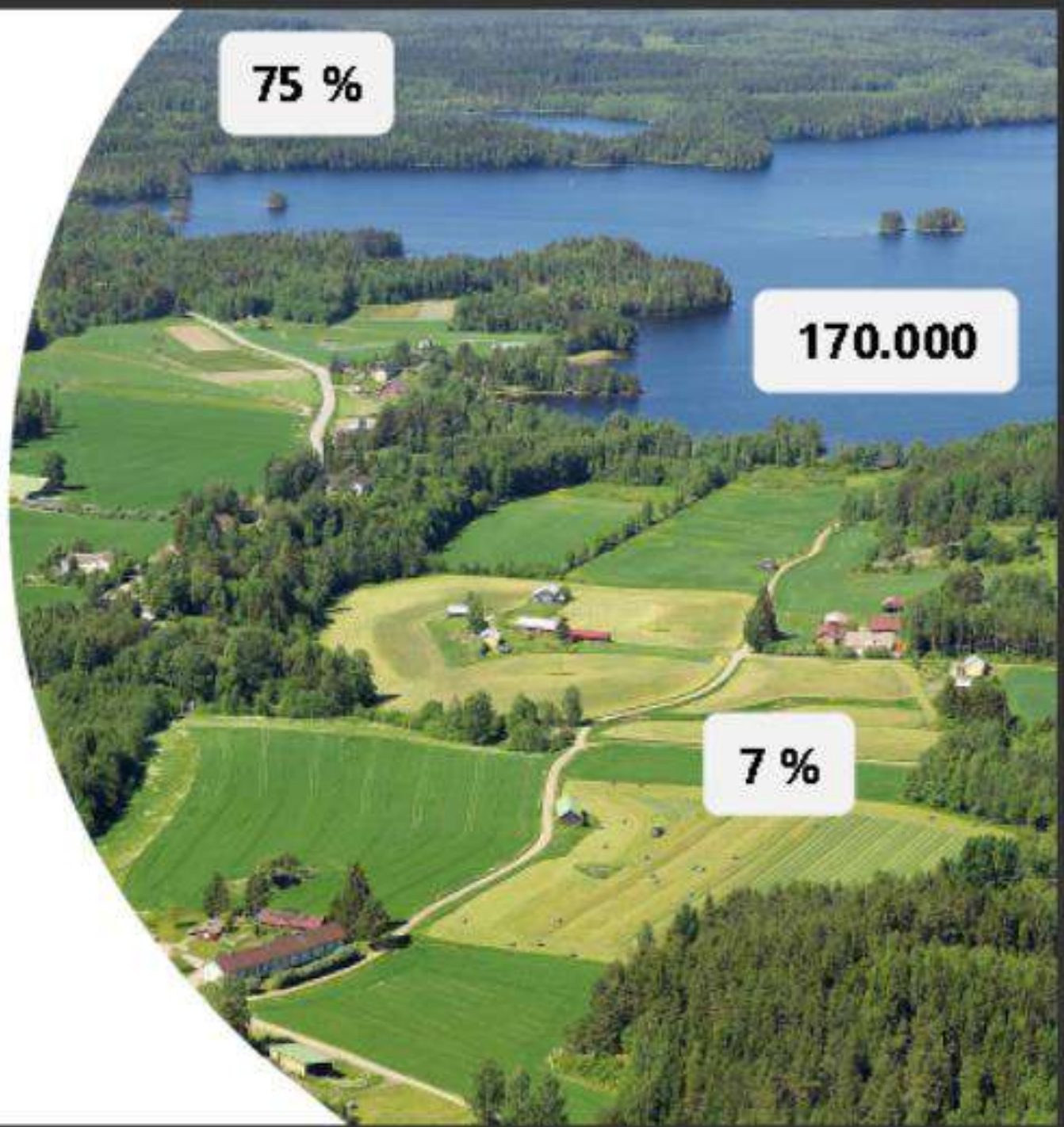


Legacy effects on farmers' fields based on satellite images – the role of nitrogen

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MISSION A sustainable future and well-being from renewable natural resources through ambitious research and knowledge

We strengthen
the renewal and innovation
of primary production

VISION

**We are bold builders
of the biosociety**

We create solutions promoting
responsible and reconciled
natural resource use




We foster a competitive and
crisis-resilient biosociety

We valorise natural resource data
and turn research into impact



Programmes and focus areas

Renewing primary production

-  Forest value chains
-  Food value chains
-  Material flows and circular bioeconomy concepts

Crisis-resilient biosociety

-  Disruptive technologies and modern breeding
-  Security of supply and risk management
-  Systemic change to biosociety

