Increasing of water retention in the landscape to mitigate the possible effects of the global climate change

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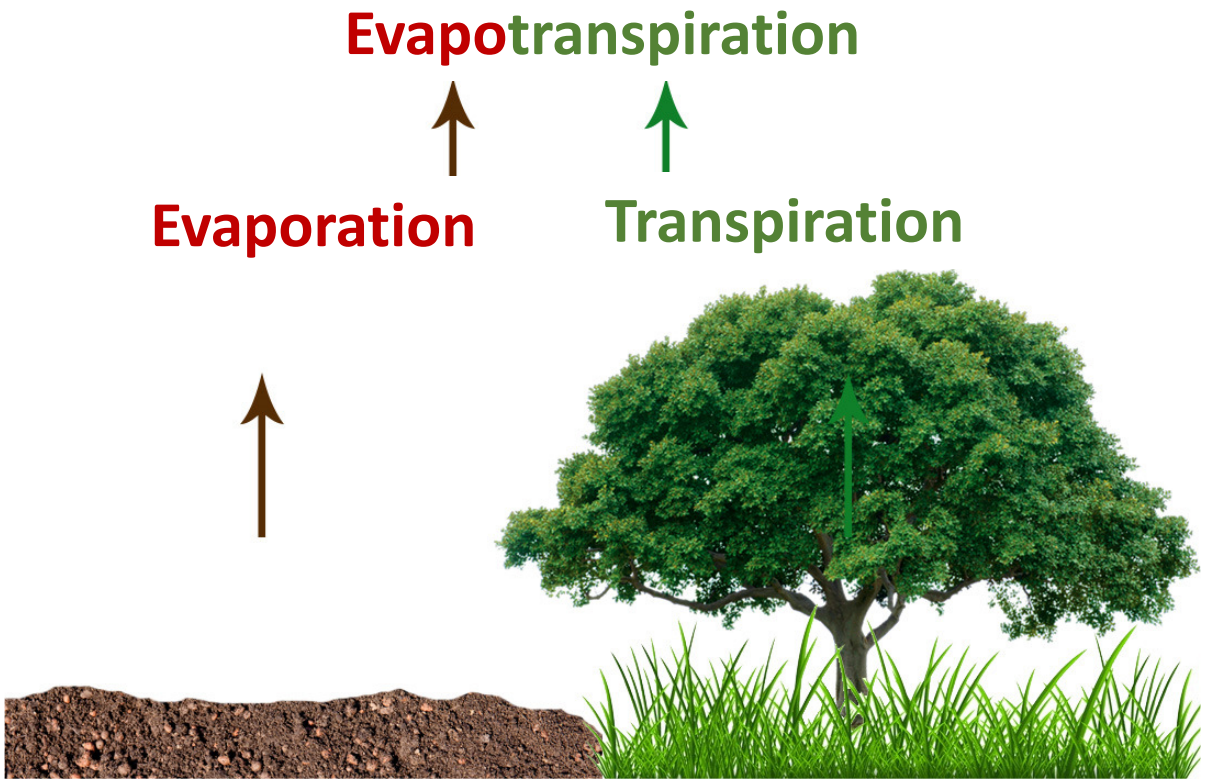
Slovak republic territory (Novák, 2001) **on average:**

2/3 of the annual total precipitation evaporates and 1/3 of the water flows away.

The average annual rainfall is about 753 mm, with about 492 mm evaporating and 261 mm being the runoff.

- Due to the varied morphological **up to 95% of precipitation evaporates from southern Slovakia**
  about 30% of the annual total precipitation from mountain areas



