



# Impact of different tillage systems on soil water availability and erosion potential in agricultural catchments, Example from Slovenia

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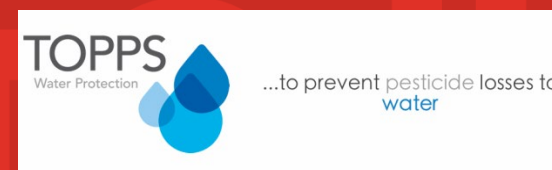
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ARIS L4-2625



# 1 Aim

To examine the environmental and economic sustainability of agricultural **soil water management (abundance, scarcity) and soil management (erosion)**, using small measures to **retain water** and **prevent soil erosion** in fields under conventional and conservation minimal tillage.



## Key policy objectives of the future CAP

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The nine key objectives

Analysis of the key policy objectives

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### The nine key objectives

For the period 2021-27, the European Commission proposes that the common agricultural policy (CAP) be built around nine key objectives. Focused on social, environmental and economic goals, these objectives will be the basis upon which EU countries design their [CAP strategic plans](#).



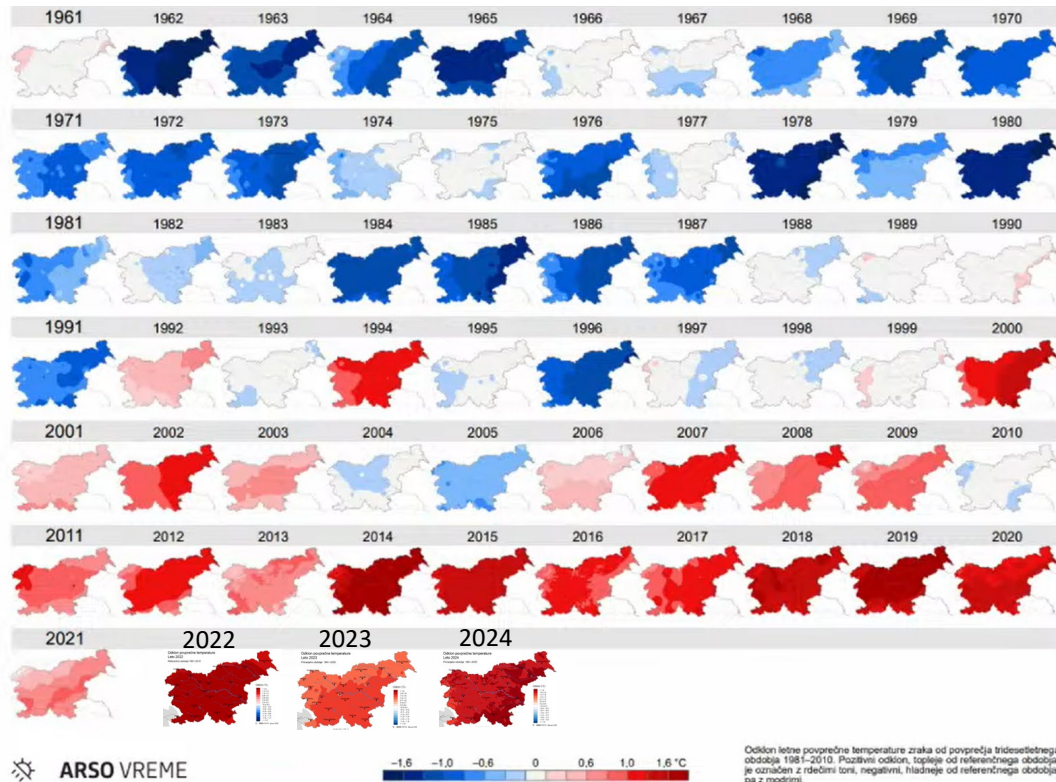
The objectives are:

- to ensure a fair income to farmers;
- to increase competitiveness;
- to rebalance the power in the food chain;
- climate change action;
- environmental care;
- to preserve landscapes and biodiversity;
- to support generational renewal;
- vibrant rural areas;
- to protect food and health quality.

