

# Soil fertility and sustainable yields

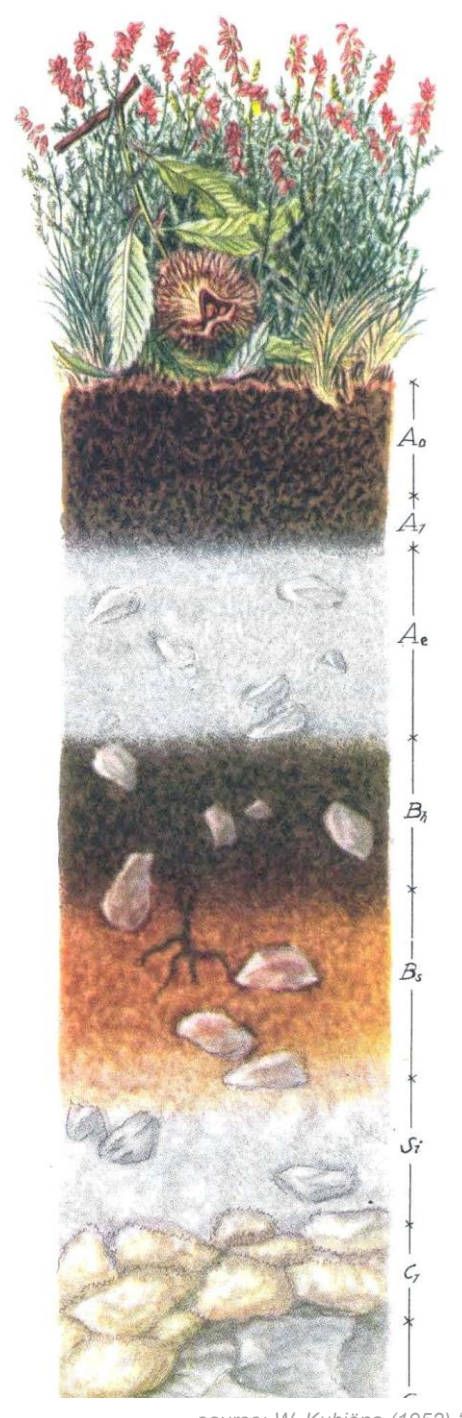
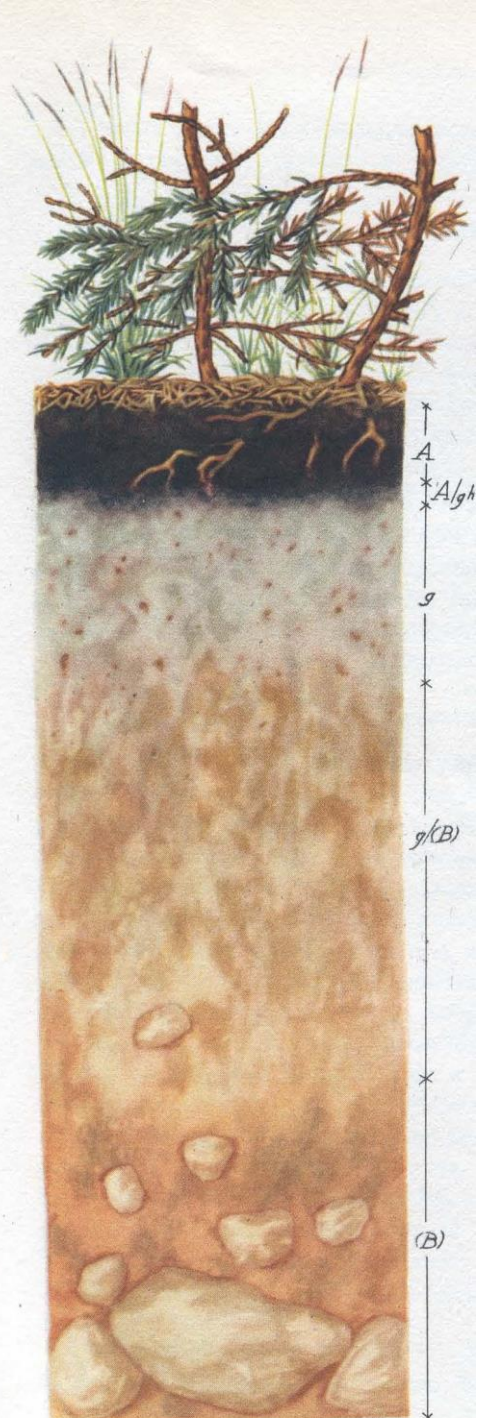
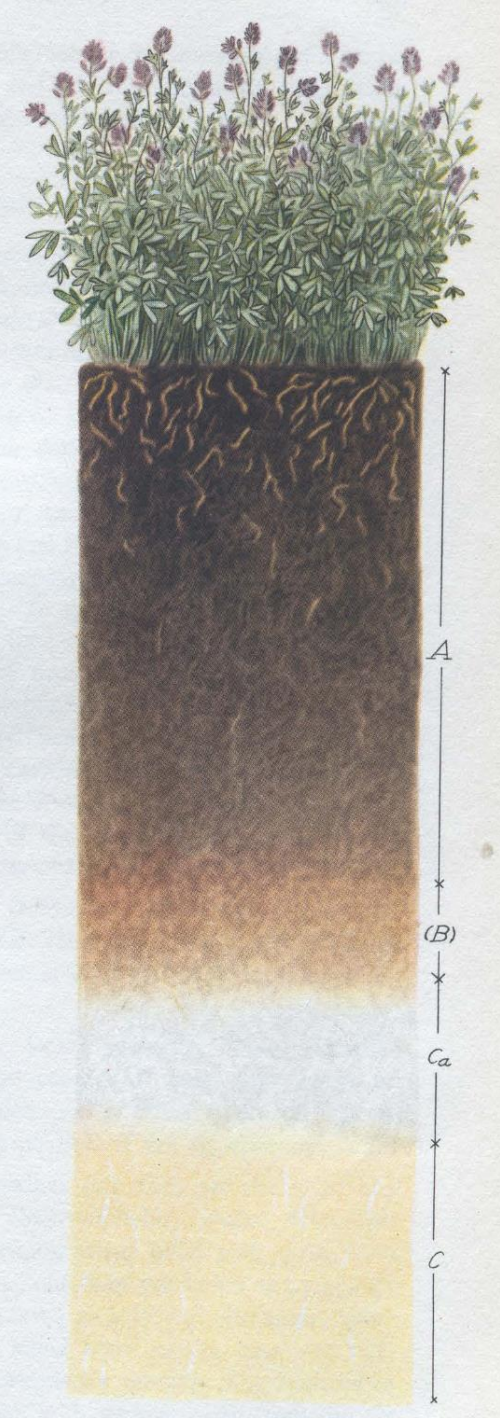
Gergely Tóth

