HRZZ (Croatian Science Fundation) project:
"Assessment of conservation soil tillage as advanced methods for crop production and prevention of soil degradation"
ACTIVEsoil: IP-2020-02-2647

http://www.activesoil.eu/

14th congress of Croatian society of soil science
12-16 September 2022| Sveti Martin na Muri, Croatia

Prevention and mitigation of soil degradation by Conservation Soil Tillage

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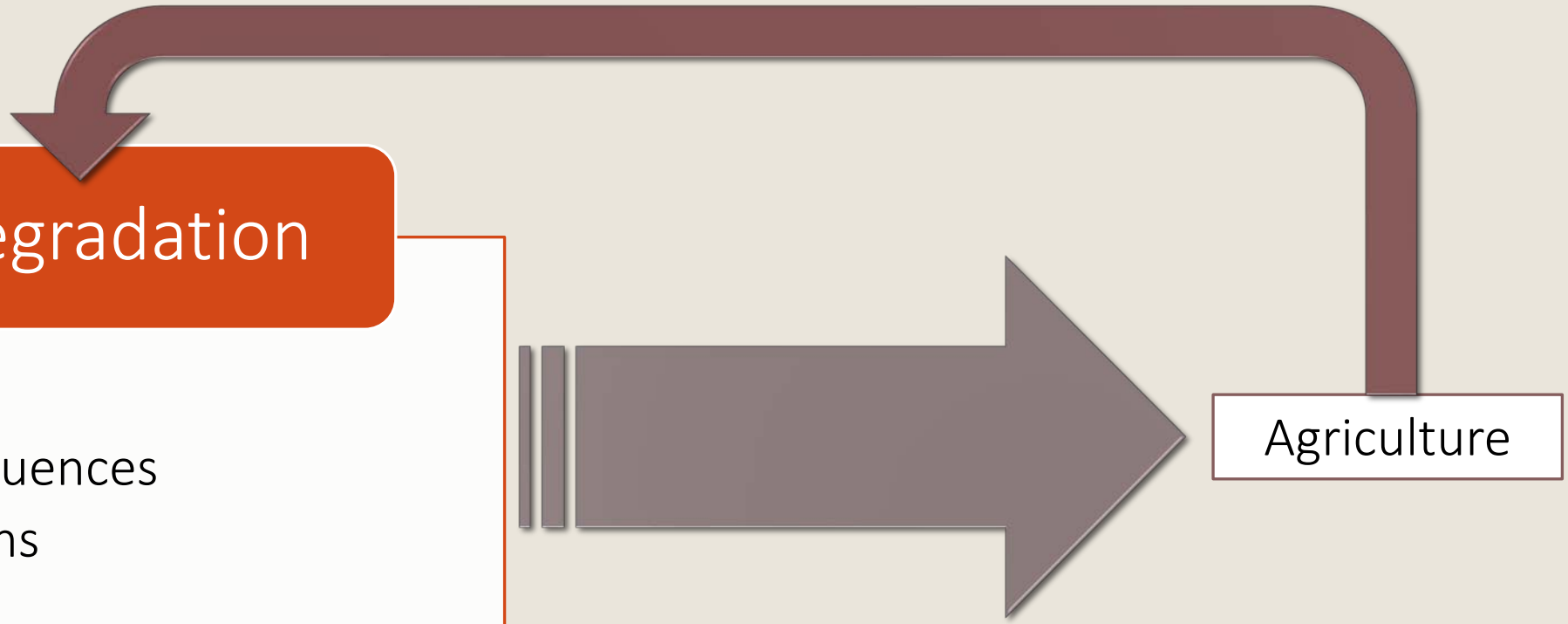
Soil degradation

- Causes
- Consequences
- Solutions
- Actions



"Soil degradation is defined as a ***change in the soil health status resulting in a diminished capacity of the ecosystem to provide goods and services for its beneficiaries"*** (FAO, http://www.fao.org/soils-portal/soil-degradation-restoration/en/)

Soil degradation is a serious global problem!