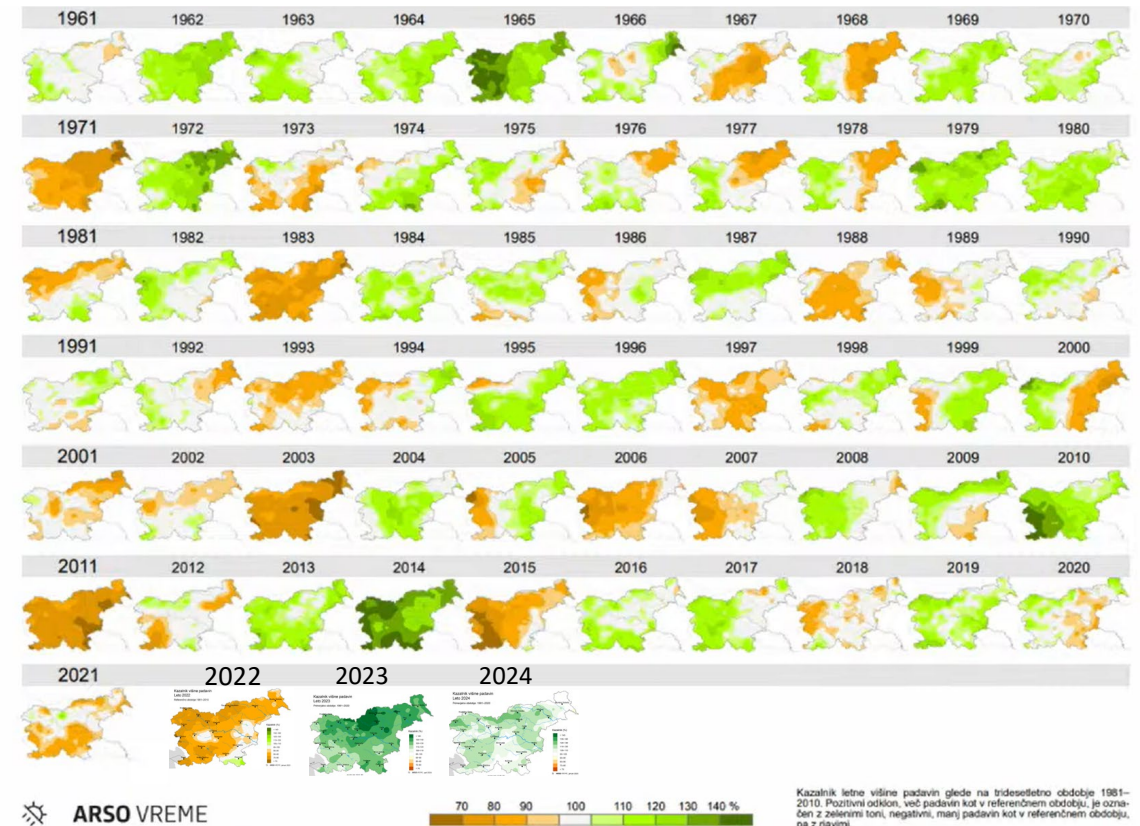
## 2 Background

- For every 1°C rise in average temperature, the atmosphere can hold up to around 7% more moisture. With more moisture available, rainfall can become more intense.

Deviation of the annual average temperature (1981-2010)



Deviation of the annual average precipitation (1981-2010)

