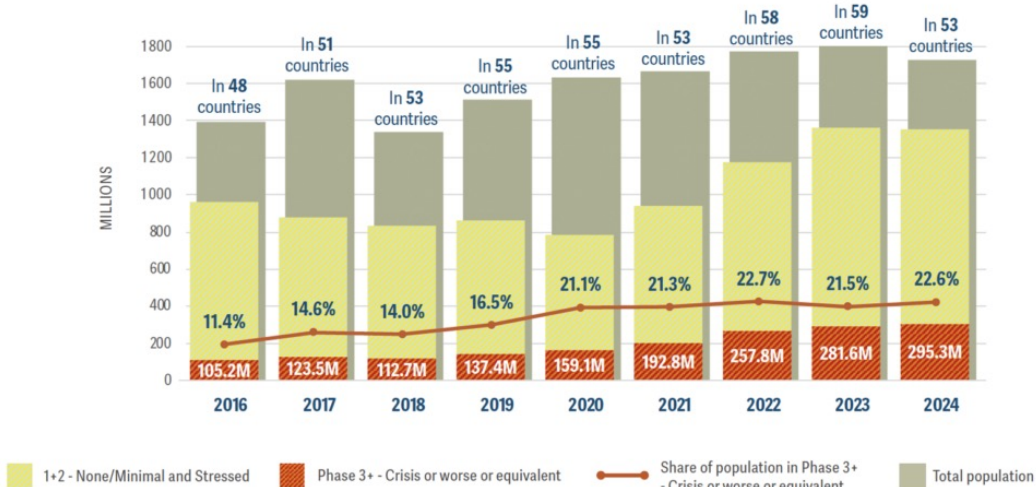


The growing food crisis



Prediction of highest global impact scenario in **2050** applying RCP6.0 SSP3

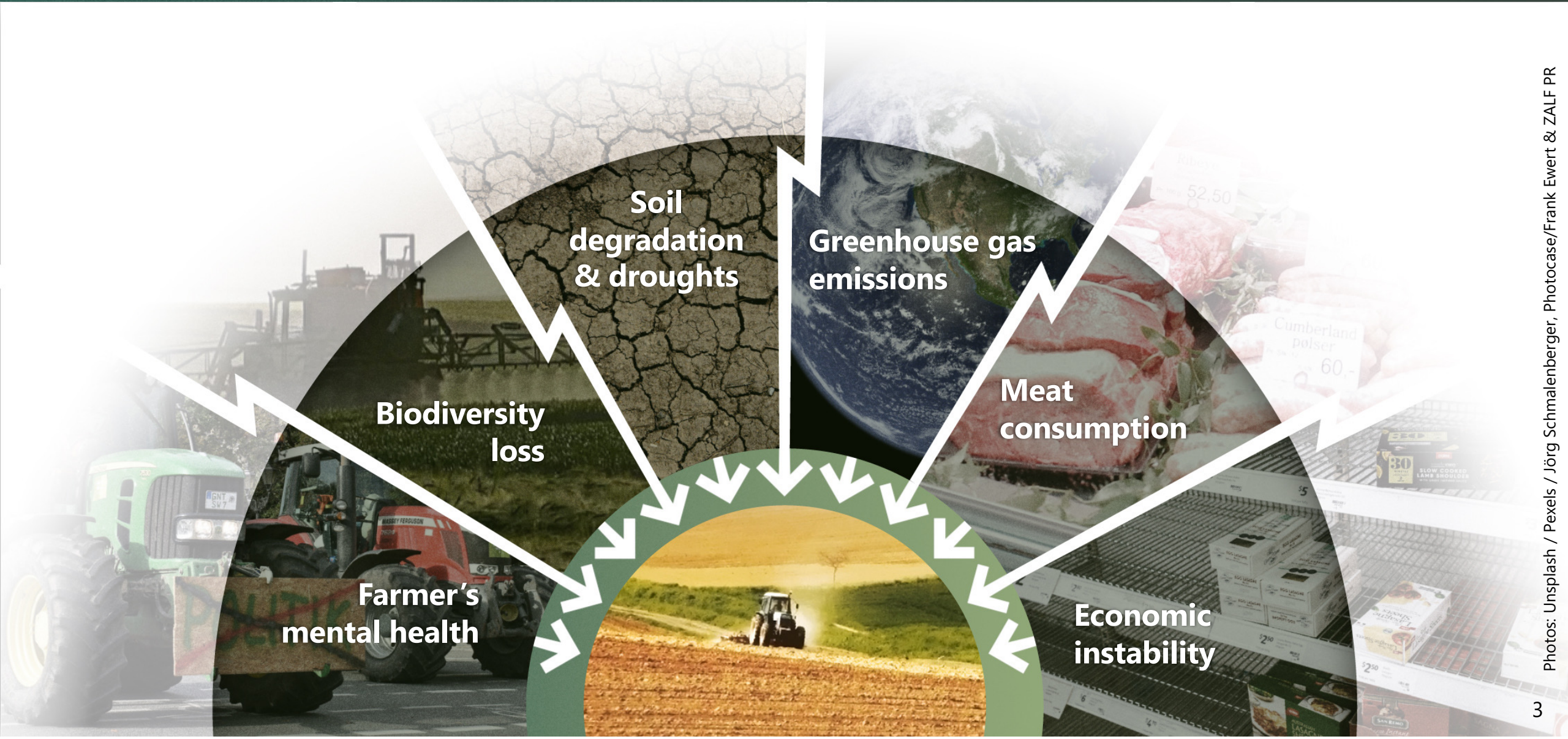
Numbers of people and share of analysed population in GRFC countries/territories facing high levels of acute food insecurity, 2016–2024