Multifunctional nature resource use



Land and water use



Climate change mitigation and adaption



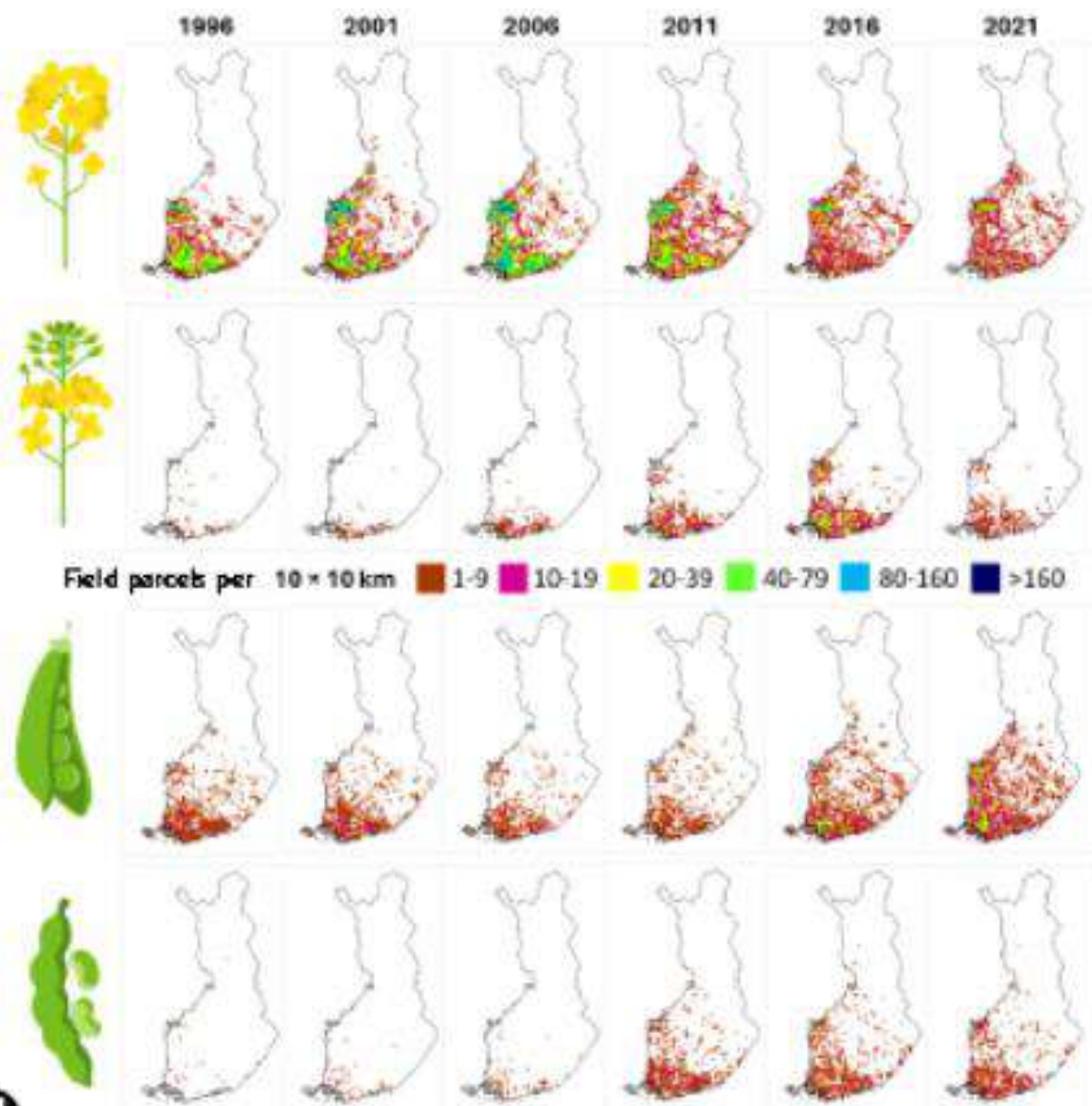
Biodiversity and ecosystem services



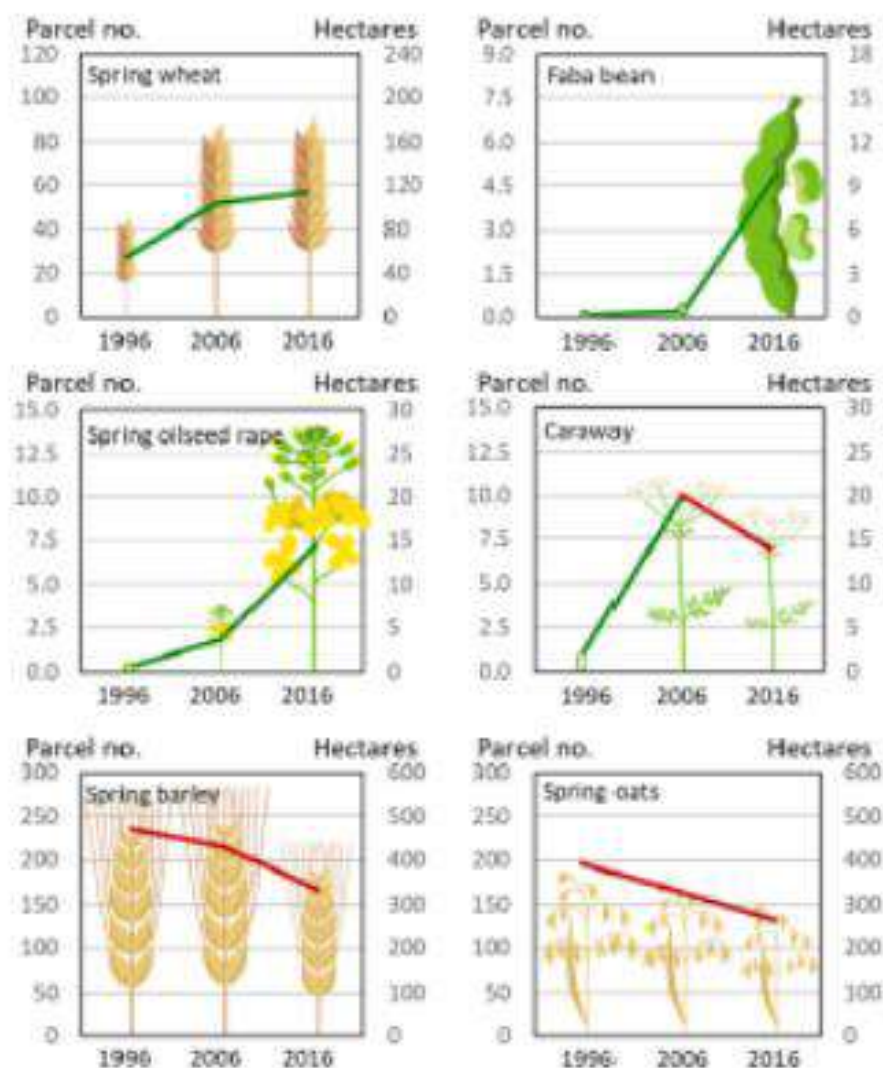