Major causes of soil degradation

Climatic variations

- [ ] Climate change
- [ ] Decrease in precipitation
- [ ] Drought
- [ ] Moisture loss on global level

Human activities

- [ ] Overgrazing
- [ ] Deforestation
- [ ] Natural vegetation cover removal
- [ ] Unsustainable agricultural activities in vulnerable ecosystems

Triggered by:

Population growth

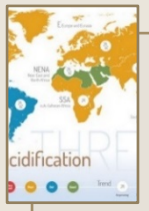
+

Market economy

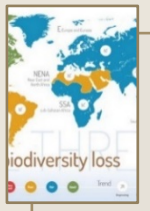
+

Poverty

Main soil threats ↔ Main threats to agriculture



[Acidification]

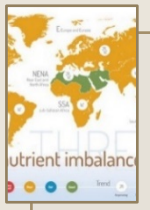


[Biodiversity]

[Compaction]

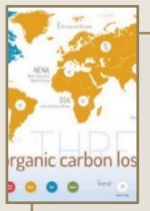
[Contamination]

[Salinization and Sodification]



[Nutrient imbalance]

[Sealing]



[Soil Organic Carbon loss]

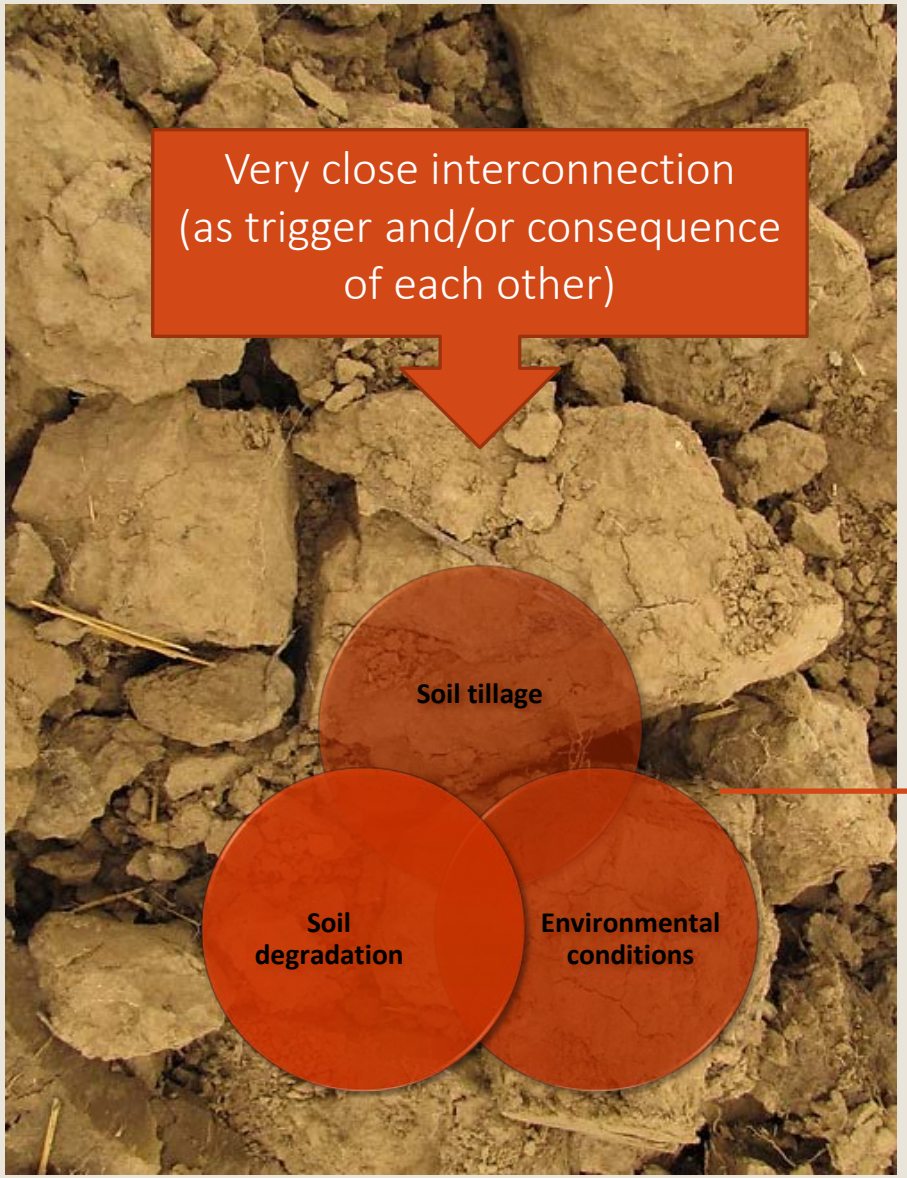
[Erosion]