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Centre for Agricultural Sciences*

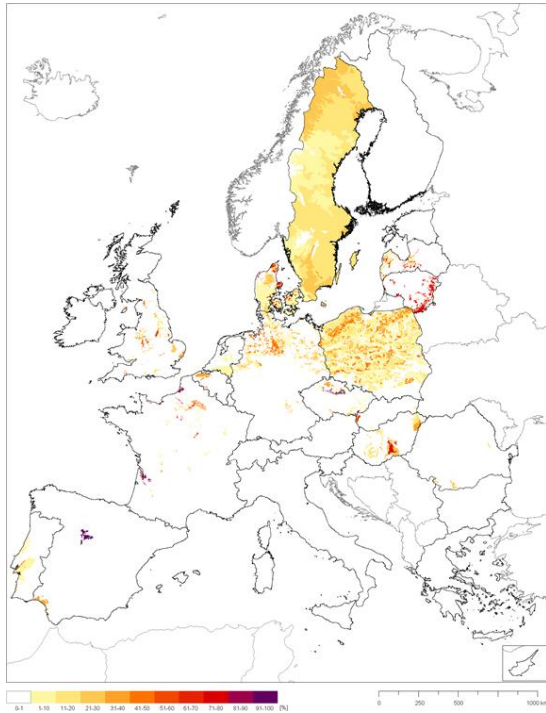




source: W. Kubiěna (1952) "The Soils of Europe". C.S.I.C. Madrid in 1952.

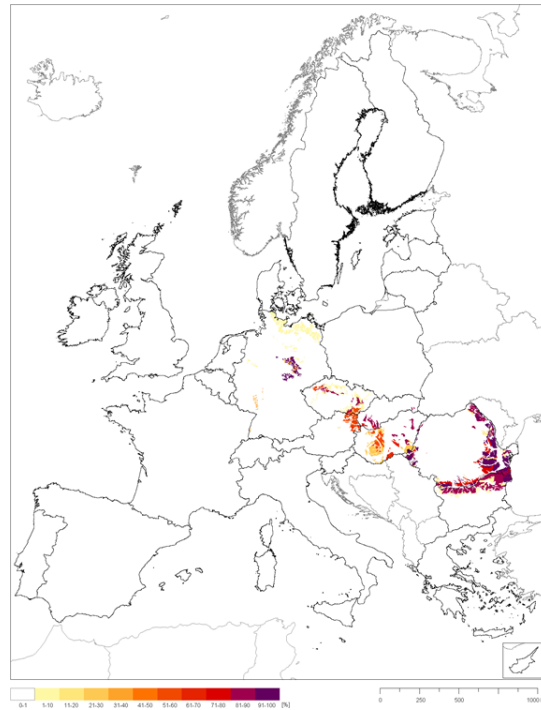
# Spatial distribution of some Reference Soil Groups in the EU

by % area cover



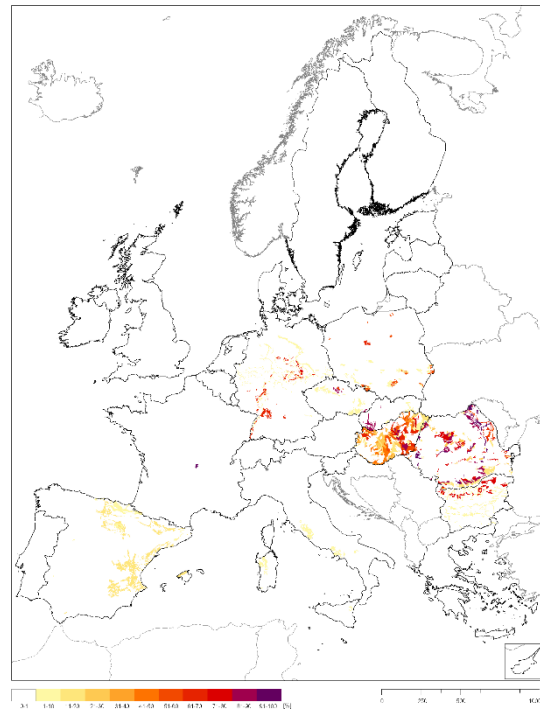
Arenosols

„sandy soils”



Chernozems

„black soils”