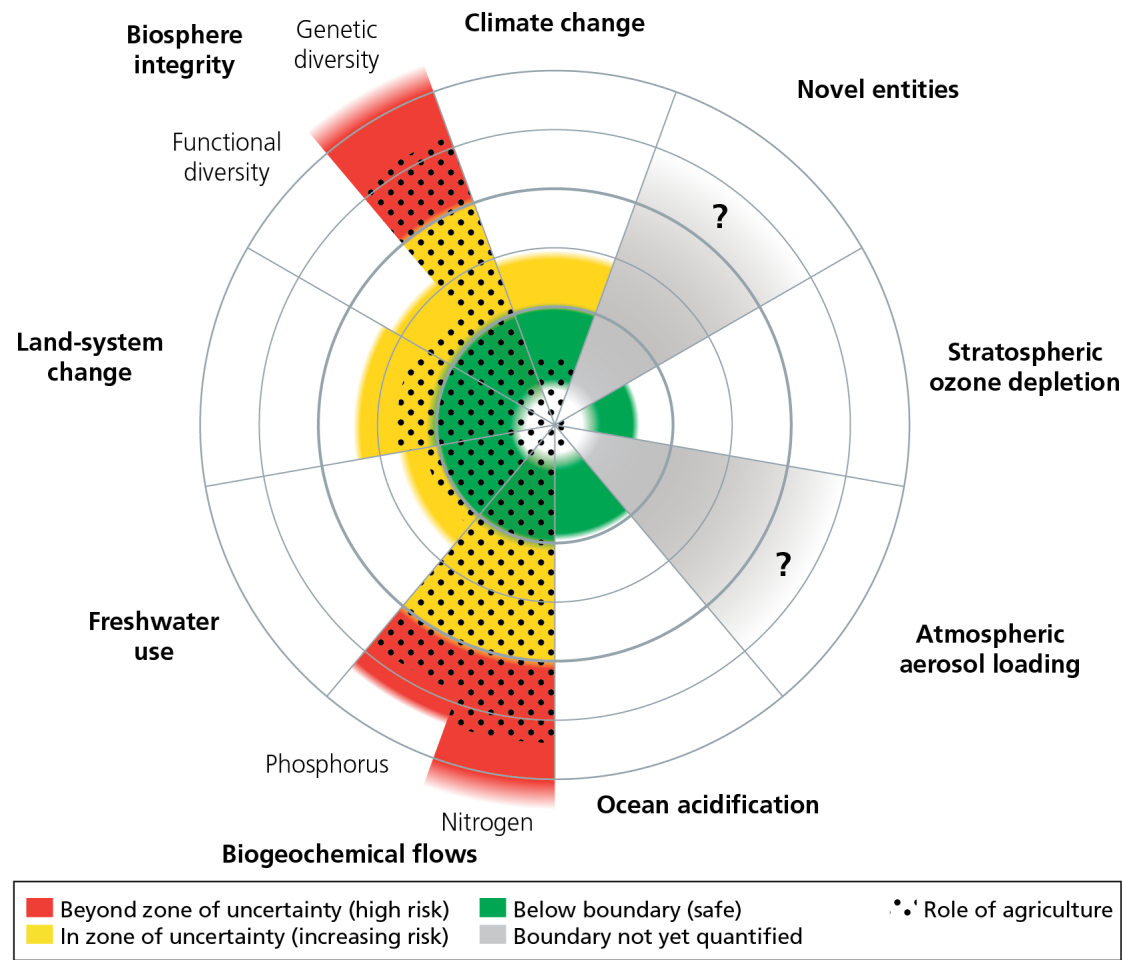
International Food Policy Research Institute: 2025 Global Report on Food Crises