Diversification of land use in Finland



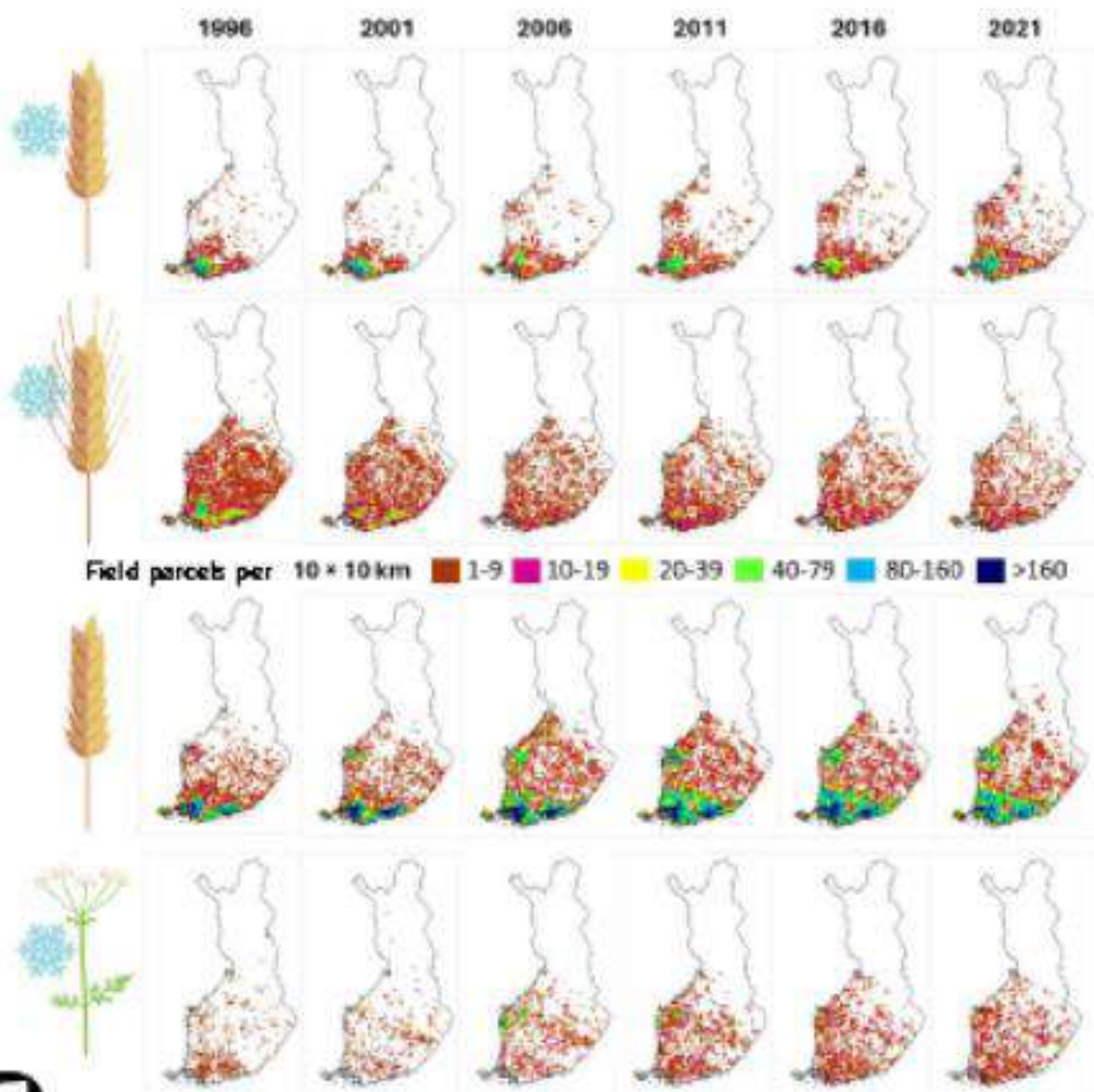
Examples of land use changes



Shifts in crops in the total number of parcels (lines) and hectares (crop icons) in Finland (both × 1000)