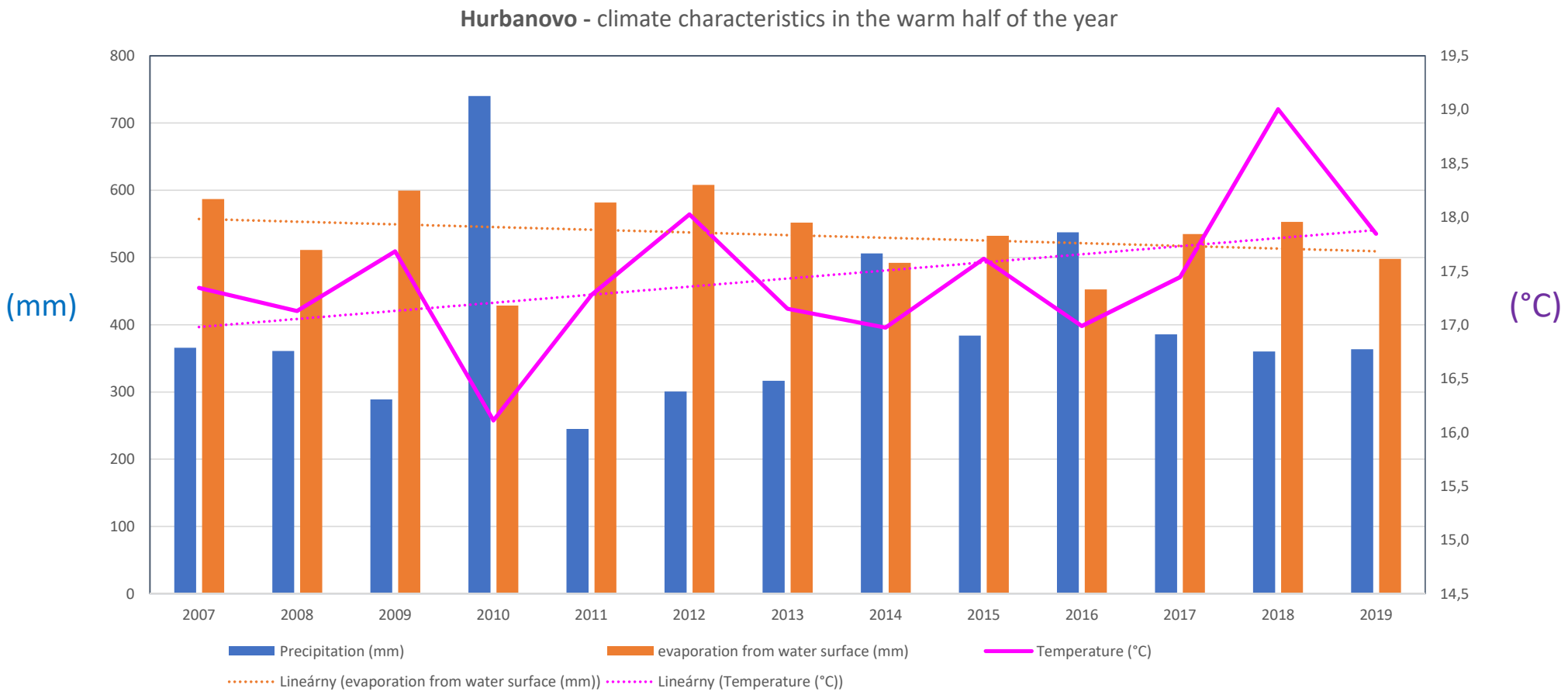
(source: Kubinský, 2021)

Water retention capacity is influenced by:

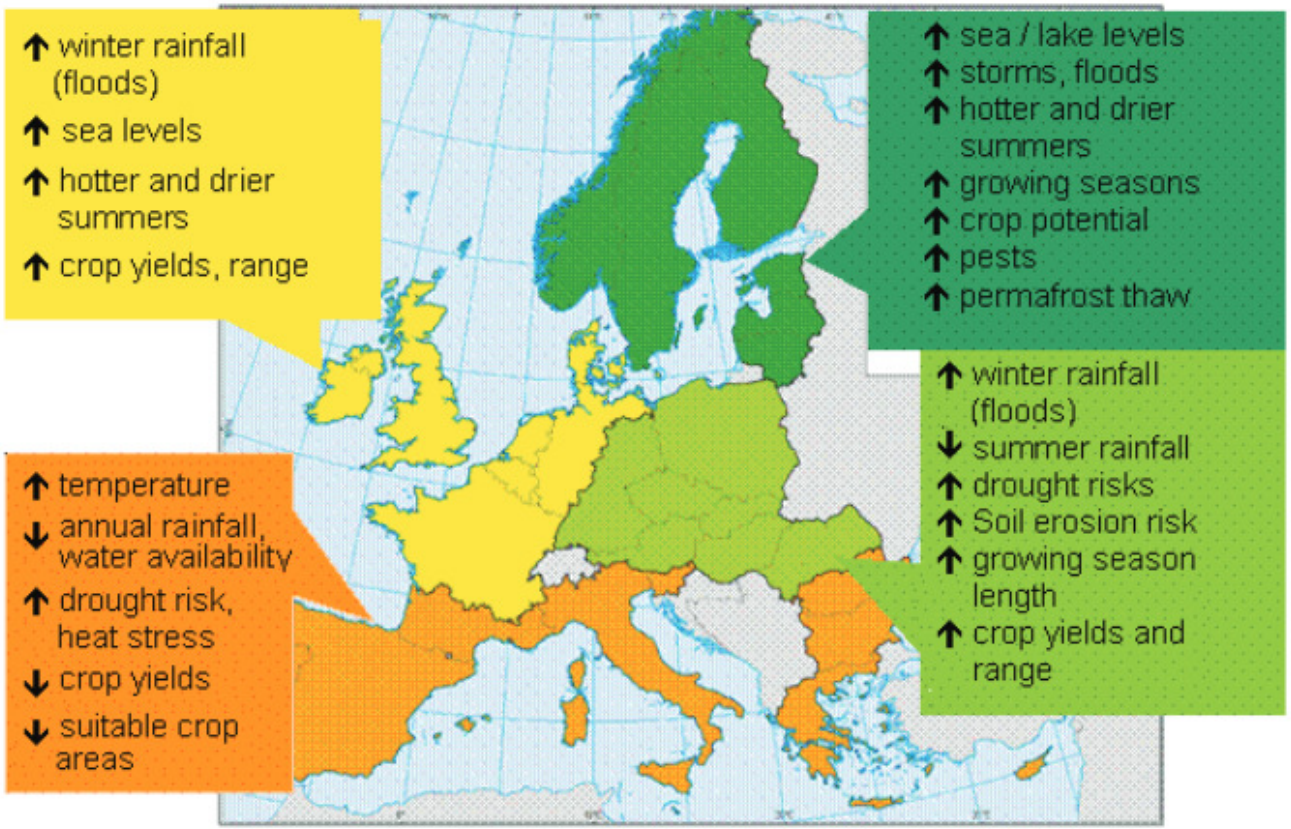
- **the land use**
- **the climate**
- the year season
- the type of precipitation
- and other meteorological factors.