Most pressing challenges facing agriculture

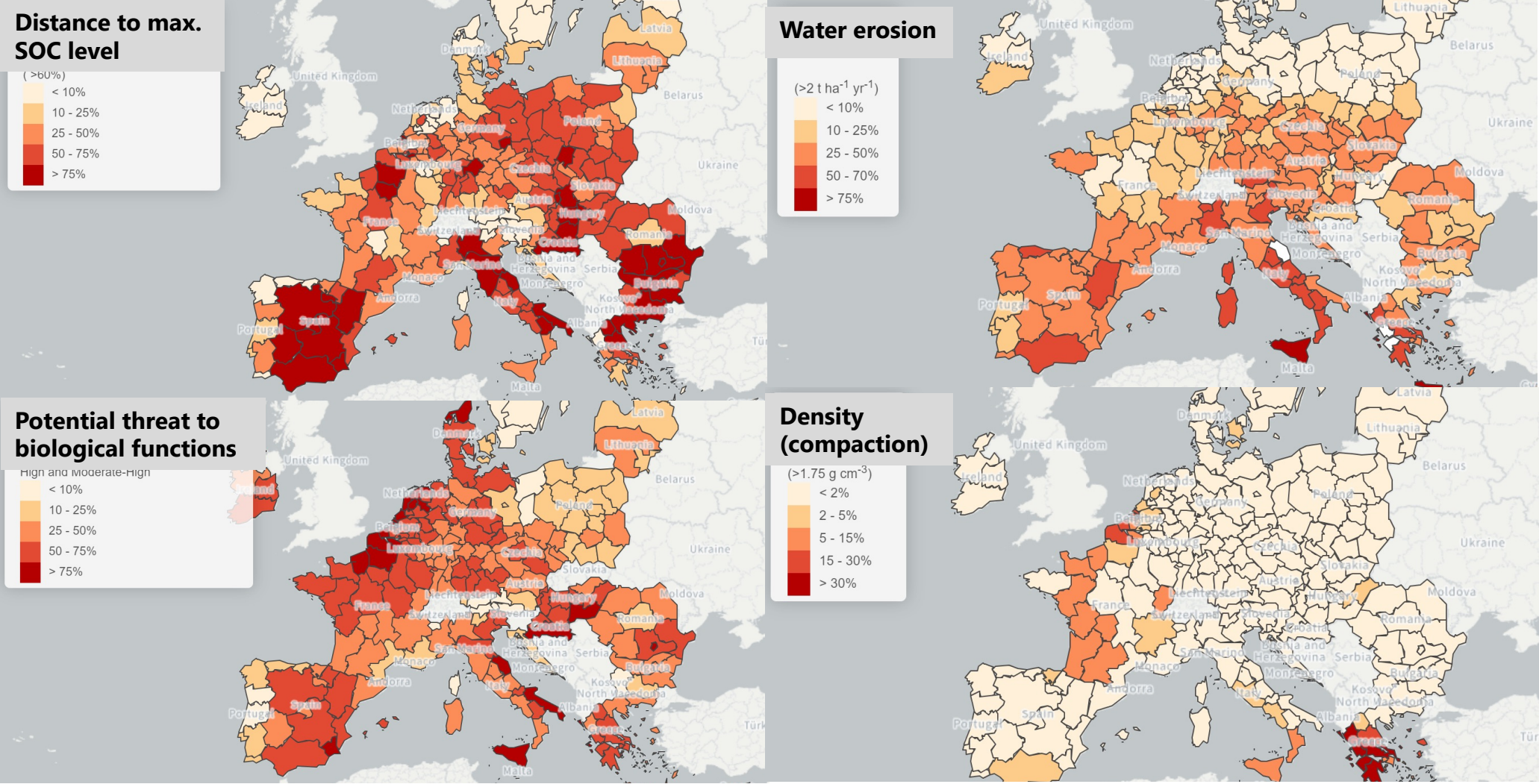


Planetary boundaries



