SCIENTIFIC-PROFESSIONAL CONFERENCE

"Challenges in meteorology 9"

"The importance of agrometeorology in supporting the agricultural sector"

Can conservation agriculture be an effective tool in climate change adaptation?

Danijel Jug, Irena Jug, Boris Đurđević, Bojana Brozović, Monika Marković, Vesna Vukadinović, Ivan Kovaček

16 – 17 November, 2023, Zagreb, Croatia

[Main soil threats]

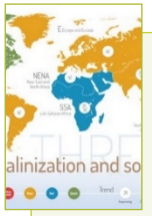
[Main climate threats]

[Acidification]

[Biodiversity]

[Compaction]

[Contamination]



[Salinization and Sodification]

[Nutrient imbalance]

[Sealing]

[Soil Organic Carbon loss]

[Erosion]

[Deforestation]

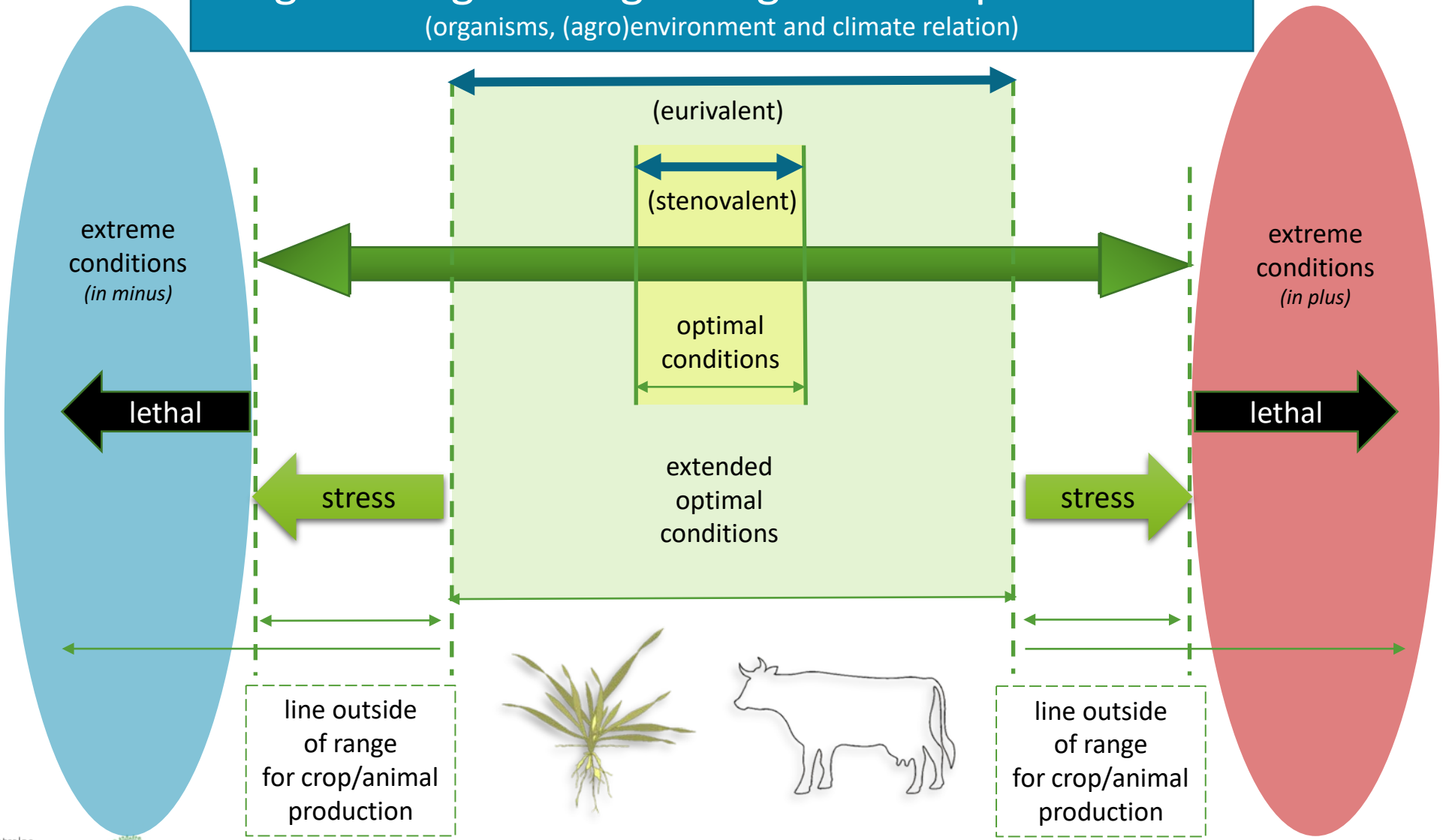
[Desertification]

EC – (Thematic Strategy for Soil Protection, Communication COM(2006) 231)

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

Agroecological range of agricultural production

(organisms, (agro)environment and climate relation)



Main types of stress (short overview)

[According: CSSA, 2011 Position Statement on Crop Adaptation to Climate Change. Crop Science Society of America, Madison, WI.]