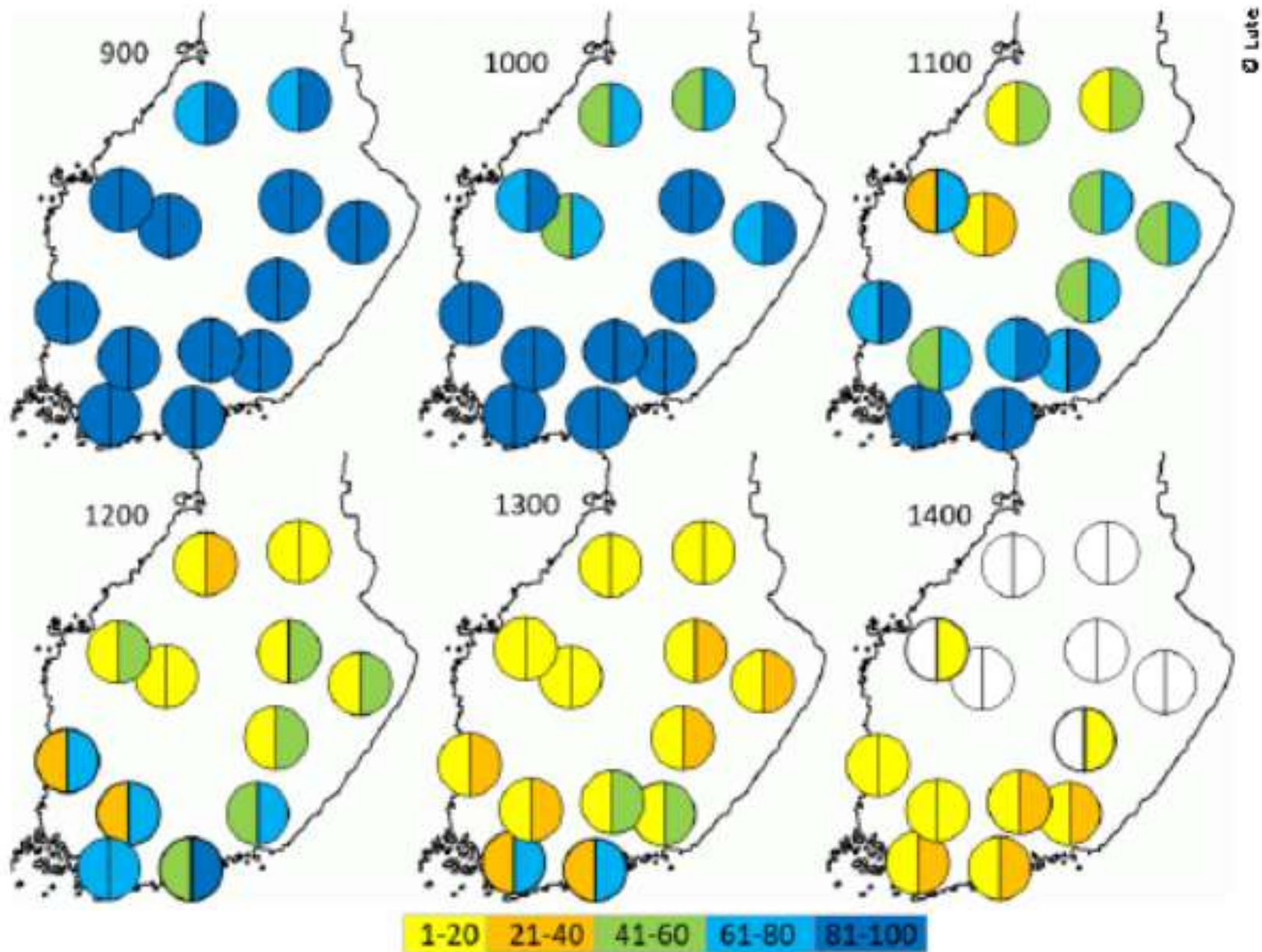
Examples of land use changes



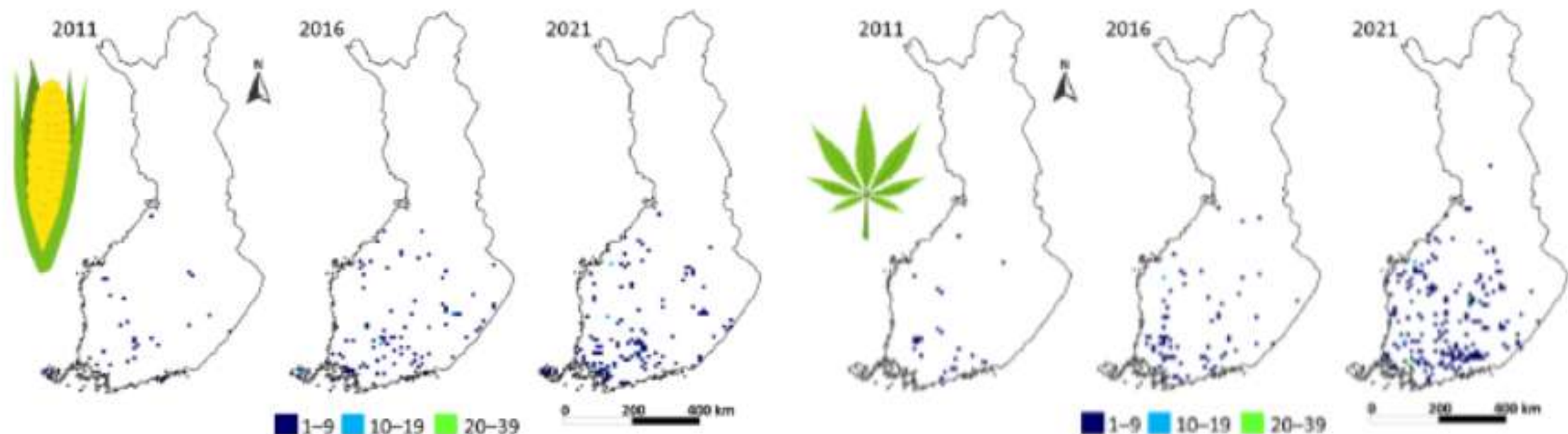
Climate warming

Differences in relative frequencies (%) for growing seasons with degree days of 900, 1000, 1100, 1200, 1300 and 1400 °Cd (+5 °C as the base temperature)

The left half of the circle indicates the relative frequencies for 1970–2000 and the right half 1993–2023