Phaeozems

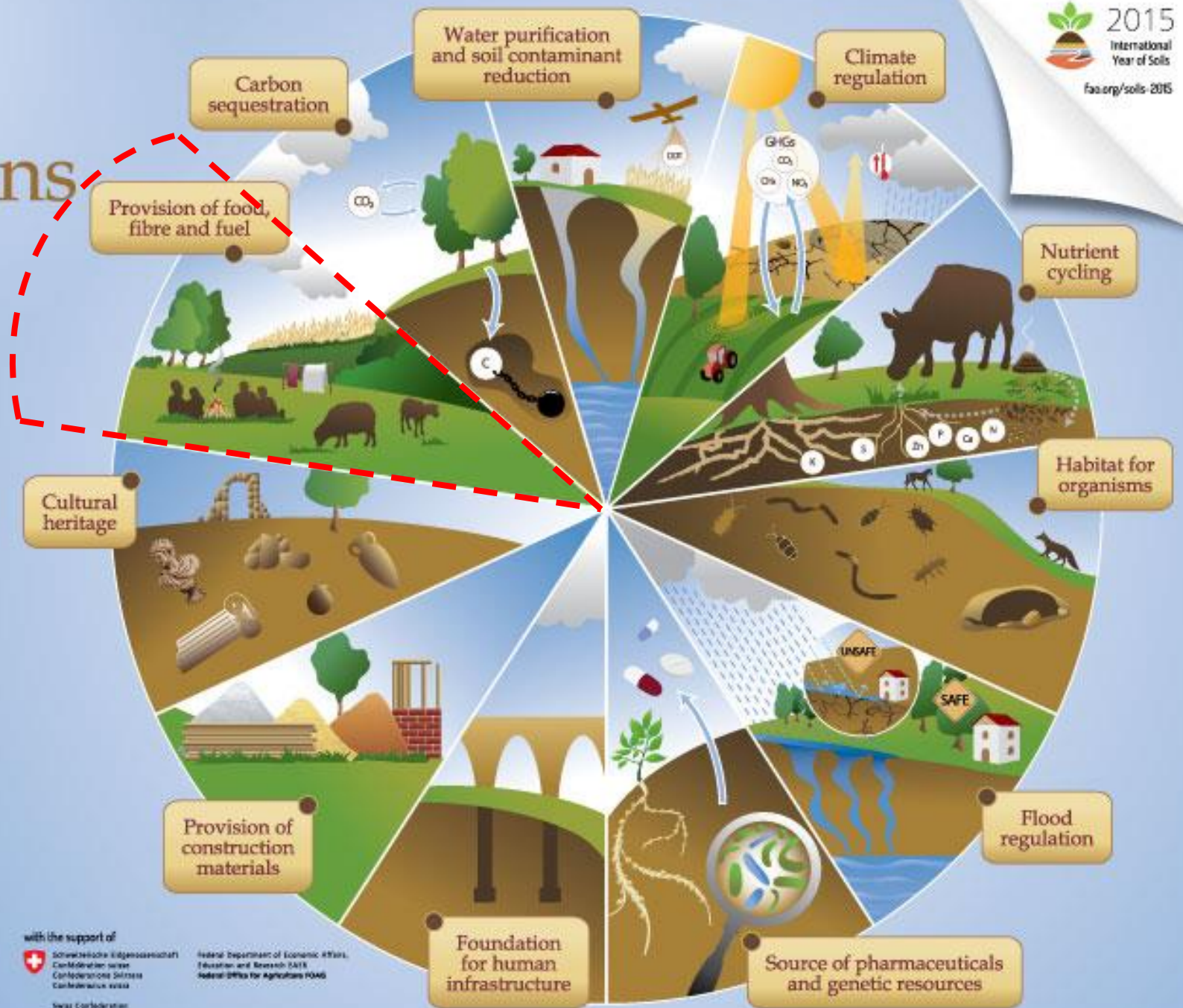


Solonchets

„salty soils”

# Soil functions

Soils deliver ecosystem services that enable life on Earth



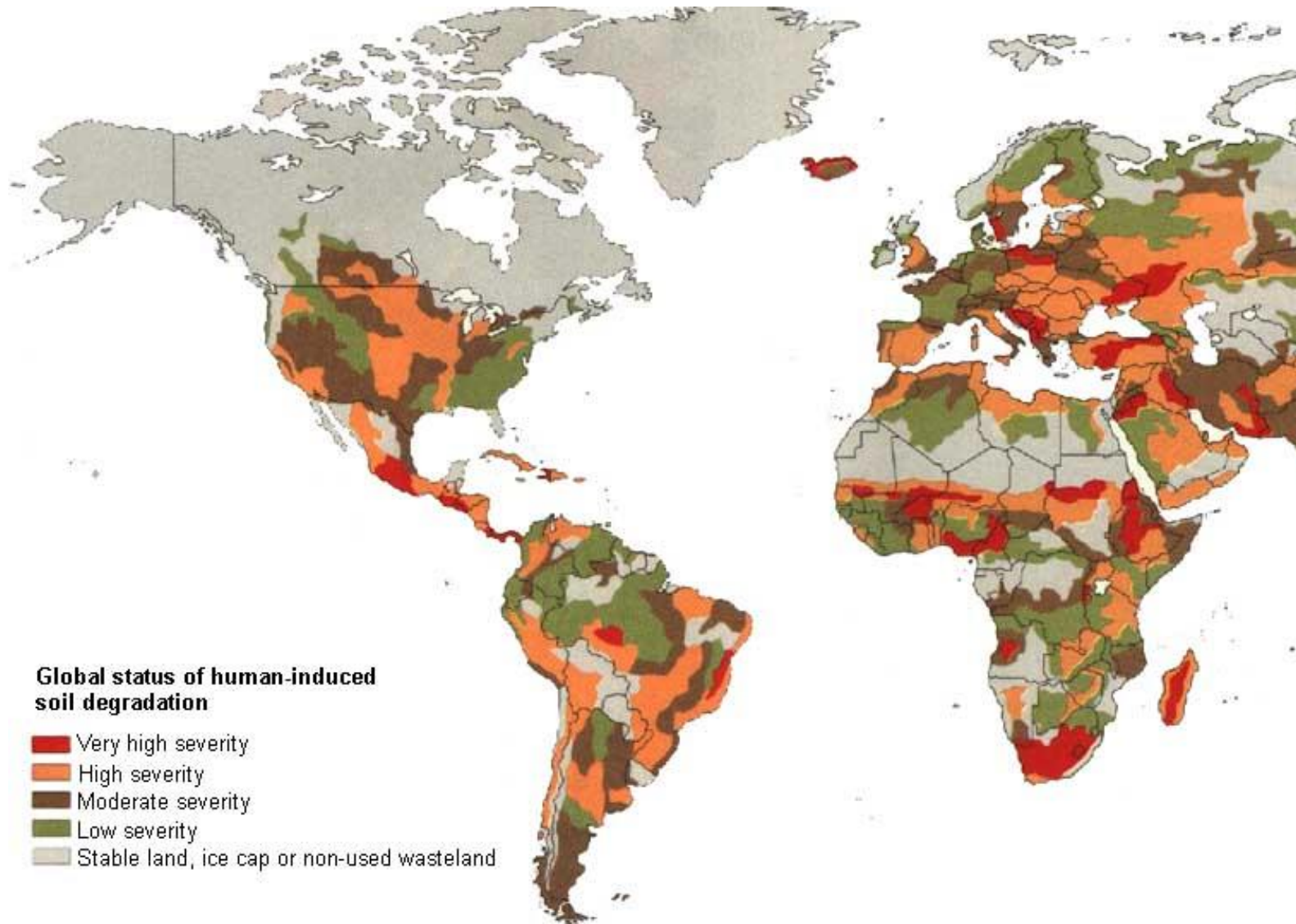
# The role of soil in preserving and improving the quality of environmental and social systems

- **stability** (food security, food safety)
- **efficiency** (natural capital, competitiveness)
- **sustainability** (ecosystem services, environmental conservation)



- **social well being** (rural development, safe operating space)