The impact of forest on runoff course is more substantial than impact of the other land cover, however it is limited.

13-years global climate trends



The forecasted influence of global climate changes on agriculture



(source: Federal Ministry for Environment, 2007 in Natural small water retention measures, 2015)

water abstraction
water abstraction
water abstraction

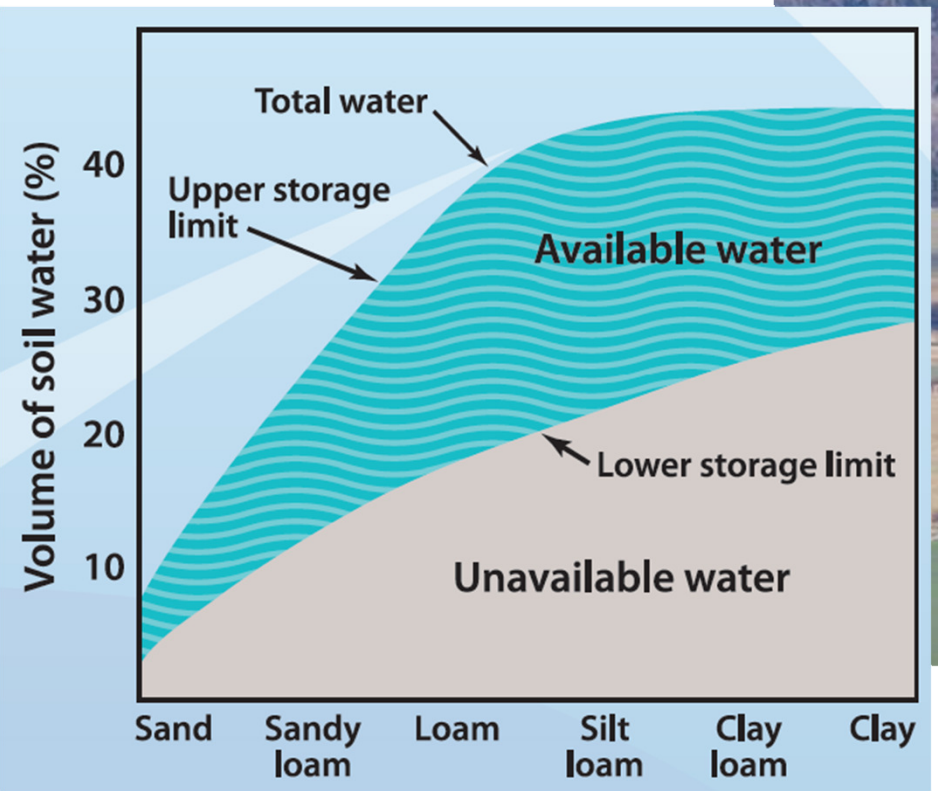
Water retention in the landscape

Increasing of water retention

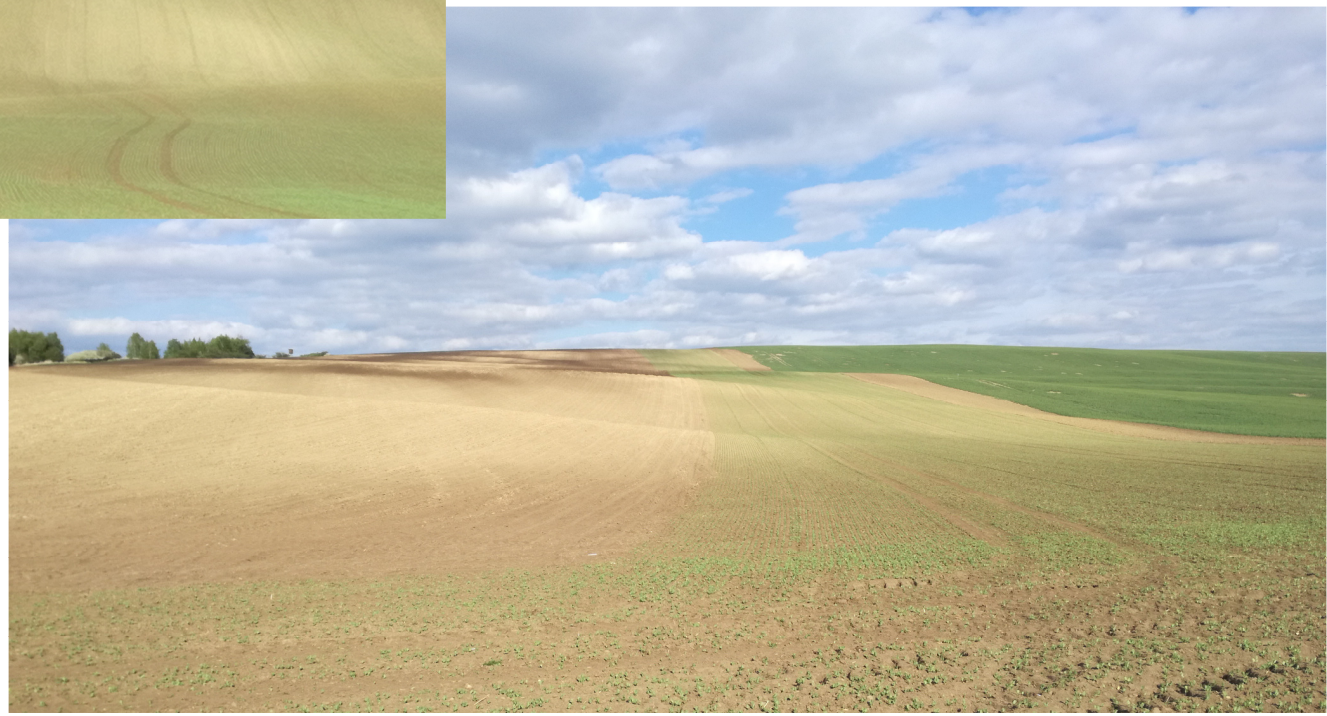
Increasing water content in the landscape
(infiltration to the soil , reservoirs.....)