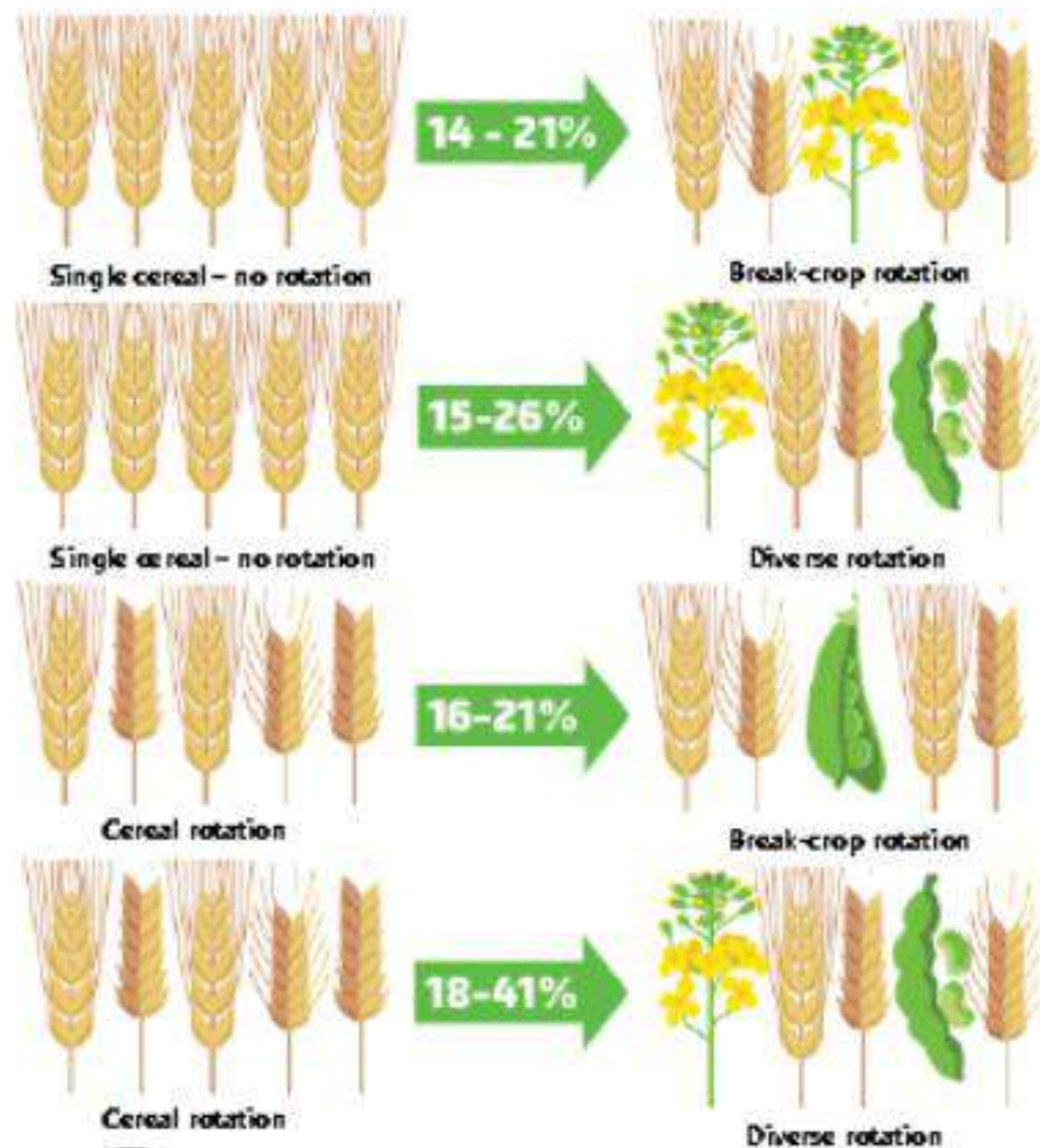
Examples of novel crops



Most influential farm characteristics that impact adoption of diversifying crops in Finland

Big icon indicates great impact and ★ variation in importance depending on region

Diversifying crop	Organic farm	Pig farm	Poultry farm	Cereal farm	Cattle farm	Farm size	Parcel productivity
			★			Large	
	★	★	★			Large	
	No difference between farming systems		★			Large	
						Large	Limited data
	Limited data		★			Large	Limited data



Pre-crop values

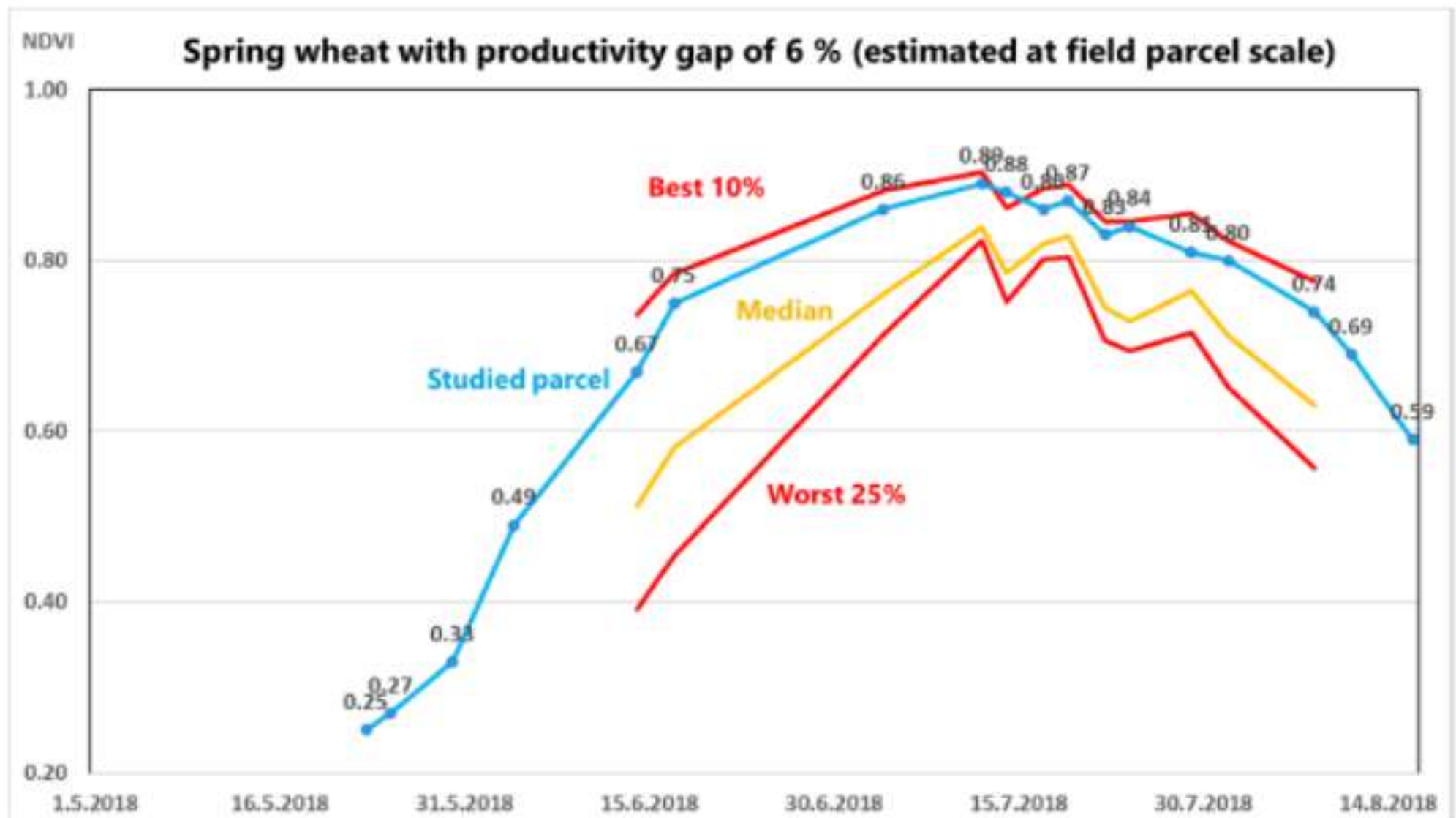
- ... are necessary to encourage farmers to diversify crop rotations and land use in a rational and feasible way
- ... are often the missing link
 - call for multi-locational, multi-year, resource-intensive experiments
 - challenged by changes in climate, conditions and management
 - high number of potential previous and subsequent crop combinations
 - therefore, in experiments often only a single following crop (wheat)
 - farmer's fields comparable to experimental conditions?