# Global status of human-induced soil degradation

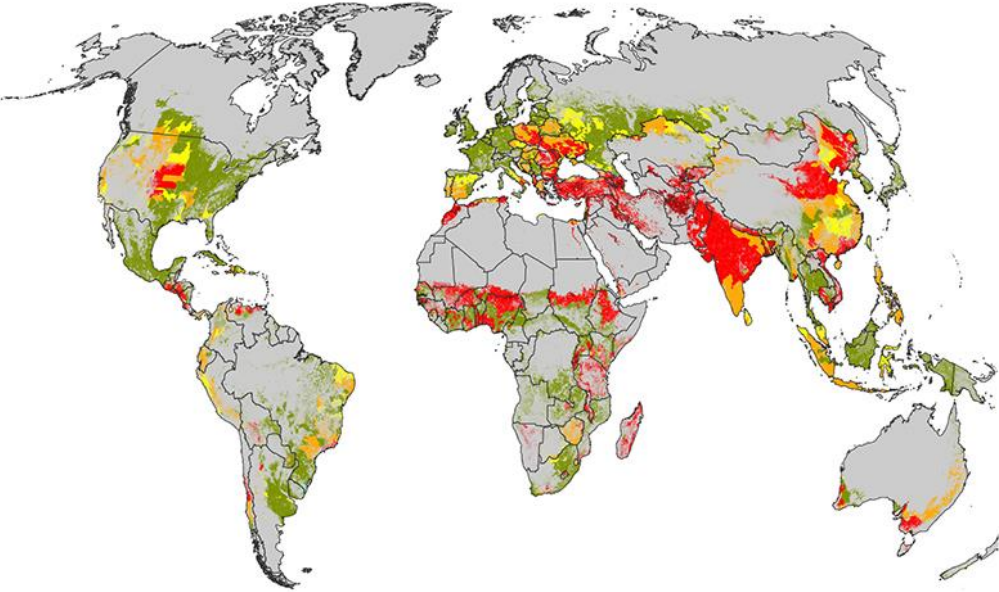


## Main soil degradation threats in Europe\*

- erosion
- organic matter decline
- Salinization
- compaction
- Landslides
- soil sealing
- contamination
- flood

\*Thematic Strategy for Soil Protection, EC 2006

# Changing climatic conditions and their effect on yield

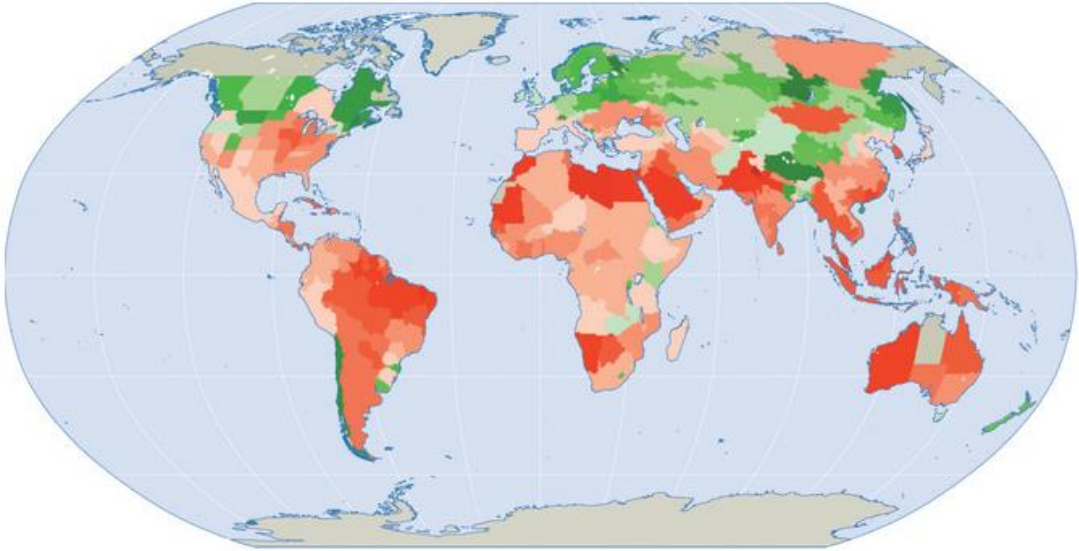


Water Stress Condition  
Lower Near Normal Higher

WORLD RESOURCES INSTITUTE

Sources: <http://ow.ly/rpfMN>

**Change of water stress conditions in agricultural areas**  
(by 2025, based on IPCC scenario A1B)



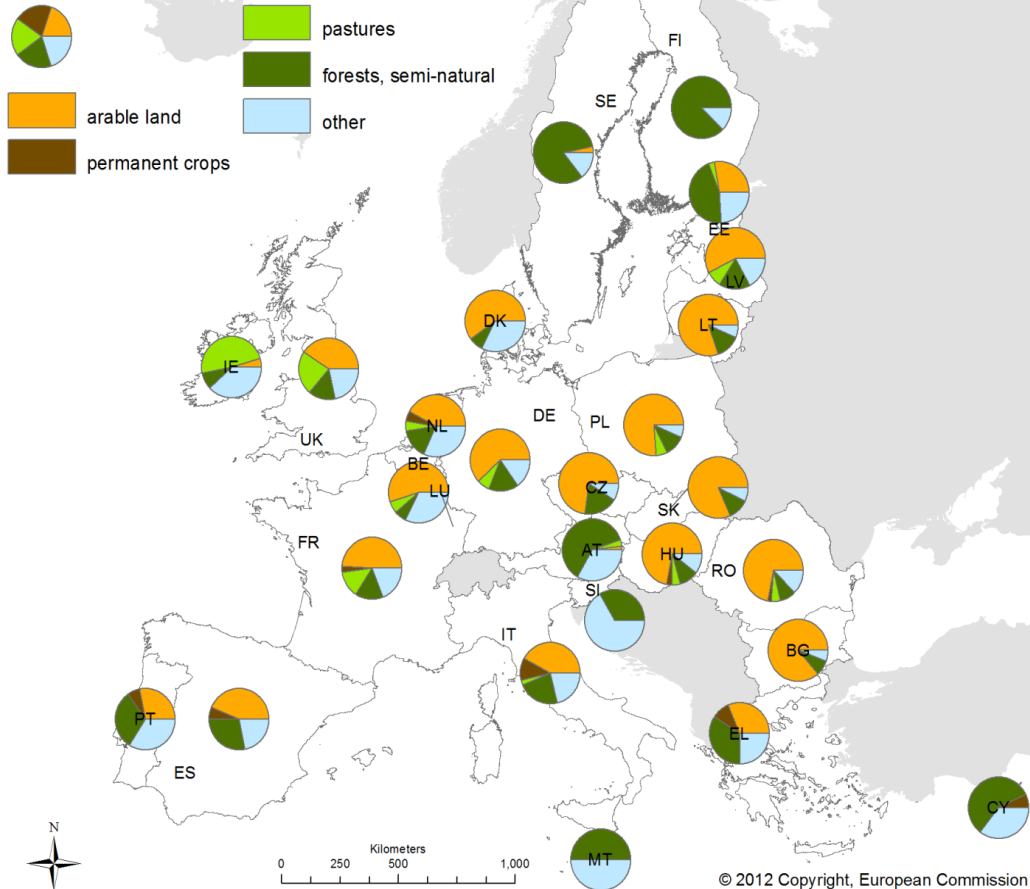
Percentage change in yields between 2010 and 2050  
-50 -20 0 +20 +50 +100 No data  
Source: World Bank (2010)