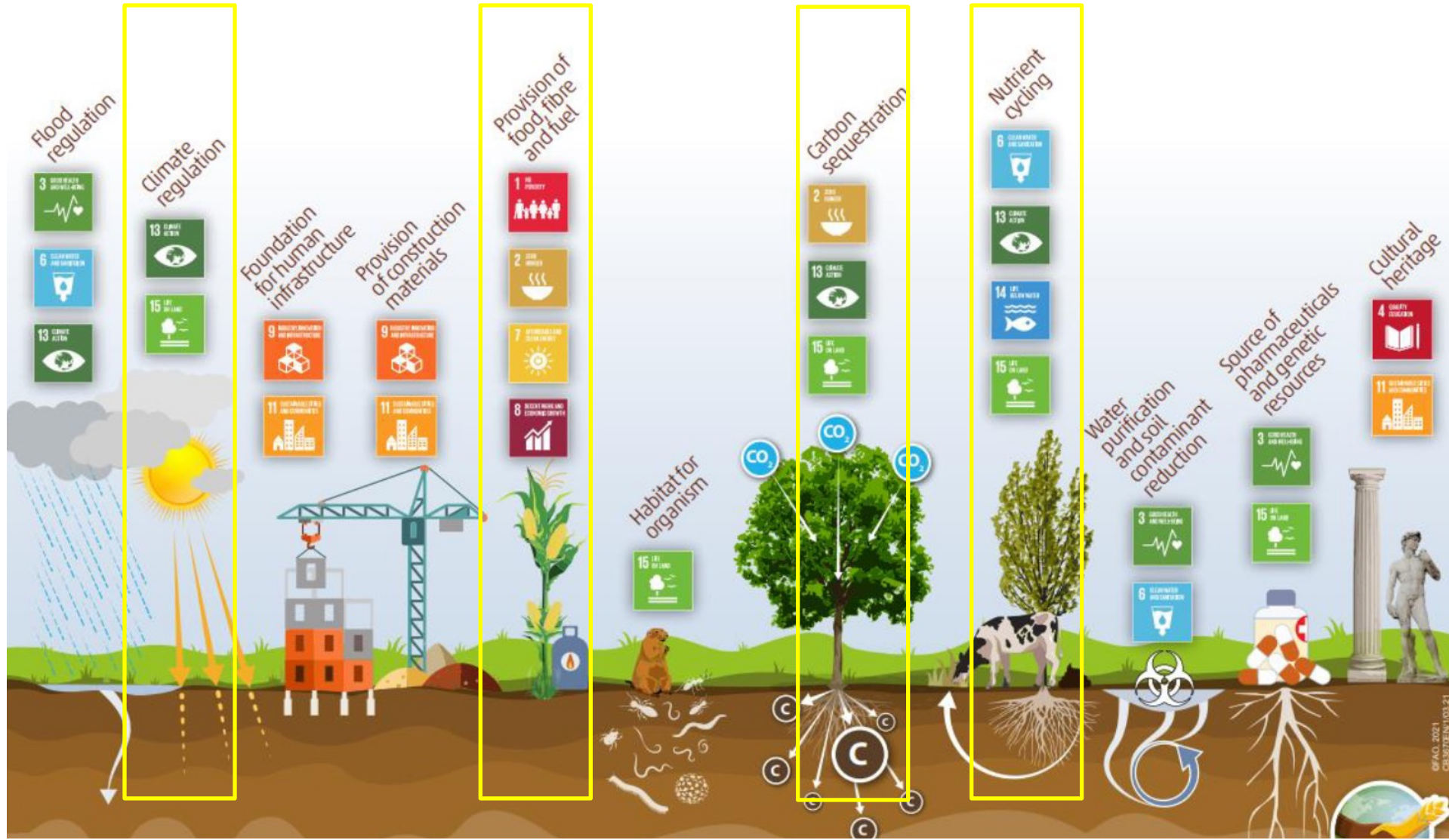
Source: Campbell et al. 2017, photo: tulumtimes, oysterheaven