Legacy effects on farmers' fields based on satellite images

Pre-crop values

- The productivity gap is determined from timeseries data of *Sentinel 2* satellite images of **individual fields** by calculating the Normalized Difference Vegetation Index (NDVI) values during the growing season and comparing them with the NDVI value of other parcels in the same large region with the same crop
- If the parcel is in the top 10 %, the gap is set to 0 %
- ...

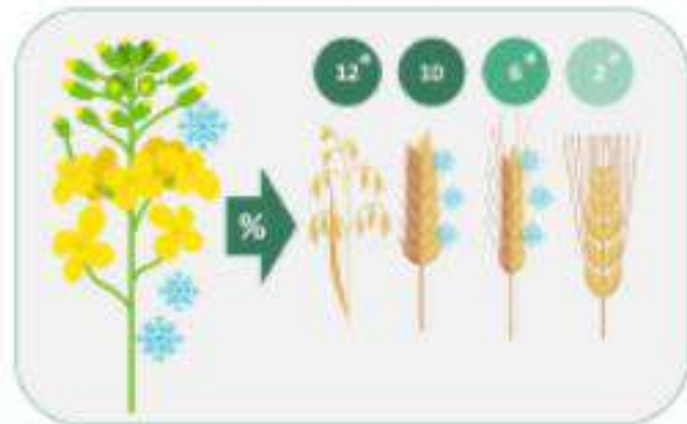
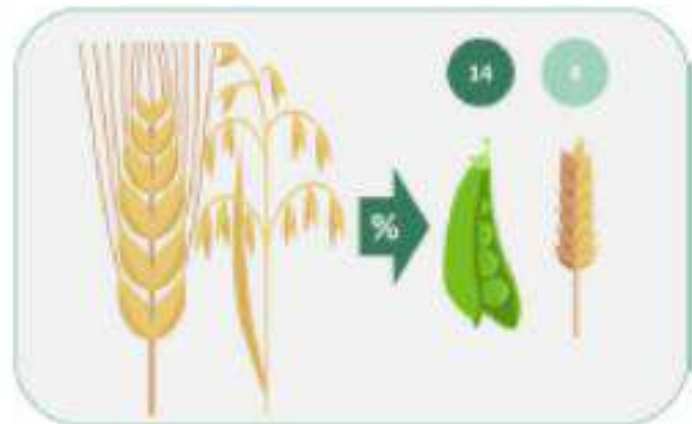


Peltonen-Sainio, P., Jauhainen, L., Hantavaara, E., Witte, S., Rajala, M., & Putanen, E. 2019. Pre-crop values from satellite images for various pre- and subsequent crop combinations. *Frontiers in Plant Science* 10: 462. <https://doi.org/10.3389/fpls.2019.00462>

Peltonen-Sainio, P., Nieminen, M., & Jauhainen, L. 2024. Legacy effects of crop sequencing on biomass and their variability on farmers' fields in Finland are shaped by weather, farm conditions and rationales for land use. *Agricultural Systems* 215: 103850. <https://doi.org/10.1016/j.agsy.2023.103850>

Pre-crop values

- ...
- Information about previous crop in rotation is linked to NDVI-gap data to have all possible previous and subsequent crop combinations in the region
- NDVI-gap is determined for each crop combination
 - provided that at least 20 field parcels are available for a combination
- Pre-crop values (%) are estimated by comparing, e.g., the NDVI-gap of barley when following barley (i.e., no sequencing) to NDVI-gap of barley when following some other crop in rotation
- NDVI-gap is called as productivity gap (not yield gap) because it is based on estimation of aboveground biomass

