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Influence of conservation tillage on soil degradation prevention

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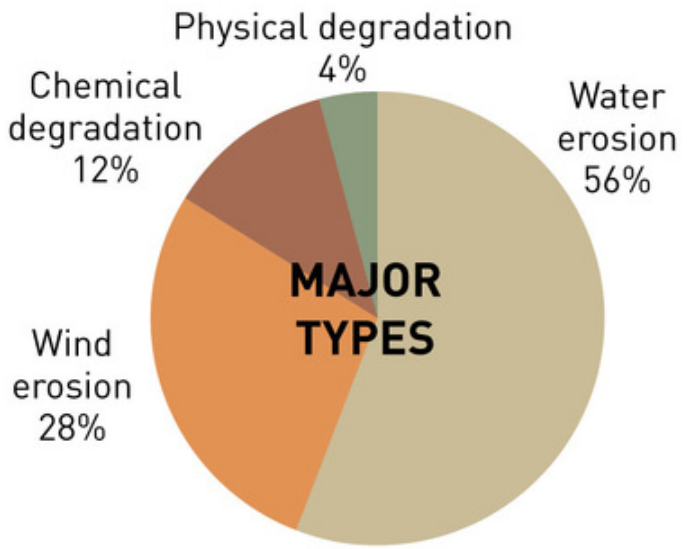
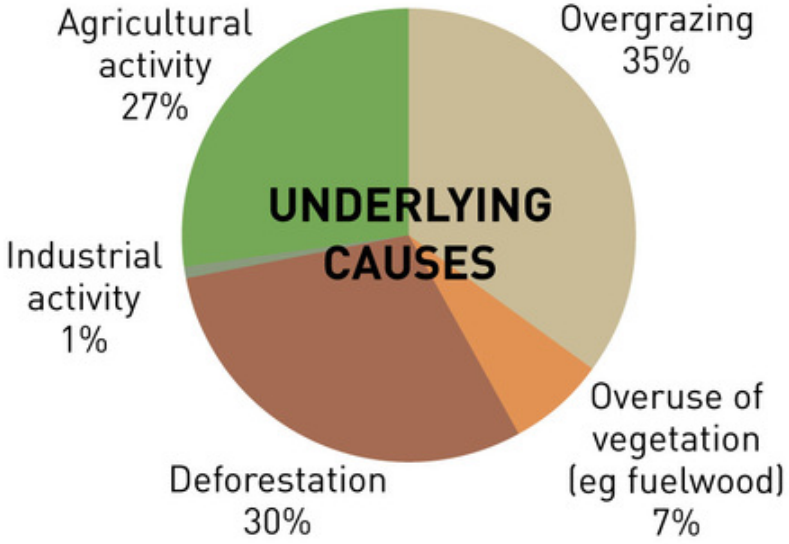
Major types and causes of soil degradation