[Deforestation]

[Desertification]

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

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



Soil degradation - Not so easy understandable and explainable complex processes

Negative effect on every:
- Human aspect
- Natural aspect
- Economy sector

- physical
- chemical
- biological

Soil Complex degradation

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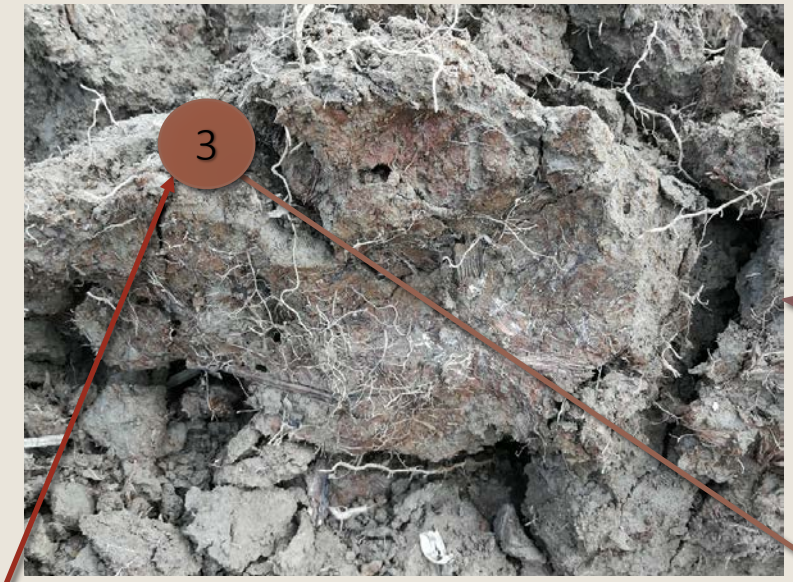
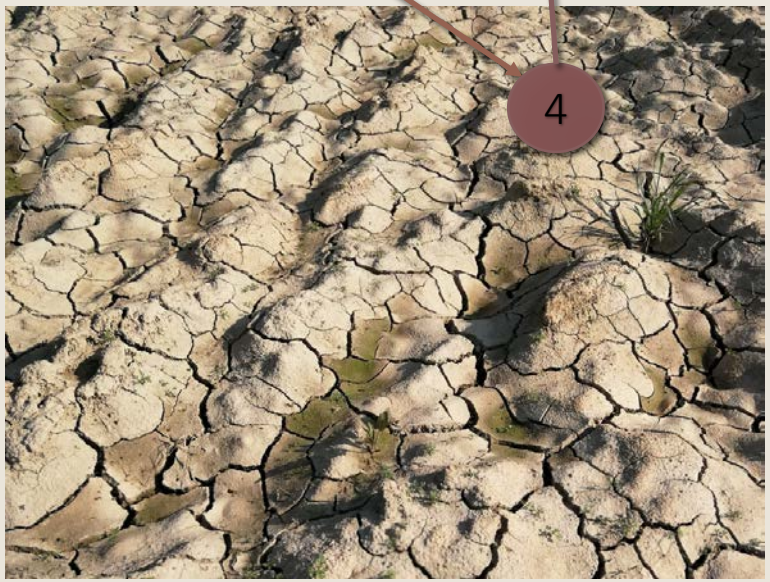
Schematic example

Plowing



Soil degradation



Inappropriate soil management – pathways to soil degradation

Intensification of soil degradation lead to...

