University J.J. Strossmayer
Faculty of Agriculture in Osijek
Kralja P. Svačića 1d, HR-31000 Osijek, Croatia,
Department for Plant Production
http://ljesnjak.pfos.hr/~jdanijel/index.htm
djug@pfos.hr

World Food Day 2016

International Conference: ***"Climate is changing. Food and agriculture must too."***

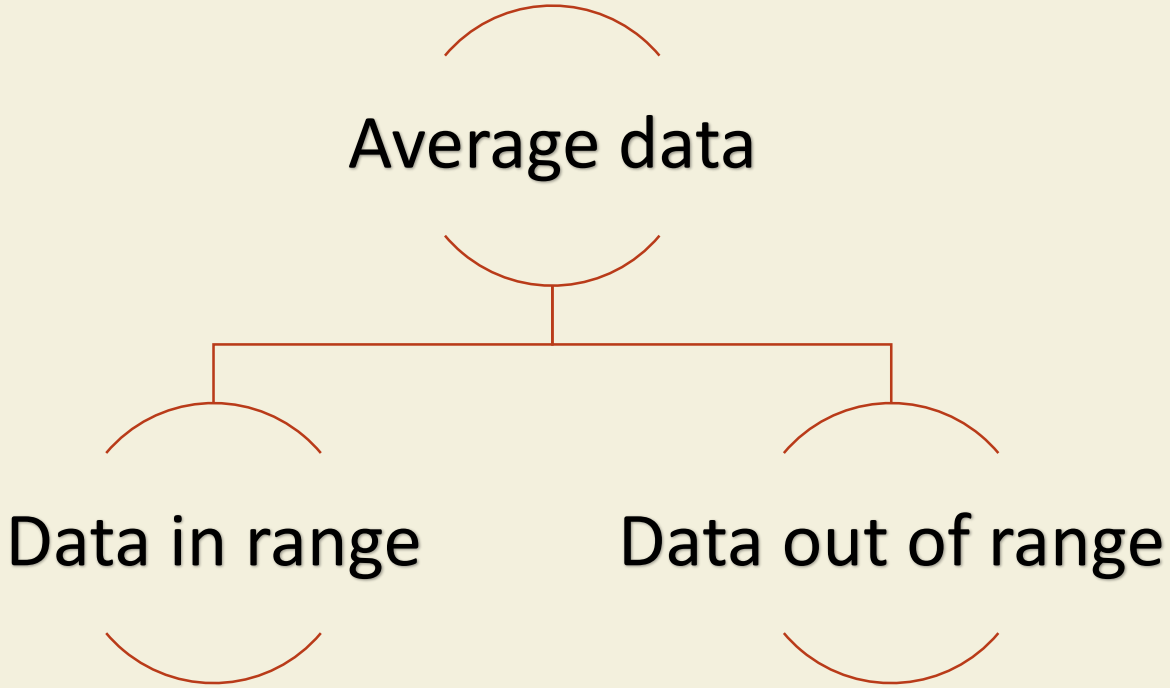
October 14, 2016, Osijek, Croatia

Adapting agriculture to climate change

Prof. dr. sc. Danijel Jug

What are climate change???
What are unfavorable weather conditions (in crop production)???

Facts



- Precipitation
- Temperature
- Wind
- Storm
- Sun light
- Clouds . . .

- Climate aberrations
- Weather aberrations
- Wetter or drier conditions
- . . .