Decreasing water abstraction from the landscape
(usage, consumption reducing outflow)

Landscape water storage – soil condition



Landscape



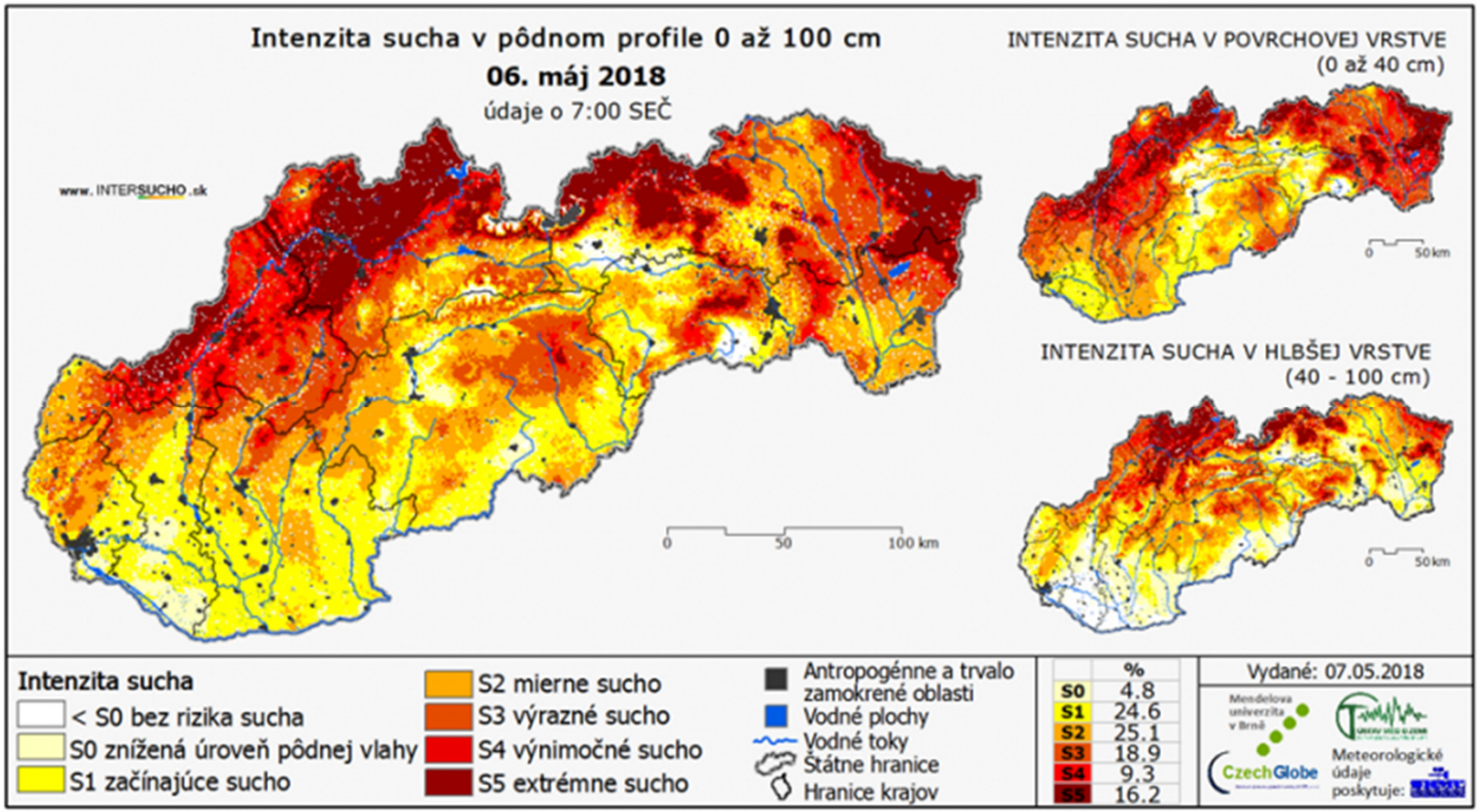
Cultural landscape with reduced water storage

Climate change and the landscape
Adapting Agriculture To Climate Change

Rainwater Harvesting and Storage
Use of Adaptive Crops
Cover Crops
No-Tillage or Minimum Tillage
Crop Diversification and Rotation

Climate change - great diversity of precipitation in the territory

Soil drought



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Water retention in the landscape

Increasing of water retention

Increasing water content in the landscape (infiltration to the soil , reservoirs.....)