- Water shortages and higher temperatures, which increase evaporation, combined with soil erosion intensified by extreme weather events, with application of inappropriate soil and crop management (soil tillage, mineral nutrition, crop protection etc.) increase risks for soil degradation





Soil erosion

Watter logging

Decreasing root elongation

Loss of fertile top soil

Nutrients depletion

Soil compaction

Tillage pan

Decreasing humus content

SOM decreasing

Soil acidification

OM decreasing

Reduction of microbial activity

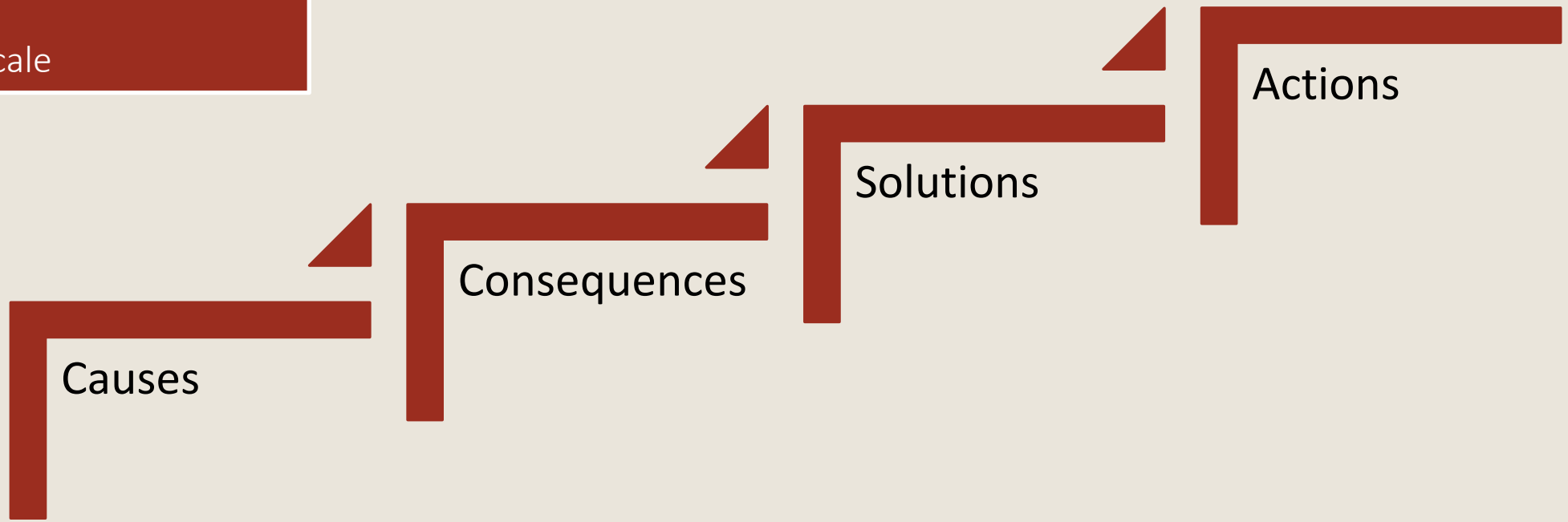
Increasing bulk density

Soil alkalinization / salinization

From soil degradation to soil restoration – simple and effective scheme for actions!

Is simple and effective action of implementation?

Different pathways intensity and responsibility on:
- local
- regional
- global scale



Intensive conventional agriculture = conditionally and only temporary increasing soil production potential !!!

