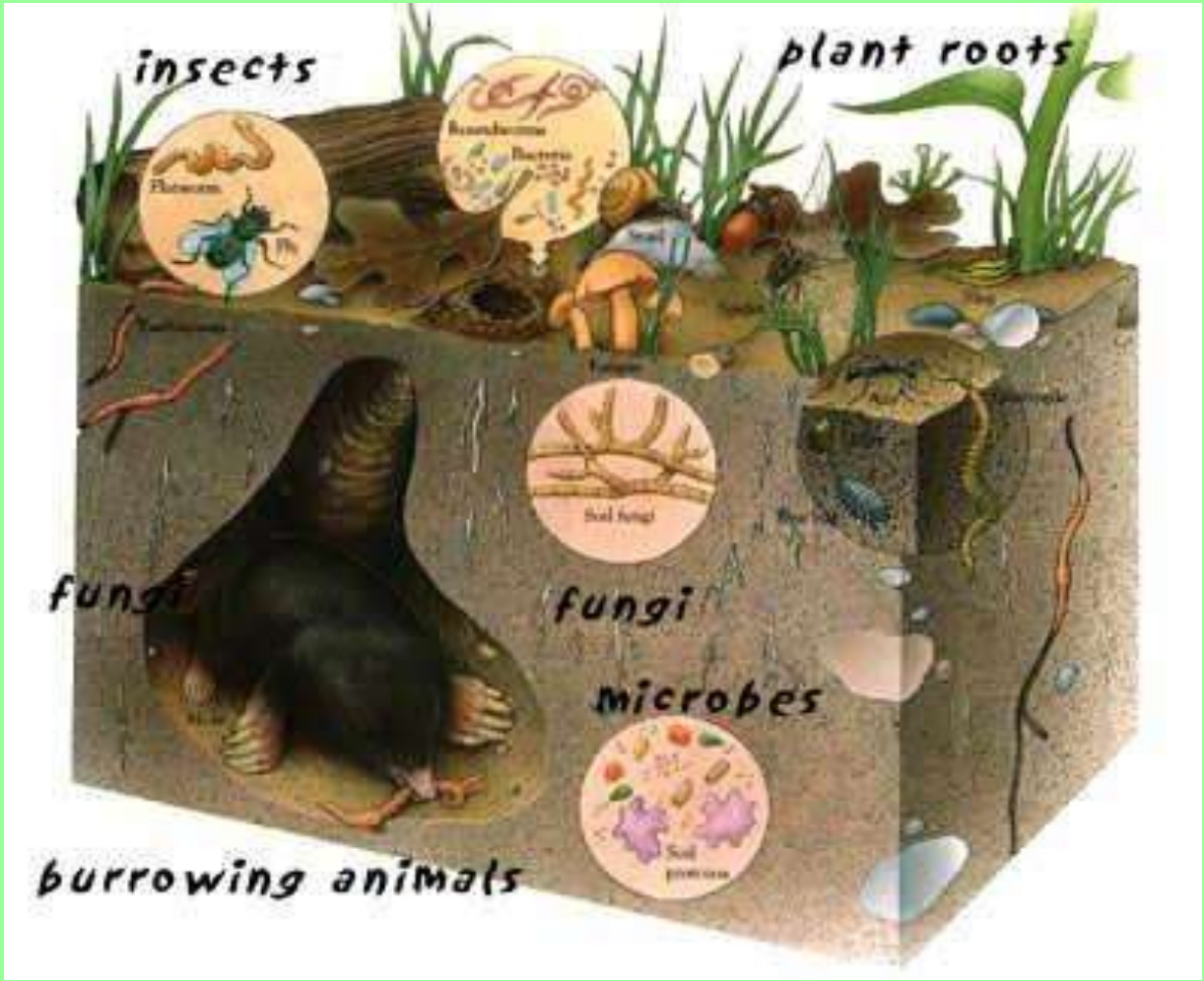
Soils of the Czech Republic: threat and protection

Bořivoj Šarapatka

Czech Society of Soil Science and
Palacký University Olomouc



„Půda je nejsložitějším biomateriálem na planetě, …..
……kterému dosud příliš nerozumíme, ….. “
„ Soil is the most complicated biomaterial on the planet …..
……. which we do not understand properly …. “
(Young and Crawford, 2004: Interactions and Self-Organization in the Soil-Microbe Complex)

Soil Degradation Processes

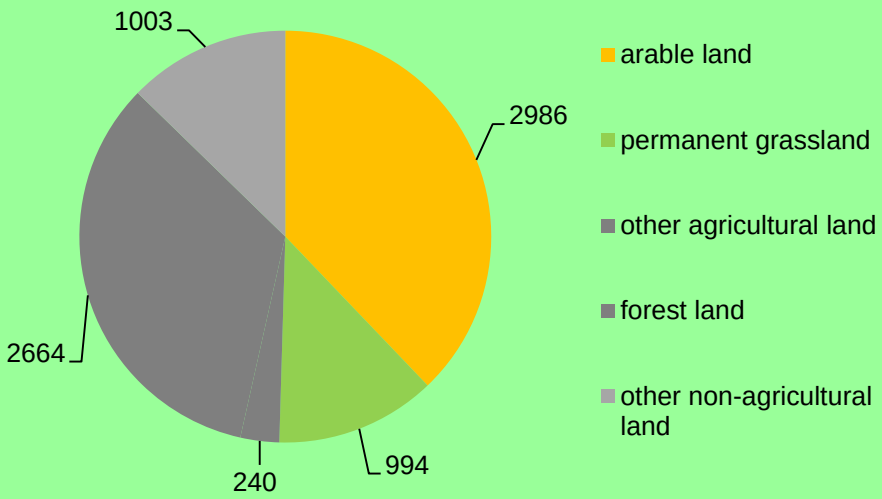
- Soil Erosion
- Nutrient Runoff
- Waterlogging
- Desertification
- Acidification
- Compaction
- Crusting
- Organic Matter Loss
- Salinization
- Nutrient Depletion by Leaching
- Toxicant Accumulation

\- **Soil Productivity** +

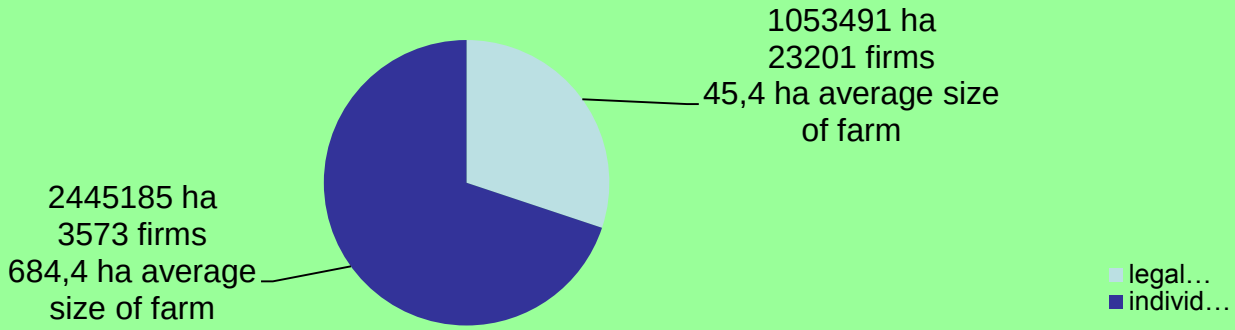
Soil Conservation Practices

- Conservation Tillage
- Crop Rotations
- Improved Drainage
- Residue Management
- Water Conservation
- Terracing
- Contour Farming
- Chemical Fertilizers
- Organic Fertilizers
- Improved Nutrient Cycling
- Improved Systems to Match Soil, Climate and Cultivars

Land use balance 2013 (ha)

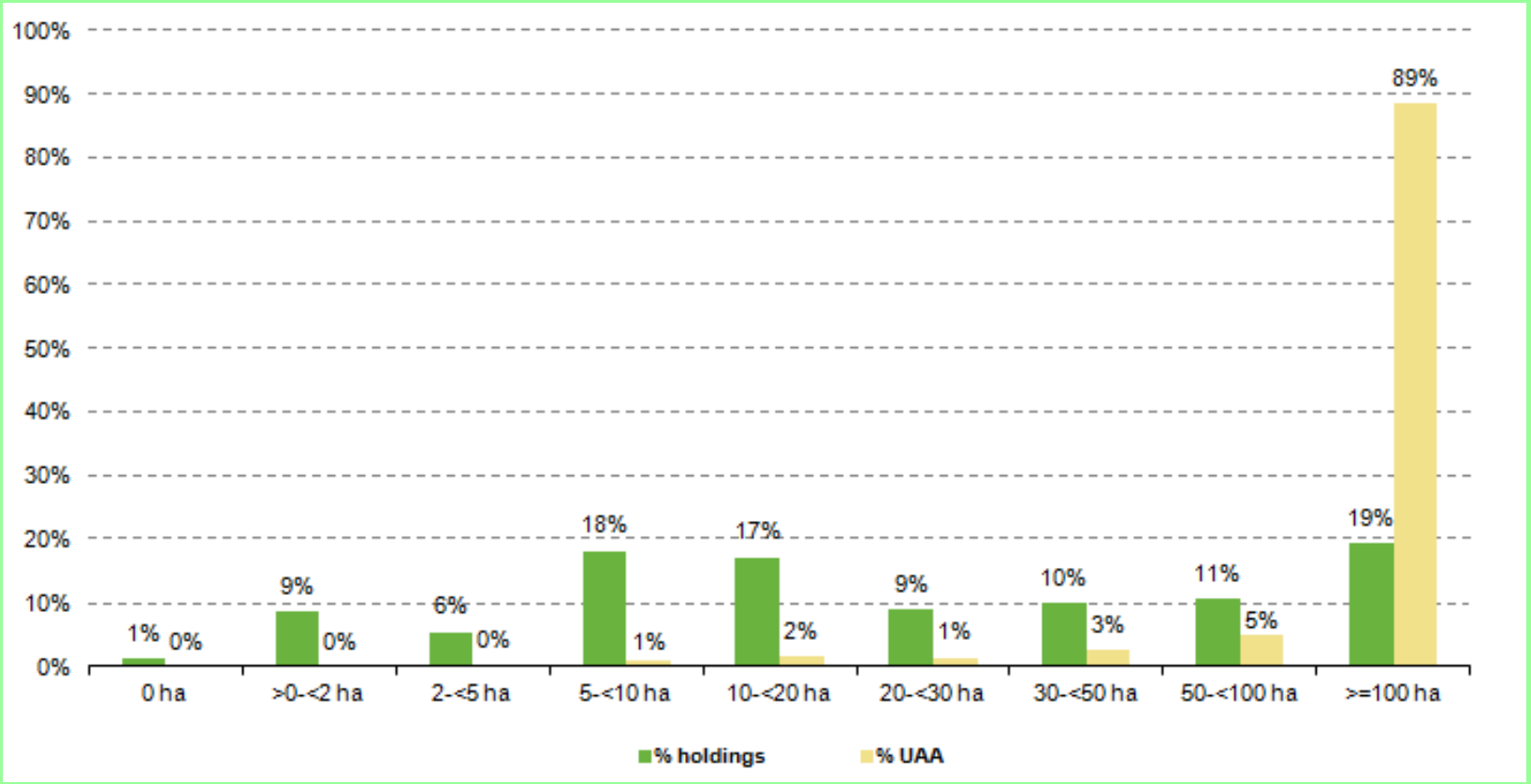


Use of agricultural land by different firms



Czech Republic	2003*	2010	Change (%)
Number of holdings	23 840	22 860	-4.1
Total UAA (ha)	3 602 630	3 483 500	-3.3
Livestock (LSU)	2 260 080	1 722 460	-23.8
Number of persons working on farms (Regular labour Force)	164 950	132 730	-19.5
Average area per holding (ha)	151.1	152.4	0.8
UAA per Inhabitant (ha/person)	0.35	0.33	-6.1

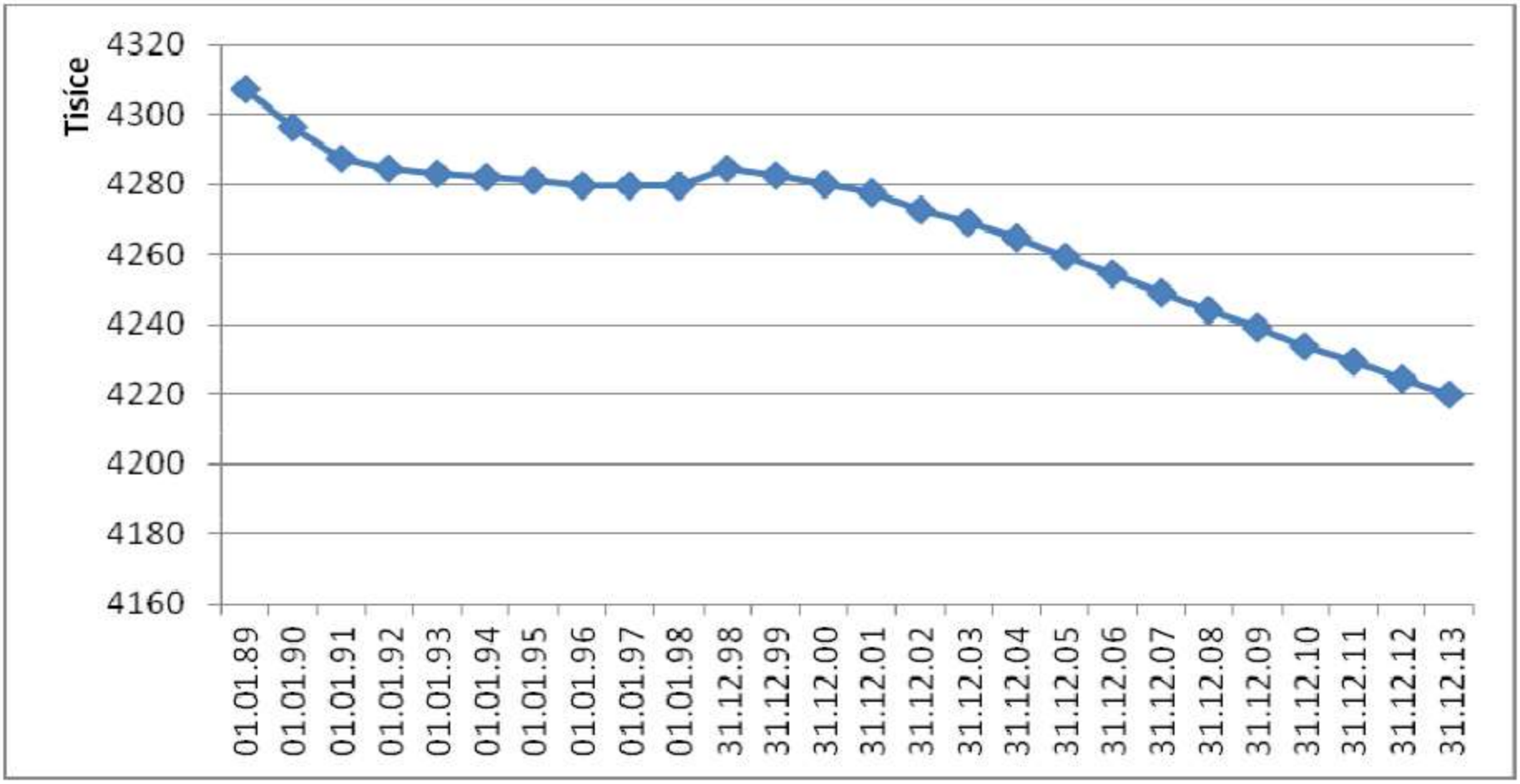
** The 2003 data presented in the table were filtered using the 2010 threshold*