Green measures,
Water terention reservoirs
Soil quality
Optimal vegetation to rain amount

DROUGHT - WATER AND LANDSCAPE

Drought and floods are connected buckets.

A healthy landscape acts like a sponge that absorbs rainwater and then dries it slowly. Otherwise, the precipitation quickly drains away and the drought continues.

In the summer we face more torrential rainfall. There is a bigger one for the climatological discussion, why suddenly precipitation comes not in the form of persistent or regular light rain, but during an hour of extremely heavy rain.

If we have a long-term drought, then a torrential rain will not solve it, because it will not have time to soak up and saturate the soil more than a few centimeters below the surface.

These are the reasons why periods of drought and floods alternate in our territory.

Original landscape - steppe

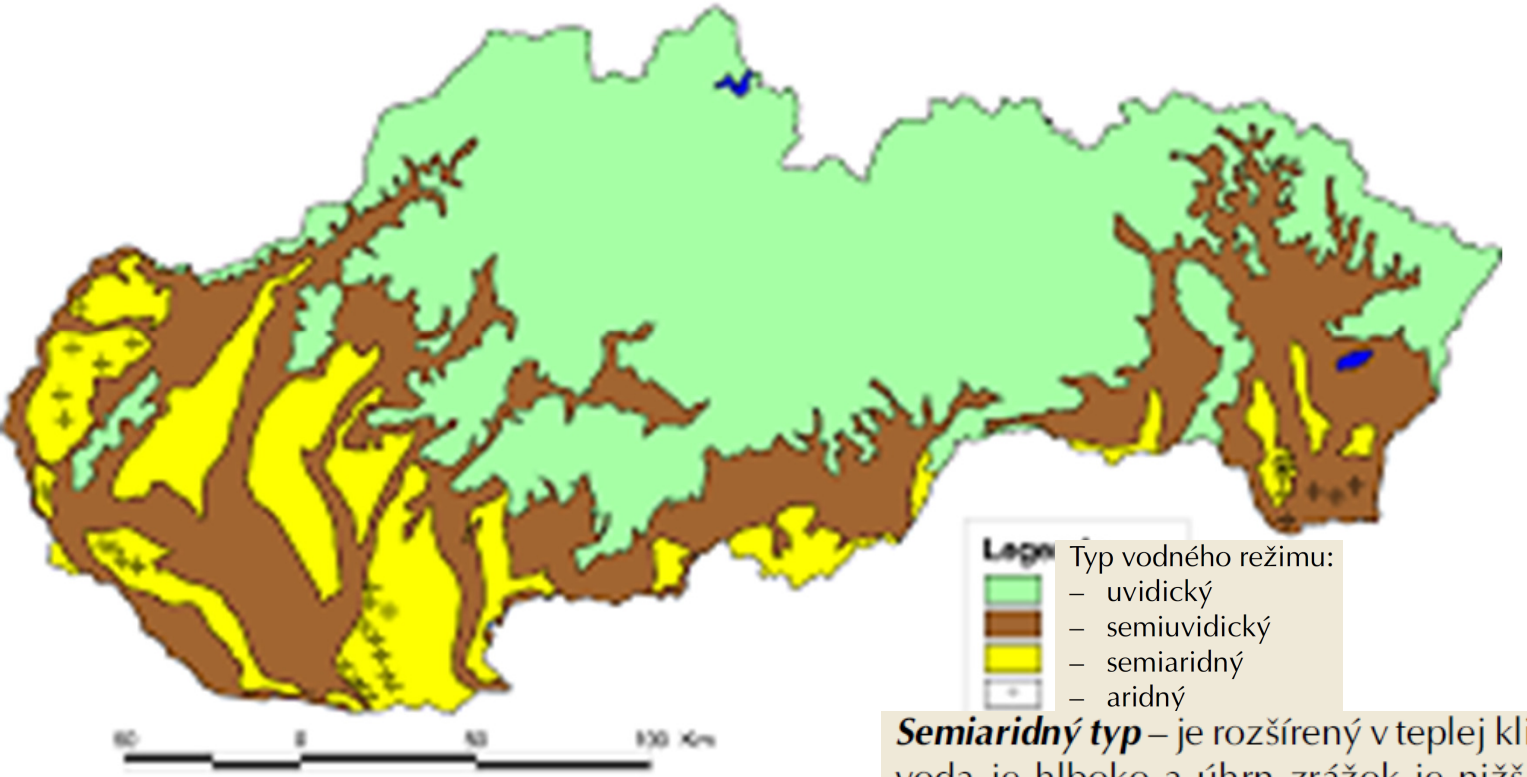
Current landscape agricultural monoculture