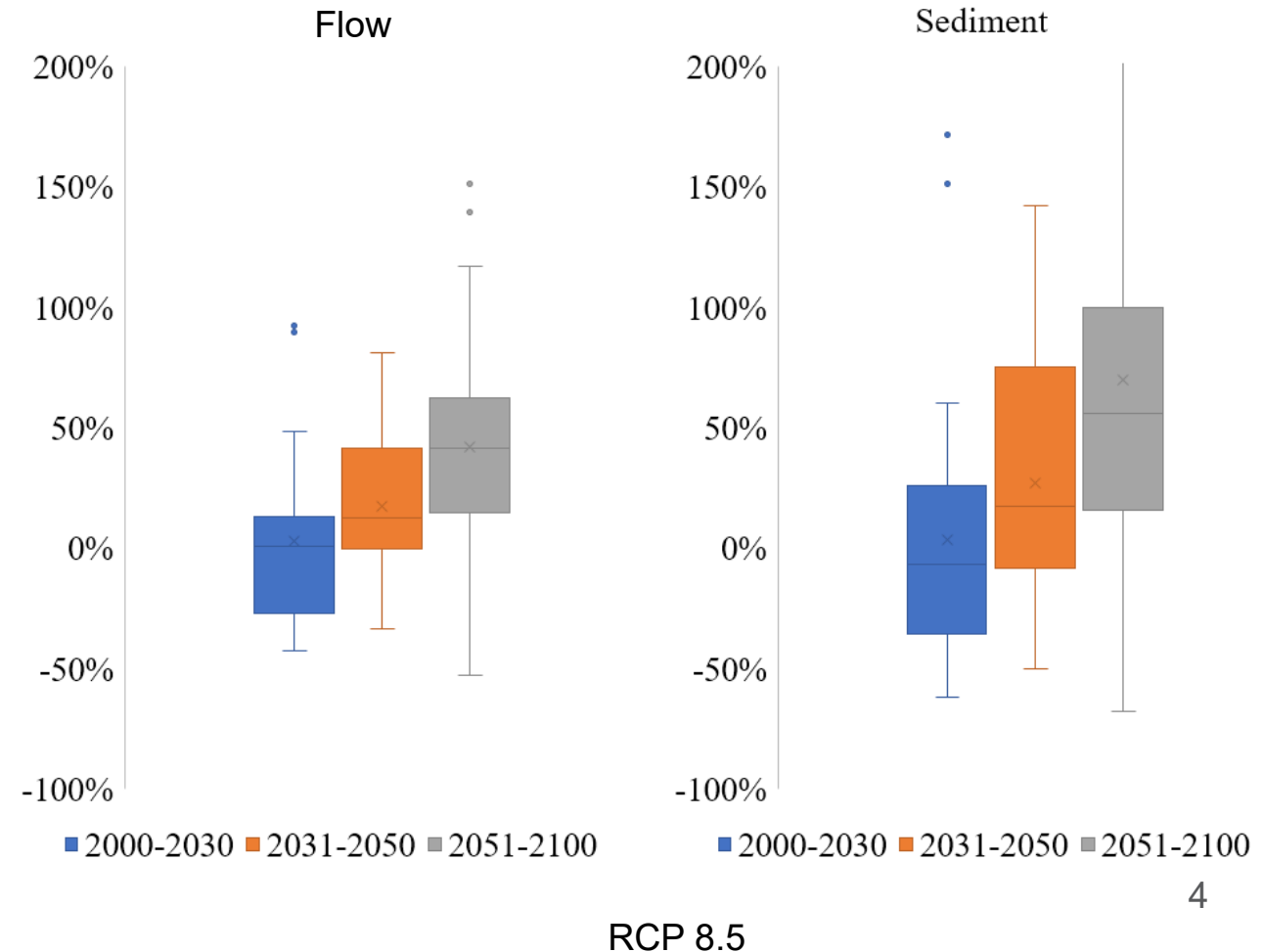
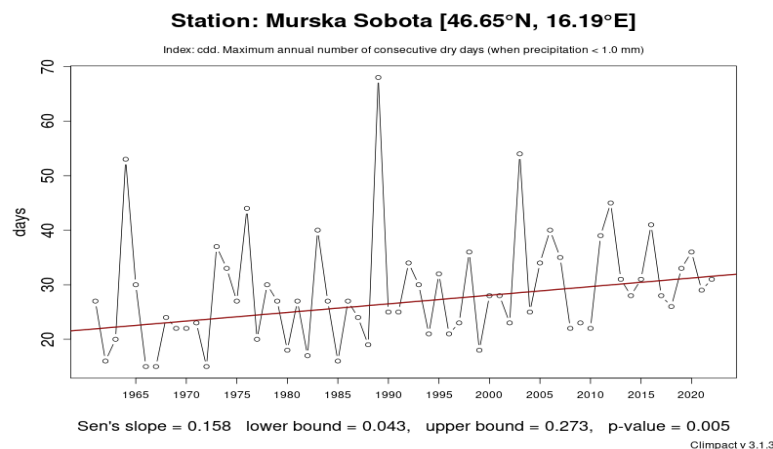