Extreme weather conditions

Drought (insufficient water content) → **Water stress** *(lack of water)*

- average occurs every 3-5 years
- decrease yield 20 – 90%



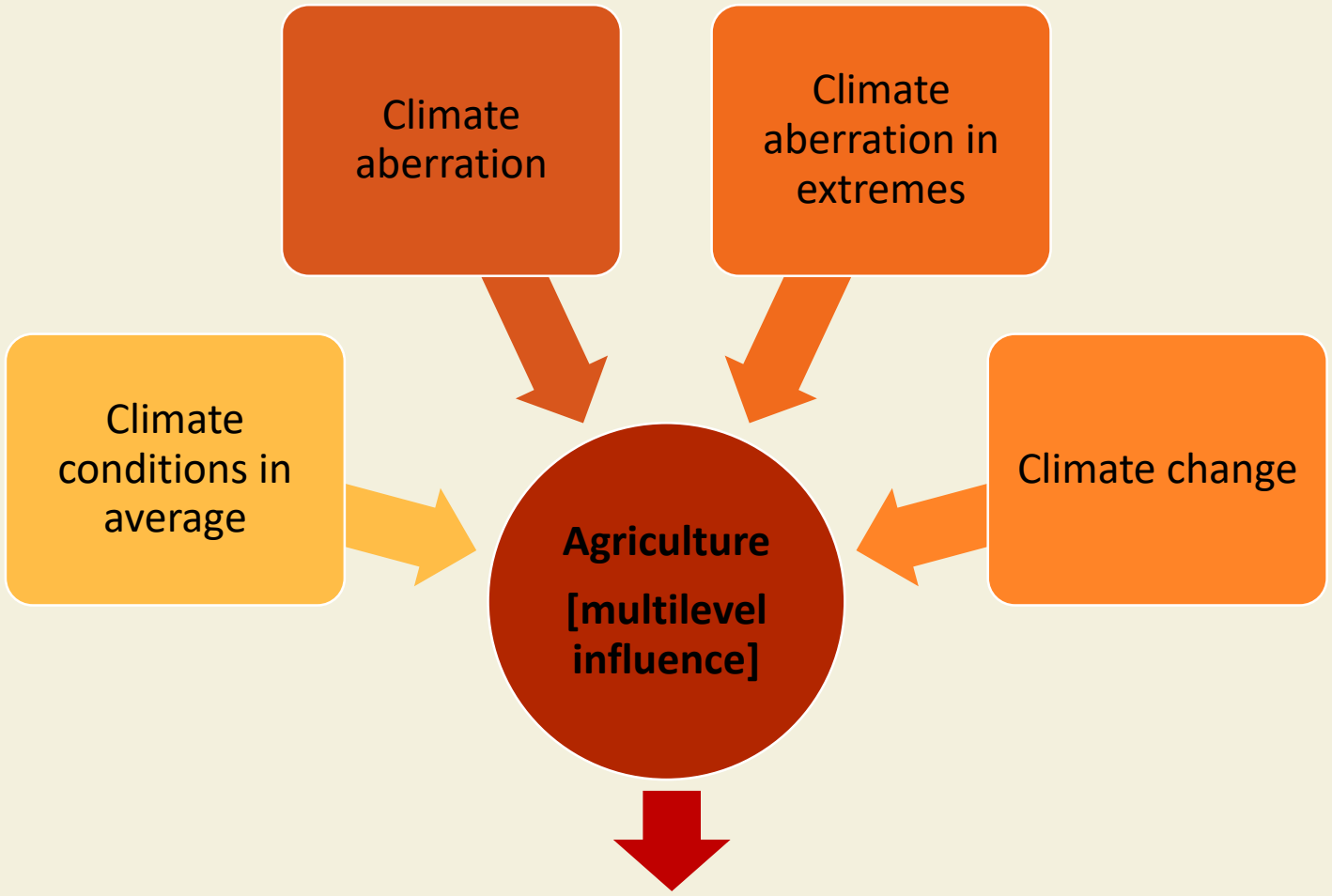
waterlogged (saturated water content) → **Anaerobiosis** *(lack of oxygen)*



We can expect more dramatic scenarios

Flood
(Račinovci, Croatia, May 17, 2014)

Drought, eastern Croatia, 2015



Changed agriculture has the great influence on:

- socio-economic conditions (indirect impact)
- farm management (direct impact)

Climatic conditions influence agriculture on:
- spatial variability and
- temporal variability