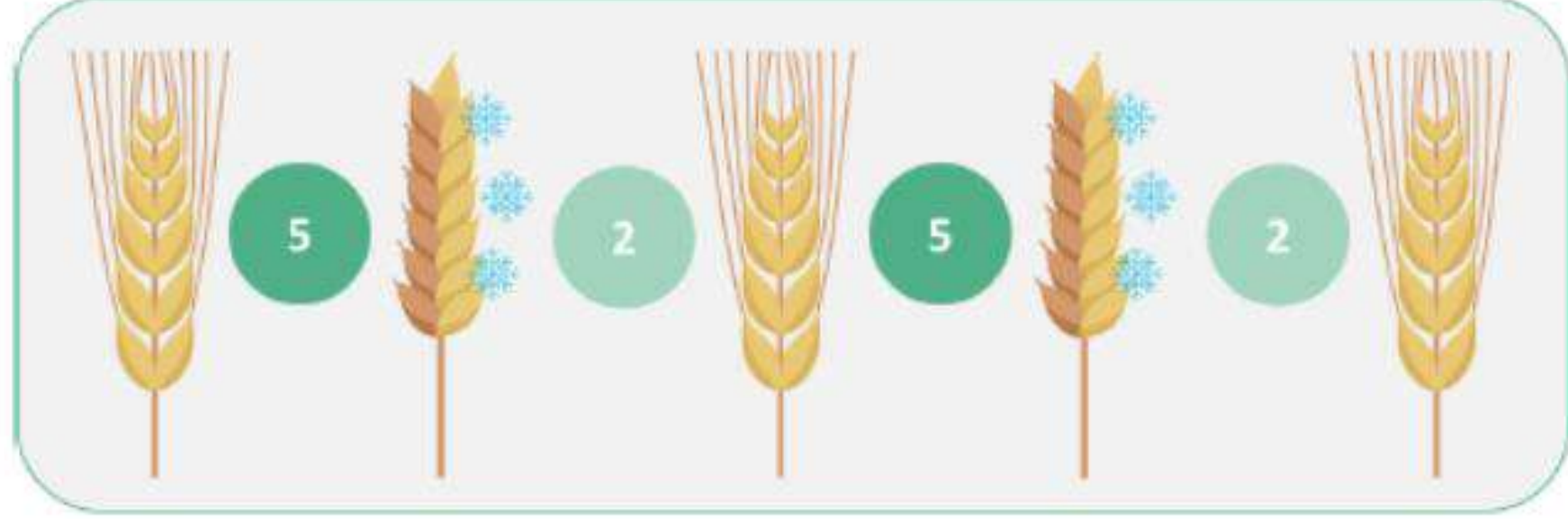
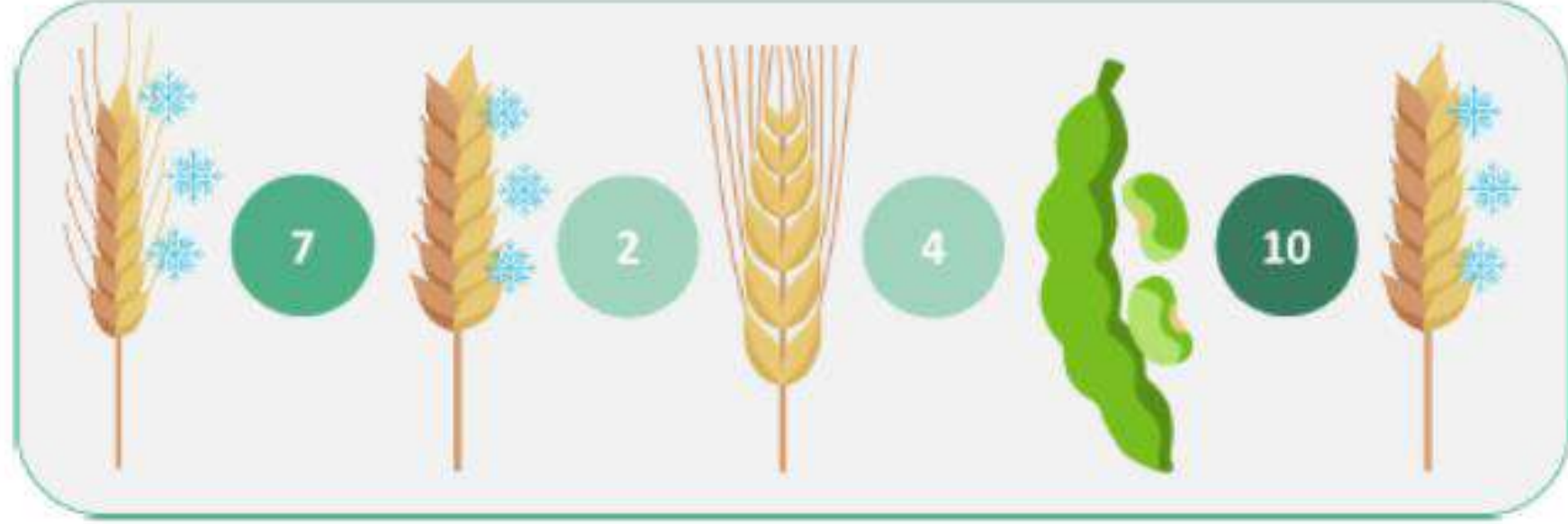