101
101
E55
E50
E55

Agricultural soil development from 1989 to 2013

Graf 3: Vývoj celkové rozlohy zemědělské půdy v ha v letech 1989-2013

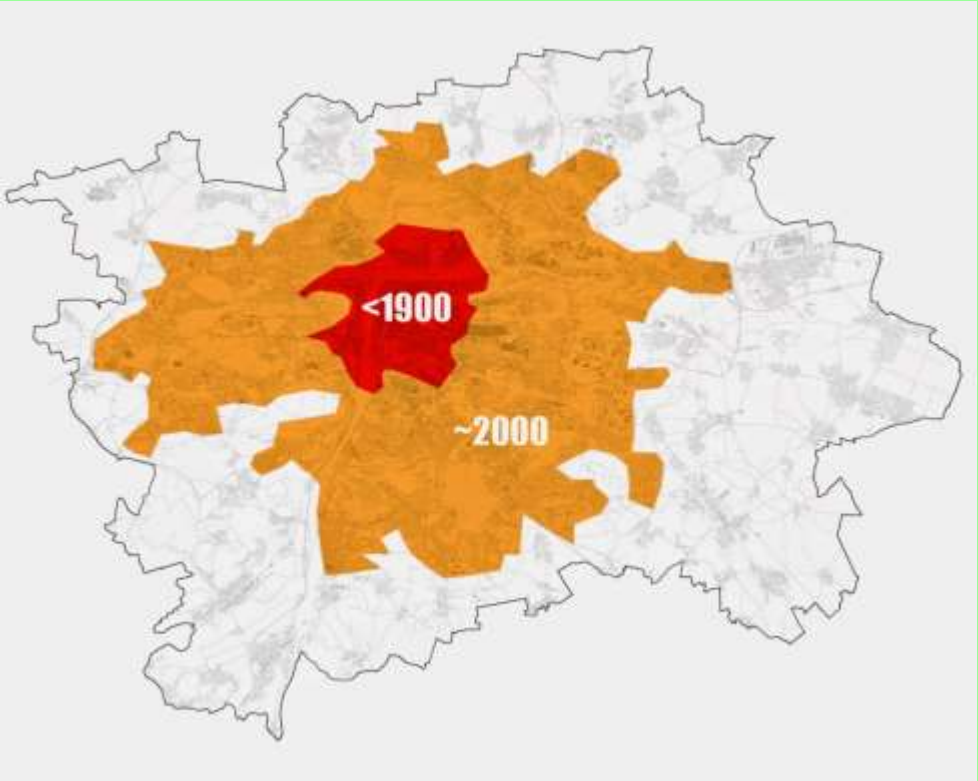


- Daily agricultural soil sealing (loss) in CZ – approx. 15 hectares

- 1990 – 2005 - agricultural soil loss - 53 700 hectares

- From 1966 to 2007 - loss - 235 thousand hectares

- From 1927 - 851 thousand hectares



Total soil loss in CZ: 5 226 ha (2007)

- **15,0 % - housing**
- **23,7 % - industry**
- **25,5 % - mining**
- **11,8 % - transportation**
- **3,6 % - water construction**
- **4,9 % - recreation and sport**
- **7,8 % - afforestation**
- **7,7 % - others**

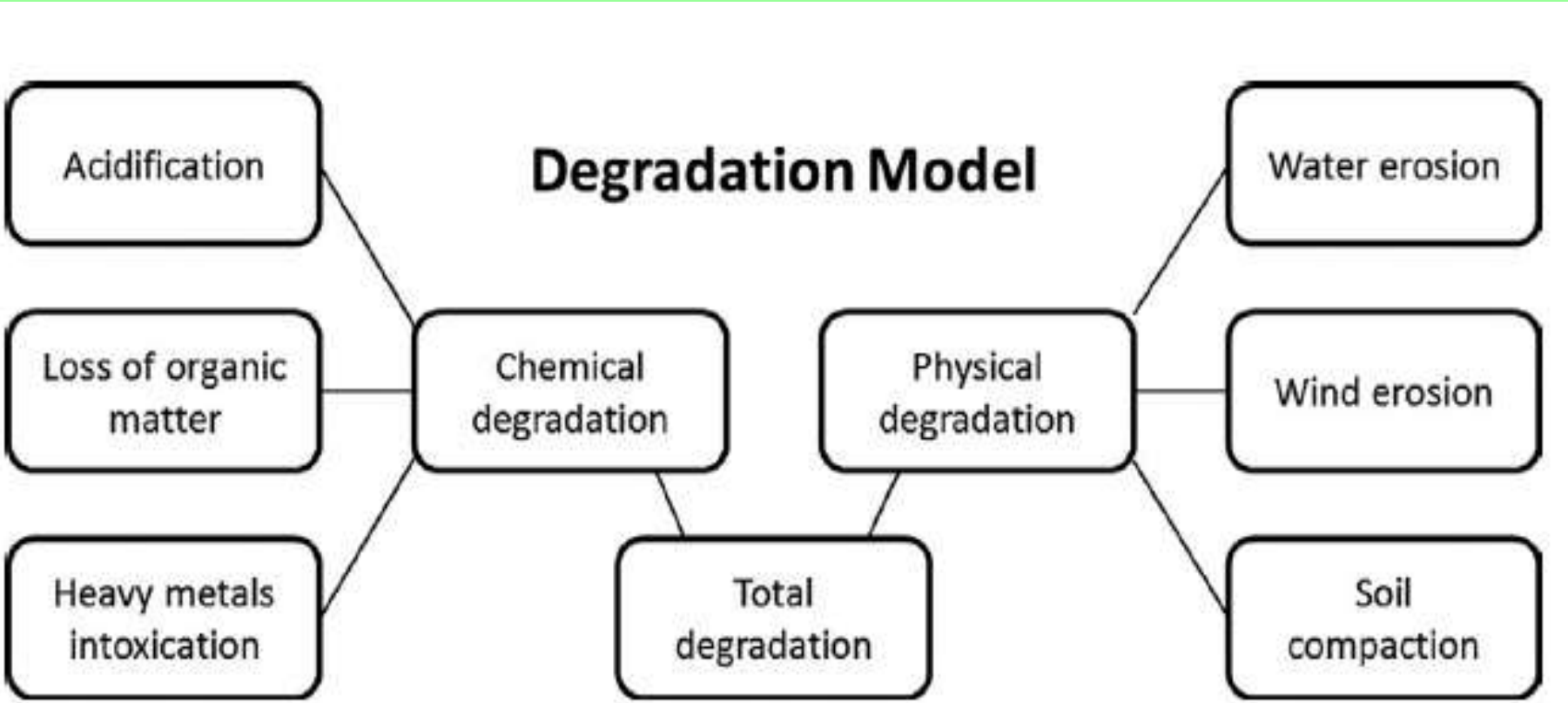
- In the last decade of 20th century agricultural soil loss in EU states was approx.1000 km^2 per year, or 275 hectares per day.

- From 2000 to 2006 - 920 km^2 per year, 252 ha per day.

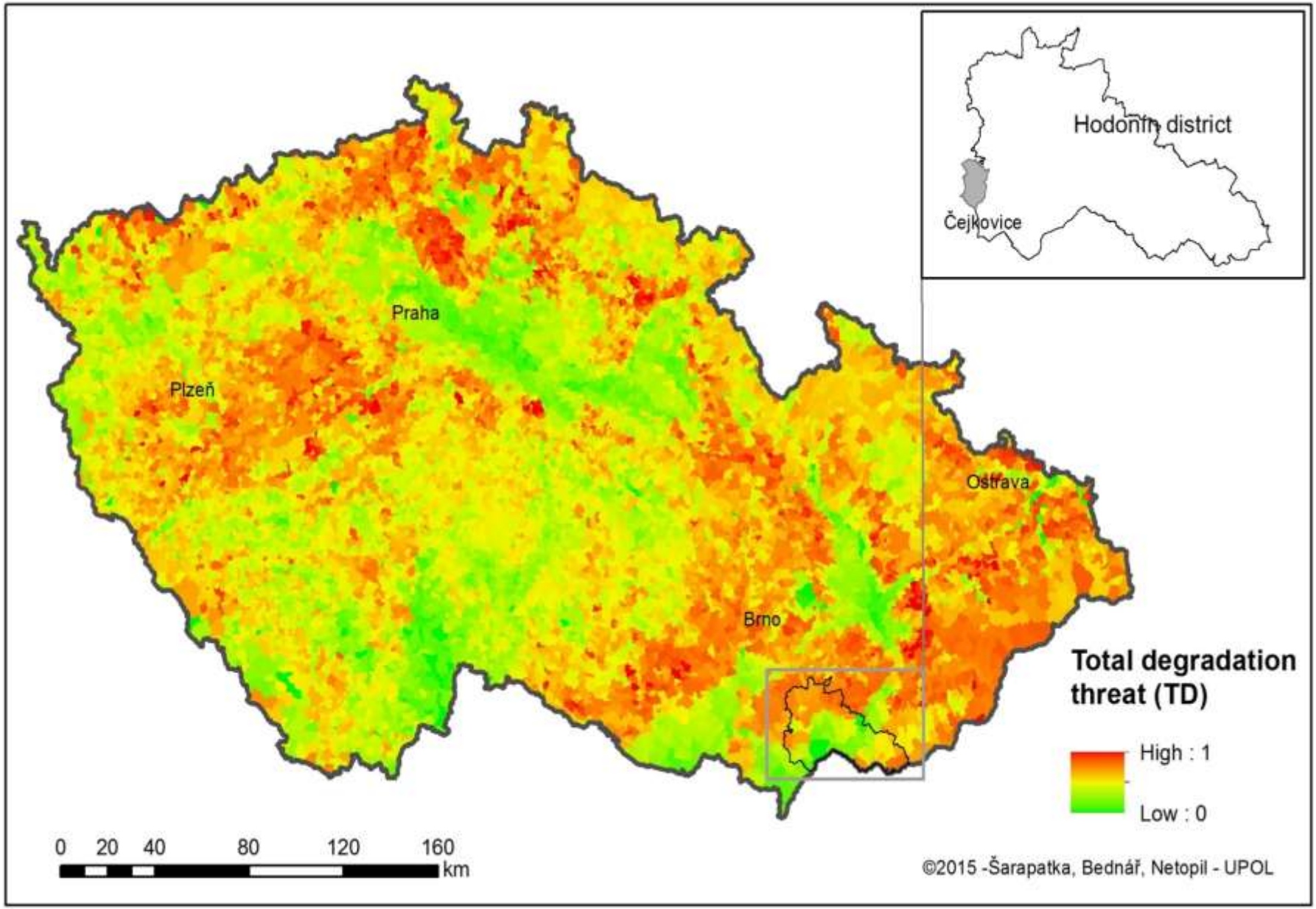
Daily losses:

Germany - 130 ha
Austria, Holland - 35 ha
Switzerland - 10 ha

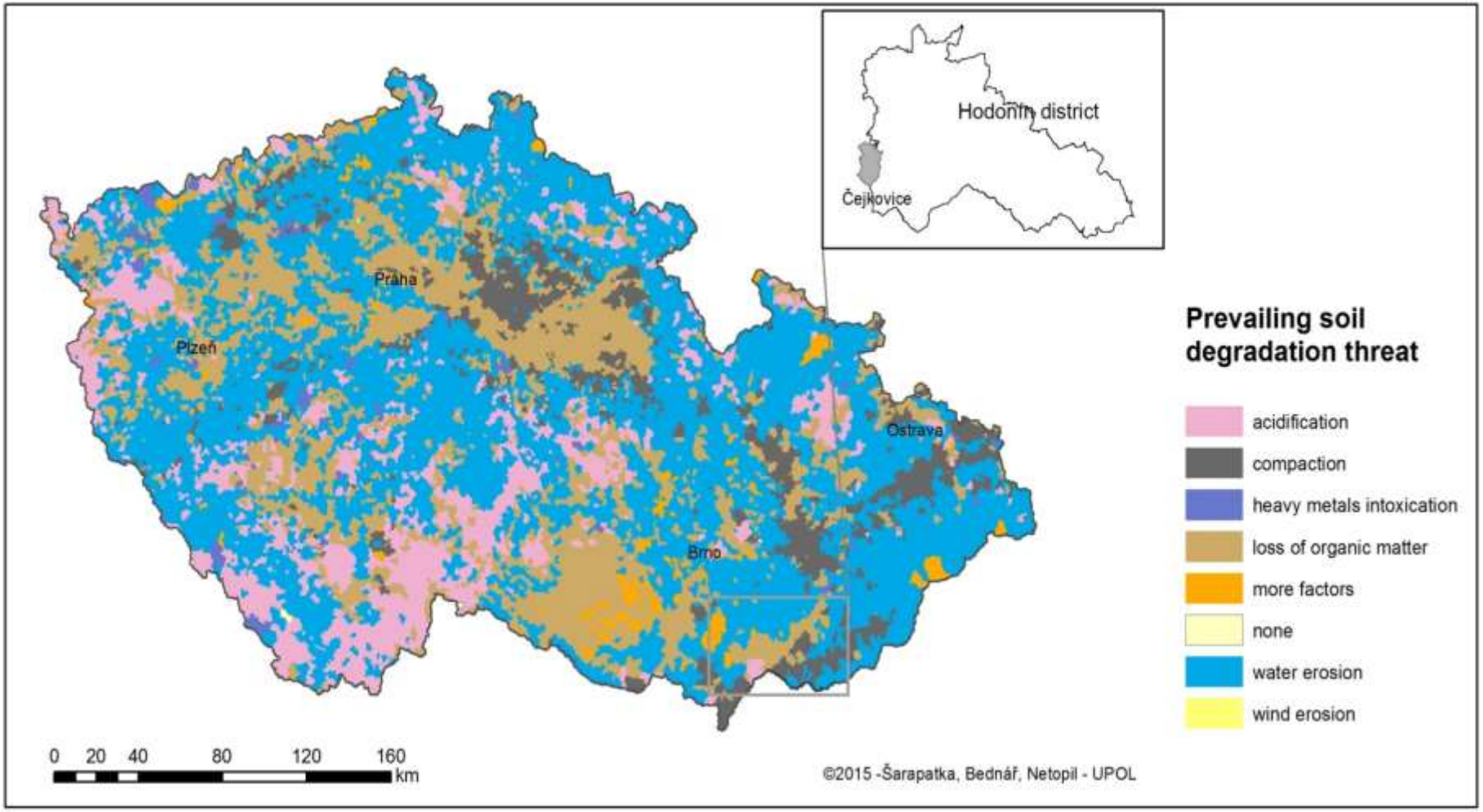
Qualitative damages of soils



Source: Šarapatka and Bednář, 2015

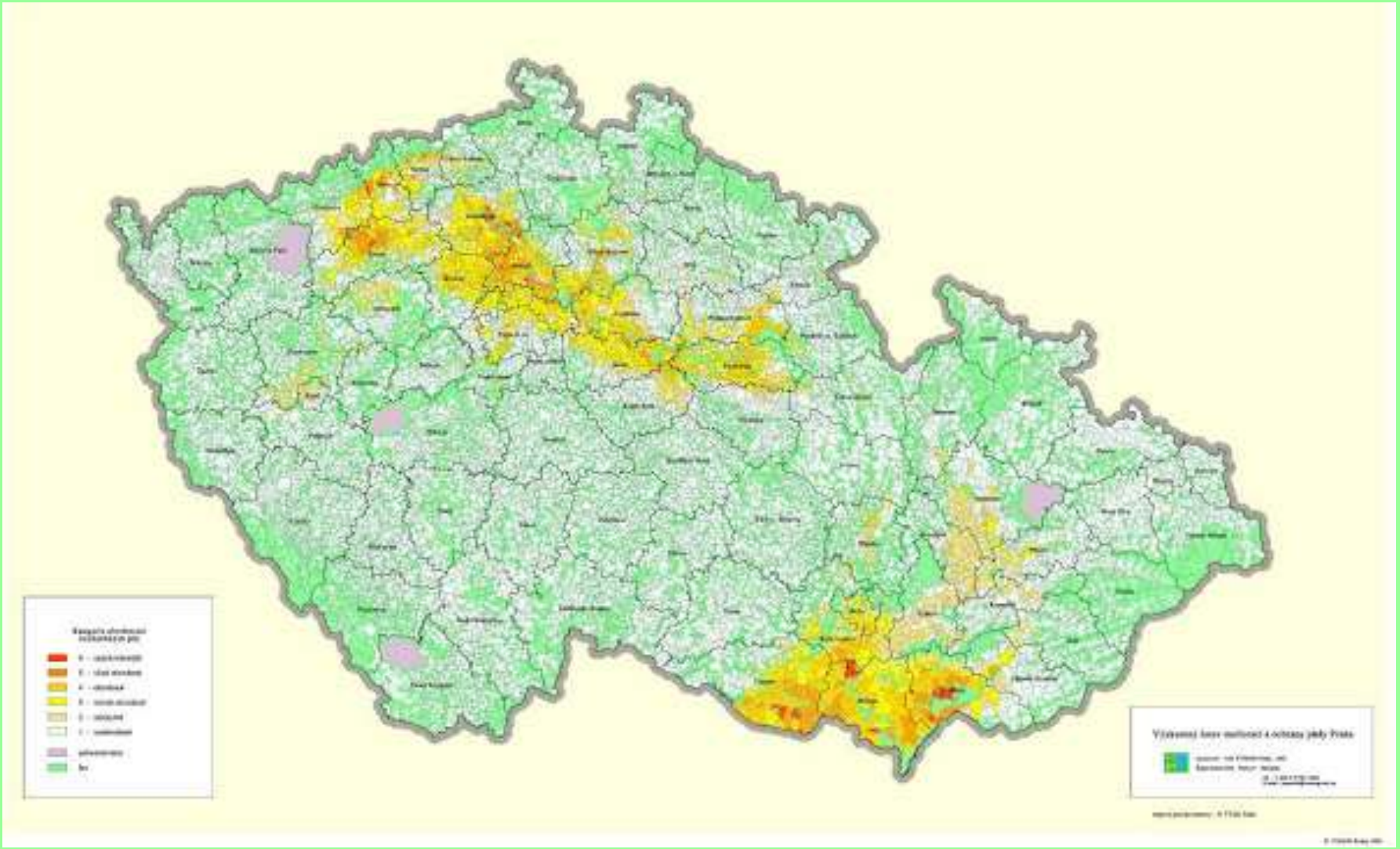


Source: Šarapatka and Bednář, 2015



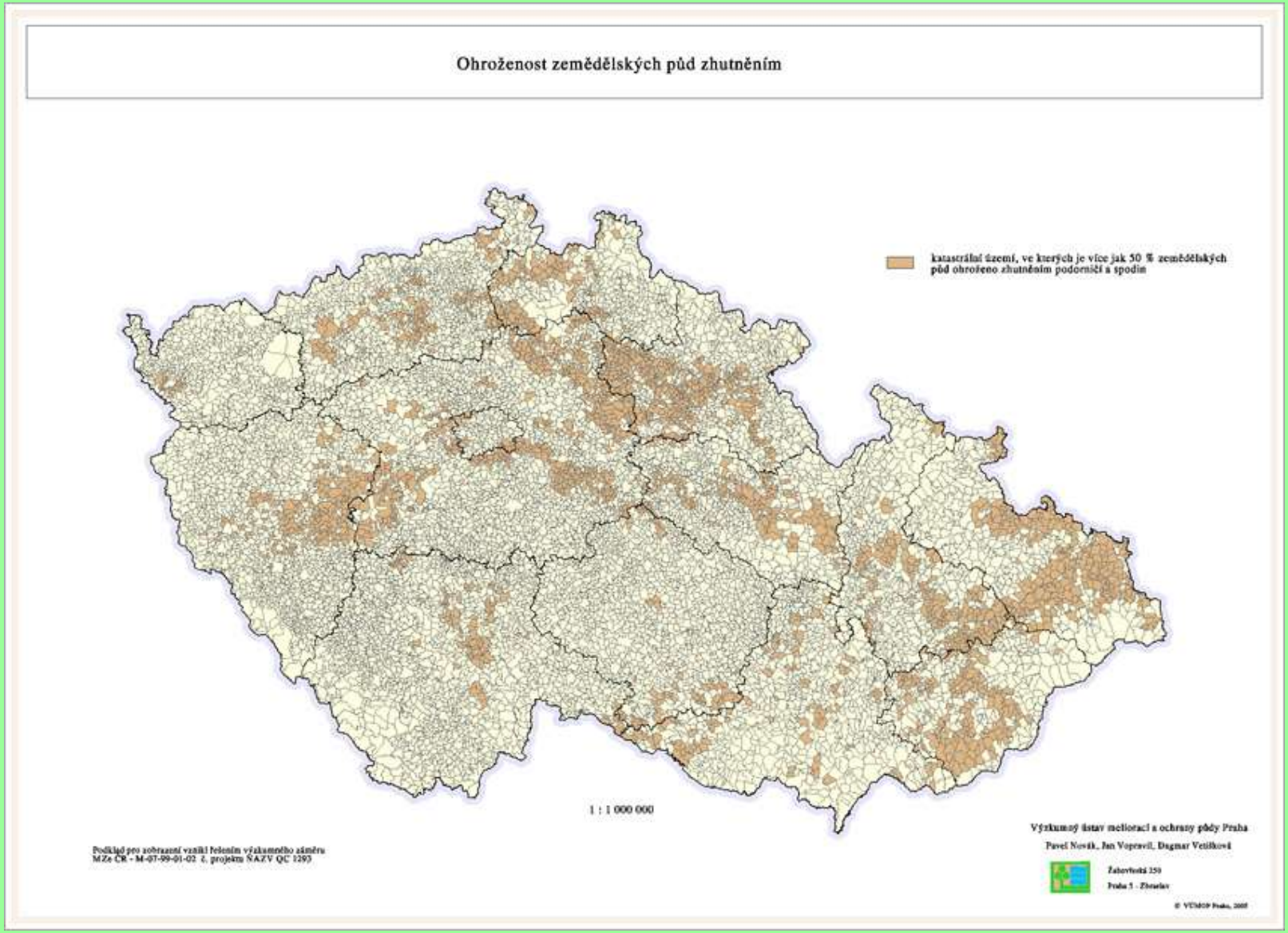
Source: Šarapatka and Bednář, 2015

10.4 % of arable land - problems with wind erosion

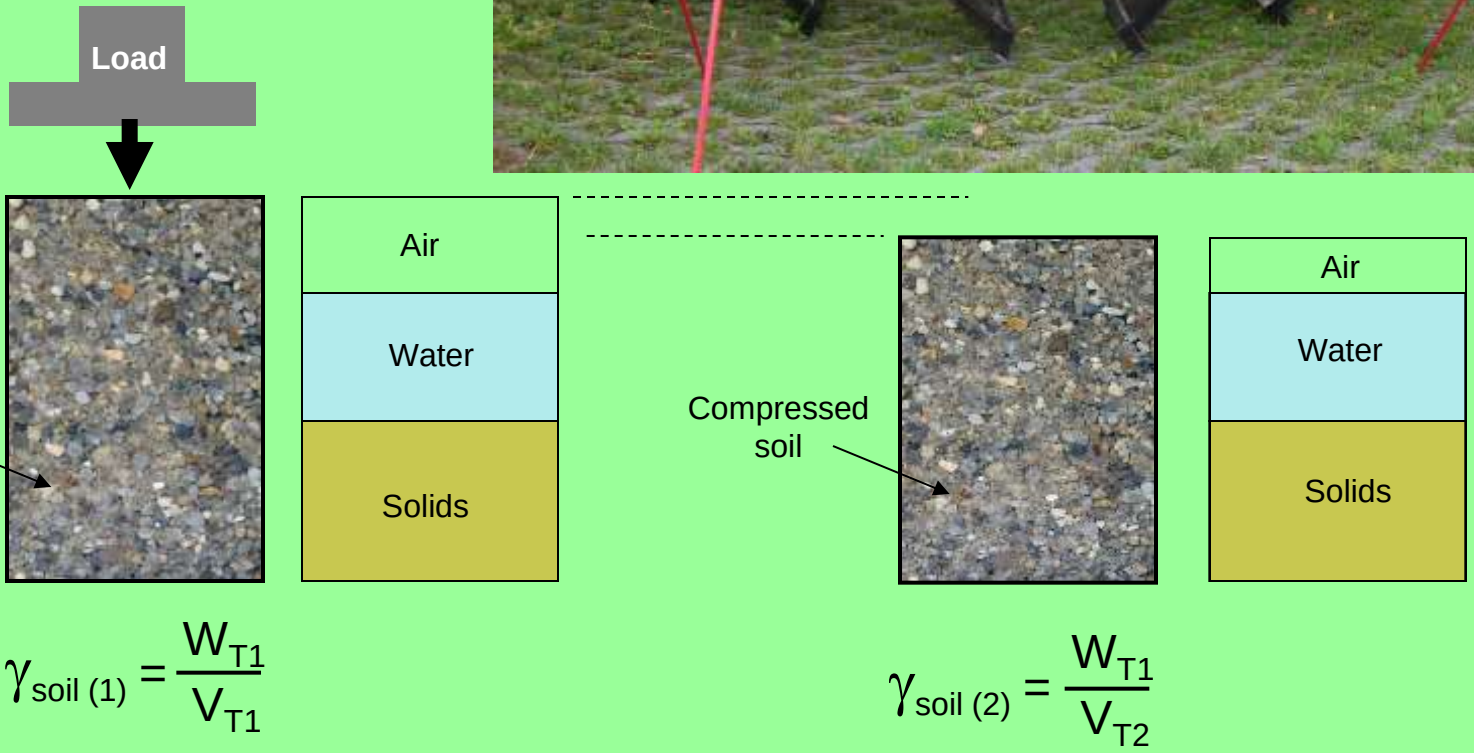


Source: VÚMOP

45 % of agricultural land - problems with compaction



Source: VÚPOP

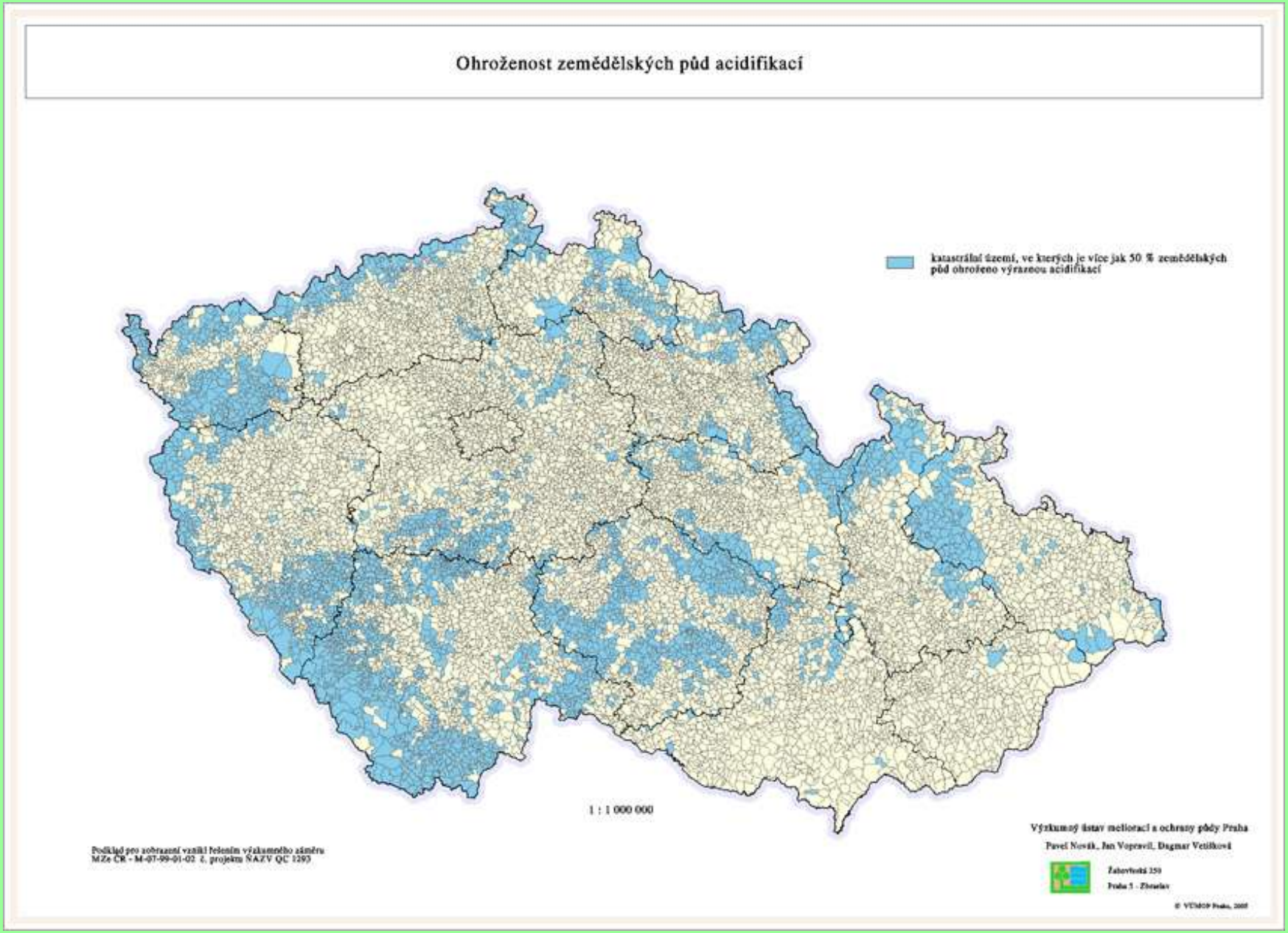


$$\gamma_{soil\ (1)} = \frac{W_{T1}}{V_{T1}}$$

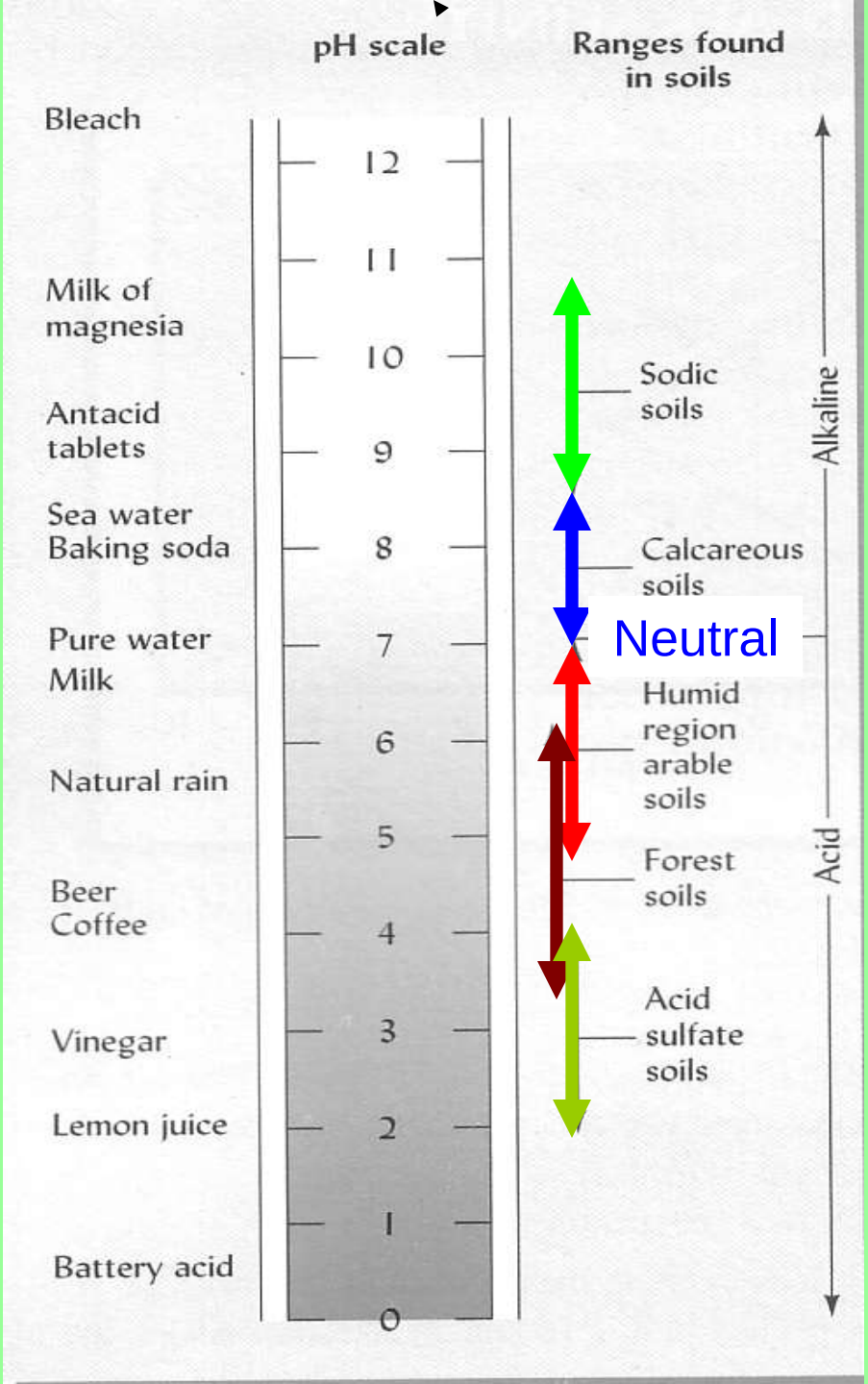
$$\gamma_{soil\ (2)} = \frac{W_{T1}}{V_{T2}}$$