Water retention

Table 4. Systems of water retention in rural areas

Water resources	Systems
Landscape (habitat) retention	Systems creating appropriate land use structure through the set up of arable lands, grasslands, forests, areas of ecological use, water holes
Soil retention	Crop systems affecting water management in soil profile, particularly the increase of potential water retention in soils
Ground waters	Cultivation and reclamation systems to decrease surface runoff and increase the recharge of ground water reservoirs
Surface waters	Hydrotechnical water distribution and management systems including construction of small reservoirs, outflow control from drainage systems

Ecological types of soil water regime



Typ vodného režimu:
- uvidický
- semiuvidický
- semiaridný
- aridný

Semiaridný typ – je rozšírený v teplej klimatickej oblasti v polohách, kde podzemná voda je hlboko a úhrn zrážok je nižší ako výpar. Obsah pôdnej vody v letnom polroku sa odčerpáva do semiaridného až aridného intervalu, t.j. pod bod vädnutia. Trvanie tohto intervalu vlhkosti v povrchovej vrstve je závislé od intenzity a frekvencie letných zrážok, ktoré ho spravidla ukončujú. Hlbšie v profile, kde letné zrážky spravidla málo prenikajú sa aridný interval vlhkosti udržuje až do nástupu jesenných dažďov. Z ekologického hľadiska je semiaridný typ charakteristický nedostatočným zásobovaním vegetácie ľahko prístupnou pôdnou vodou. Rozšírený je predovšetkým na sprašových pahorkatinách a na rovinách s hlbokou hladinou podzemnej vody a

water abstraction
water abstraction
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Water retention in the landscape

Increasing of water retention

Water consumption and outflow:

People – urban areas

Industry - urban areas

Agriculture - landscape

Energy production

Ecosystems landscape

Rivers

Decreasing water abstraction from the landscape (usage, consumption reducing outflow)

Water abstraction from the landscape

Photosynthesis - storing energy for respiration

$$\underset{\text{carbon dioxide}}{6\,CO_2} + \underset{\text{water}}{12\,H_2O} \xrightarrow[\text{Chlorophyll}]{\text{Light energy}} \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{oxygen}}{6O_2}$$

Respiration energy for life

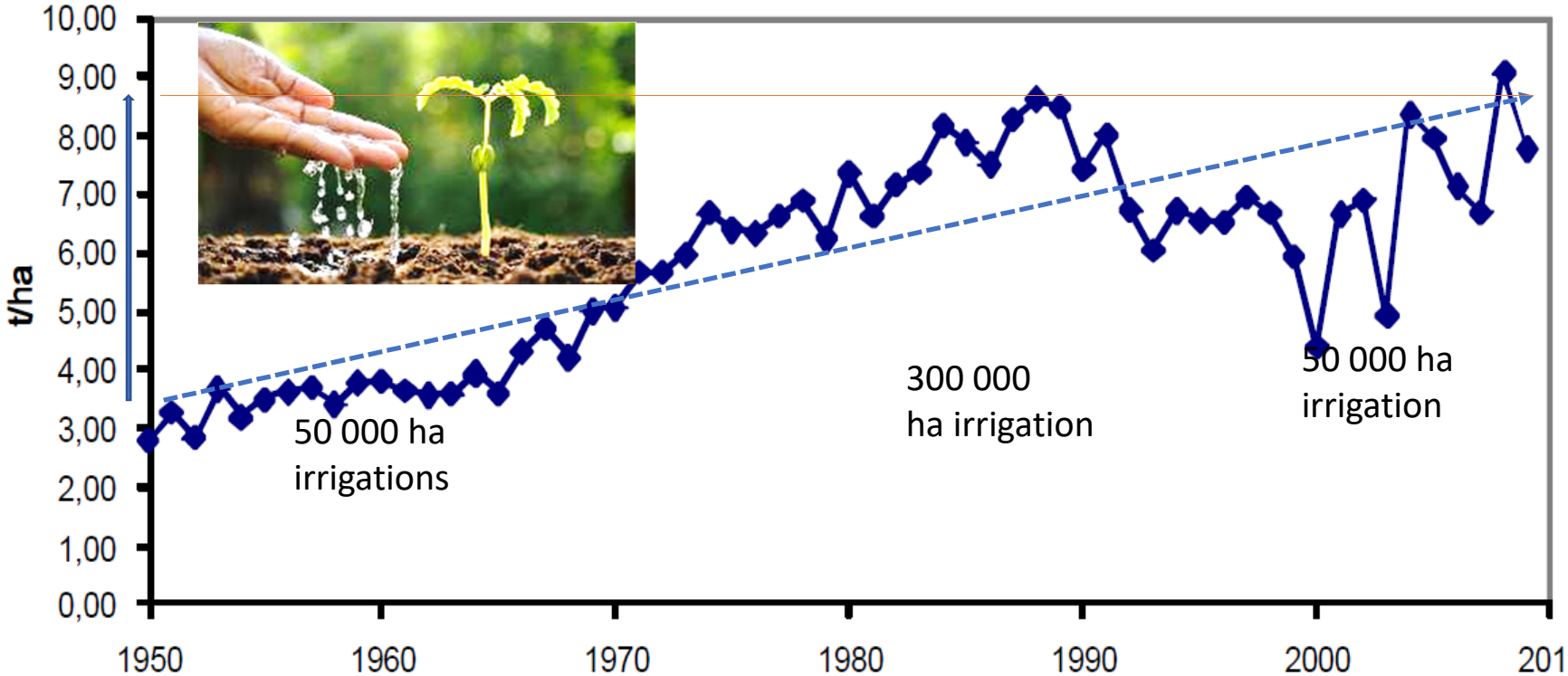
$$\underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{oxygen}}{6O_2} \longrightarrow \underset{\text{carbon dioxide}}{6CO_2} + \underset{\text{water}}{6H_2O}$$