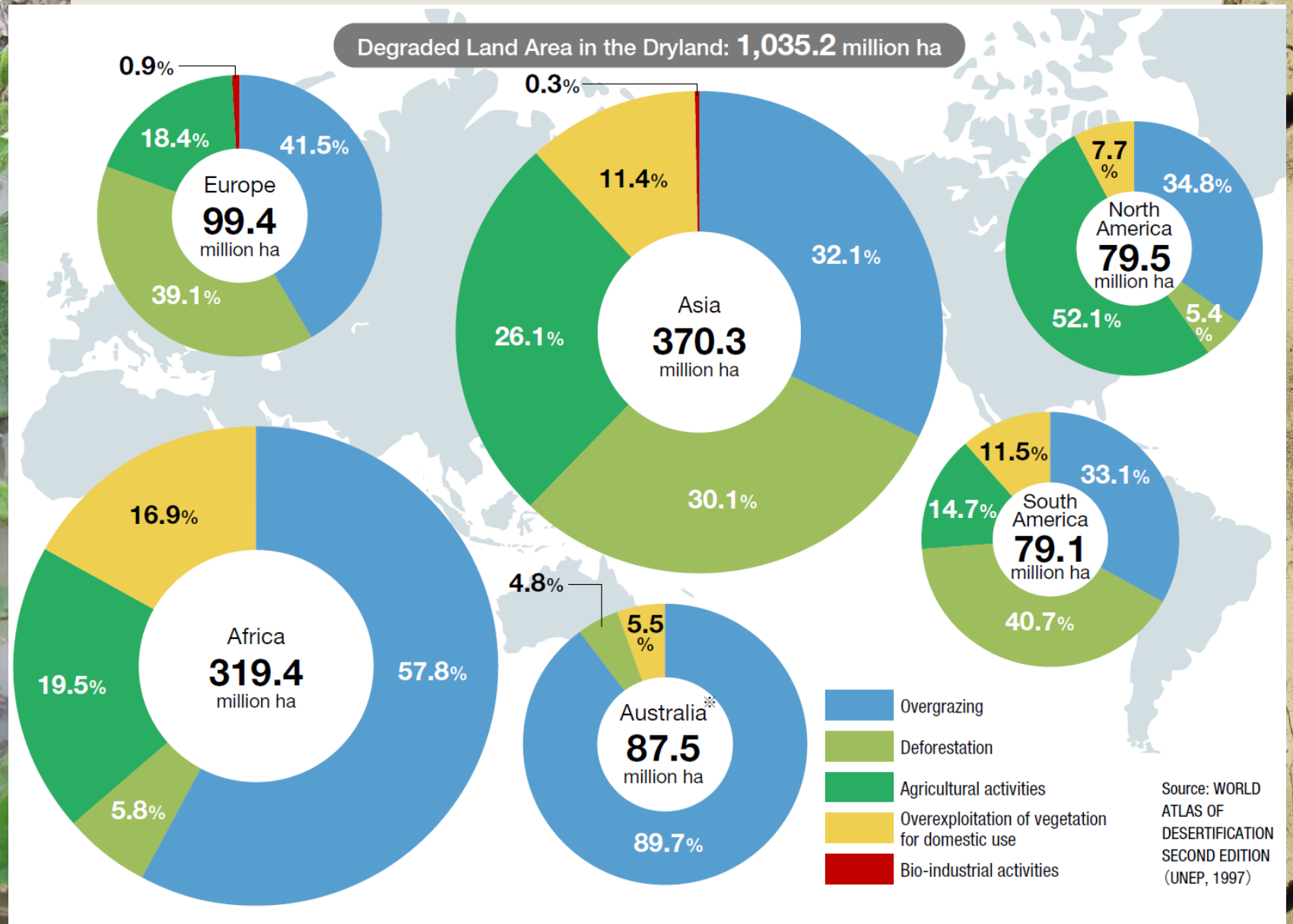
Source: FAO/UNEP

- Soil degradation is the decline in soil condition caused by its improper use or poor management, usually for agricultural, industrial or urban purposes.

- Soil degradation is a serious environmental problem.

- Soils are a fundamental natural resource, and are the basis for all terrestrial life. Avoiding soil degradation is crucial to our well-being.

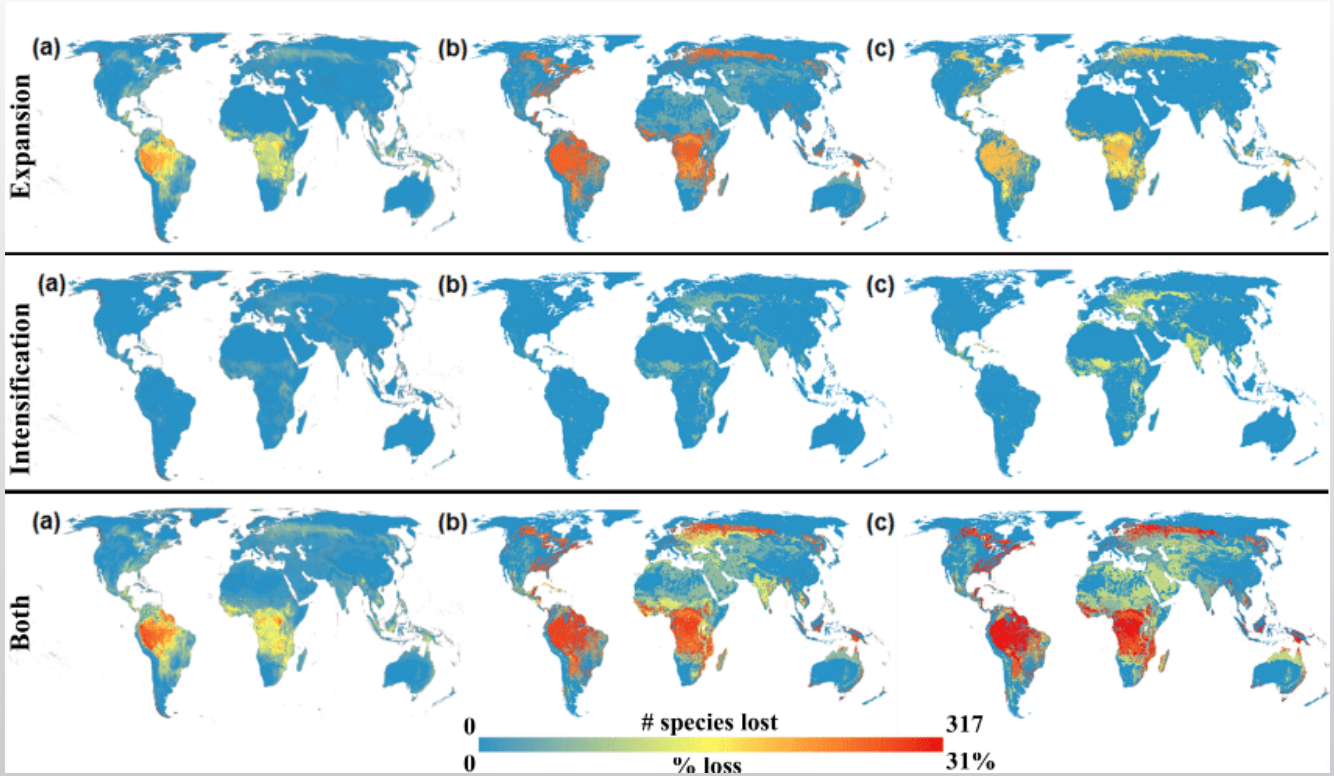
Main Causes of Soil Degradation by Region in Susceptible Drylands and Other Areas