- Slovenia is already 2°C warmer from pre-industrial area  
= potentially, the air can already contain 14% more moisture

## 3

# The problem - Climate analysis and climate modelling

- The number of consecutive dry days is increasing
- Climate change models show that the number of days with heavy rainfall will increase
- Surface runoff will increase and with it river flow
- Unless we change the way we manage our land, soil erosion and the amount of sediment and nutrients in surface waters will increase







## Vipava (V) - Pesnica (P) - Ledava (L)

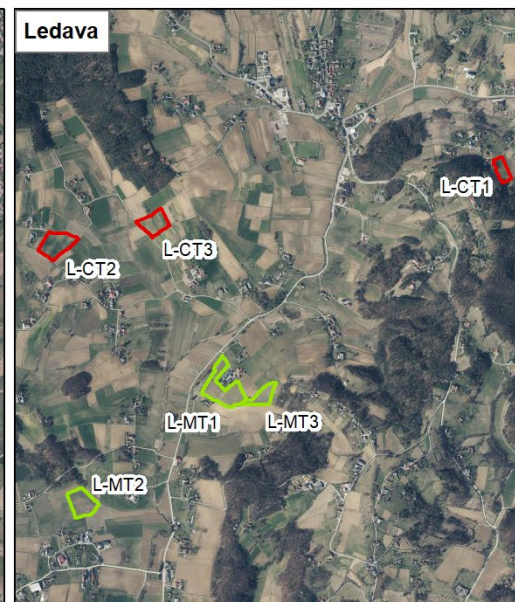
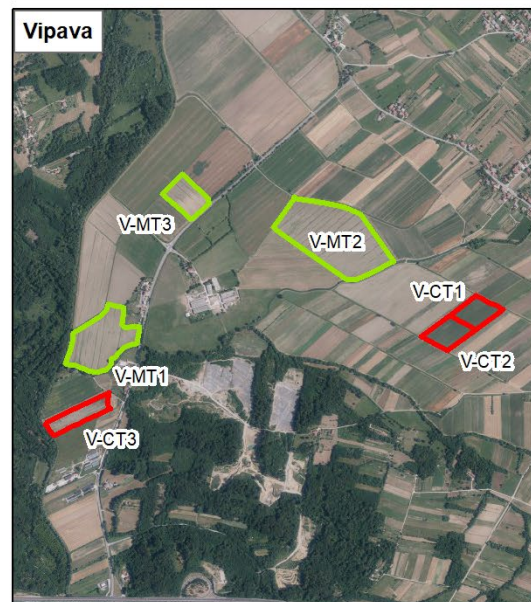
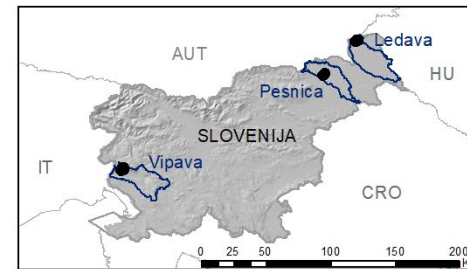
### Fields included in the measurements

C - conventional tillage (ploughing)

M - minimum tillage

0 0.25 0.5 1 1.5 2 Km

Aerial orthophoto (Ministry of Agriculture, Forestry and Food, 2023)