Chernozems can accumulate 3500 m^3 of water per hectare

Acidification

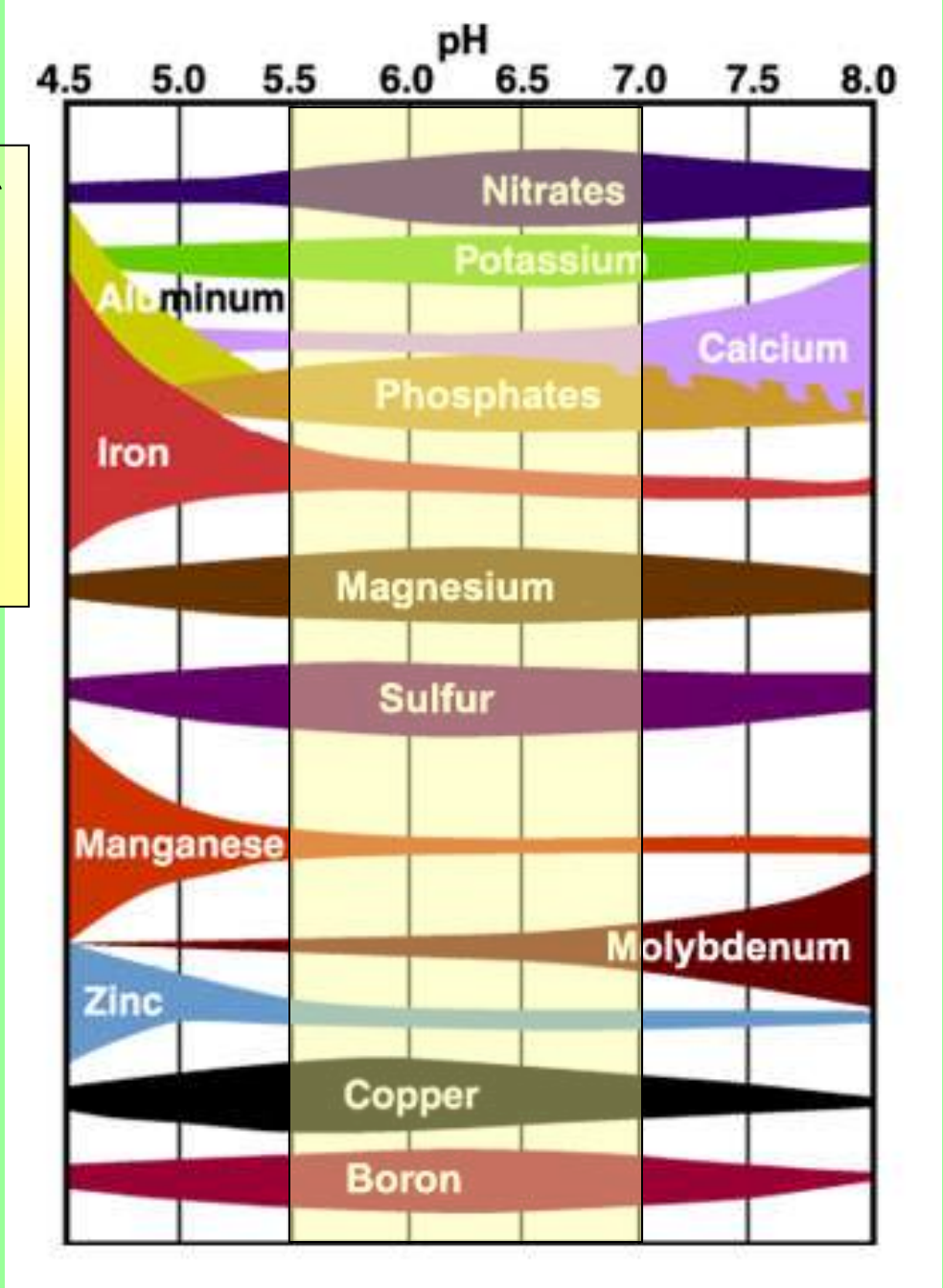


Understanding Soil Acidity



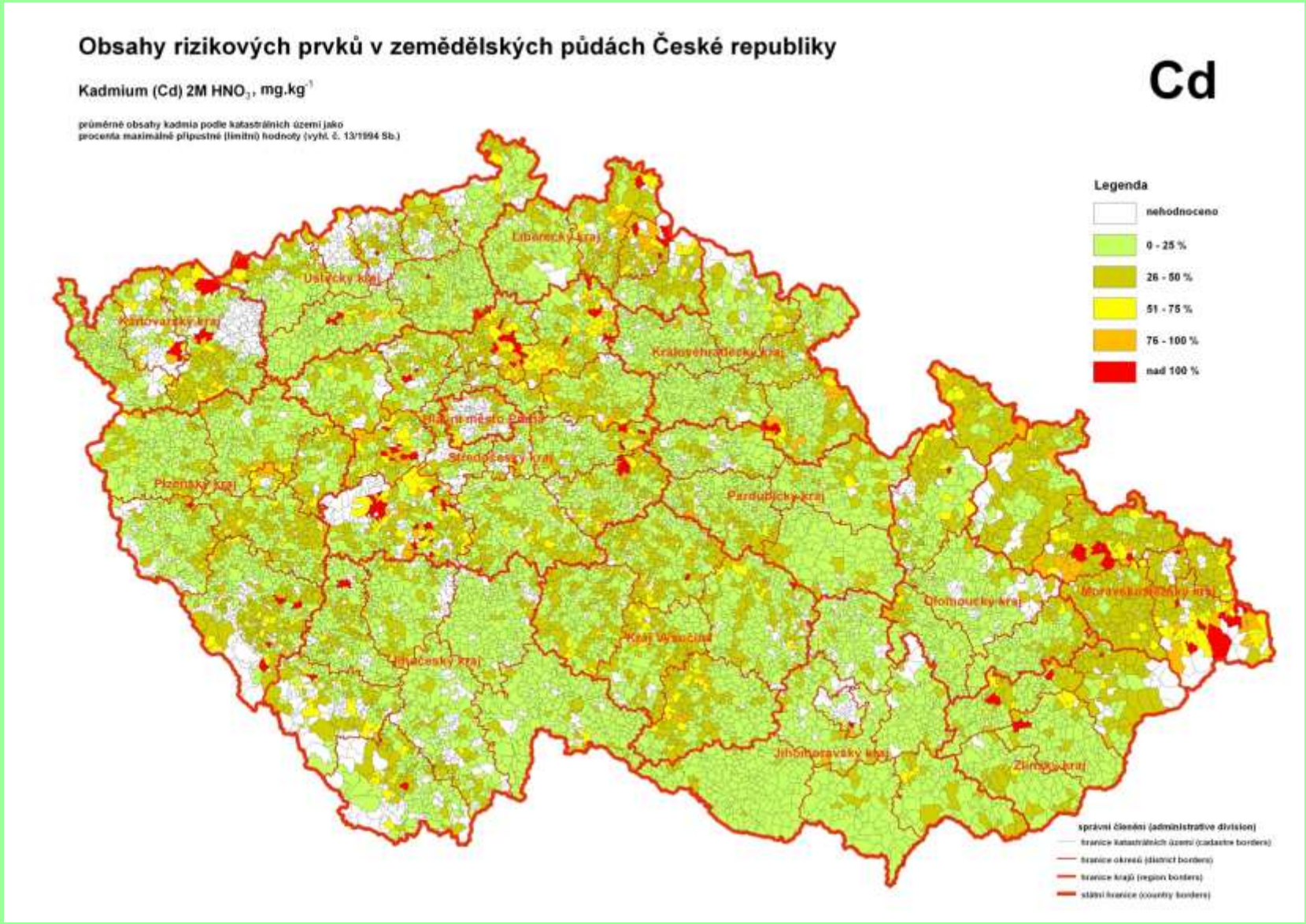
Brady and Weil (2002)

Most *nutrients* are highest and most *toxins* are lower at pH 5.5-7



http://www.traylorchemical.com/images/faqs/phchart.jpg

Soil contamination



Source: ÚKZÚZ

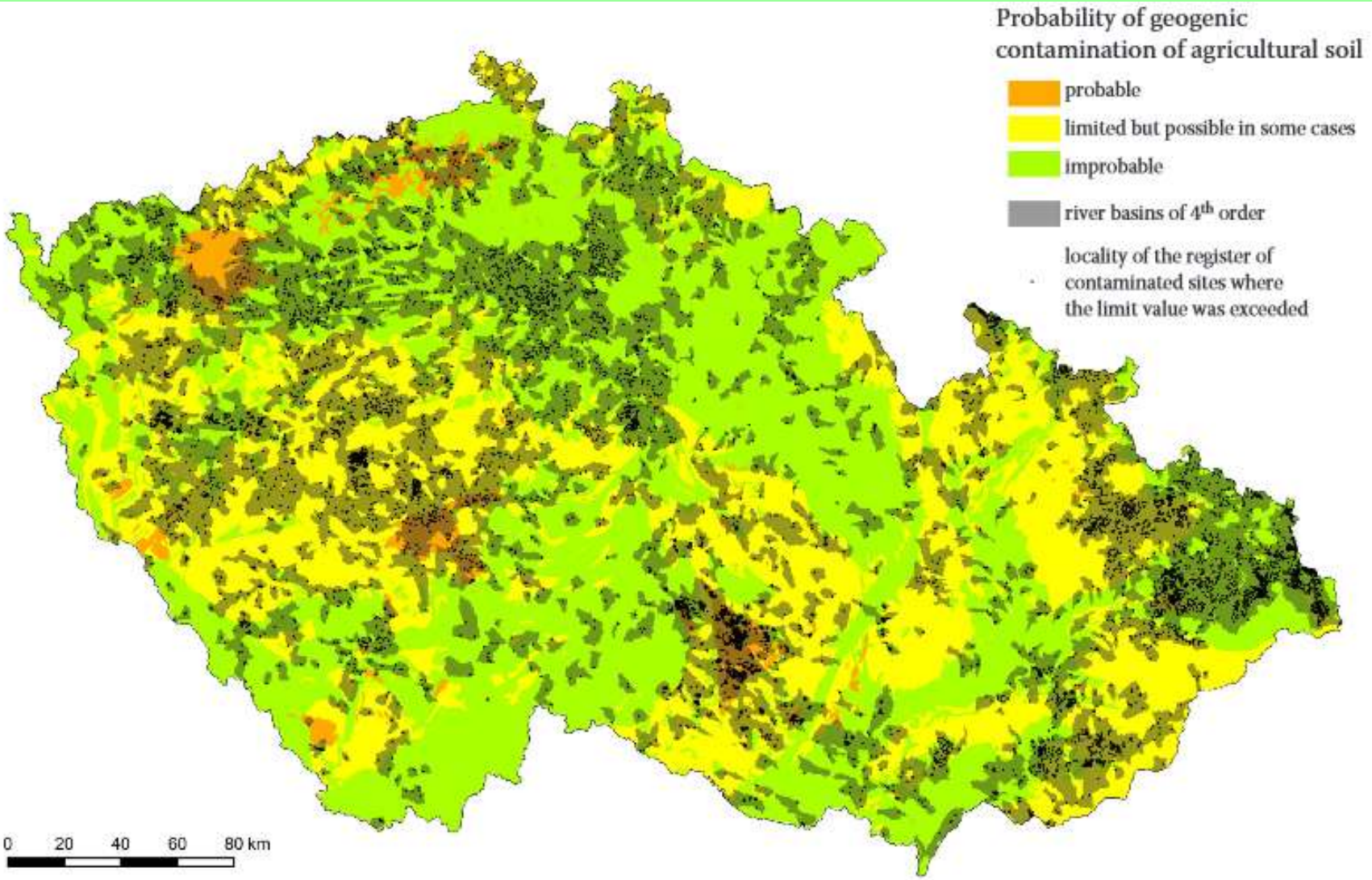


Figure 3. Probability of geogenic contamination of agricultural soils – correlation of geological substrate categories with sampling sites (Kubík 2009), where the limit value for risk element content was exceeded and polygons of river basin of 4th order

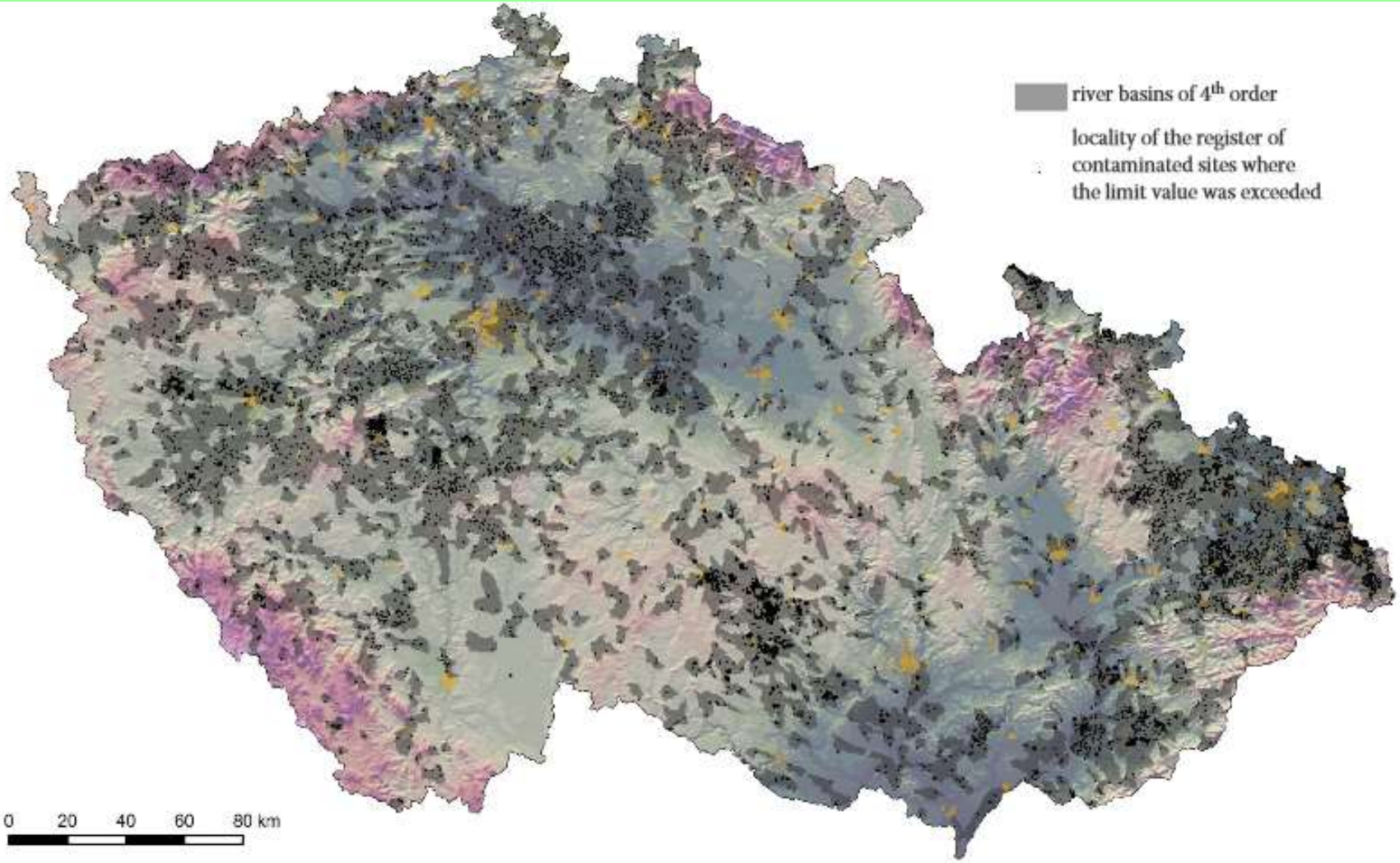
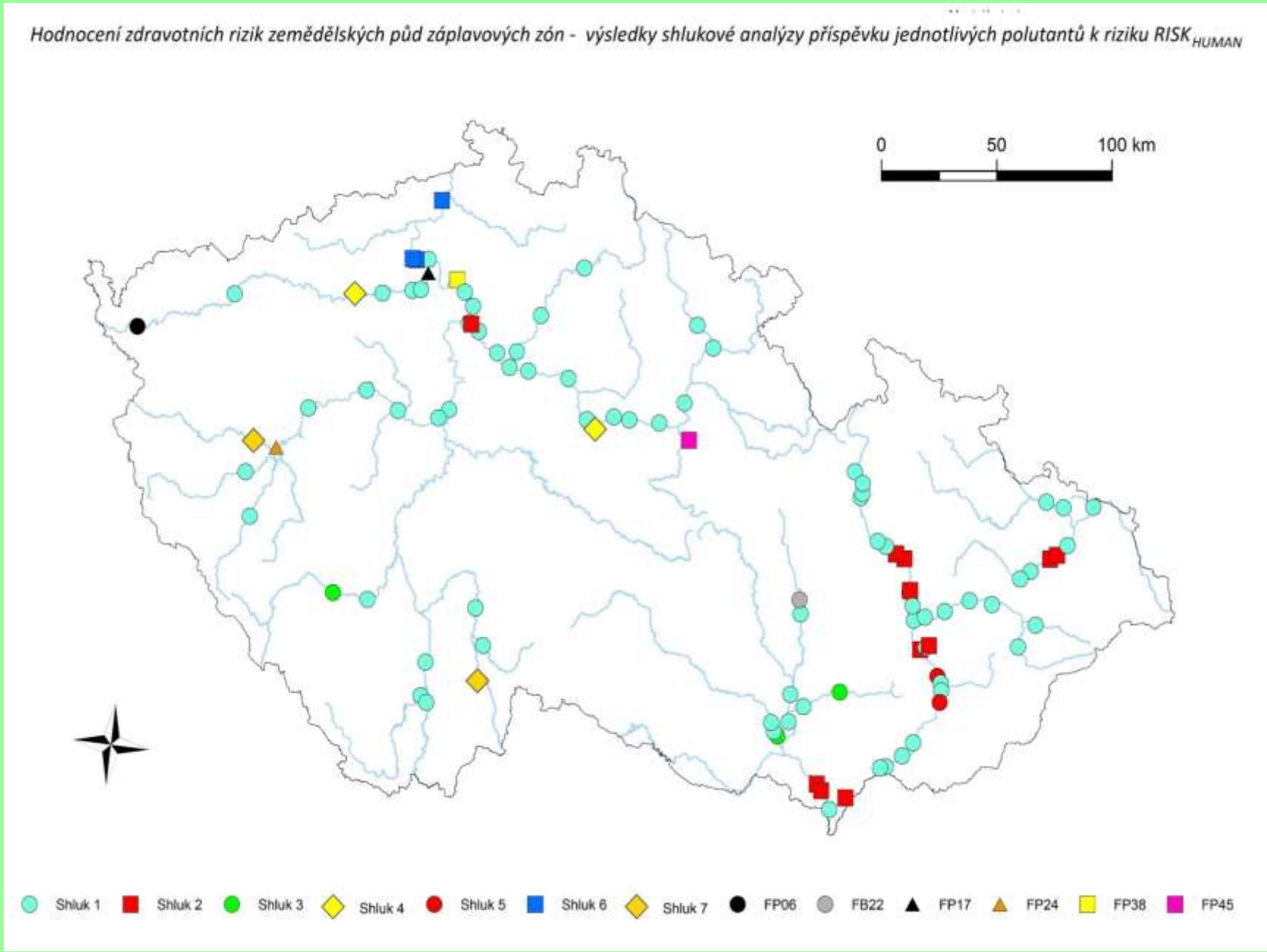
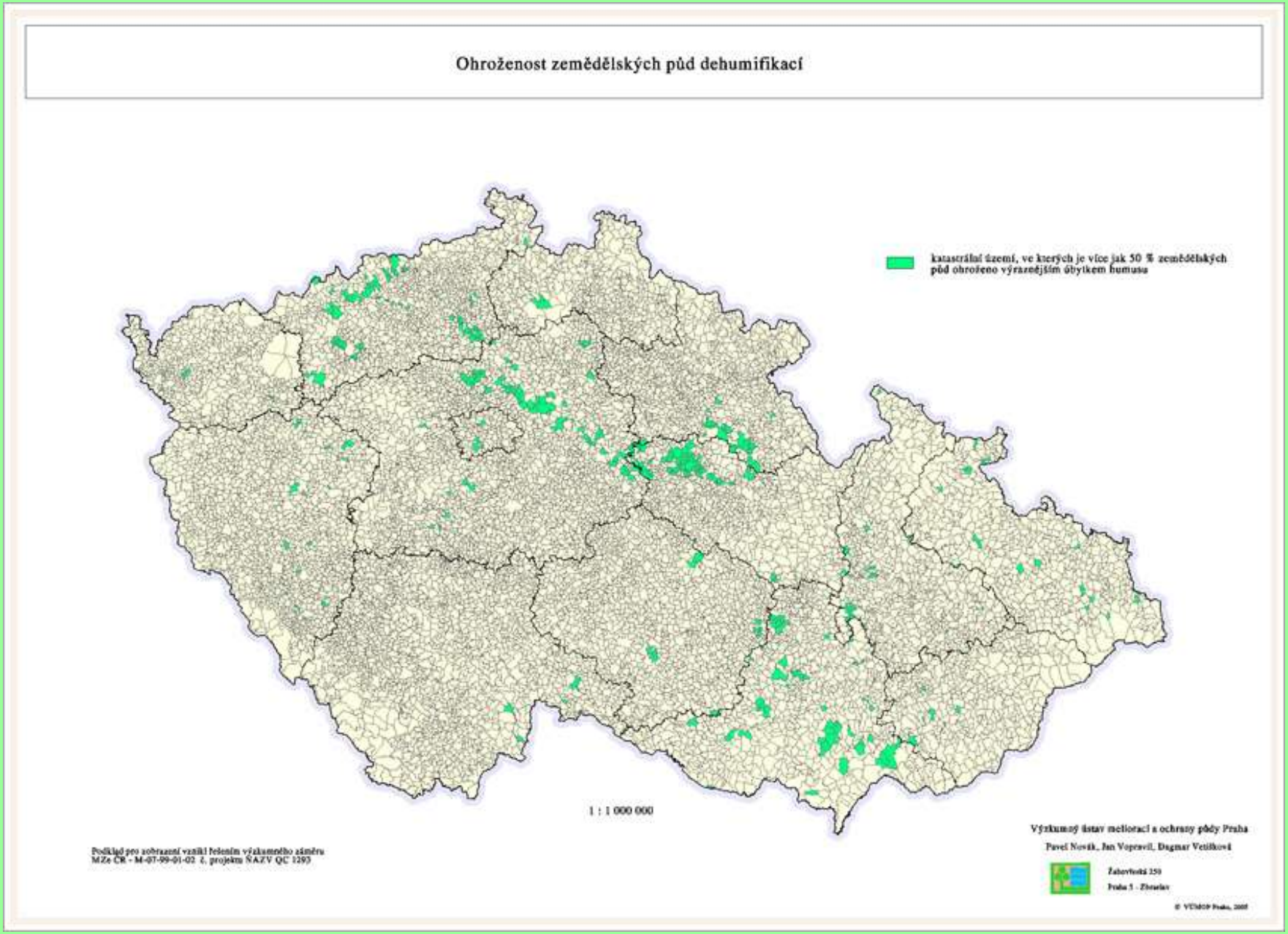