Generally

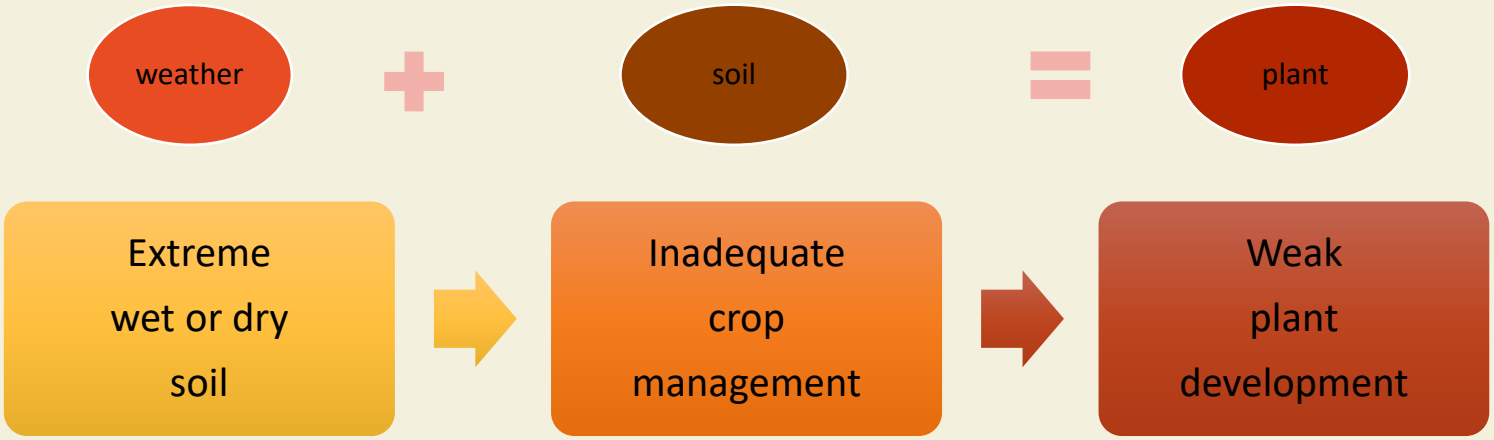
- Pannonian region has, in generally, favourable agroecological conditions for arable crop production,
- lower yields in warmer climates (spatial orientation S-N and W-E),
- precipitation distribution on temporal level (over a vegetation period - according crop needs) are more important than sum of precipitation (on yearly base),
- heterogeneous patterns across Pannonian region (as other regions in Europe),
- intensity of climate change largely depend on farm characteristic (e.g. size, land use, management, crop types, irrigation),
- different farm types adapt differently (a smaller diversity in farm types increase negative climate impacts) – (drought, heat waves, floods, ET rates etc.),
- direct impact (e.g. crop yields, income-profit),
- indirect impact (degradation of soil/air/water e.g. physical, chemical, biological)

More important climatic parameters according crop production are in domain of temperature, precipitation (water), and their variability

Important

- Agriculture is one of the largest consumer of water resources and it is strongly influenced by the availability of water
- Changes in total seasonal precipitation or in its pattern of variability are both important
- Climate change in aspects of global warming will extend the length of the potential growing season
- Less severe winters will also allow more productive cultivars of winter annual and perennial crops to be grown
- Increased temperatures increase respiration (CO_2), which resulting in less than optimal conditions for net crops growth
- Extreme meteorological events, such as waves of high temperature, heavy storms, or severe droughts, can significantly reduce crop production

Climatic changes, with primary changes in water and temperature regime, have large and perhaps the greatest impact on crop production



Main crops in region: maize, wheat, barley, sunflower, soybean, oilrape, sugarbeat, oat…

Crop production is necessary to be changed in order to achieve a safer and more stable production

Inadequate approach (unsuitable technology) to crop production can resulted with many aditional degradation processes