**Effect of climate change on yields**  
(based on 5 global model of 11 main crops)

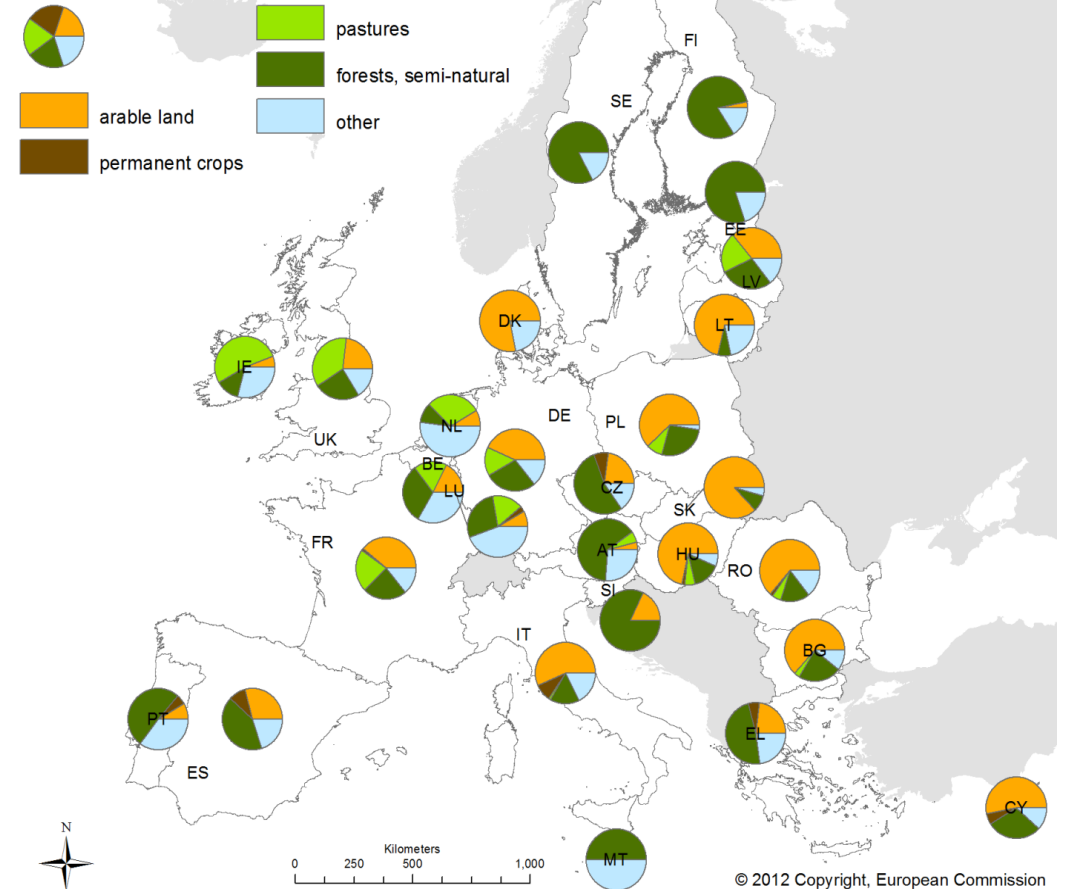
# Share of land uses affected by land productivity decline in Europe

In % of the land concerned by the relevant productivity trend

Percentage of areas showing early-signs of land productivity decline per land use



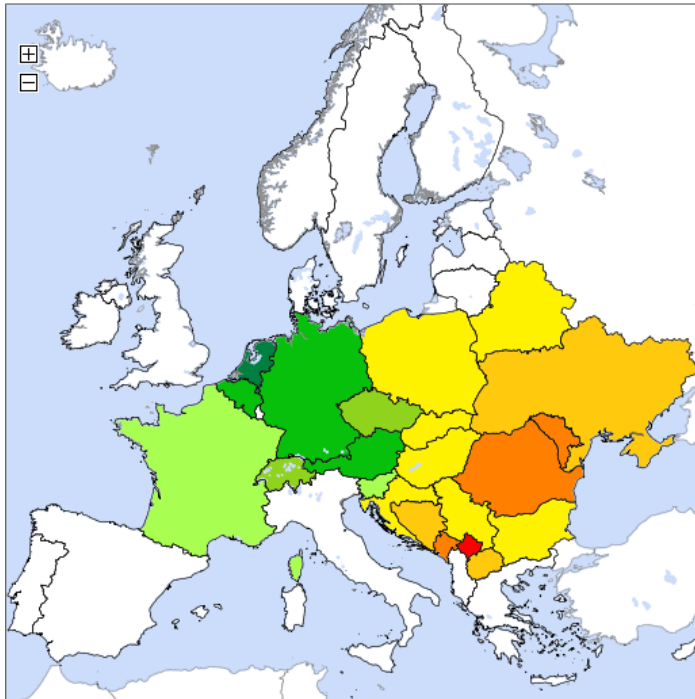
Percentage of areas showing stable but stressed land productivity per land use