Figure 2. Localisation of the river basins of 4th order with sampling sites (Kubík 2009), where the limit value for risk element content was exceeded



Source: VÚMOP, MU

Loss of organic matter



Source: VÚMOP

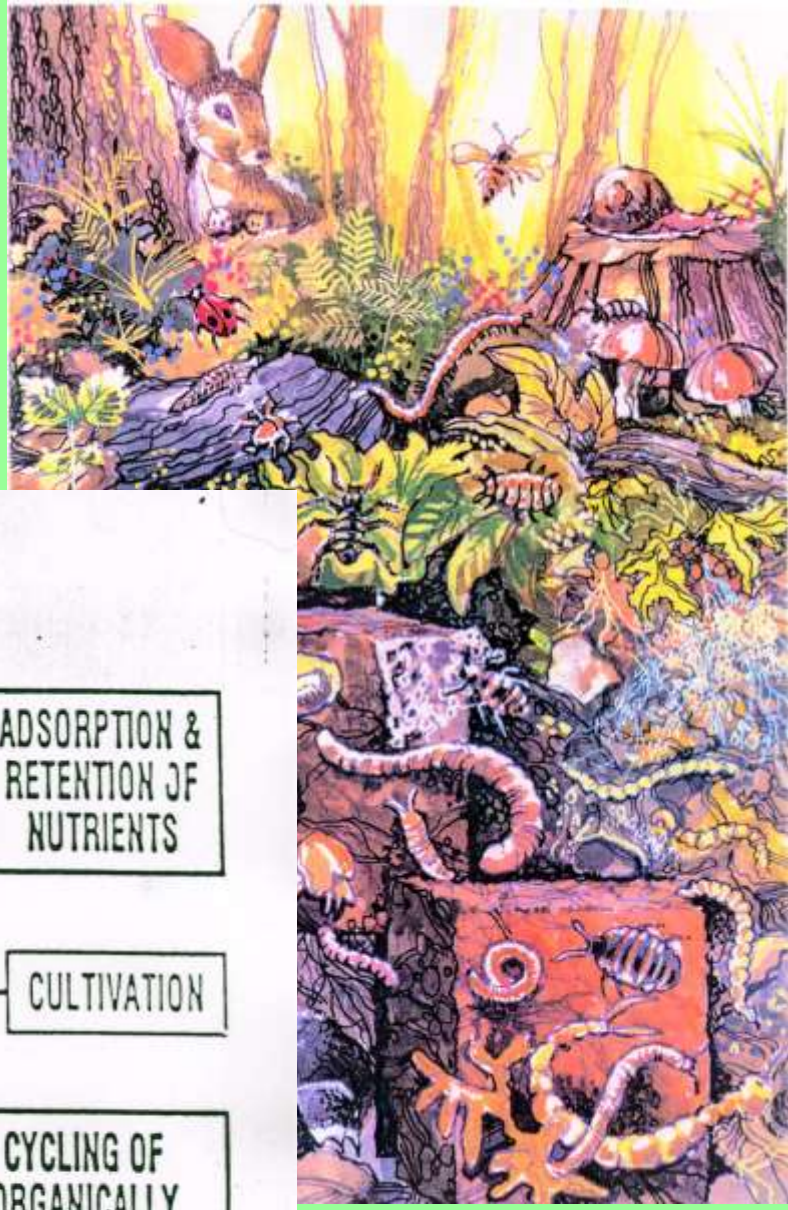
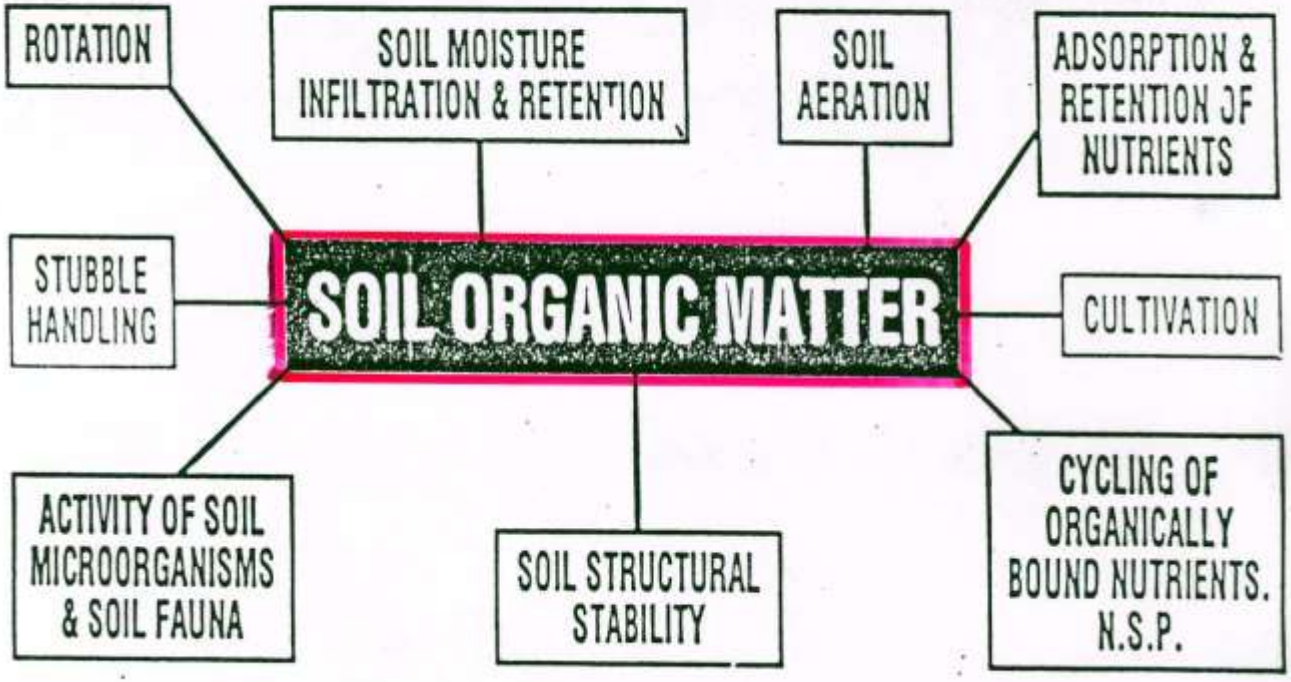
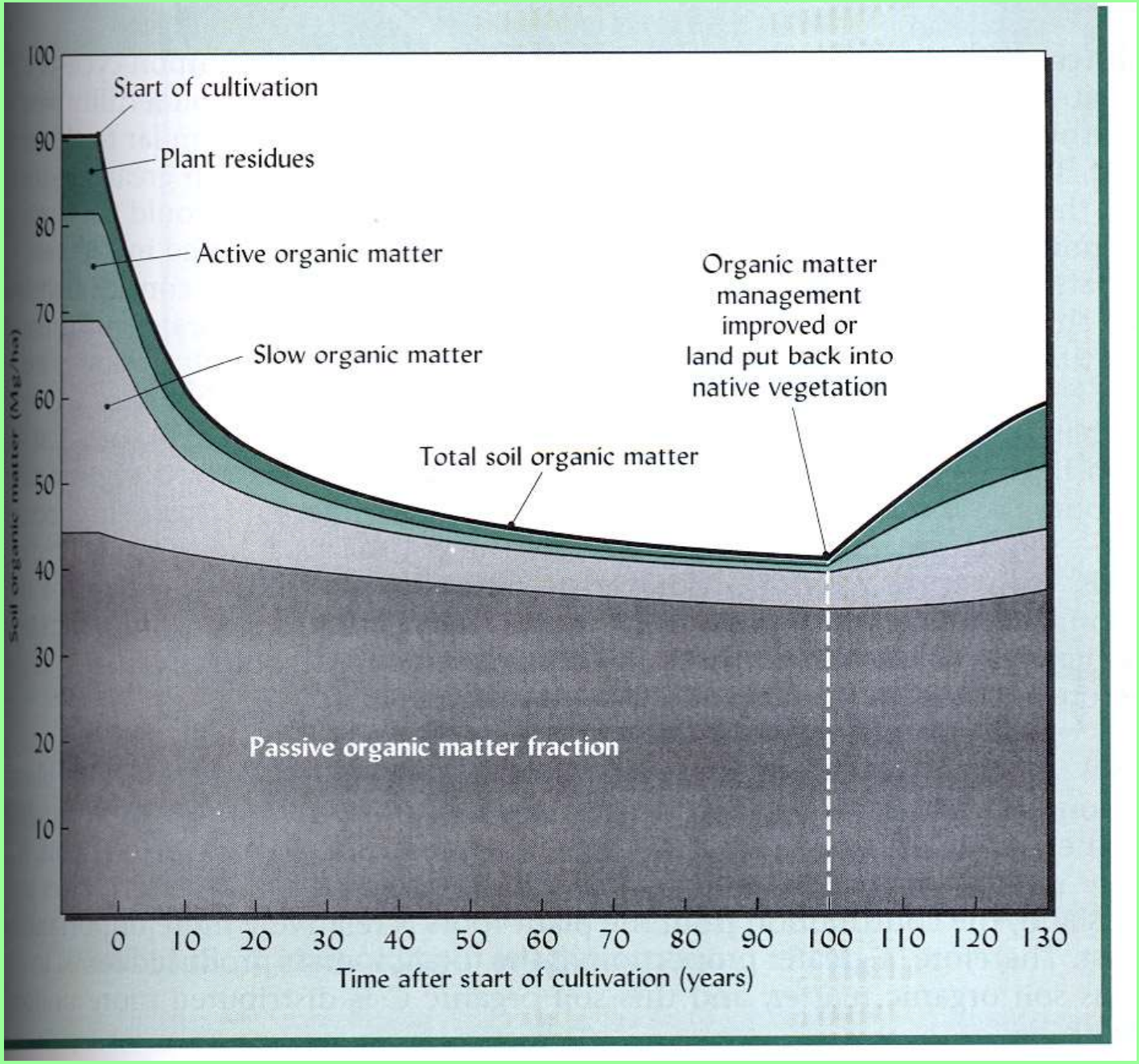
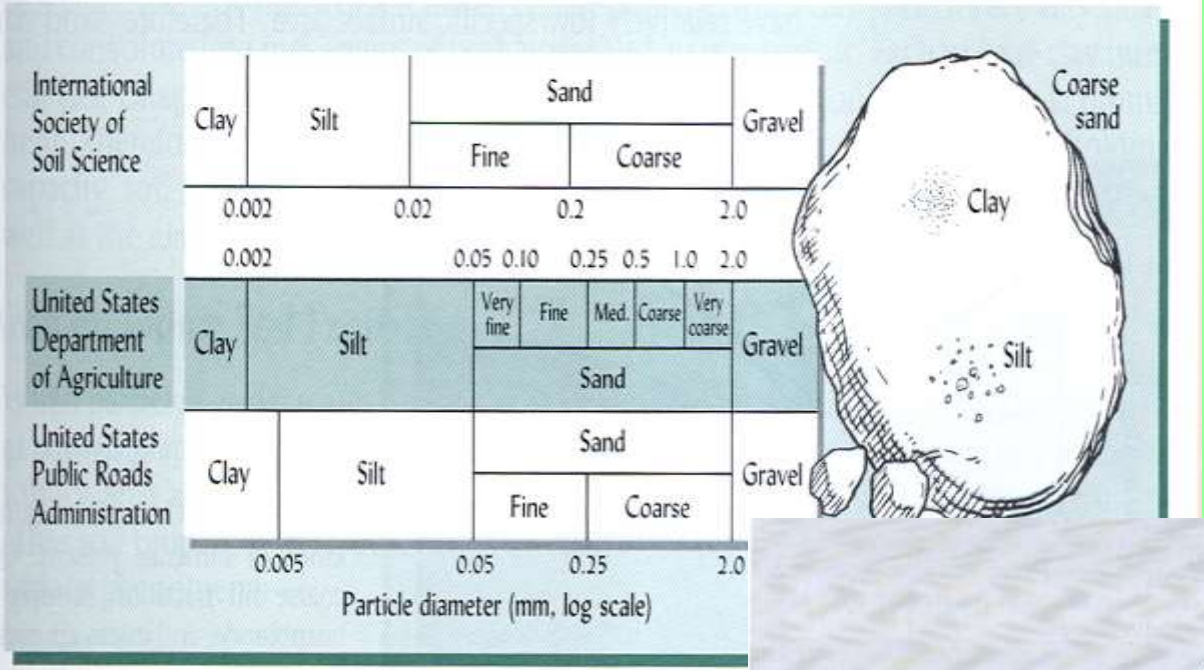