Soil degradation

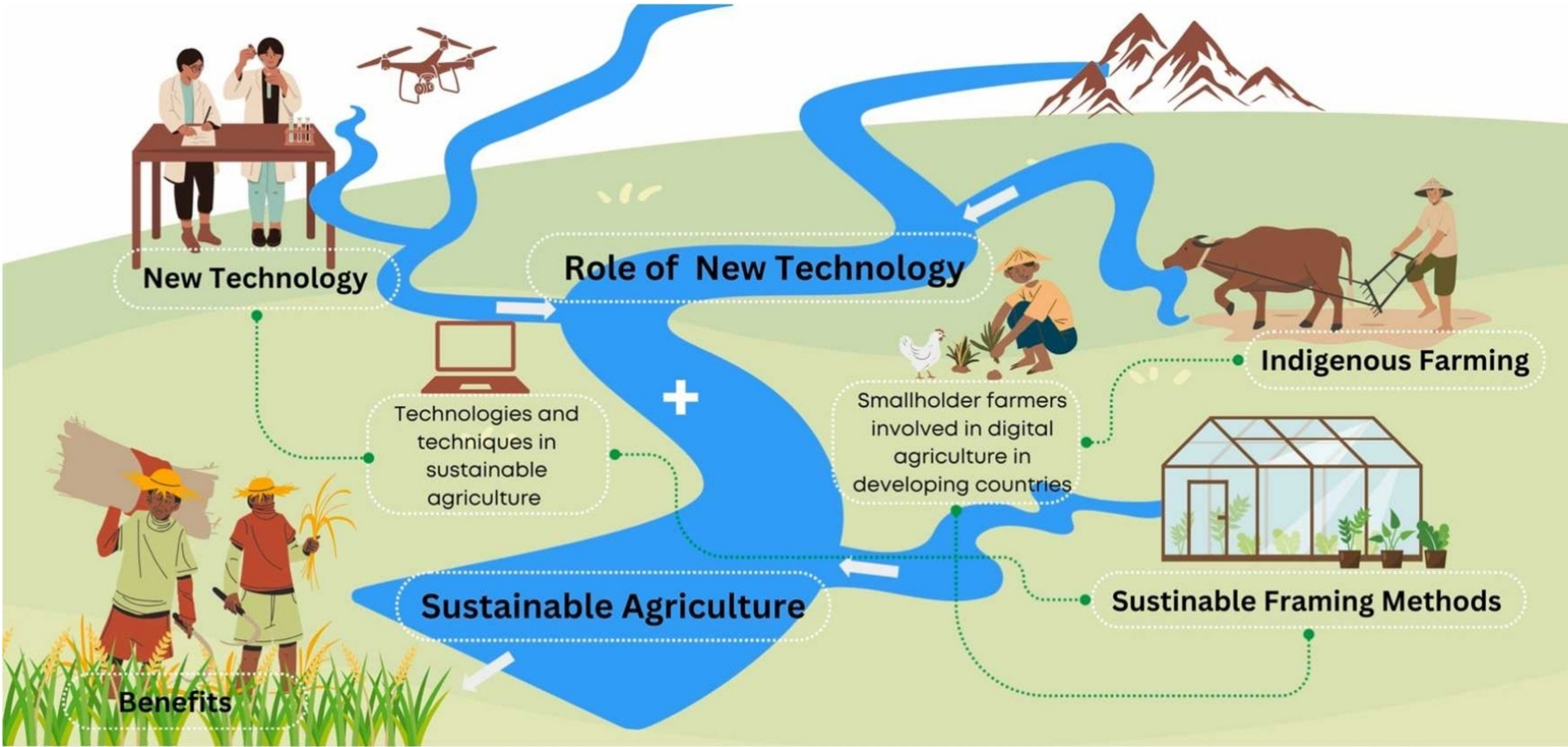


Source: EUSO Soil Degradation Dashboard - ESDAC (n.d.)