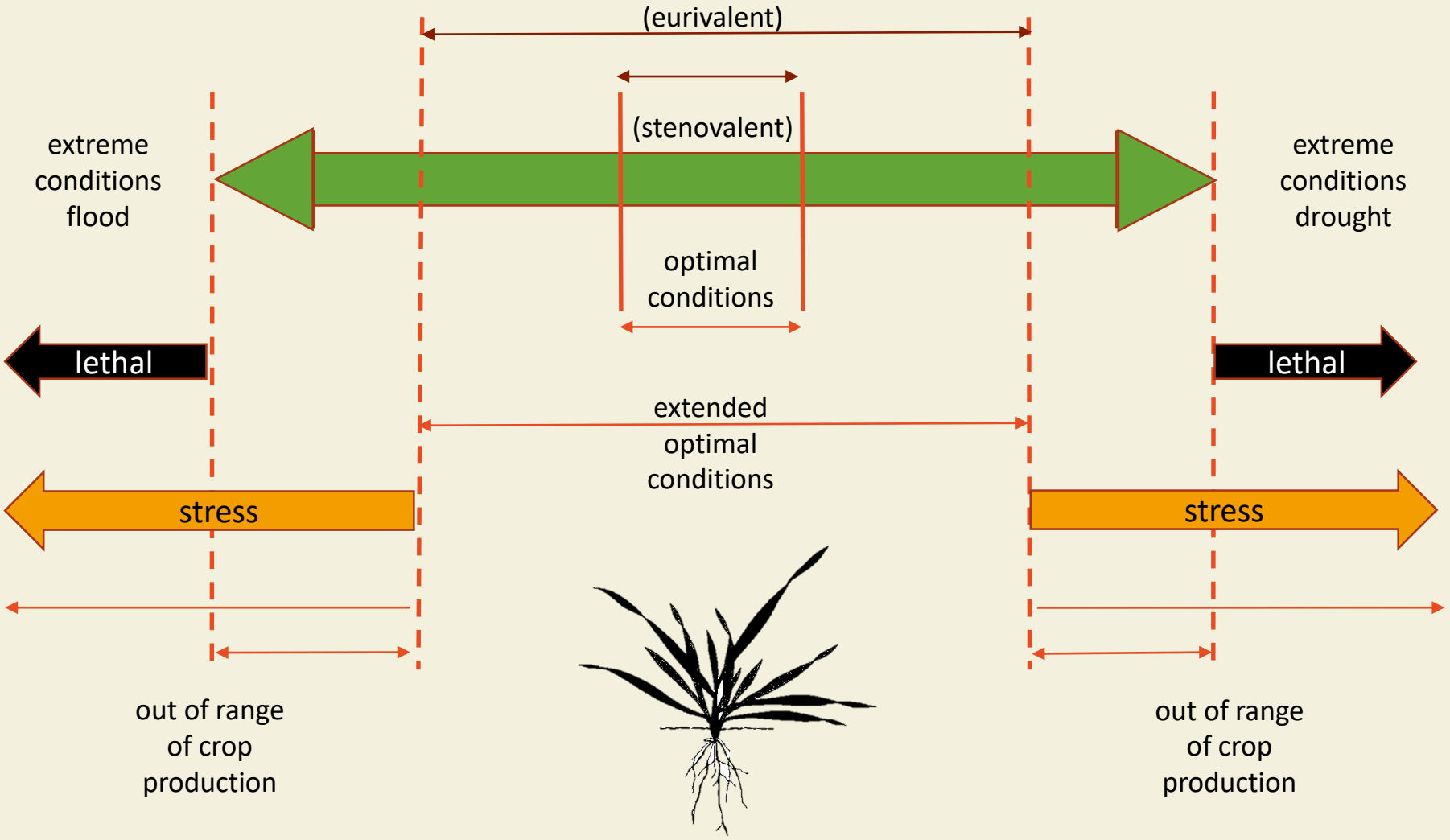


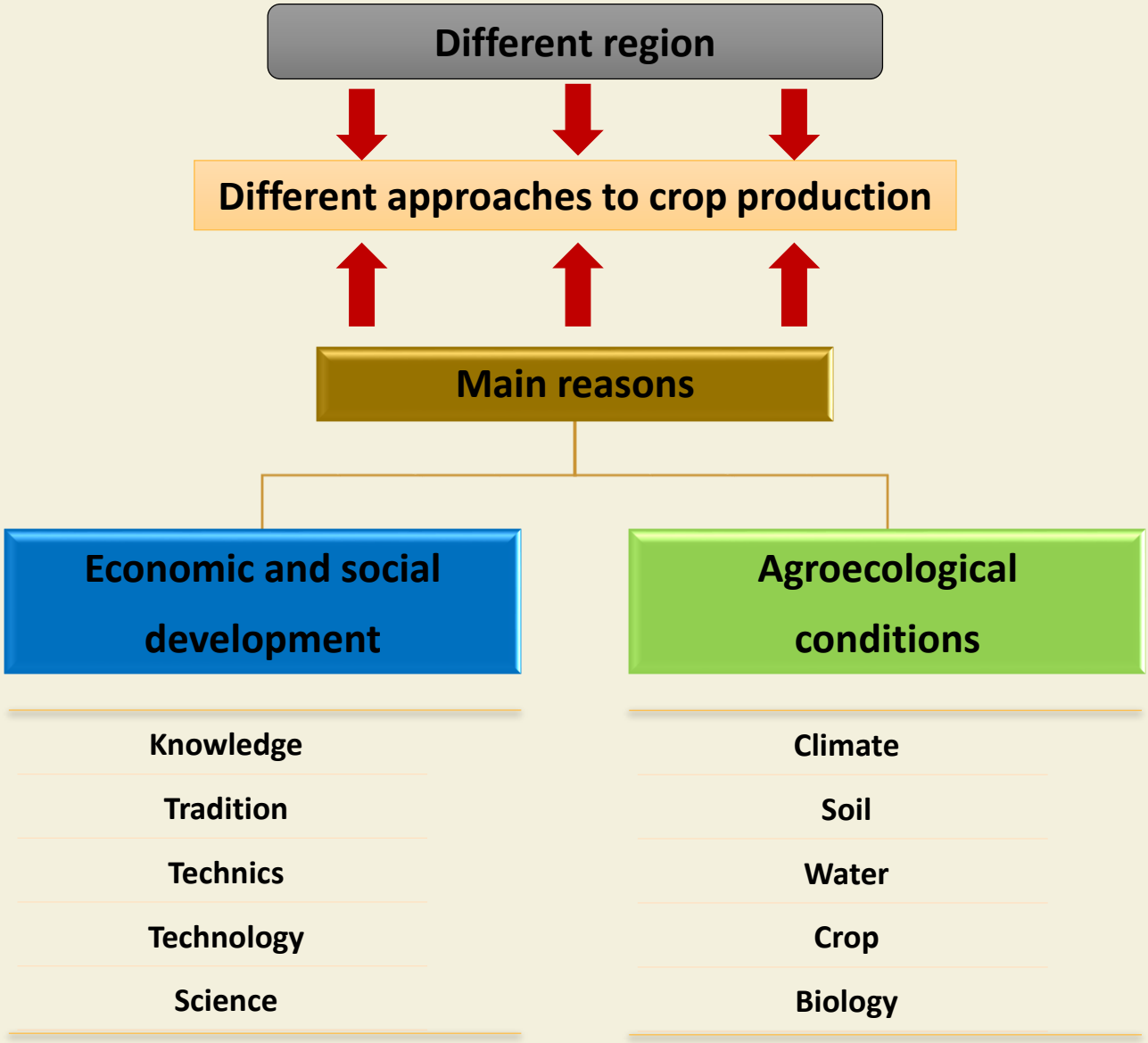

most important threats to soil

- Erosion
- Organic matter decline
- Salinization
- Compaction
- Landslides and flooding contamination
- Sealing
- Biodiversity decline