- ***Drought*** – is expected to limit the productivity of *over half* the earth's arable land in the next 50 years,
- ***Temperature*** – influences the growth and development of all crops, shaping potential yield throughout the growing season,
- ***Carbon dioxide (CO_2)*** – is fundamental to crop carbohydrate production (important for crop productivity and yield) and overall plant metabolism,
- ***Ozone (O_3)*** – Crops take ozone into their leaves during photosynthesis, where the gas lowers photosynthetic rates and accelerates leaf death, affecting crop maturity and productivity,
- ***Biological stresses*** – on cropping systems include weeds, insects, viruses, bacteria, and fungi.

From soil degradation (caused by CC) to soil restoration – effective scheme for actions

Different pathways on local – regional – global scale

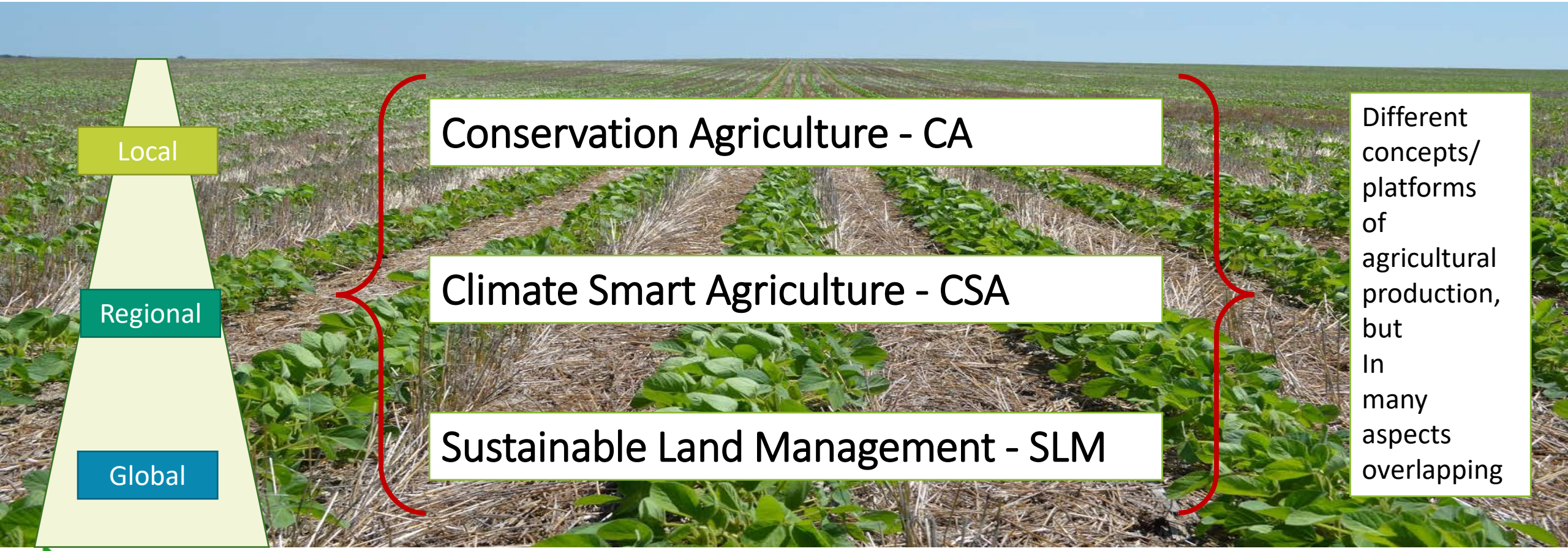
Adaptation of crop production systems

Two different group of approaches / strategies to adaptation of changing conditions in crop production:

- ***Group I*** Adaptation of crops/cultivars
  - Improvement of existing cultivars
  - Creating new cultivars
- ***Group II*** Adaptation of crop production systems
  - Improvement of existing crop production systems
  - Creating new crop production systems

Both strategy include different specific substrategies / measures / procedures

Adaptation of crop production systems - strategy selection



- Application of proper crop management can decrease negative effect of Climate Changes
- CST need to be adapted and implemented according *specificum* of every single production area – agroecological conditions
- As soil tillage is closer to CA principles, it can be expect less damages, potential problems and risks

As general facts

Facts about Conservation Agriculture [CA]

- (CA) is one of the best possible and one of the most effective way for prevention of negative impact of climate changes

CA includes three interrelated main principles as bases for successful agriculture production in relation to agro-ecological conditions (www.fao.org/ag/ca):

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

CA also uses or promotes where possible or needed various management practices listed below:

- utilization of green manures/cover crops to produce the residue cover,
- no burning of crop residues,
- integrated disease and pest management,
- controlled/limited human and mechanical traffic over agricultural soils