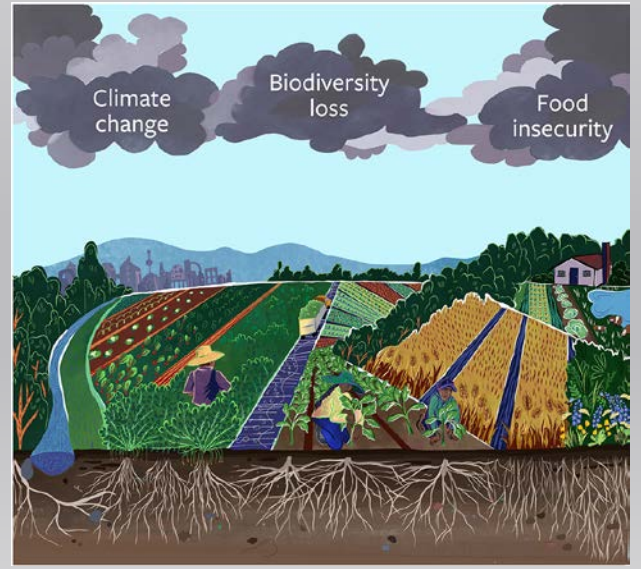
- Soil degradation has multiple and complex impacts on the global environment through a series of direct and indirect processes that affect a large number of ecosystem functions and services, including climatic regulation, carbon sequestration, greenhouse gas emissions, and increased biodiversity

Soil Functions selected by the Food and Agriculture Organisation (FAO). Source: FAO

- Introducing soil to agricultural production, agricultural biodiversity decreases, especially in conventional agriculture (soil disturbed by ploughing, application of agrochemicals, etc.).



(Source: Kehoe, Laura & Romero-Muñoz, Alfredo & Polaina, Ester & Estes, Lyndon & Kreft, Holger & Kuemmerle, Tobias. (2017). Biodiversity at risk under future cropland expansion and intensification. Nature Ecology and Evolution. 1. 10.1038/s41559-017-0234-3.)



- Adopting the CA principles agricultural activity can significantly reduce the negative impact on biodiversity and natural biological processes in the soil