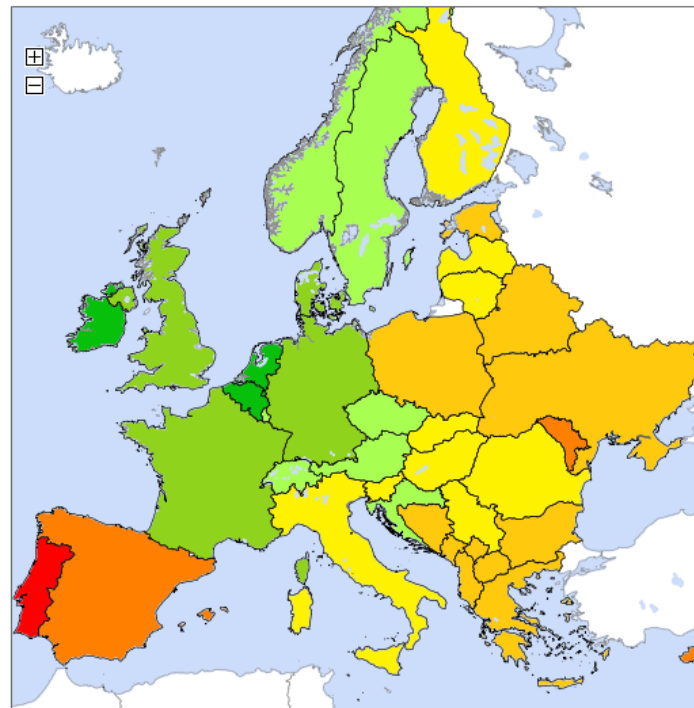


# Relative yield gap

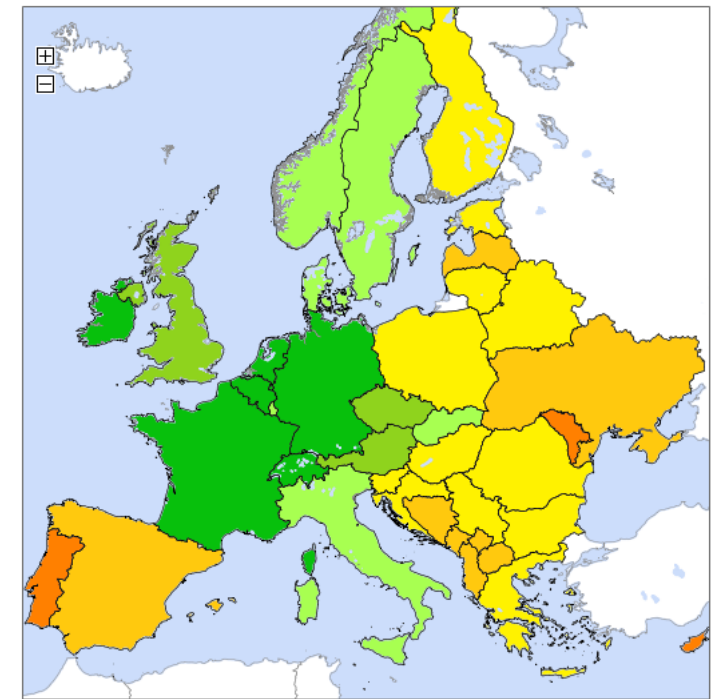
$$1 - (\text{actual yield} / \text{potential yield}) * 100$$



rainfed maize



wheat

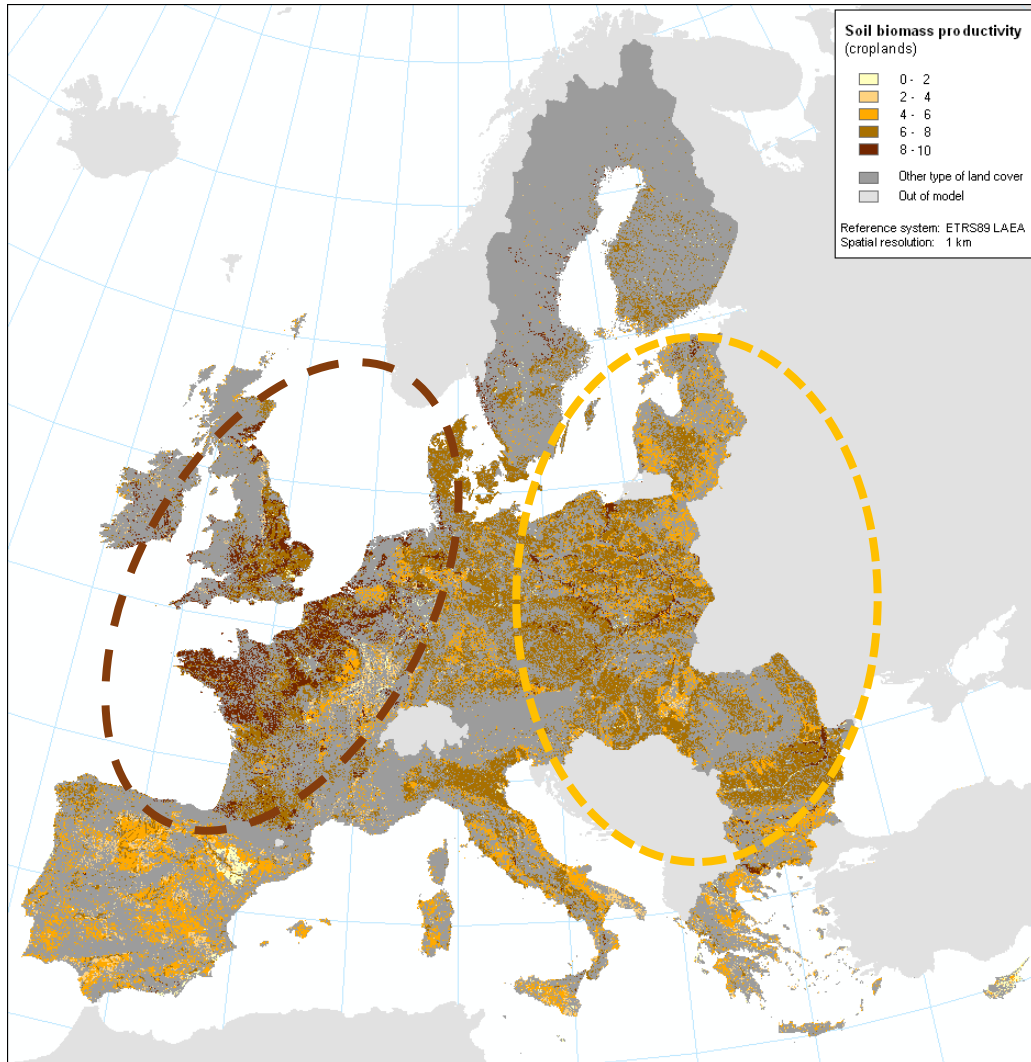


barley

%		%	
up to 10 %	50 % - 60 %	50 % - 60 %	
10 % - 20 %	60 % - 70 %	60 % - 70 %	
20 % - 30 %	70 % - 80 %	70 % - 80 %	
30 % - 40 %	80 % - 90 %	80 % - 90 %	
40 % - 50 %	more than 90 %	more than 90 %	