Facts about conservation agriculture (CA)

- Conservation agriculture (CA) is one of the best possible and one of the most effective way for prevention of soil degradation

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 crops or crop residues) and
- diversification in crop production (predominantly crop rotation)

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

- 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

facts

- Application of proper crop management can decrease soil degradation
- 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

Reasons for CST - modern principles of soil tillage imply as main:

- excluding mouldboard ploughing as necessary
- less soil tillage trafficking
- better organic matter (residue) management
- prevention to soil degradation (primarily soil erosion)
- shallow residue incorporation or their leaving on soil surface

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) adhering to the principles of sustainability

Depth of soil tillage and number of passes machinery and tools for tillage operations, should be harmonized with the natural (agroecological) conditions, and the level of crop production must be economically adjusted

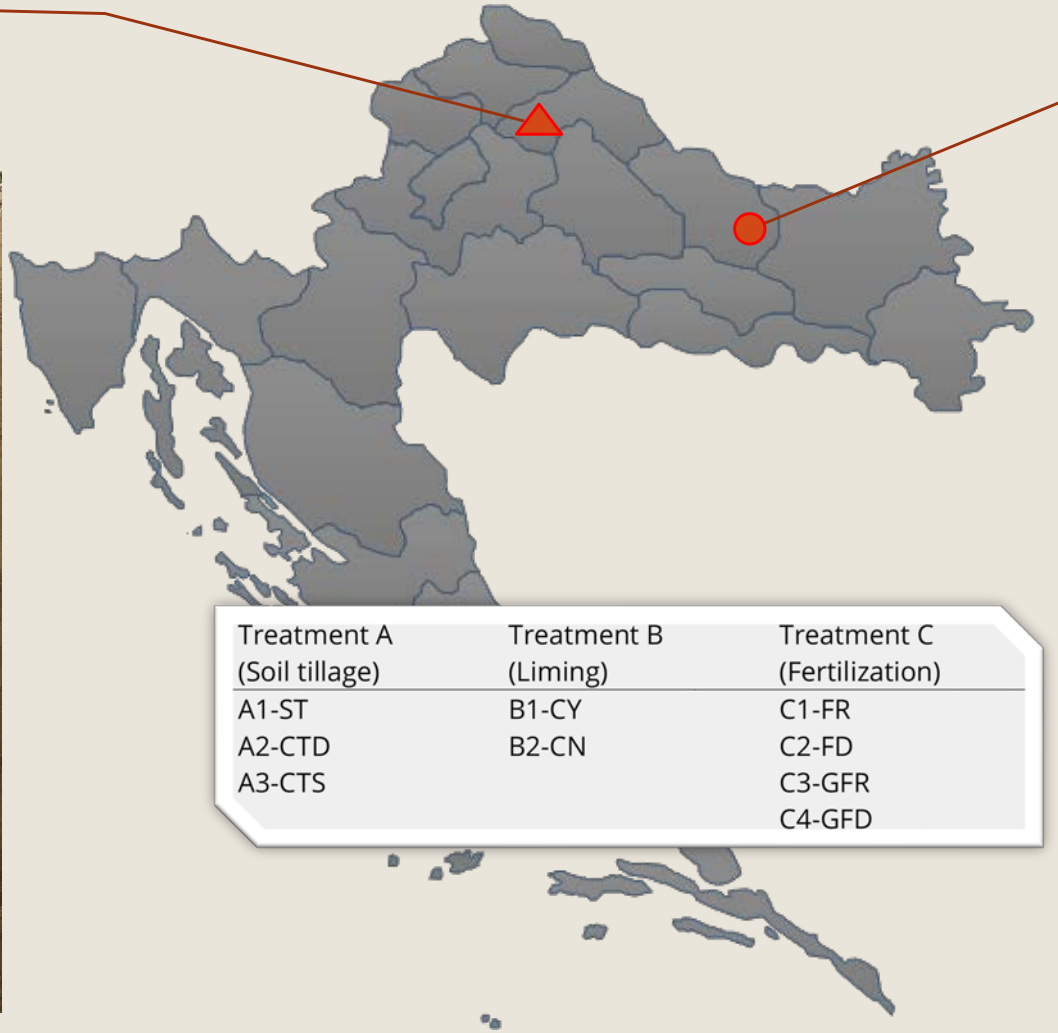
Research Project

Assessment of conservation soil tillage as advanced methods for crop production and prevention of soil degradation