Average yields in Slovakia (t.he)

	1990	1993	1995	2000	2005	2010	2013	2014	2015
grain maize	3.56	4.62	4.90	3.04	6.97	5.53	7.33	5.07	4.98
potatoes	14.12	18.15	11.07	15.47	15.77	11.45	20.62	18.15	24.38
sunflower	1.94	2.01	1.73	1.70	2.14	1.81	2.66	2.33	2.41
sugar beet	30.82	34.31	34.27	30.37	52.16	54.52	61.04	56.29	51.49

(Source: *SLOVSTAT,* **SPPK**)

Development of total dry matter production of crops grown on agricultural land in Slovakia



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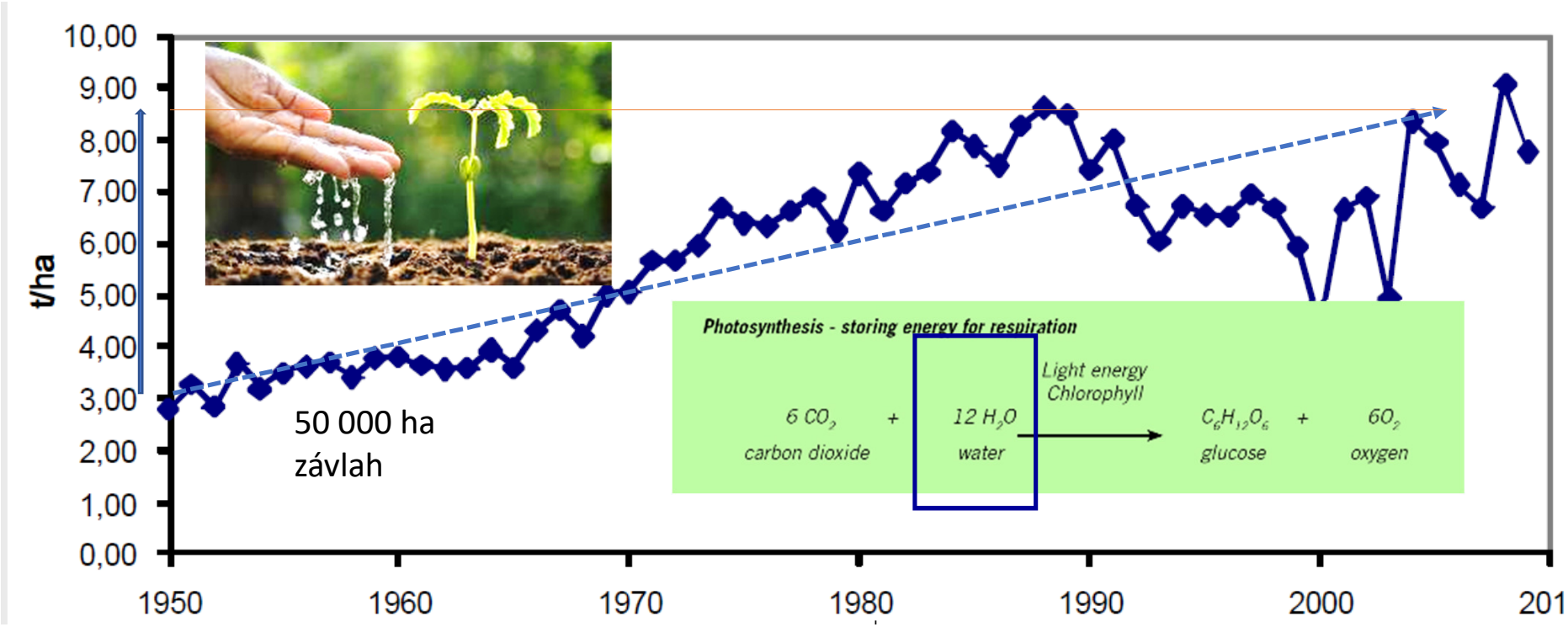