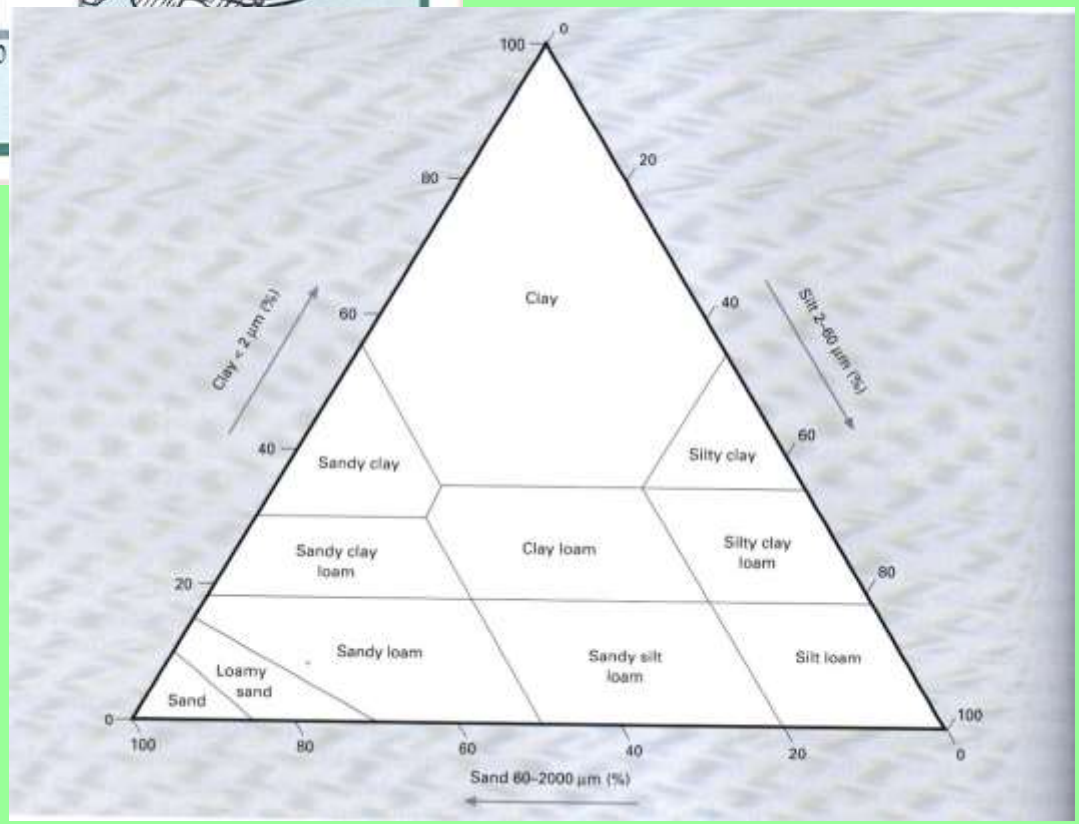
Figure 2 **Central role of organic matter**





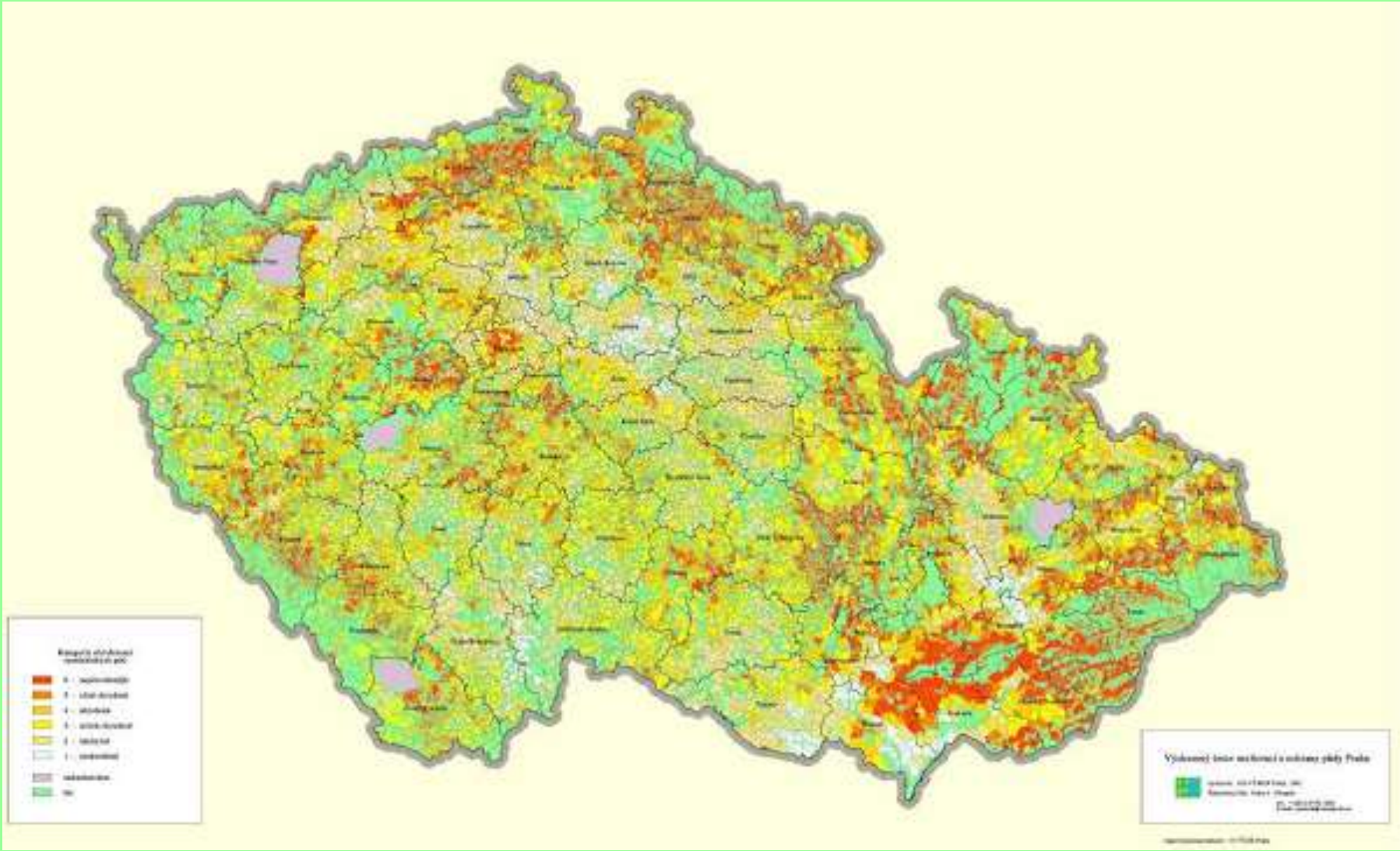
Source: Brady and Weil, 2002


International Society of Soil Science
Clay
Silt
Sand
Fine
Coarse
Gravel
0.002
0.02
0.2
2.0
United States Department of Agriculture
0.002
0.05
0.10
0.25
0.5
1.0
2.0
Very fine
Fine
Med.
Coarse
Very coarse
United States Public Roads Administration
0.005
0.05
0.25
2.0
Particle diameter (mm, log scale)
Coarse sand
Clay
Silt


Clay
Sandy clay
Silty clay
Clay loam
Sandy clay loam
Silty clay loam
Sandy loam
Sandy silt loam
Silt loam
Loamy sand
Sand
Clay < 2 µm (%)
Silt 2–60 µm (%)
Sand 60–2000 µm (%)

Příklad kombinace degradačních faktorů

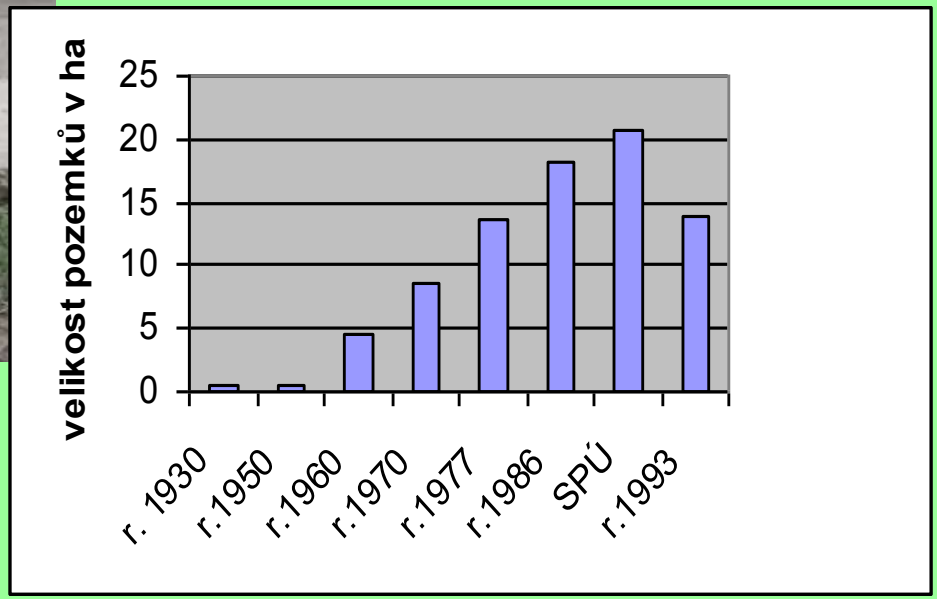
54 % of arable land - problems with water erosion

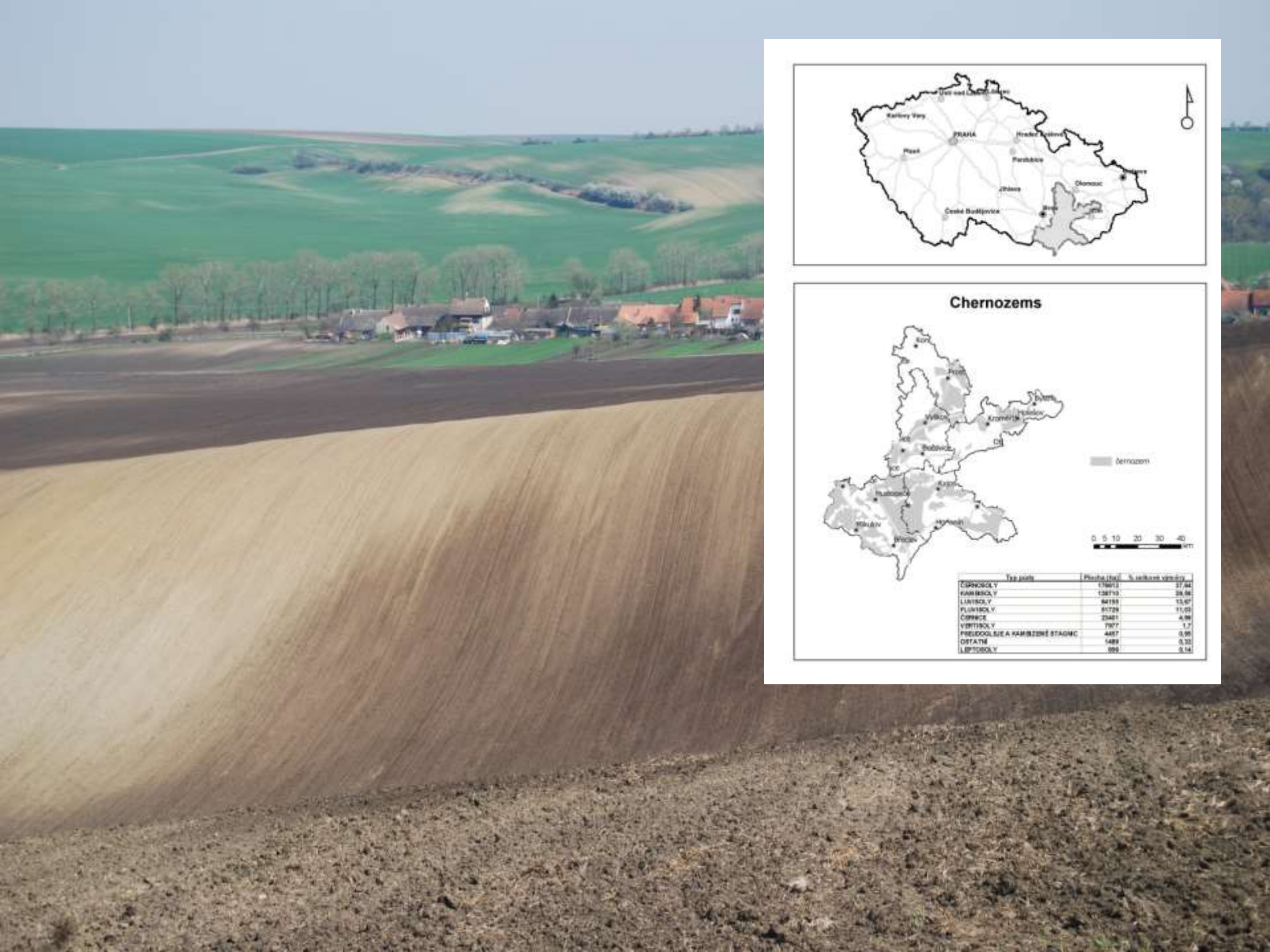


Source: VÚMOP

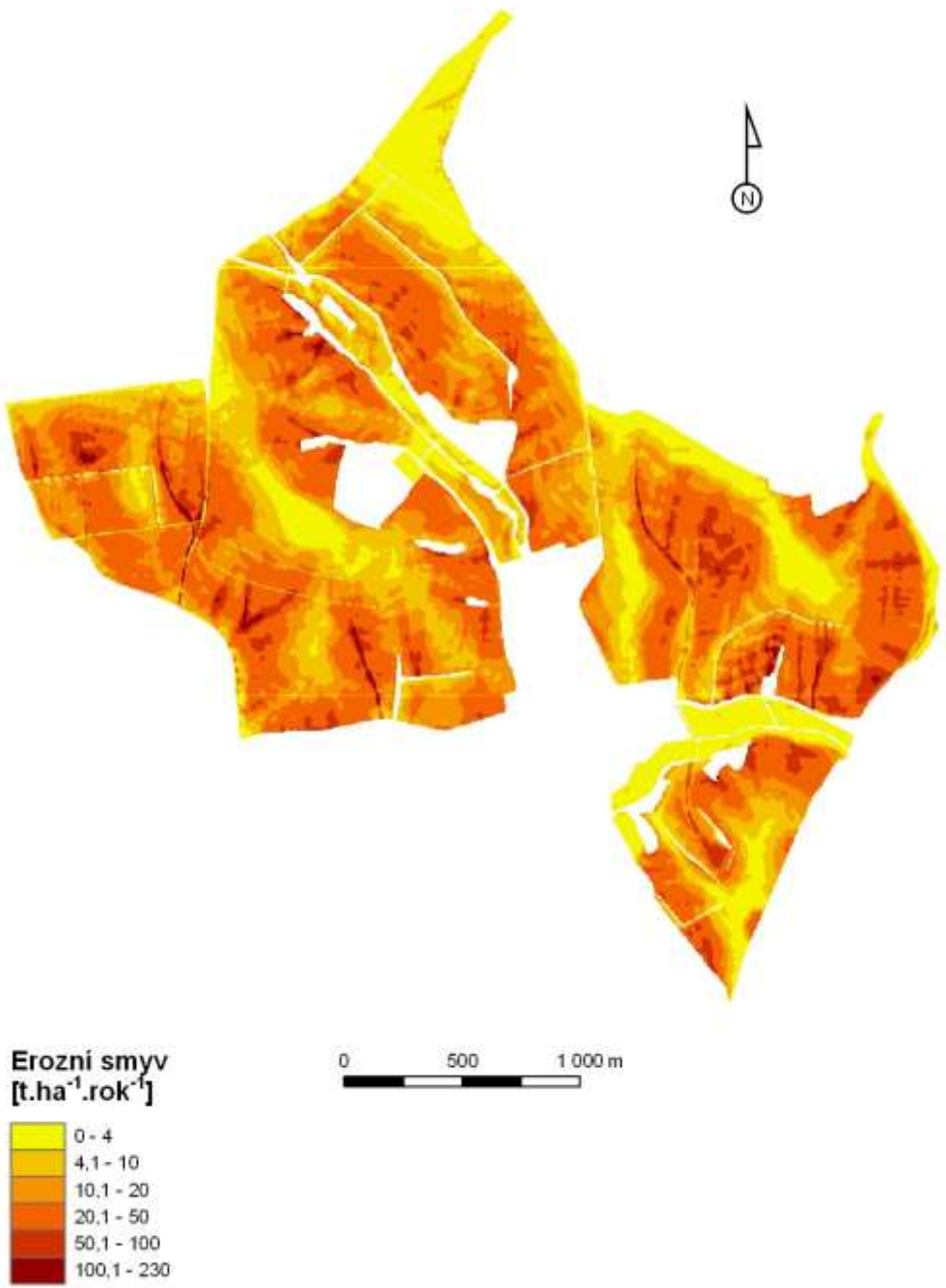
Soil erosion vs. average size of fields (in hectares)