The aim of these studies is to determine the level of degradation of selected components of the physical, chemical and biological soil complexes by comparison of conventional and conservation soil tillage systems. Also, defining positive measures and procedures for stopping, preventing and mitigating anthropogenic and natural degradation processes in the soil at different agroecological research sites will be of great pertinence to environmental protection, agricultural producers, scientific and professional community, decision-makers, and will certainly serve as a basis for further scientific research.

Experimental site B (Križevci)

Gleysol



Treatment A (Soil tillage)	Treatment B (Liming)	Treatment C (Fertilization)
A1-ST	B1-CY	C1-FR
A2-CTD	B2-CN	C2-FD
A3-CTS		C3-GFR
		C4-GFD

Experimental site A (Čačinci)

Stagnosol

Soil tillage treatments

ST standard (conventional) tillage

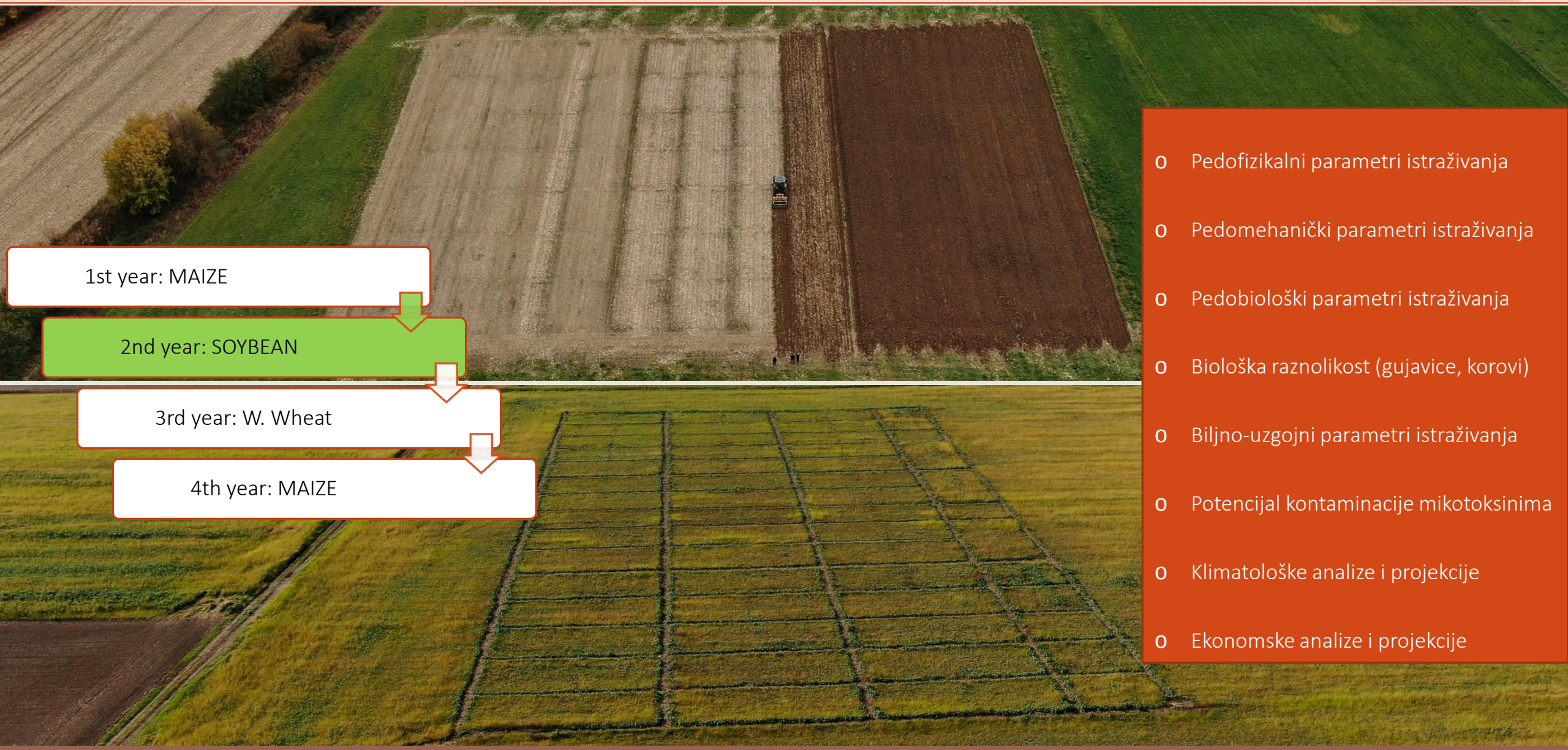
- Ploughing
- Up to 30 cm deep
- Soil surface covered with crop remains at maximum 15%