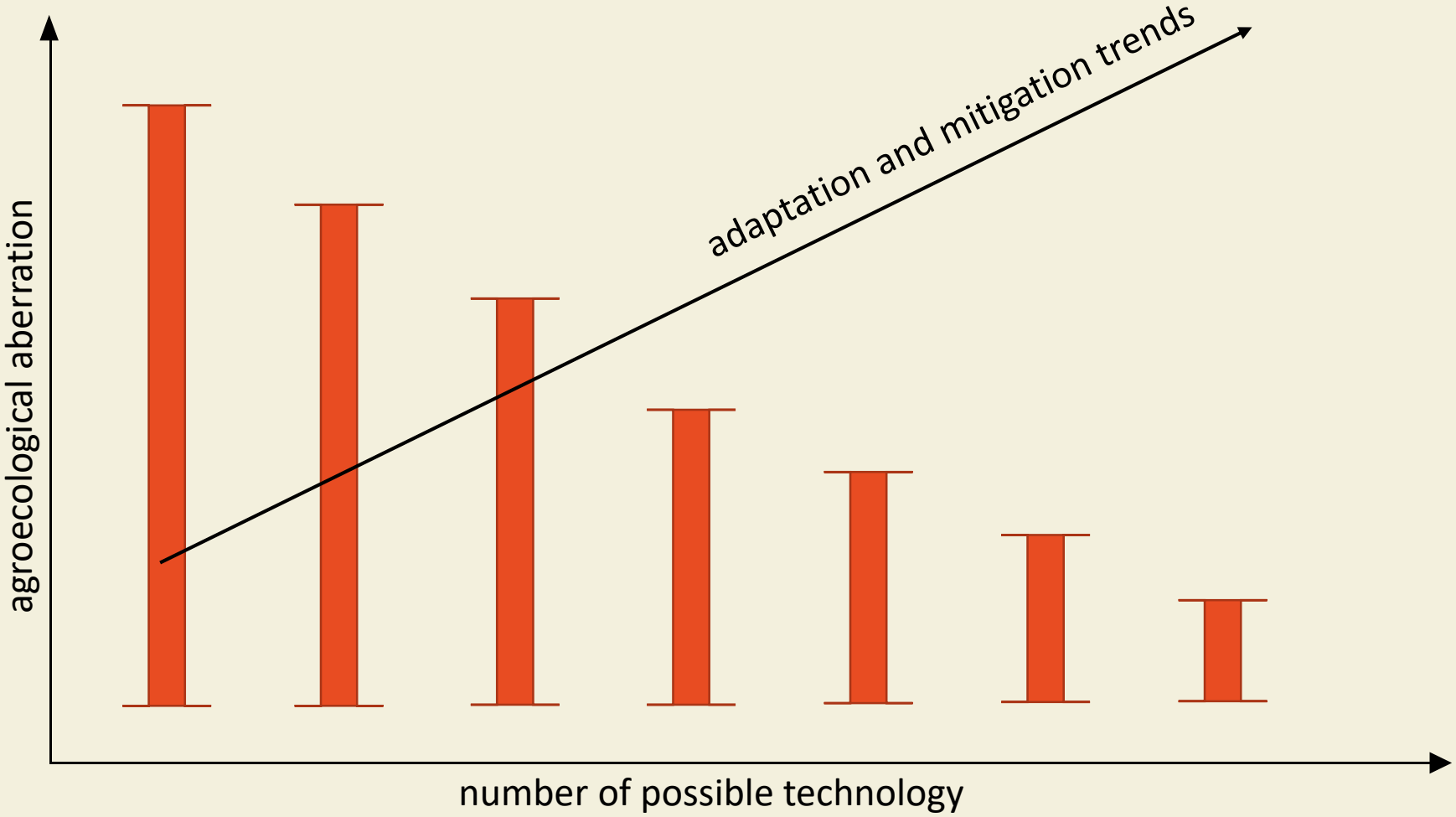
These degradation processes vary from region to region, with different degrees of severity

Agroecological range of crop production
(mainly soil and weather)




Different region
Different approaches to crop production
Main reasons
Economic and social development
Agroecological conditions
Knowledge
Tradition
Technics
Technology
Science
Climate
Soil
Water
Crop
Biology

Range of possible application of crop production technology



- Many techniques and technologies are offered as an adequate solution for adaptation and mitigation to climate change, for example:
  - plant breading,
  - irrigation,
  - crop introduction,
  - SOM increasing,
  - fertilization intensification,
  - erosion control,
  - excluding power plant from crop production,
  - carbon sequestration,
  - etc.

Possible solutions

(according predominantly threats to crop production)

Conservation agriculture (CA) is one of the possible ways to combat primarily negative influence of climatic changes

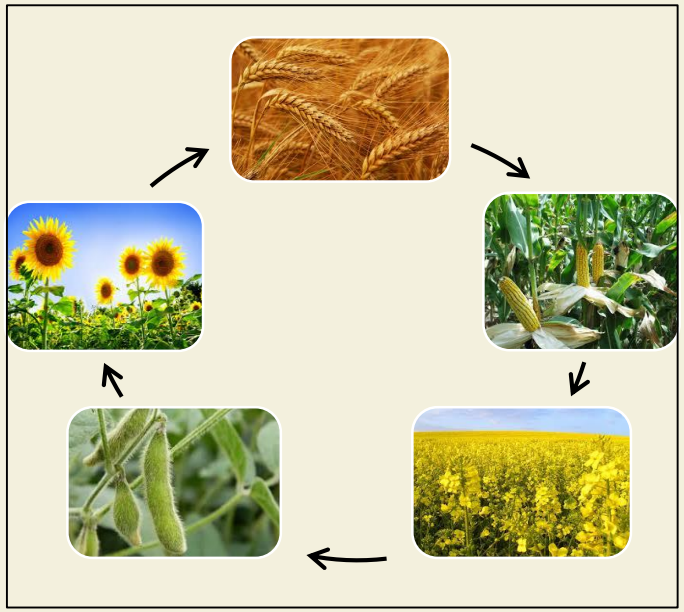
CA includes three interrelated main bases for successful agriculture production in relation to agro-ecological conditions:

- minimal set of soil tillage treatments (minimal soil disturbance),
- permanent soil cover (with crop or crop residue) and
- diversification in crop production (predominantly crop rotation)

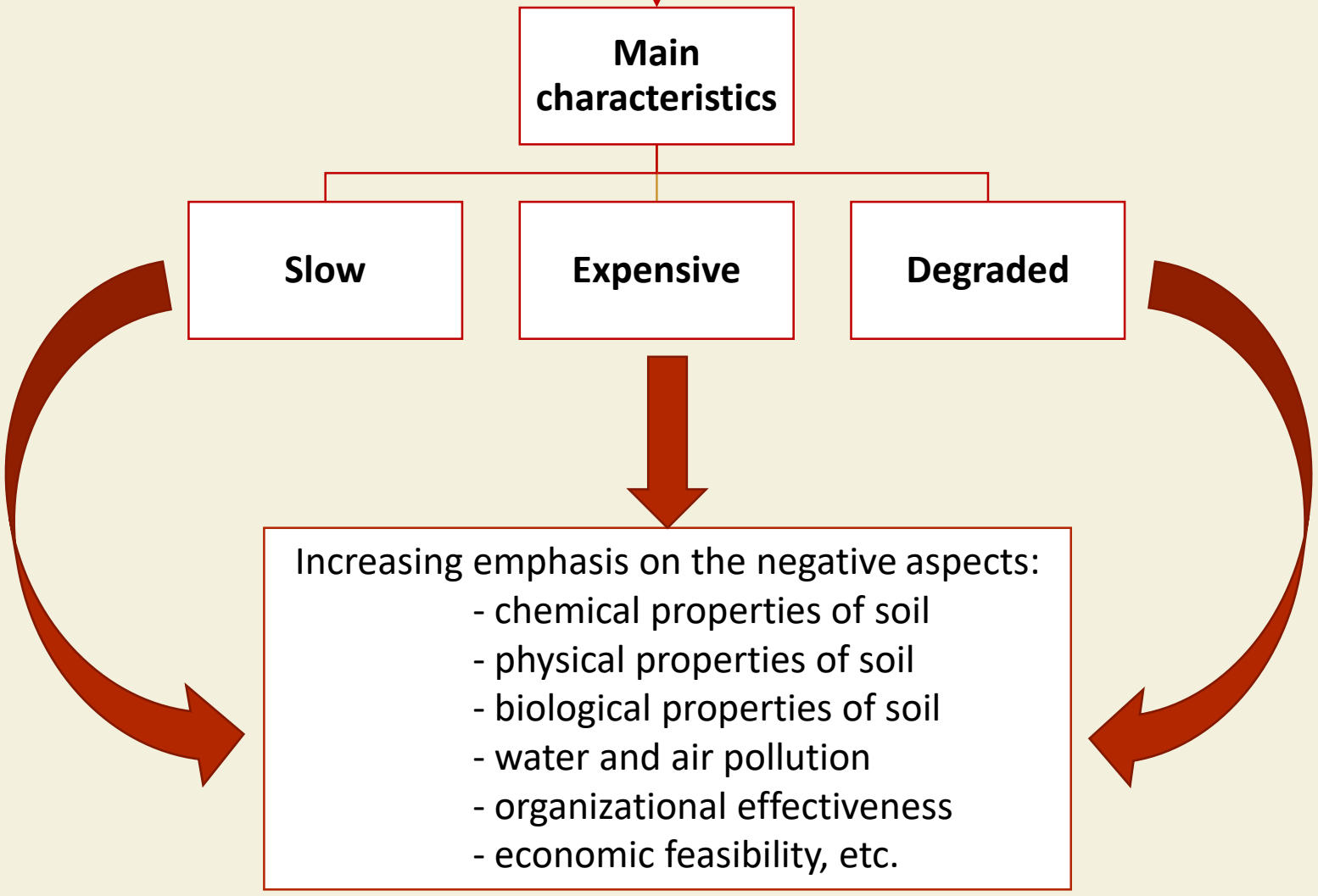
CA principles are universally applicable to all agricultural landscapes and land uses with locally adapted practices. CA enhances biodiversity and natural biological processes above and below the ground surface. Soil interventions such as mechanical soil disturbance are reduced to an absolute minimum or avoided, and external inputs such as agrochemicals and plant nutrients of mineral or organic origin are applied optimally and in ways and quantities that do not interfere with, or disrupt, the biological processes.