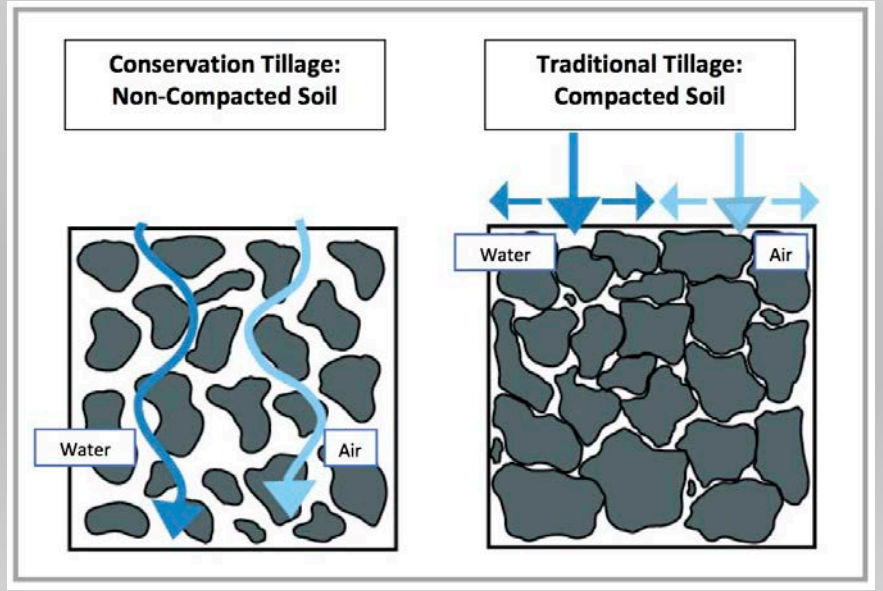
Increasing degradation of agricultural soils caused by a number of natural and anthropogenic factors puts the role of conservation soil tillage as a measure that is able to cope with these problems, following the principles of sustainable soil management

Conservation soil tillage is one of the fundamental postulates of conservation agriculture (CA)

Conservation tillage is any method of soil cultivation that leaves the previous year's crop residue (such as corn stalks or wheat stubble) on fields before and after planting the next crop to reduce soil erosion and runoff, as well as other benefits such as carbon sequestration

https://youtu.be/eCPkMWzkgvc

With this technique, at least 30% (up to 100%) of the soil surface is covered with crop residue/organic residue following planting



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

BENEFITS OF CONSERVATION TILLAGE

RESOURCES: TIME & MONEY

DECREASED labor time

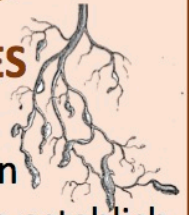
MORE family time

FEWER passes & **LESS** equipment wear & tear: **Average** - $5 per acre savings[1]

REDUCED fuel costs: **Average** - 3.5 gallons per acre savings[1]

SOIL HEALTH

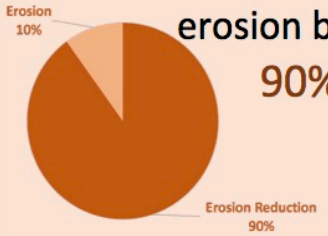
IMPROVES soil aggregation for roots to establish



INCREASES organic matter

FEEDING the biology

REDUCED soil erosion by 90%[1]



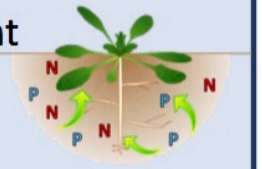
WATER

IMPROVES water availability

REDUCES sediment loading

IMPROVING water clarity

REDUCES nutrient runoff



REDUCING algal blooms & dead zones

[1] Values cited from "Top 10 Conservation Tillage Benefits," Conservation Technology Information Center at Purdue University (2017)