Coluvisols development during erosion processes




Karlovy Vary
PRAHA
Hradec Králové
Plzeň
Pardubice
Olomouc
Jihlava
České Budějovice
Chernozems
černozem
0 5 10 20 30 40

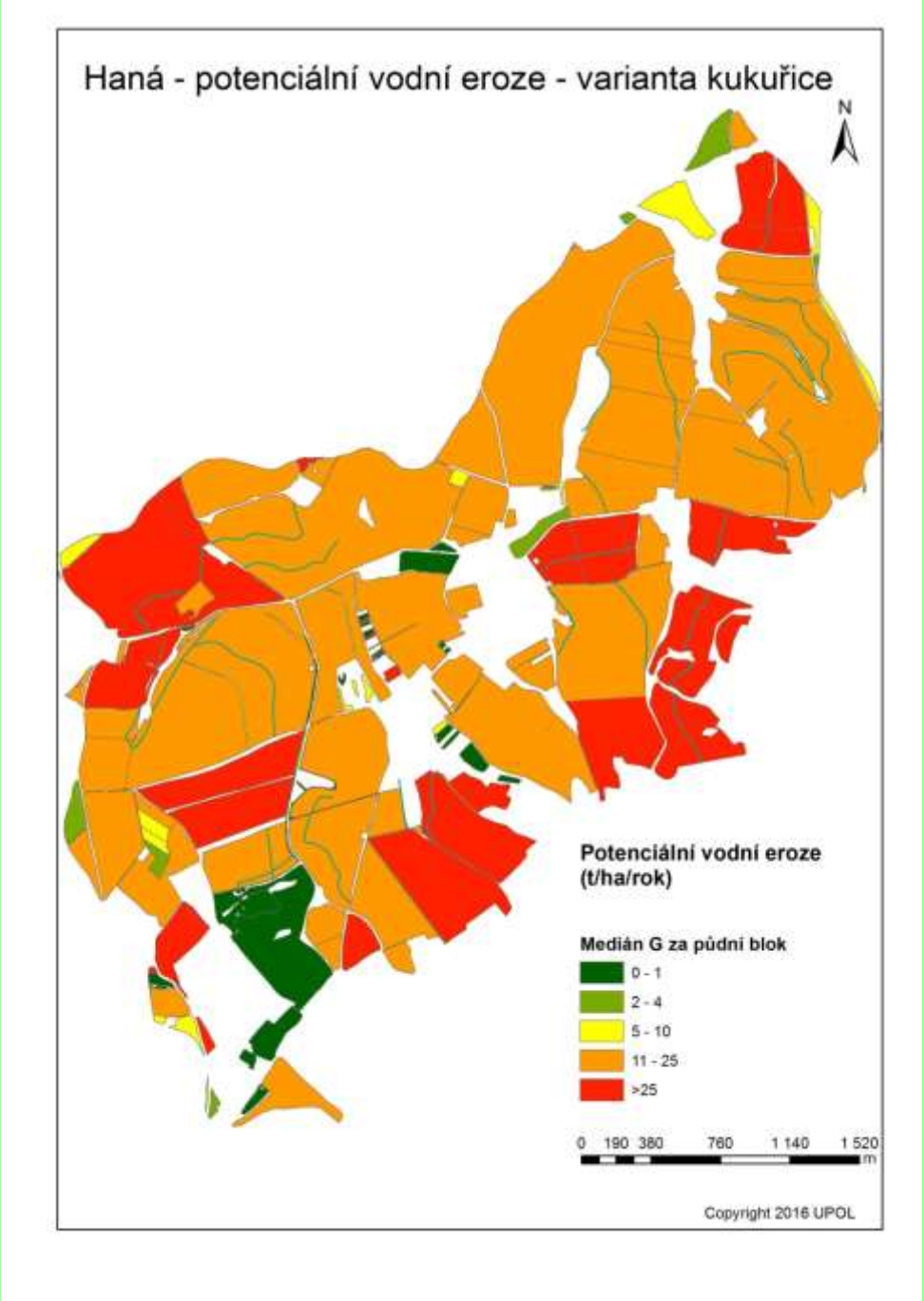
South Moravia – very productive region




protierozní osevní postup, vrstevnicové obdělávání, bez širokořádkových kultur
mez s krajinnou zelení
protierozní ochrana chmelnic - zelené hnojení, dodávka organické hmoty do půdy
možná kukuřice při vrstevnicovém obdělávání a protierozní technologii pěstování kukuřice
zatravnění
protierozní ochrana chmelnic - zelené hnojení, dodávka organické hmoty do půdy
zatravněný průleh
problémová oblast, nutnost řešit i zatravněním
vyloučení kukuřice z osevního postupu

Haná catchment

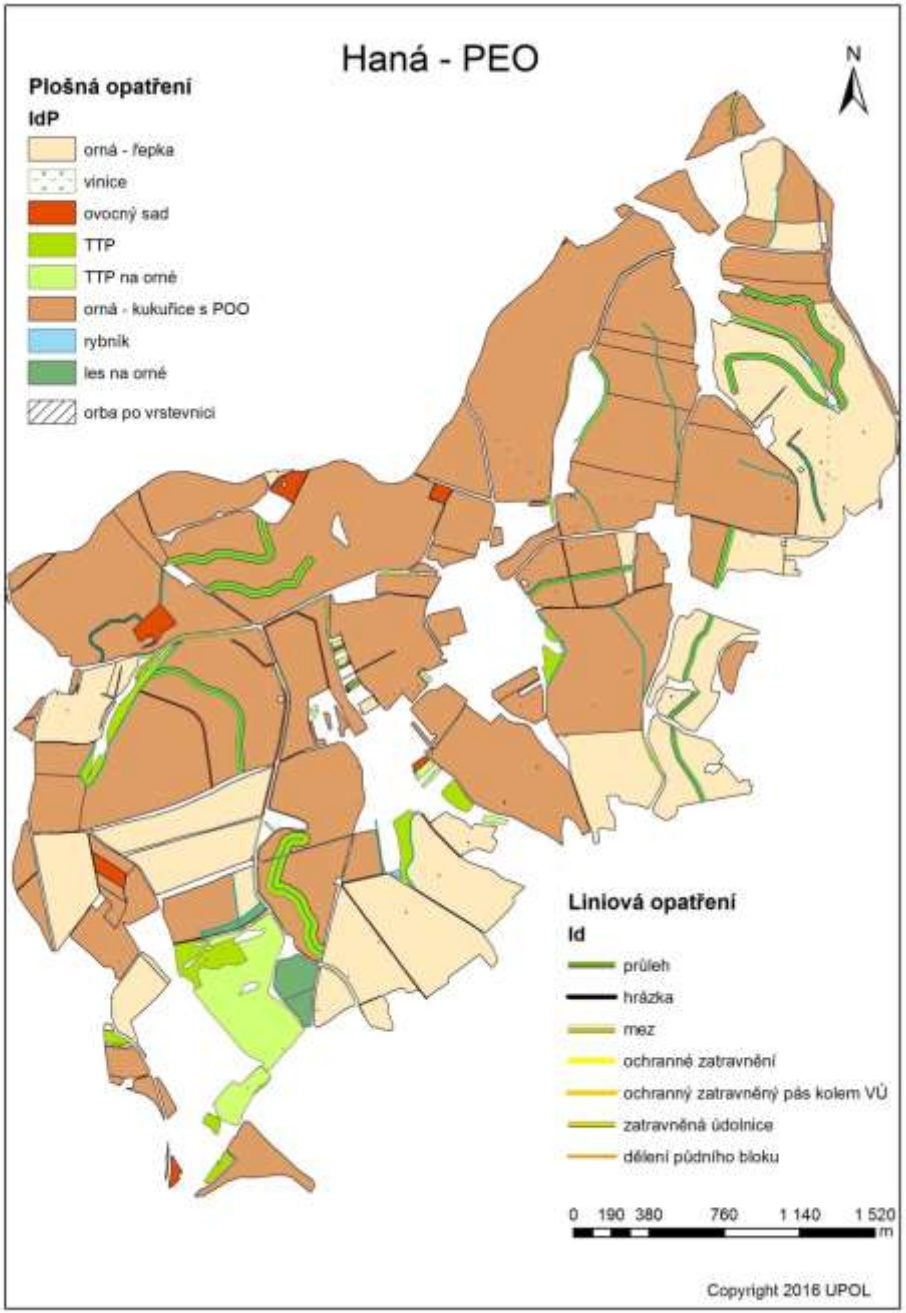
water erosion in t/ha/year
calculated for maize growing



Source: Šarapatka and Bednář, 2016

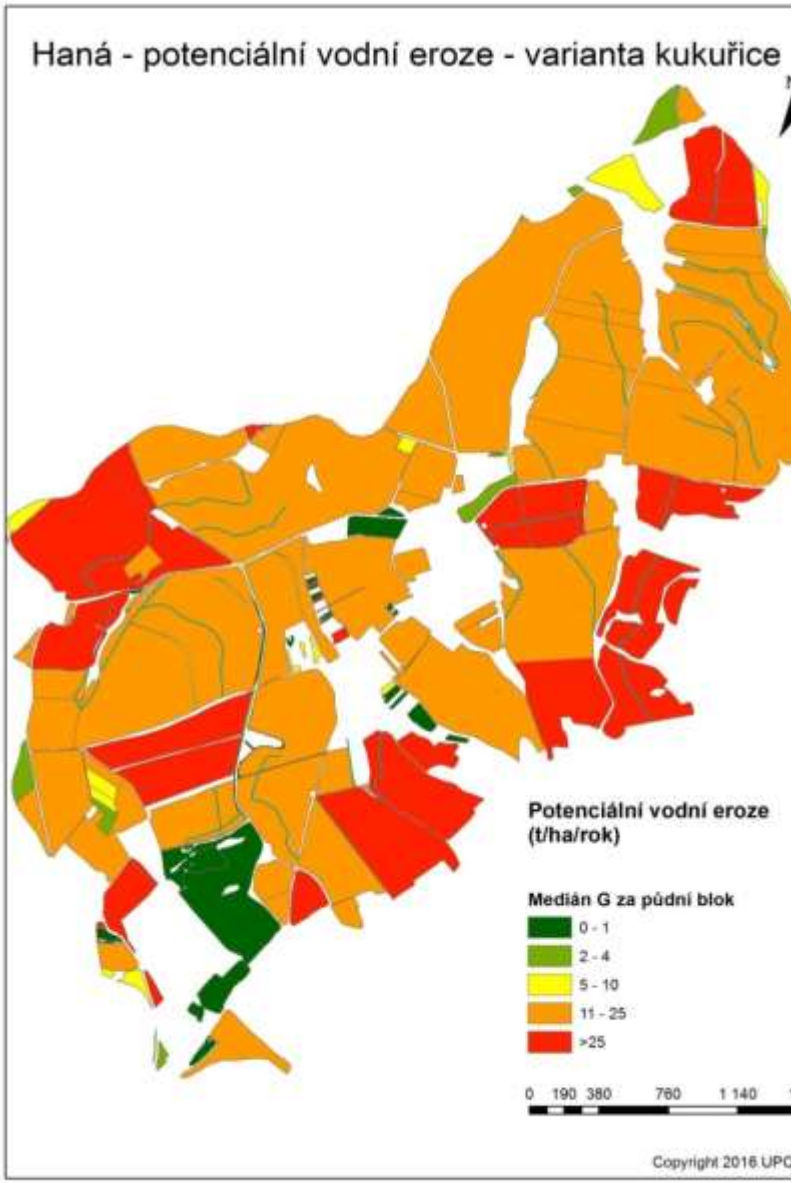
Haná catchment

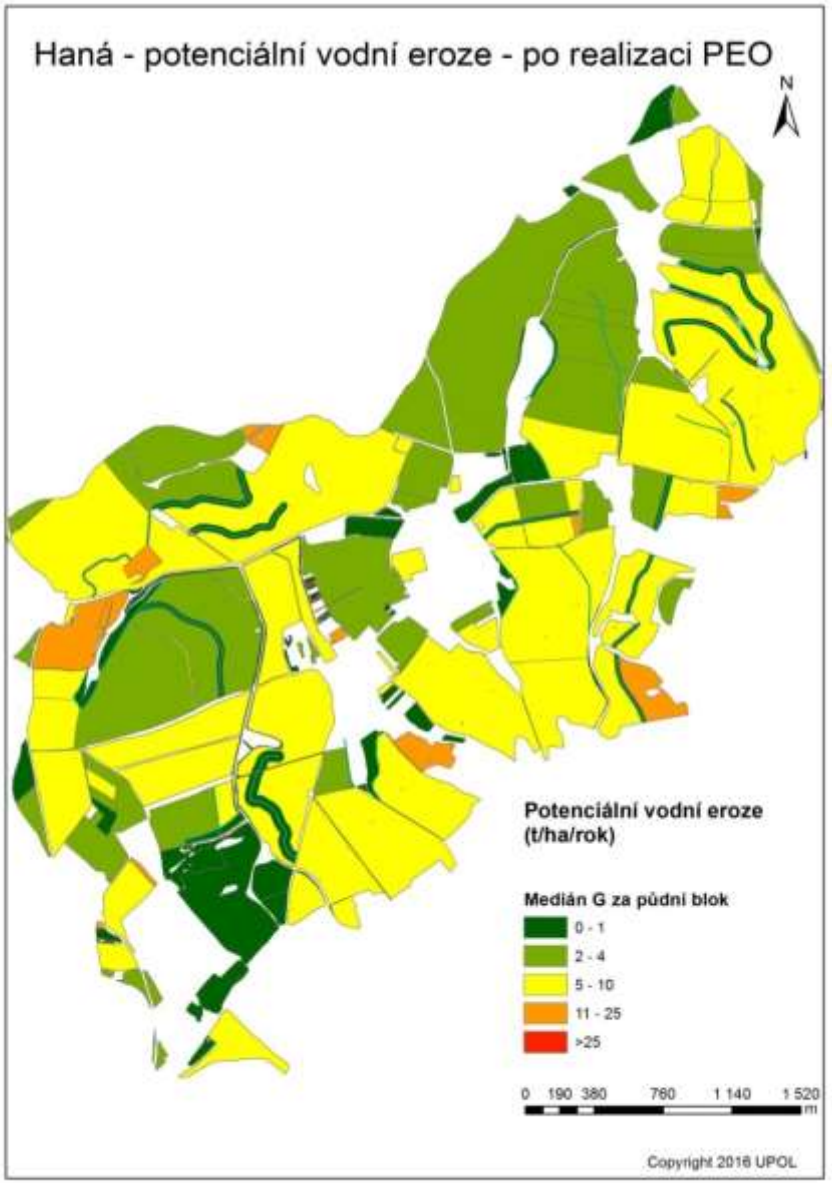
Agronomical and technical measures against erosion