CA facilitates good agronomy, such as timely operations, and improves overall land husbandry for rainfed and irrigated production. Complemented by other known good practices, including the use of quality seeds, and integrated pest, nutrient, weed and water management, etc., CA is a base for sustainable agricultural production intensification. It opens increased options for integration of production sectors, such as crop-livestock integration and the integration of trees and pastures into agricultural landscapes.

(www.fao.org/ag/ca)



Predominant crop production systems in Pannonia region: **Conventional system**



Conservation agriculture – CA (sustainable principles)

CA affects many soil quality aspects:

- erosion (by water and wind),
- biogenity (organisms),
- organic matter (SOM),
- water content (storage, infiltration),
- compaction (anthropogenic or natural causes),
- nutrient status,
- pest and diseases (potential risk),
- weed infestation, in word physical,
- other physical, chemical and biological aspects.

- With application of proper crop management can decrease negative influence of climate changes
- CA need to be adapted and implemented according every single production area – agroecological conditions
- With application of crop management closer to CA principles, we can expect less damages and potential problems and risks

Main approaches of soil tillage systems

Conventional tilage

Reduced tillage

Conservation tillage

Best soil tillage systems in practice is tillage which provide the best (optimal) conditions for crop production with minimum of negative influence on soil state (conditions)

Some Benefits of Conservation agriculture

- reduced wind erosion
- reduced water erosion
- erodible land brought into production
- increased options for multiple cropping
- improved soil moisture management (conserves)
- flexible timing for field operations
- improved soil structure
- better humus management
- carbon sequestration (increase OM)
- moderation of soil temperature
- saves fuel and labor
- changes weed dynamics
- improved soil biogenity
- Generaly: improved MECHANICAL – CHEMICAL – BIOLOGICAL properties of soil

Changes and new approach in crop production systems:

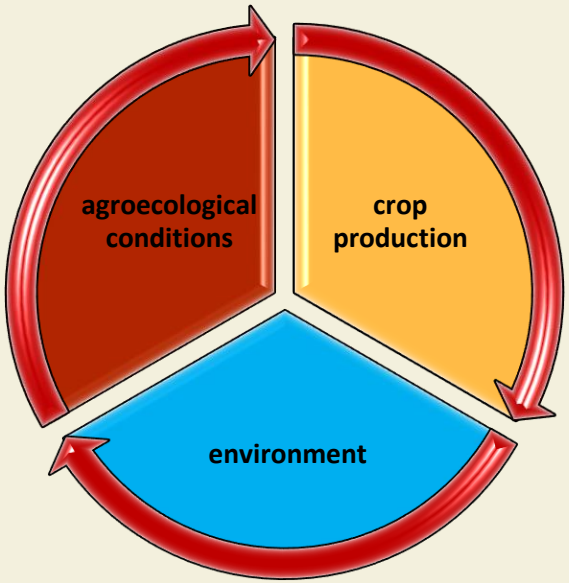
Short overview and conclusions

- conservation / reduced / adapted soil tillage
- stop land degradation
- reduce soil erosion (caused by wind and water)
- improve soil biogenity
- reduce energy consumption
- reduce emissions of carbon dioxide and the risk of global pollution
- reduce the required number of machines and time for tillage operations
- growing or introduction tolerant crops (cultivars)
- intercropping and multicropping (*cover, catch* and *cash* crops)
- crop rotation
- weather forecasting (and climate) adaptation
- regard to environmental requirements in land use

Short overview and conclusions

Adaptation and mitigation of climatic change needs to be based on long-term research and in relation with stronger regional cooperation with professional competence to reach the satisfying results in relation to agroecological conditions-crop production-environment

Since climatic changes do not follow national borders and since agriculture is extremely vulnerable to them, a common action to find adequate and effective measures to face climatic changes is an imperative



For successful approach to adaptation and mitigation processes, we need to create an adequate and useful information system (mainly about usually applied technology in crop production and agro-ecological conditions), which will be used as a starting point in processes of creating strategy and further decision making

Thank you very much for your attention !!!