Research Projects

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

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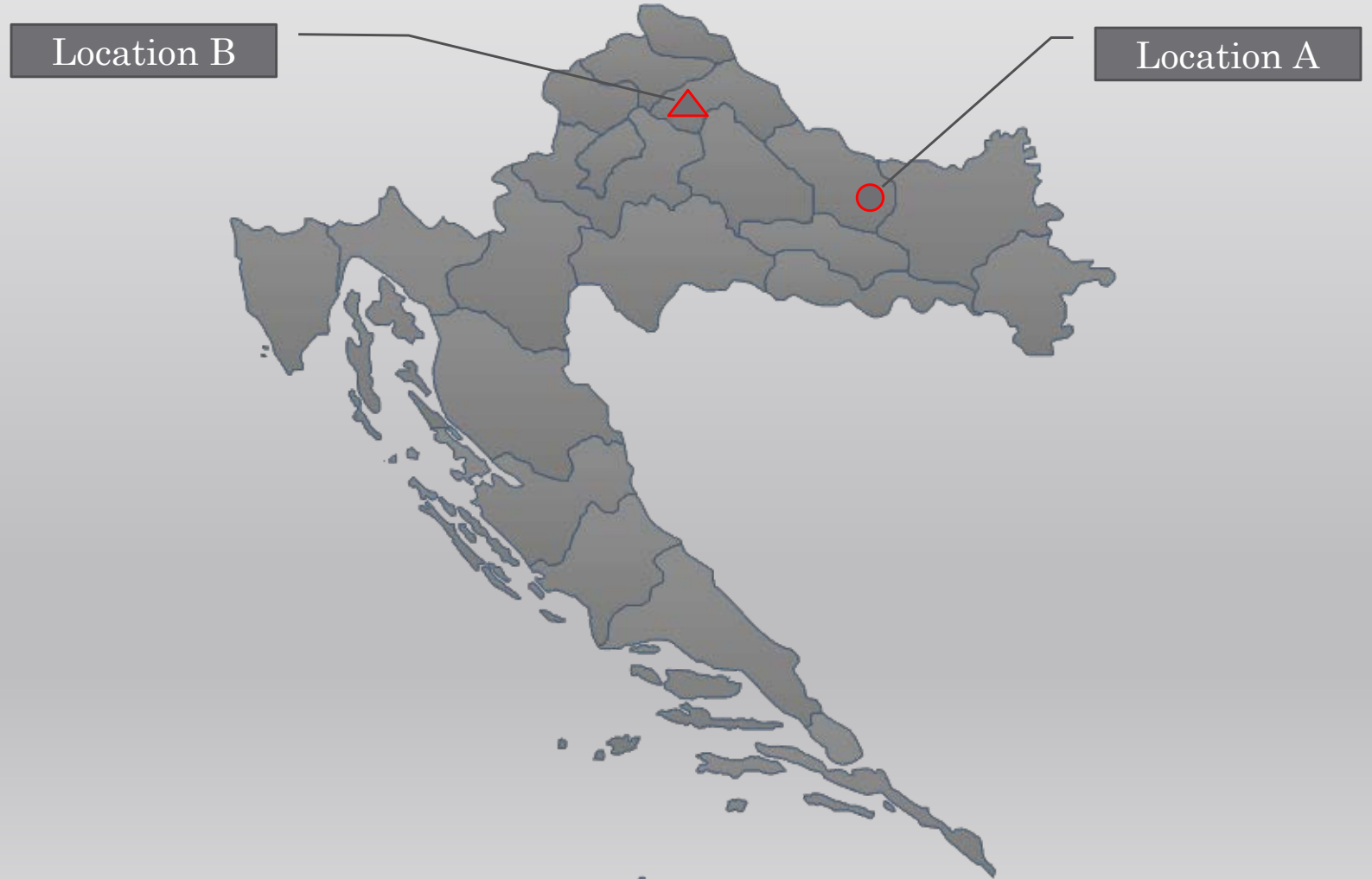
The experimental part of the study will be conducted at stationary experimental fields, in two (2) locations:

- Location A: Virovitica-Podravina County (Čačinci Place – Owned by PG "Knežević"),
- Location B: Koprivnica-Križevci County (place Križevci–trial site of Križevci College of Agriculture–KCA),



Experimental site

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HRZZ Hrvatska zaklada za znanost

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

Treatment A Soil tillage)	
A1-ST	Conventional/standard tillage
A2-CTD	Conservation System Deep
A3-CTS	Conservation System Shallow

Treatment B liming	
B1-CN	Bez kalcizacije
B2-CY	with liming

Tretman C (fertilization/conditioners)	
I-C1-FR	according recommendation
II-C2-FD	decreased by 50%
III-C3-GFR	according recommendation + GeO2
IV-C4-GFD	decreased by 50% + GeO2

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 in the soil, weeds, aflatoxin contamination potential in soil and on crops),
- 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 plant production,
- to prepare and propose recommendations to the Ministries and other state bodies to supplement and elaborate regulations in the field of sustainable land management with regard to the effects of climate change and to point-out the importance of systematic soil monitoring.

The expected planned results arise as a logical result of the well-defined research goals, which outline the most significant

- the integration and consolidation of the postulates of conservation agriculture with application in different agroecological conditions and for different cultures
- the development of an optimal plant production system, taking into account all the investigated indicators
- progress in the development of agro-climatic projection models,
- progress in development of methodology for tracking economic indicators specific to conservation systems and projections for the future,
- 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 (accumulation and conservation of water in the soil, reduction of CO_2 and N_2O as greenhouse gases),
- 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.