Source: Šarapatka and Bednář, 2016

Water erosion in t/ha/year before and after measures



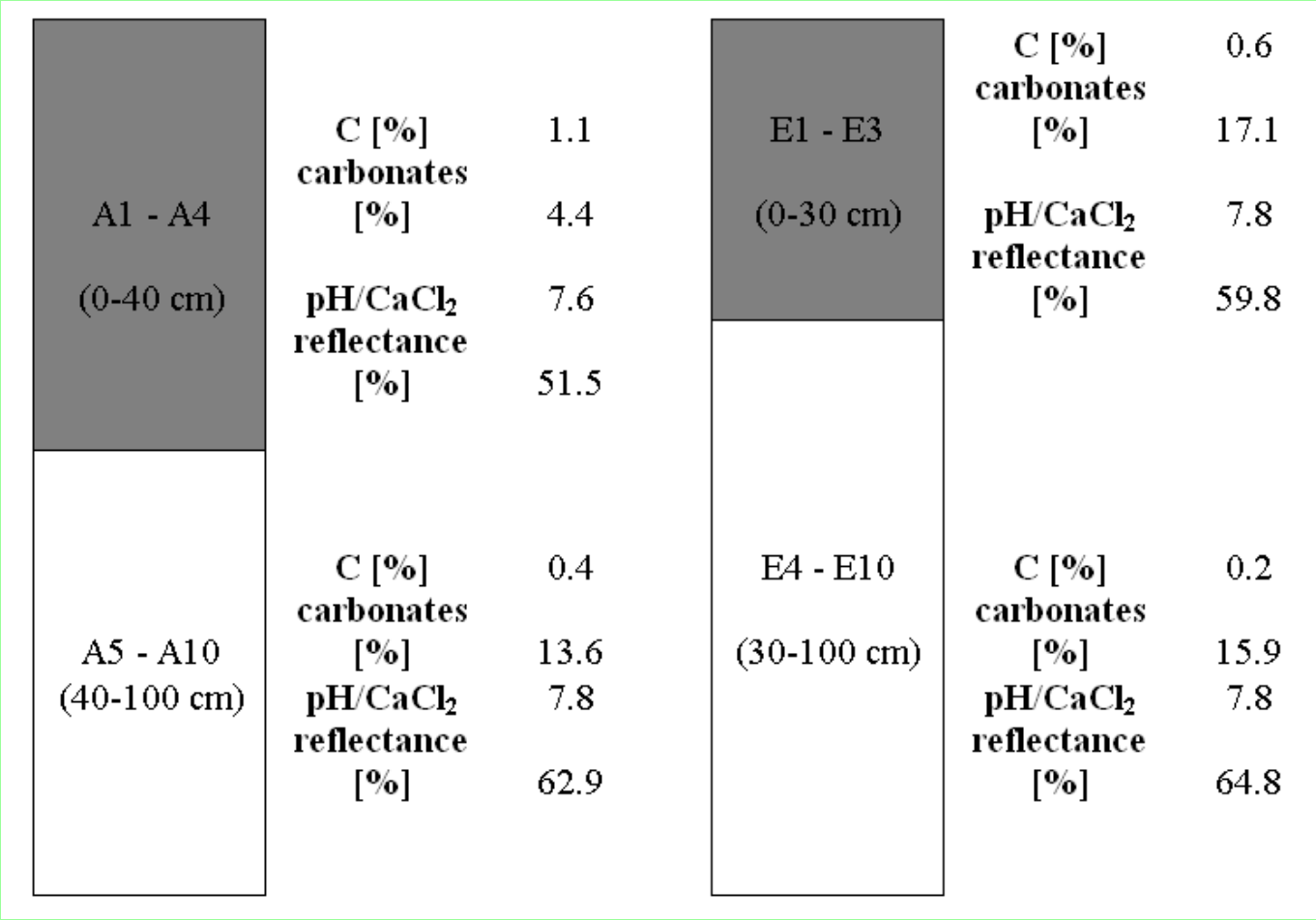


Source: Šarapatka and Bednář, 2016

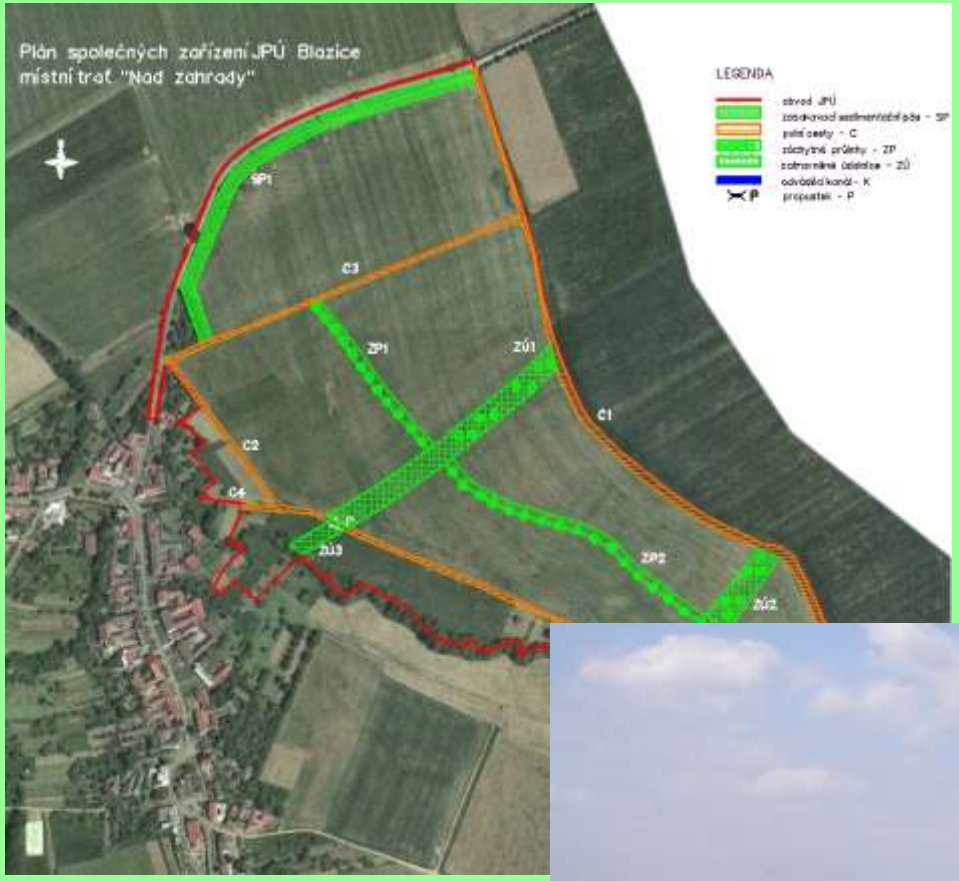
Assessment of soil erosion and deposition using ^{137}Cs

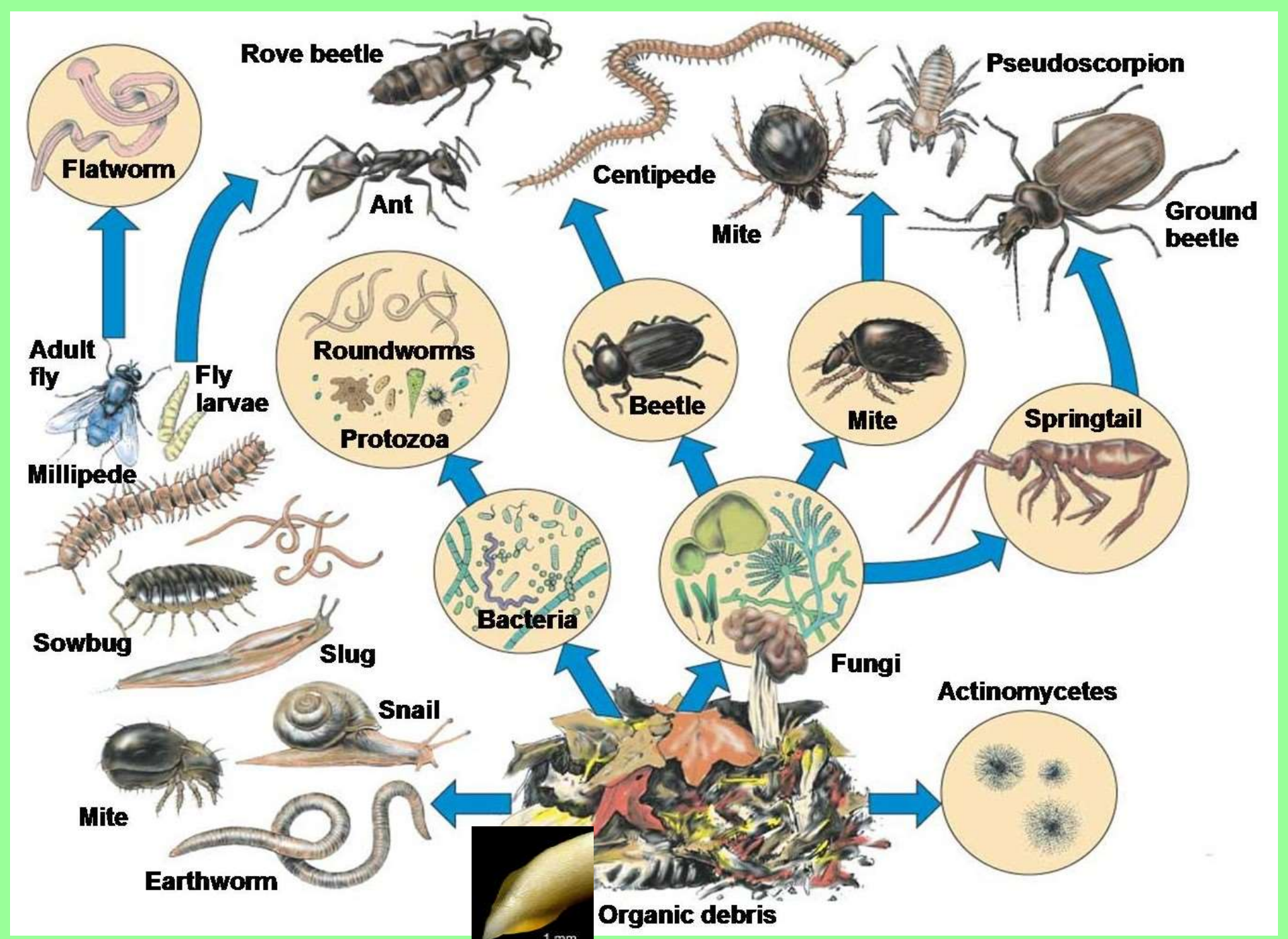
The key assumption to use caesium-137 radionuclide as a erosion tracer is finding of significant relationship between soil loss and radionuclide loss. Then the spatial distribution of these radionuclides in the field can determine areas of net soil loss (erosion) and net gain (deposition).
The assessment of ^{137}Cs redistribution is based on a comparison of measured inventories (^{137}Cs total activity per area) of a individual sampling point in the field with an reference inventory (stable site, without erosion/deposition).

Average values of selected observed soil characteristics in accumulation and erosion areas of slopes within the studied block of land, the highlighted area shows the border of the topsoil horizon.

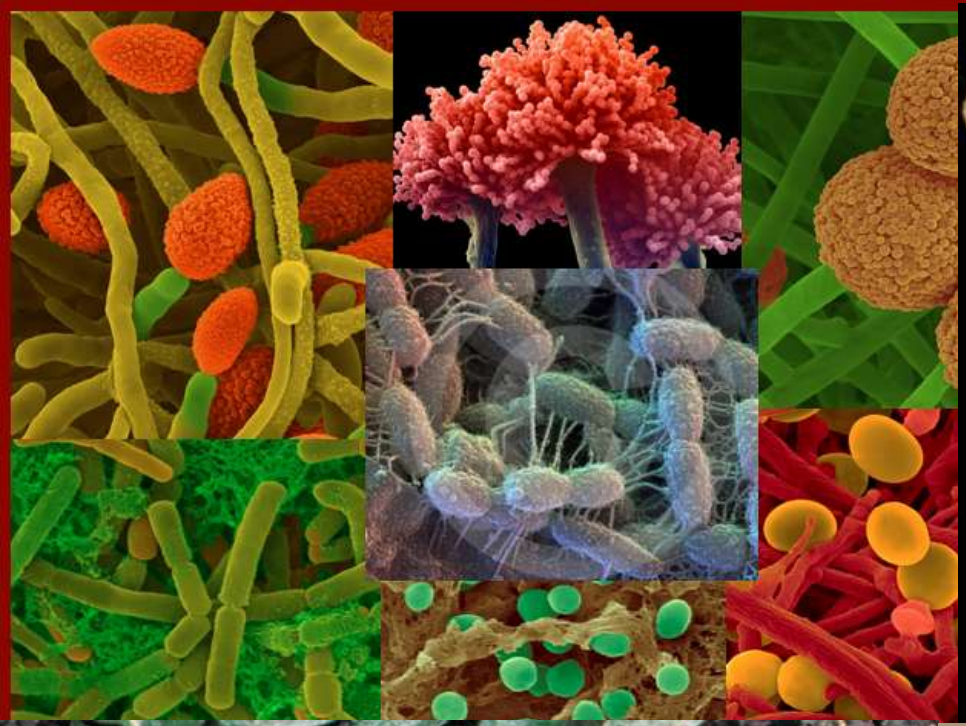


Source: Šarapatka, Bednář, Netopil, 2015

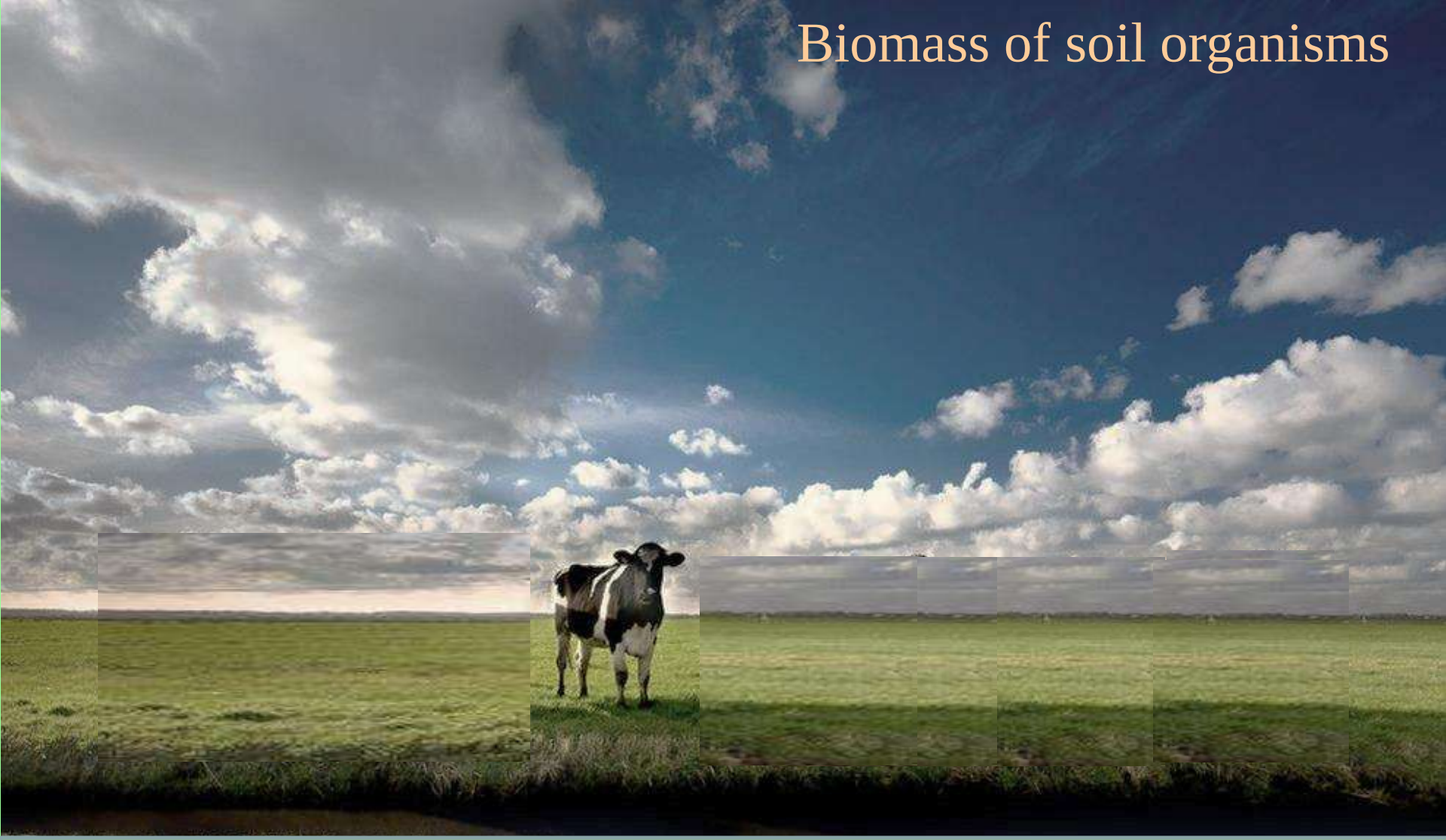

Plán společných zařízení JPÚ Blazice
místní trať "Nad zahrady"
LEGENDA
SP1
C3
ZP1
ZÚ1
C1
C2
C4
ZÚ3
ZP2
ZÚ2



http://www.wunderground.com/blog/gardencoach/comment.html?entrynum=14



Biomass of soil organisms



FINISHED, BUT

International Decade of Soils (2015-2024)

IUSS President Prof. Rainer Horn took the opportunity to announce the International Decade of Soils 2015 -2024, which was unilaterally declared by IUSS, to keep the momentum and further increase soil awareness. IUSS will seek the support of global organizations such as CGIAR, FAO, IAEA, UNEP and others for this initiative. We kindly ask you to actively support us through the channels at your disposal. We intend to provide a logo and other information/dissemination materials in the near future.

Soil Science Conference 2017 ???

Thanks for your attention