Healthy soils as a Game-Changer



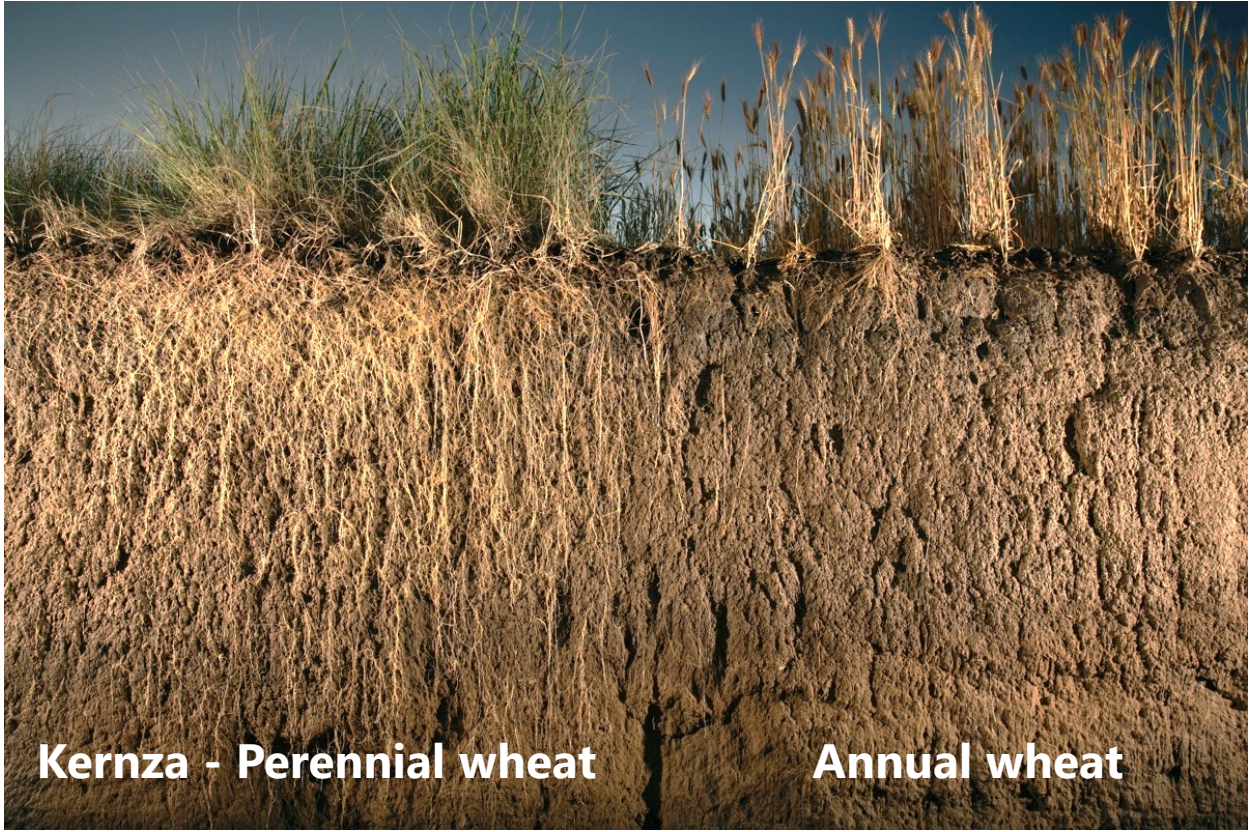
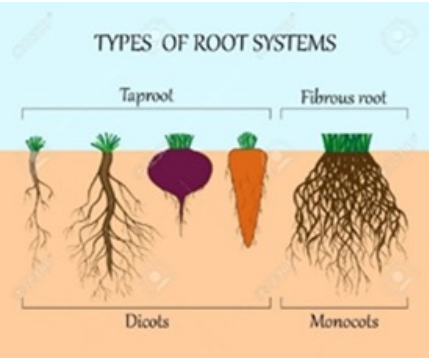
Role of technologies in agriculture



Crop rotation & diversification

YEAR 1	YEAR 2	YEAR 3	YEAR 4
 CORN	 CORN	 CORN	 CORN
 CORN	 SOYBEAN	 CORN	 SOYBEAN
 CORN	 WHEAT	 SOYBEAN	 CORN
 CORN	 WHEAT	 SOYBEAN	 ALFALFA

Crop pasture
rotation



Kernza - Perennial wheat

Annual wheat

Photos: Leah Penniman; kernza.org

Soil fertility

Water use efficiency

Yield stability

Pest & disease
resistance

Crop rotation & diversification



Crop pasture rotation



Milpa



Legume-based intercropping

Soil structure

Income diversification

Risk reduction

Soil fertility

Water use efficiency

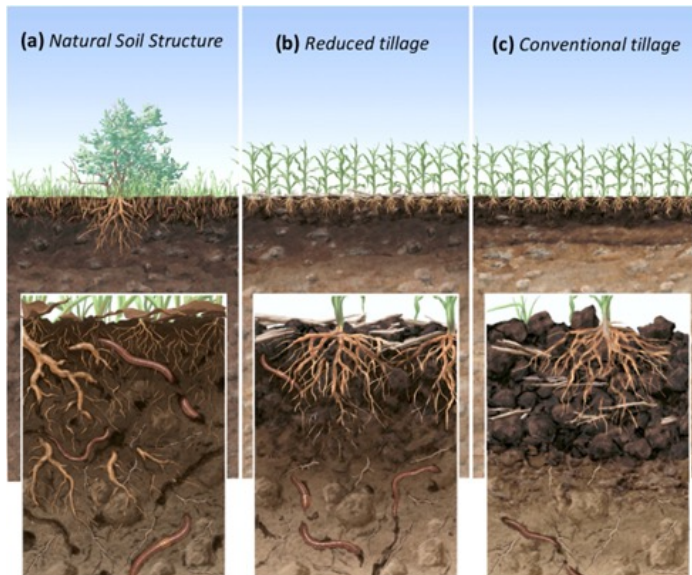
Yield stability

Pest & disease resistance

Conservation agriculture

Comprises three basic components

- Surface crop residue retention
- Minimal soil movement
- Economical viable crop rotations