CONSERVATION AGRICULTURE (CA)

- ✓ a concept for resource-saving agriculture crop production which is based on enhancing natural and biological process above and below the ground
- ✓ CA has emerged as an alternative strategy for conserving natural resource

Reasons for Conservation soil tillage - CST (main benefits - selected):

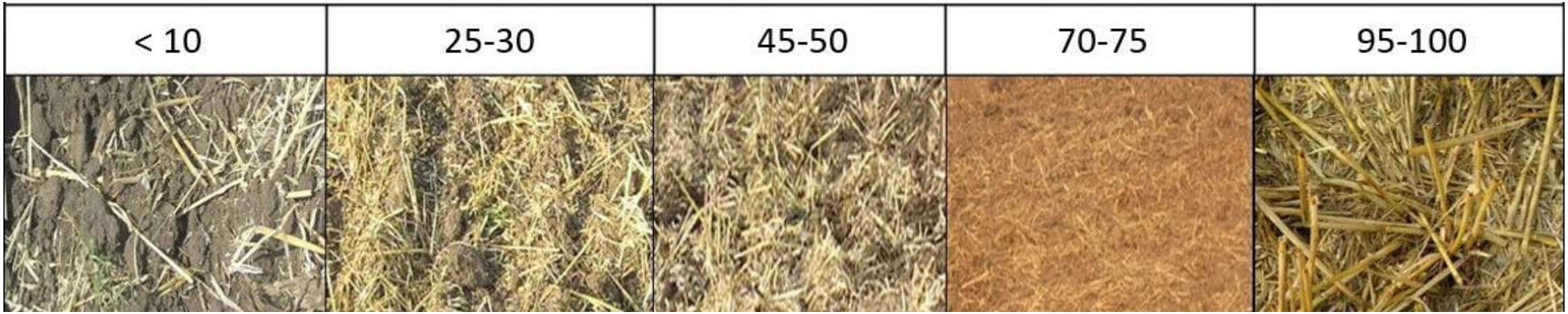
- reduced wind erosion
- reduced water erosion
- erodible land brought into production
- increased options for multiple cropping
- improved soil moisture management (conserves)
- flexible timing for field operations
- improved soil structure
- better humus management
- carbon sequestration (increase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

- **Conventional (intensive) tillage systems**
  - leave less than 15% crop residue cover or less than 550 kg/ha of small grain residue

- **Reduced tillage systems**
  - leave between 15 and 30% residue cover on the soil surface or 550 to 1100 kg/ha of small grain residue

- **Conservation tillage systems**
  - leave a minimum of 30% up to 100% of crop residue on the soil surface or at least 1100 kg/ha of small grain residue on the surface

% of crop residue on the soil surface - after tillage preparation for the next crops

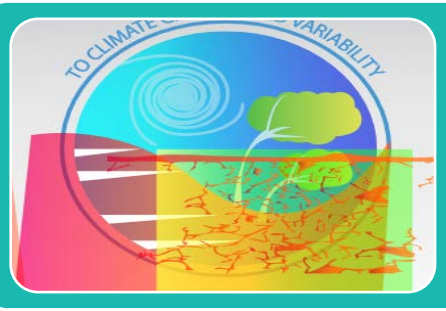


Issues	Conservation agriculture	Traditional agriculture
Tillage	Minimum soil disturbance	Disturbs the soil
Soil cover	Soil surface permanently covered	Leaves naked surface
Erosion	Minimum	Maximum
Soil physical health	Good	Poor
Soil compaction	Potential problem in initial stage!!! can solve by using mulch and promotion of bio-tillage or some conservation tillage eq. subsoiling	Reduces compaction by tillage operation/recompaction
Soil biological health	Enhancing biodiversity	Poor biodiversity
Water infiltration	Best water infiltration	Lowest water infiltration
SOM	Build up SOM	Oxidizes SOM and causes its lost
Soil temperature	Moderate	Variable
Production cost	Low	High

Contribution CA to CC

Productivity

- improve soil fertility,
- soil water availability
- reduce the loss of nutrient-rich topsoil through erosion,



Adaptation

- reduce risk of rainfall run-off and soil erosion, especially on sloping land.
- contour tillage,
- micro-catchments and surface mulching

Mitigation

- carbon sequestration
- temperature aberation
- integrated Soil Fertility Management, weed suppresses

Thank you for your kind attention!!!

University of Josip Juraj Strossmayer in Osijek
Faculty of Agrobiotechnical Sciences Osijek
Vladimira Preloga 1, HR-31000 Osijek, Croatia,
Department for Crop Production and Biotechnology
Chair for Basic Plant Production and Agroclimatology
https://www.opb.com.hr
Prof. dr. sc. Danijel Jug
e-mail: djug@fazos.hr

This work has been fully supported by Croatian Science Foundation under the project "Assessment of conservation soil tillage as advanced methods for crop production and prevention of soil degradation – ACTIVEsoil" (IP-2020-02-2647)