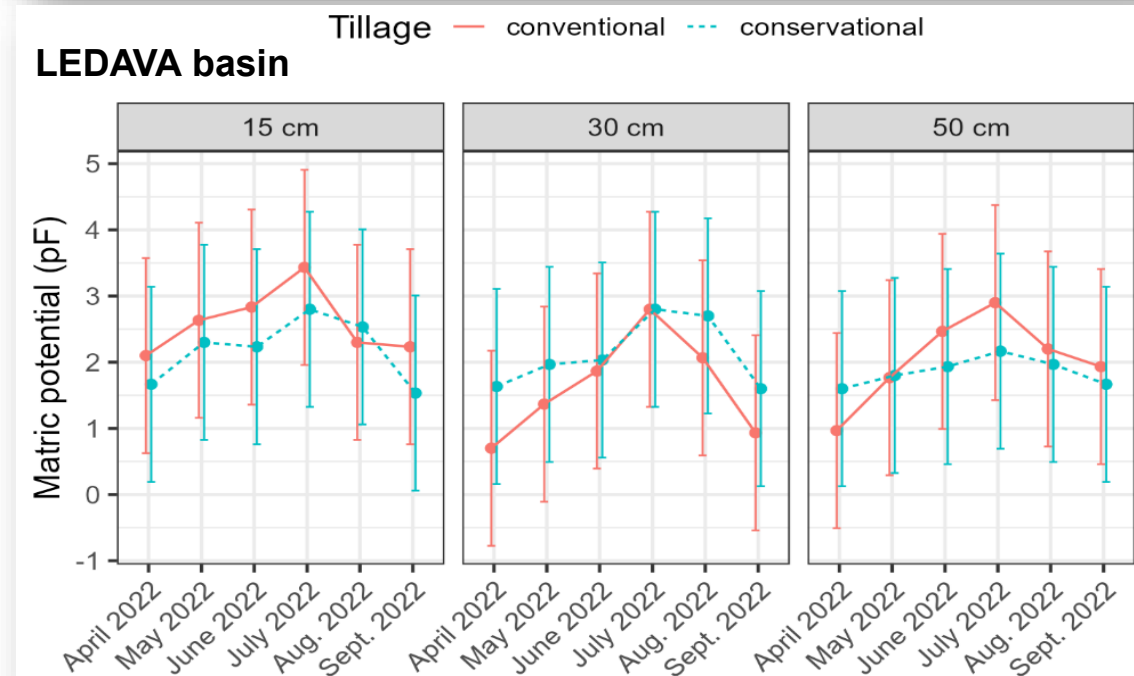
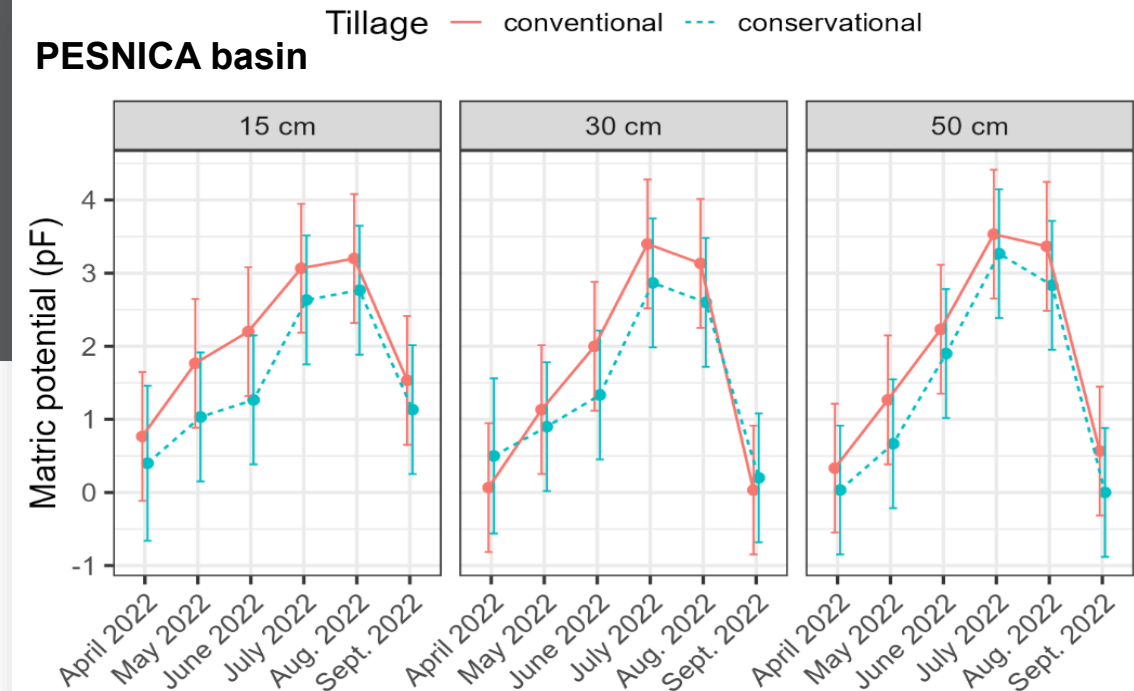