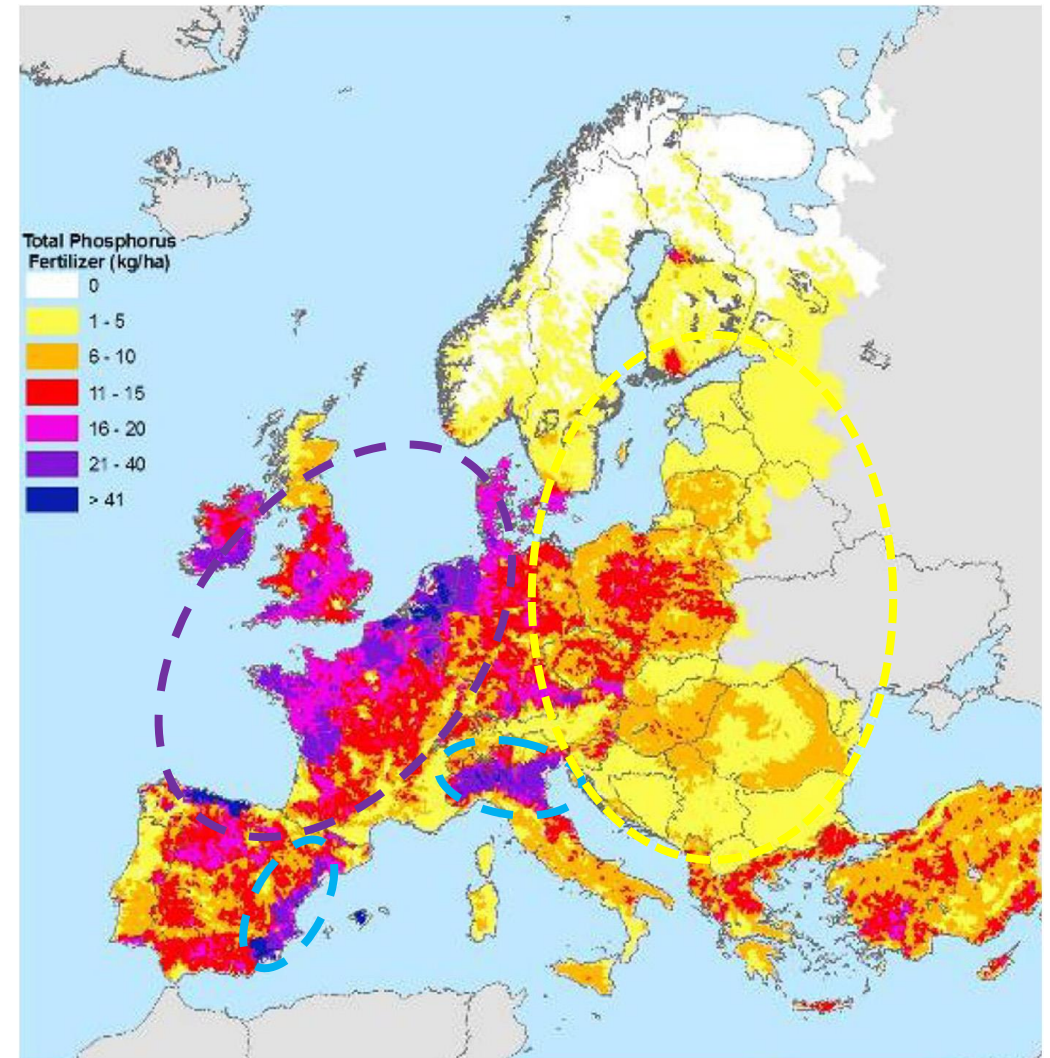
# Soil productivity and input intensity

Rainfed soil productivity (*croplands, relative index*)



Tóth et al., 2013

Fertilizer P input (*kg/ha*)