> 2 million pre-crop values

Examples of rotational benefits



Examples of rotational benefits





The role of nitrogen

Short-term benefit



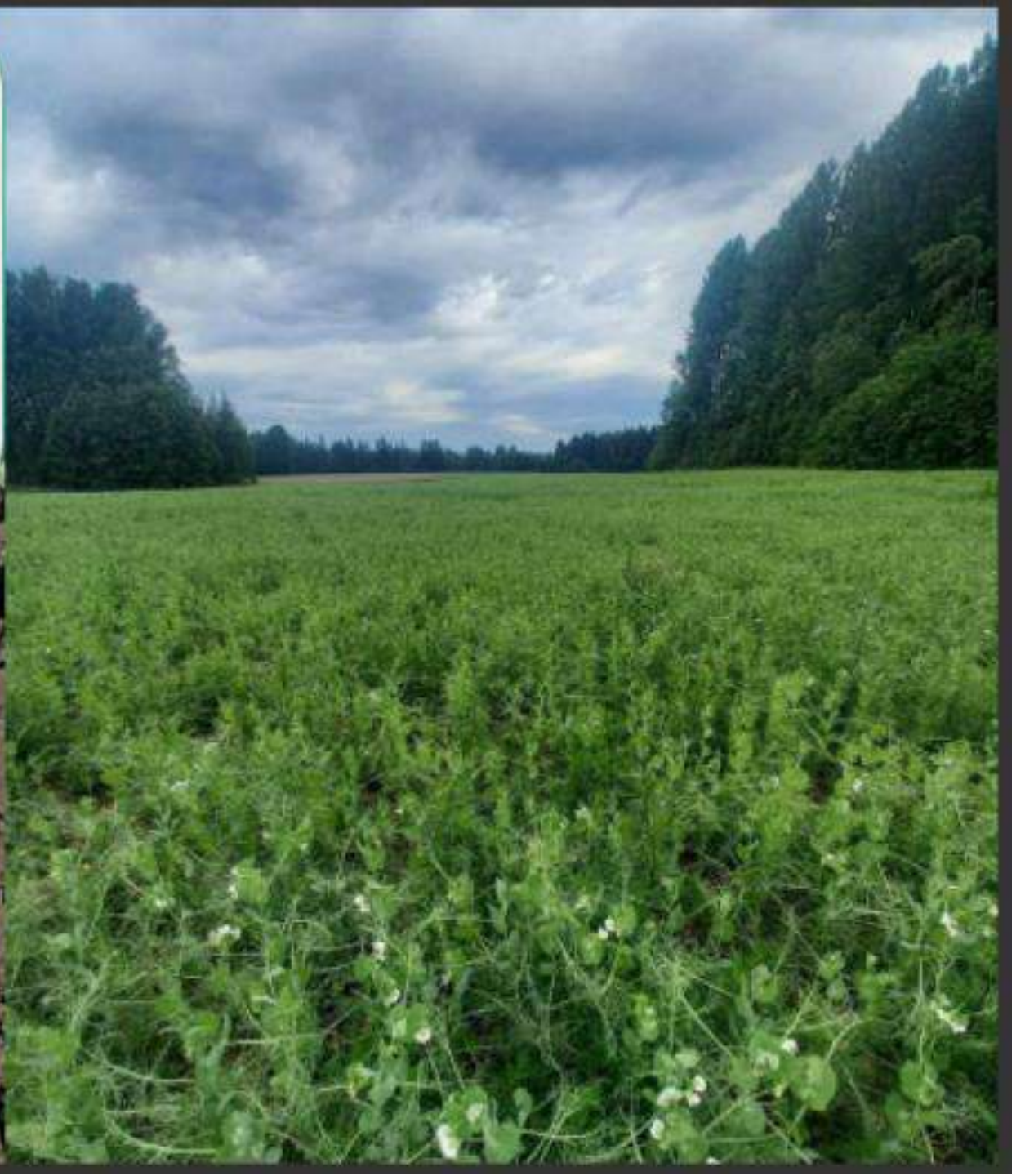
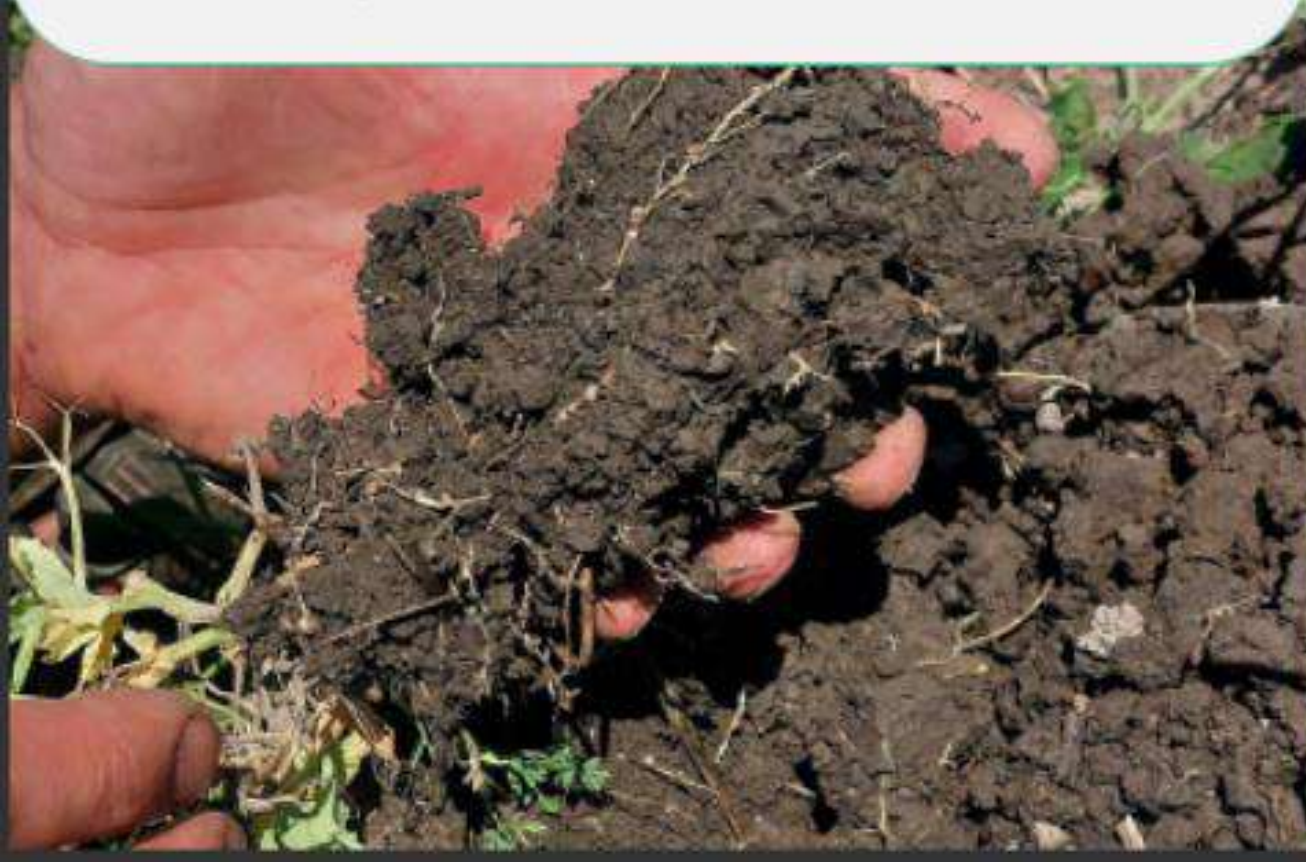
10

2⁺

2⁺

1⁺

1⁺





12

6

5

3

1





Muchas gracias!





**Water-Food
Futures**



Precilience



SOILRES