Soil moisture
retention

Soil biological
activity

Fuel savings

Erosion protection





Erosion control

Water retention

Biodiversity
enhancement

Wind speed

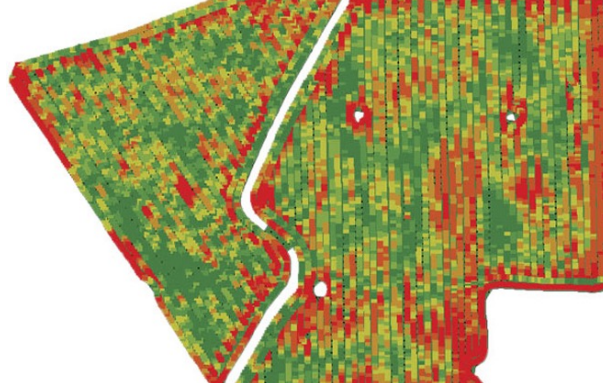
Income
diversification

(a) hedgerow for wind protection, (b) meadow orchard, (c) silvopastoral system with grazing sheep, (d) short rotation alley cropping system (e) recently established silvo-arable alley cropping system

Precision farming



Precision machinery



Yield maps



GPS path planning

Time savings

Pest & disease
management

Resource use
efficiency

Soil compaction

Profitability

Environmental
impact

Agri-photovoltaics



Single-axis tracker

Microclimate
benefits



Vertical Agri-PV

Biodiversity



Agri-PV with high
elevation

Hail protection

Dual/ Triple purpose

Marginal land use

Wind erosion

Photos: M. Donat, S.Bellingrath-Kimura, next2sun, gridparityag

Precision agriculture & technologies to manage diversified fields

Field sizes decrease

Crop diversification increases

Complexity unmanageable



Spot farming



Pixel cropping



Increasing number of relevant tasks, decisions & data

Agricultural robotics



Mechanical
weeding

Renewable energy
use



Planting

Pesticide reduction



Spot spraying

Labor-saving
automation



Harvest

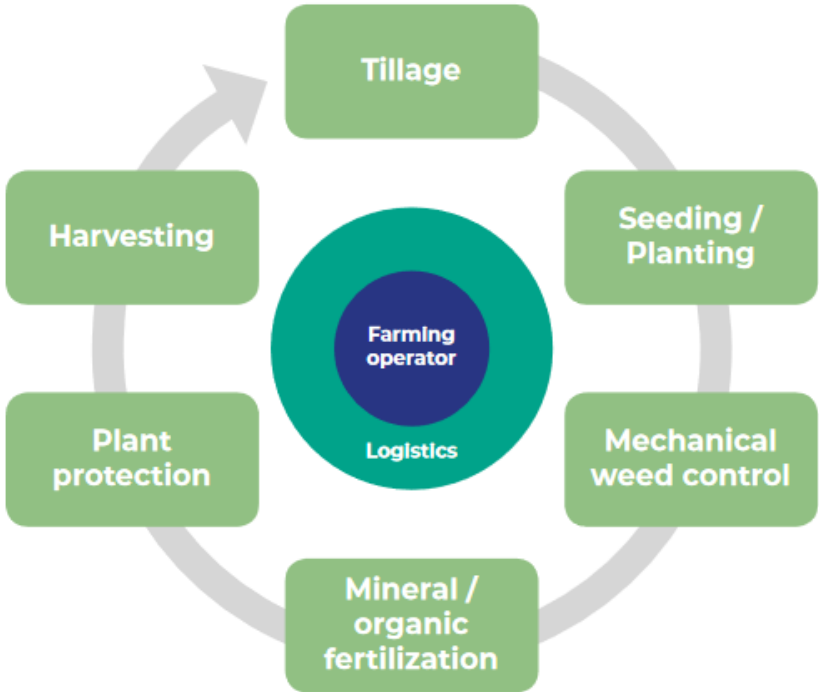
Soil compaction

Market evolution for autonomous field robots

Market share of automation type in **2045**, estimation based on expert interviews/workshops