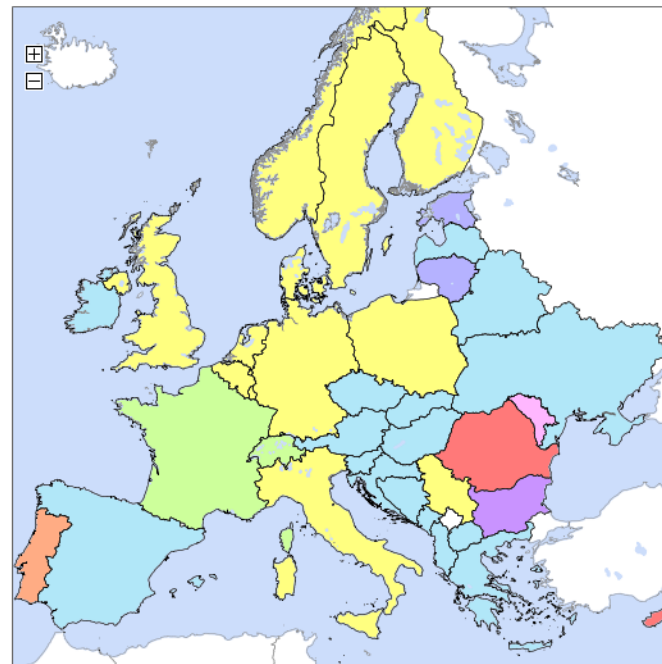
Eurostat, 2013

# Temporal variation of yield

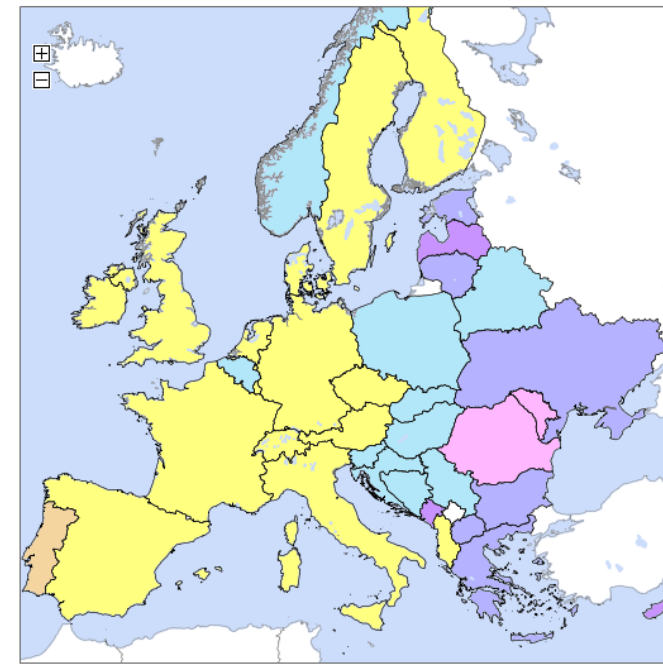
rainfed maize



wheat



barley



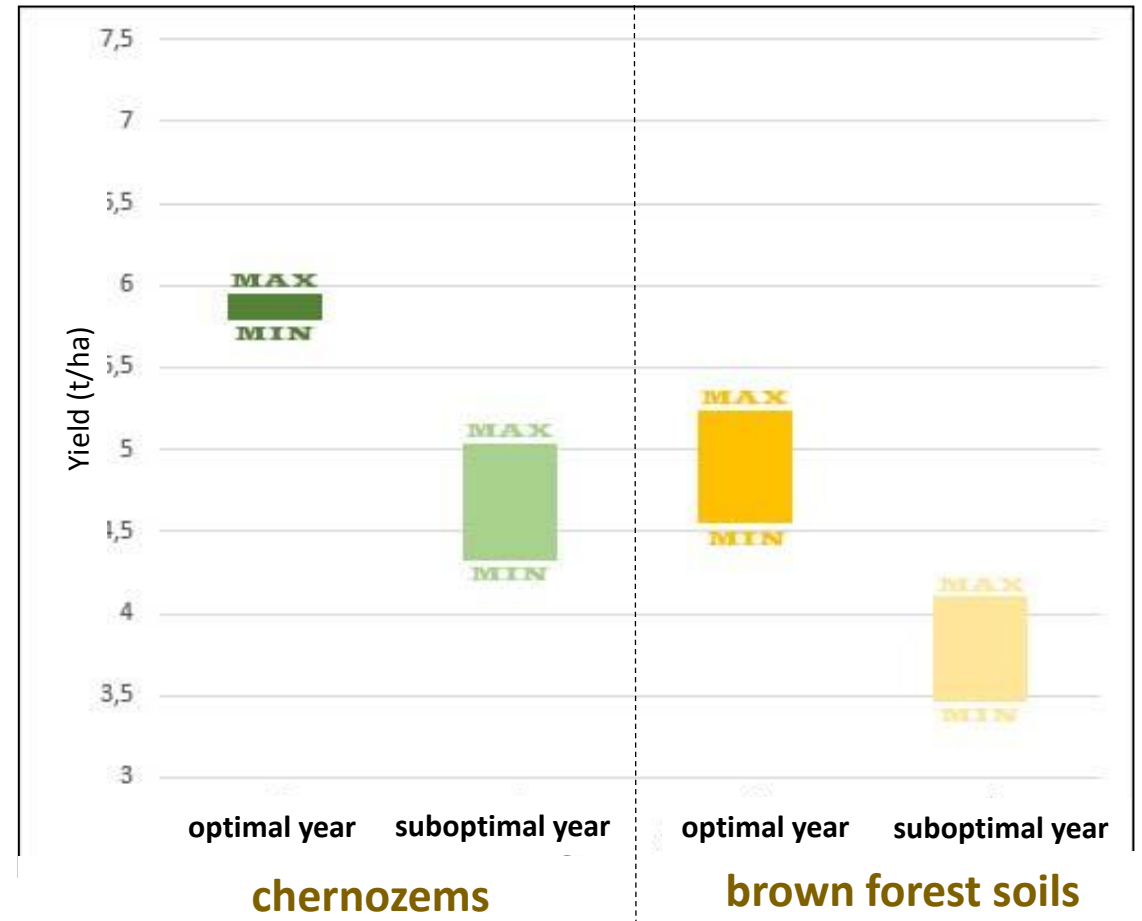
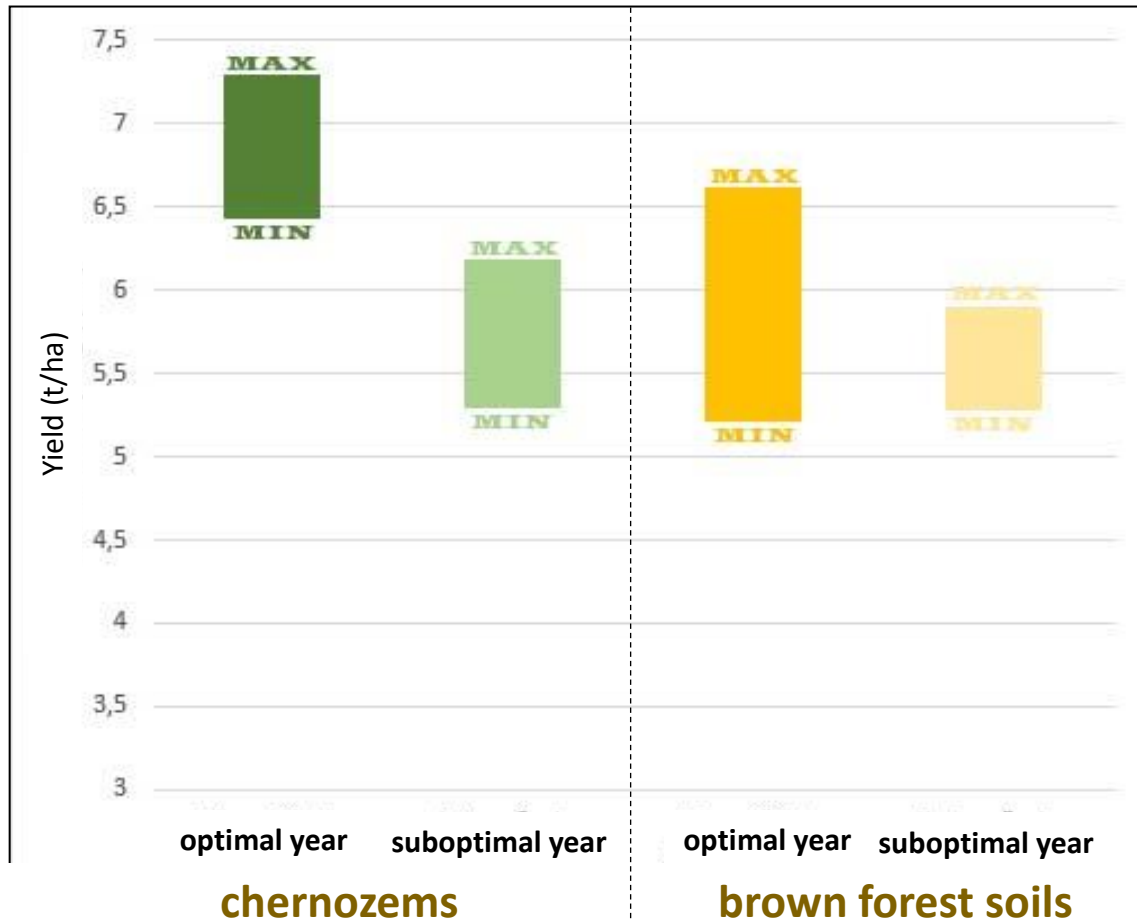
StdDev / Mean x 100%
up to 5 %
5 % - 10 %
10 % - 15 %
15 % - 20 %
20 % - 25 %
25 % - 30 %
30 % - 35 %
35 % - 40 %
more than 40 %

# Effect of soil phosphorus content on yield

under Pannonian climate by soil type, crop and year type



MIN: very low content (lowest yield)  
MAX: optimal P content (highest yield)



# Conclusions

- ❖ Soils secure food, ecosystem functioning and social development
- ❖ Soil - quantity and quality - is **unevenly distributed** among and within countries
- ❖ Eastern Europe has **specific and diverse soil** and climatic conditions
- ❖ **Yields** in Eastern Europe show **high temporal variability**
- ❖ **Degradation** processes and **climate change** threaten soil resources - and yields
- ❖ **Sustainable intensification** and improvement of the **efficiency of farming** in Eastern Europe need to address **(soil) specific challenges**  
*(specific climate-, soil-, degradation types and patterns, management needs, uncertainties)*

# Thank you !

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