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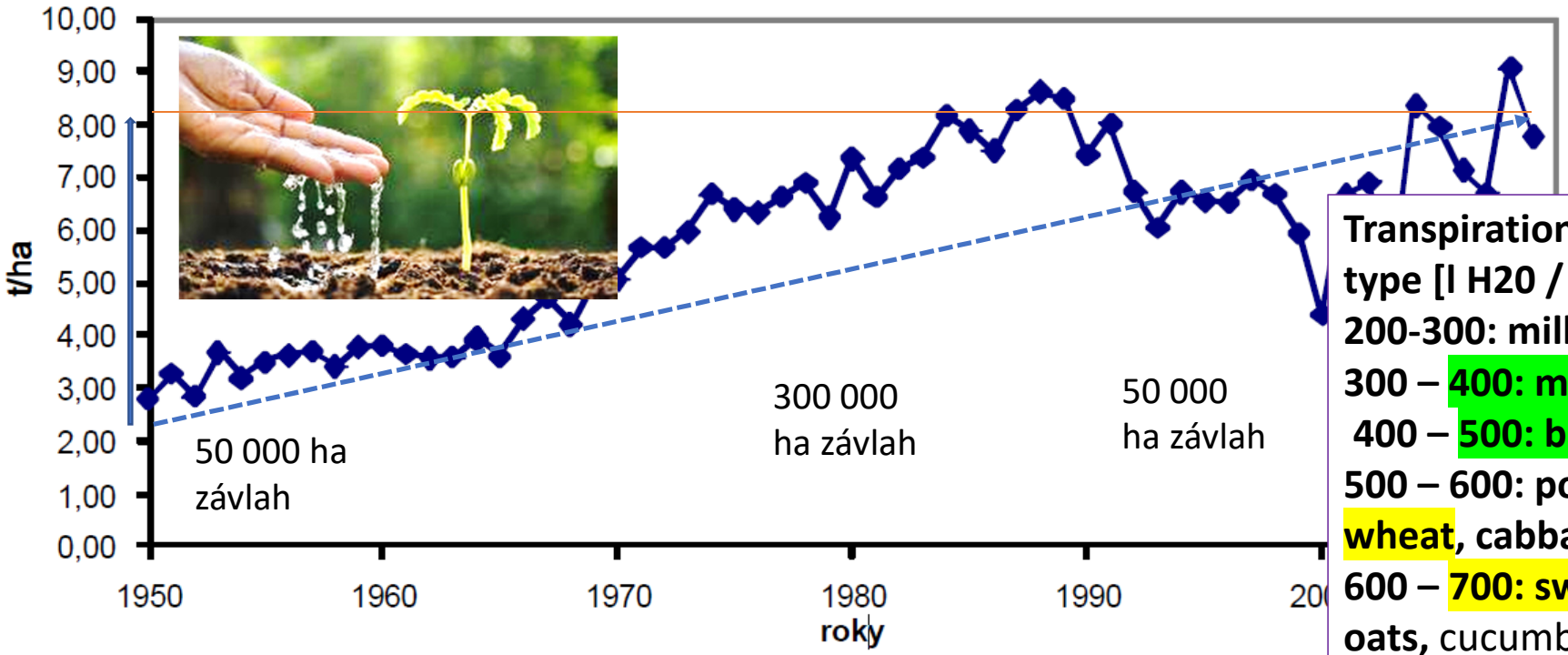

Efektívnosť využitia vody (kg ha-1 mm-1) sa počítala vydelením výťažku sušiny rastlín (kg ha-1) na skutočnú evapotranspiráciu (mm) (Howe

Transpiration coefficient of the crop type [l H20 / kg DM]
200-300: millet
300 – 400: maize, fodder beet
400 – 500: barley, rye, durum wheat
500 – 600: potatoes, sunflower, wheat, cabbage, buckwheat,
600 – 700: swede rape, peas, beans, oats, cucumbers, **red clover**
more than 700: lucerne, soya, flax, pumpkin, turnips

Optimal landscape

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water abstraction
water abstraction

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Systems and methods of water retention in rural areas (source: Mioduszewski, 2003)

Water resources	Systems and methods
Landscape (habitat) retention): landscape planning	Systems shaping the proper structure of land use through: • system of arable fields, grasslands, forests, ecological lands and ponds • forestation, creation of protective belts, woodlots shrubs, creation of bruises and terraces • increasing of the area of wetlands, peatlands and swamps, rewetting of peatland
Soil water retention: agriculture technology	Cultivation systems shaping water management in a soil profile: • improvement of soil structure (differential porosity), agricultural drainage, liming, the proper agro-techniques, proper crops rotation, increase of the organic matter content in soil
Groundwater: agriculture and landscape planning	Cultivation and drainage systems limiting surface runoff: • limiting of the surface runoff • increase of soil filtration capacity (deep-loosening) • anti-erosion measures, phyto-drainage and agricultural drainage measures • runoff regulation from the drainage system • ponds and infiltration wells for storage of precipitation runoff from sealed surfaces
Surface waters: water management, hydraulic structures	Hydro-technical systems of division and storage of water: • ponds and small water reservoirs • regulation of water runoff from ponds and small water reservoirs • water management – retention of water in drainage – irrigation systems and water governance • regulated outflow of water from ditches systems • increase of river valley retention including construction of polders

.....??????

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