Year 2045	Entirely human driven (no technological assistance)	Assisted human driven (with technological assistance, e.g. GPS)	Supervised autonomous machines	Entirely autonomous machines
High-technology, large-scale markets (North America & Australia)	<div></div>	<div></div>	<div></div>	<div></div>
Western European markets	<div></div>	<div></div>	<div></div>	<div></div>
Small-scale Asian markets	<div></div>	<div></div>	<div></div>	<div></div>
Low-technology, large-scale markets (Latin America)	<div></div>	<div></div>	<div></div>	<div></div>
Eastern European market	<div></div>	<div></div>	<div></div>	<div></div>
African & Middle Eastern Markets	<div></div>	<div></div>	<div></div>	<div></div>

Legend	<div></div>	<div></div>	<div></div>	<div></div>
Market share	> 80 %	50 – 80 %	10 – 50 %	< 10 %



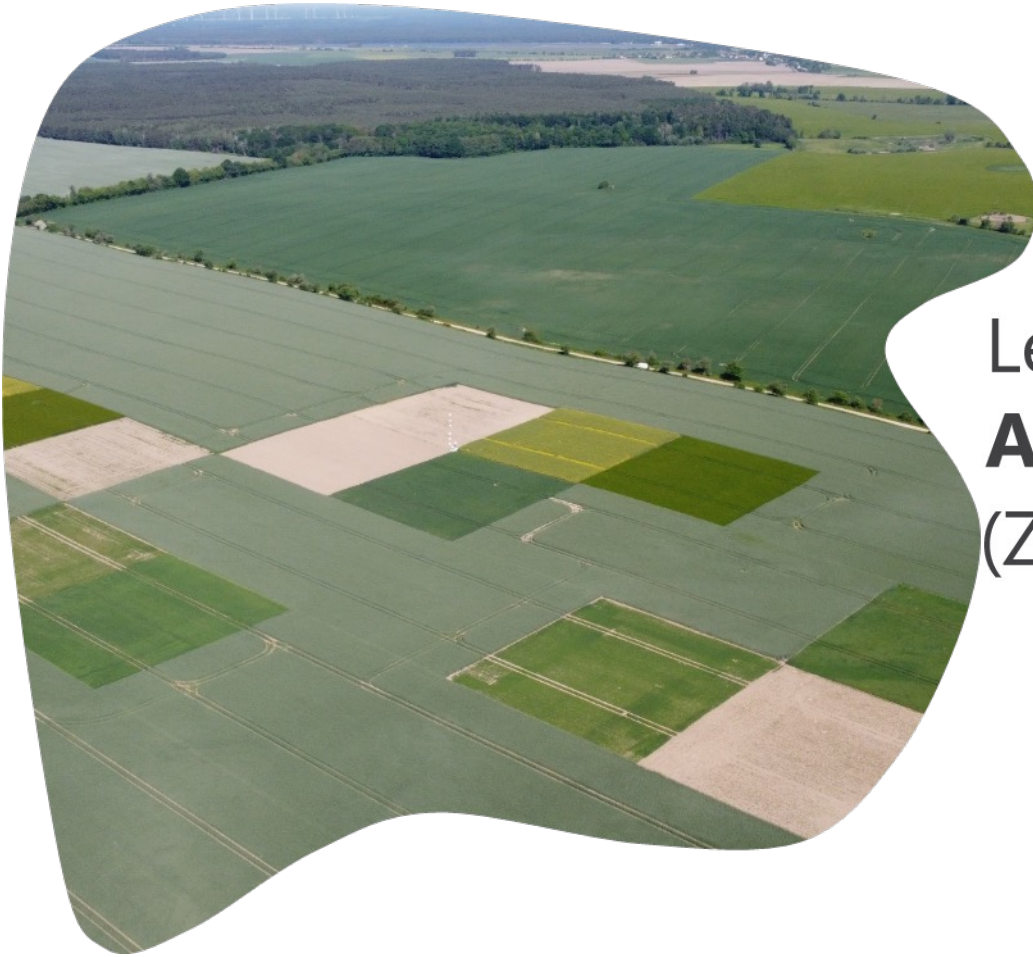
Source: Dörr et al. 2019

The future we can build

- Nature-based + digital = tool to cope with climate change
- Tech exists — but adoption is key and highly lacking
- Bioeconomy perspective links food, energy, biodiversity, and soil health
- Requirements: Change must happen with farmers, not just for them
 - Living lab approach (take it to the farmer, innovator hubs, co-creation of knowledge)



Thanks a lot for your attention!



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