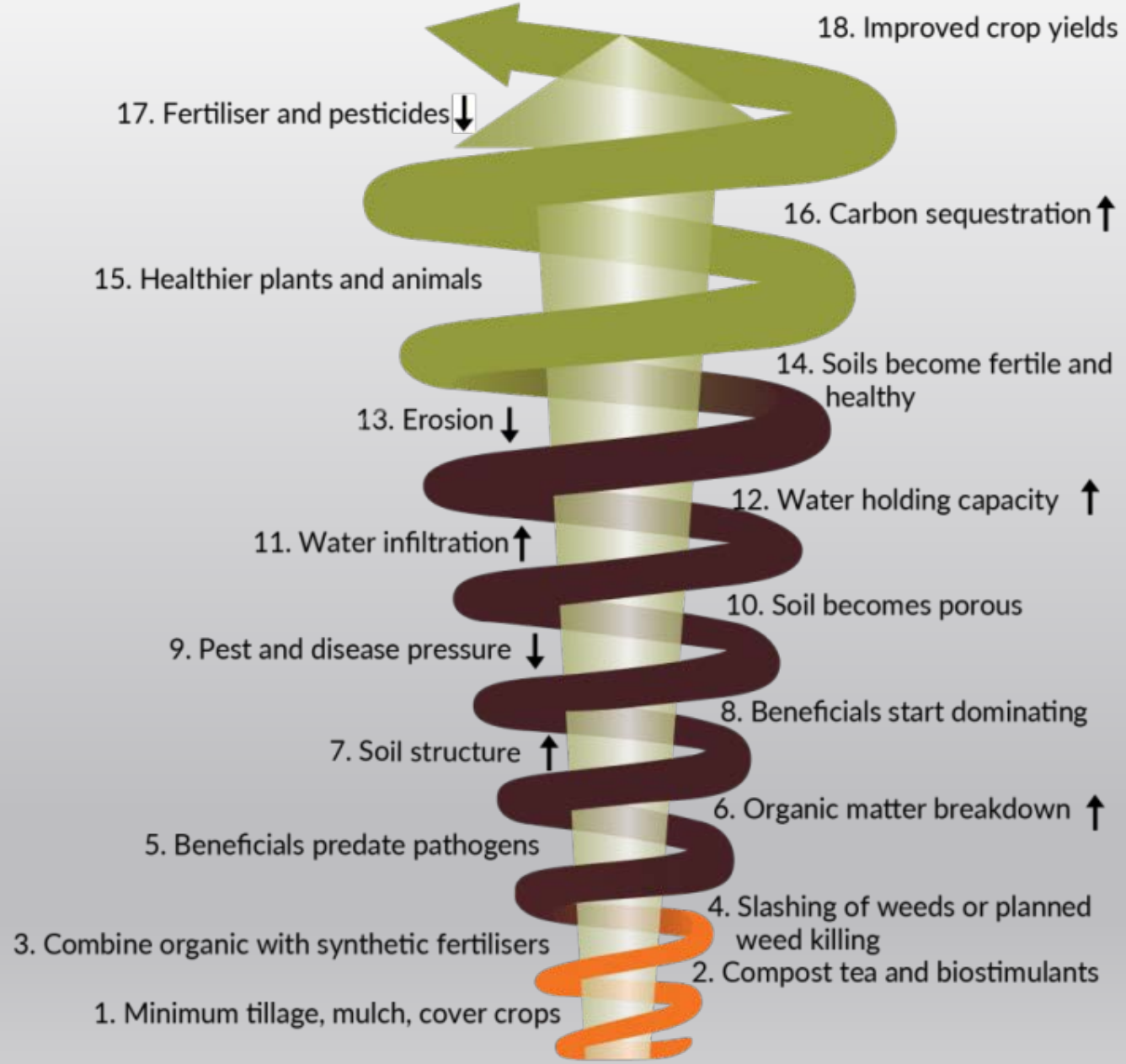
Expected results

Conclusion


1. Intensive tillage
2. Soil organic matter ↓
3. Aggregates break down
4. Monoculture
5. Microbial diversity ↓
6. Synthetic fertilisers added
7. Weed killer, no mulch
8. Soil carbon oxidised
9. Pathogens starts ↑
10. Soil structure collapses
11. Pests and disease ↑
12. Surface crust forms
13. Low water infiltration
14. Run off and erosion ↑
15. Low soil fertility
16. Reduced crop yields
17. More fertiliser needed
18. Creating more problems
Low profitability and resilience

Conclusion

Higher Profitability, Resilience and Continuous Soil Regeneration




THANK YOU FOR YOUR ATTENTION