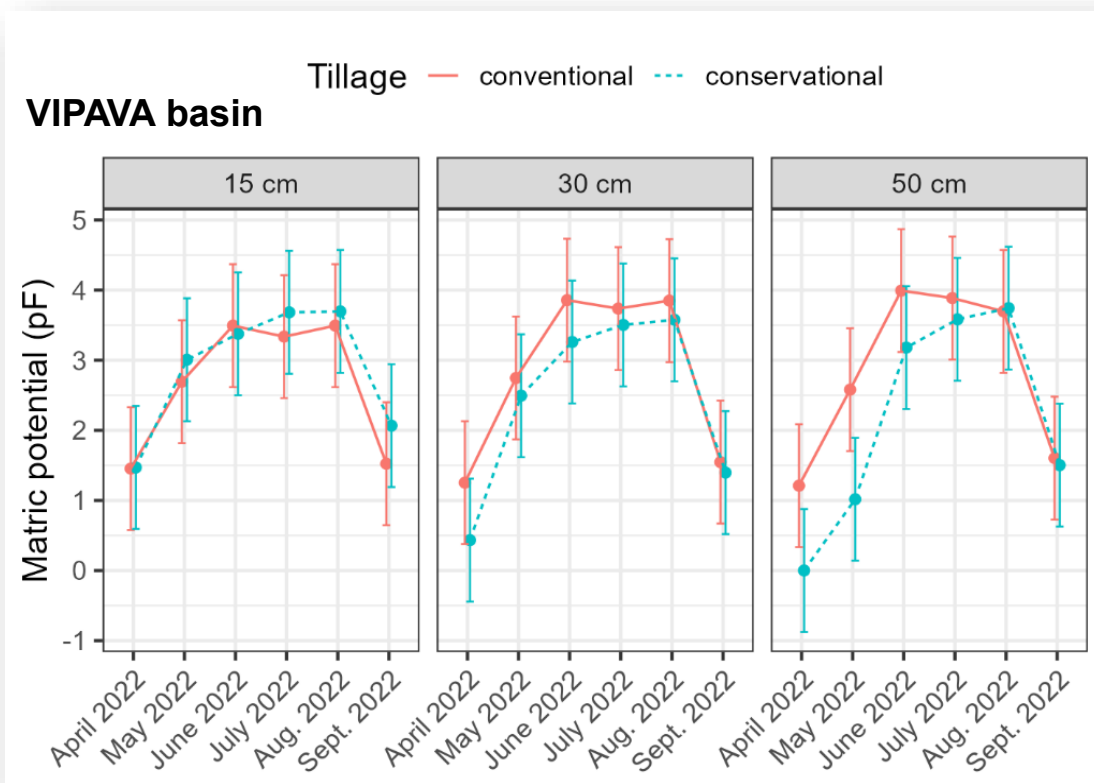