CTD Conservation tillage - Deep

- Chiseling
- Up to 30 cm deep
- Soil surface covered with crop remains at minimum 30%

CTS Conservation tillage - Shallow

- Chiseling
- Up to 10 cm deep
- Soil surface covered with crop remains at minimum 50%



1st year: MAIZE

2nd year: SOYBEAN

3rd year: W. Wheat

4th year: MAIZE

- Pedofizikalni parametri istraživanja
- Pedomehanički parametri istraživanja
- Pedobiološki parametri istraživanja
- Biološka raznolikost (gujavice, korovi)
- Biljno-uzgojni parametri istraživanja
- Potencijal kontaminacije mikotoksinima
- Klimatološke analize i projekcije
- Ekonomske analize i projekcije

Objectives

- to determine the level and time dynamics of changes in physical, chemical and biological parameters that indicate soil degradation by mutual comparison of the researched systems of plant production
- to determine the impact of plant production on biodiversity (earthworms, weeds, micotoxins contamination…),
- to determine and analyses the intensity of changes in plant-breeding parameters of research (phenological observations, biometric components, yields and yield components) considering the system of plant production,
- analysis of collected agrometeorological and agroclimatic elements, evaluation of the level of their impact on the investigated parameters and development of future projections/simulations based on research results,
- to developed a low-cost sensory system for measuring biological activity through CO_2 production and measuring N_2O emissions on agricultural soils,
- to analyses and evaluate each system of plant production from an economic point of view and to develop future projections of economic trends,
- to develop a system of recommendations to prevent soil degradation for the researched agroecological region, which will be based on the principles of sustainable soil management and will be used for choosing of an optimal system of crop production,
- to prepare and propose recommendations to the Ministries and other state bodies to supplement and elaborate regulations in the field of SLM with regard to the effects of CC and to point-out the importance of systematic soil monitoring.

Expected planned results

- integration and consolidation of the postulates of conservation agriculture with application in different agroecological conditions and for different cultures
- development of an optimal plant production system, taking into account all the investigated indicators
- progress in the development of agro-climatic projection models,
- projections for the future of the economic indicators specific to conservation systems,
- better insight into the degradation processes in the soil and the way they are mitigated,
- optimization of sampling methods and measurements of biotic and ecological potentials of arable land as a tool for monitoring the success of conservation systems of plant production,
- contribution to reducing the negative effects of climate change (conservation soil water, reduction of CO_2 and N_2O as GHG),
- interpretation and significance of CO_2 and N_2O emissions on agricultural soils, elaborated in conceptually different ways for soil quality assessment and impact assessment of global climate change,
- encouraging and developing agro-biodiversity,
- better understanding of the complexity of climate-soil-plant relationship,
- better elaborated rules on sustainable land management and treatment in plant production.

Thank you for your kind attention!!!

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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)

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