# 5

## Matric potential (pF) and soil water content ( $\theta$ )

Conventional (C) vs. conservational minimal tillage (M)

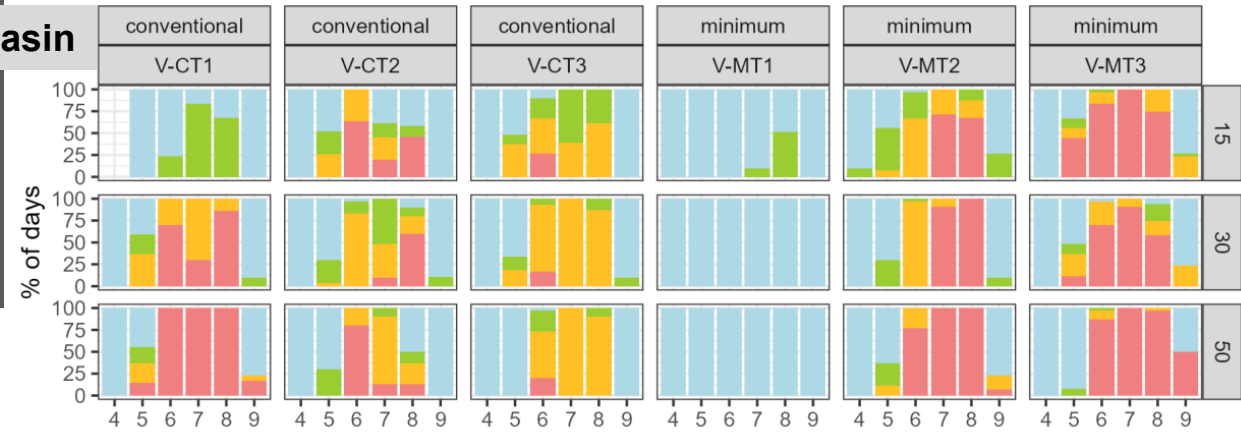


## 6

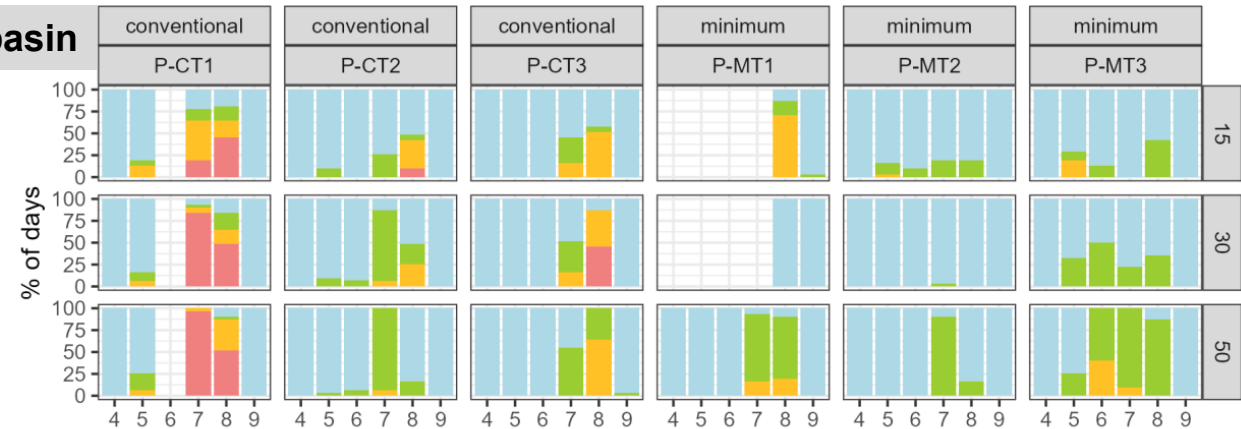
# Categories of plant water availability

The measurement of soil matric potential between the different tillage systems showed **similar soil water status in terms of percentage of days within the different category of plant water availability**, expressed as pF value.

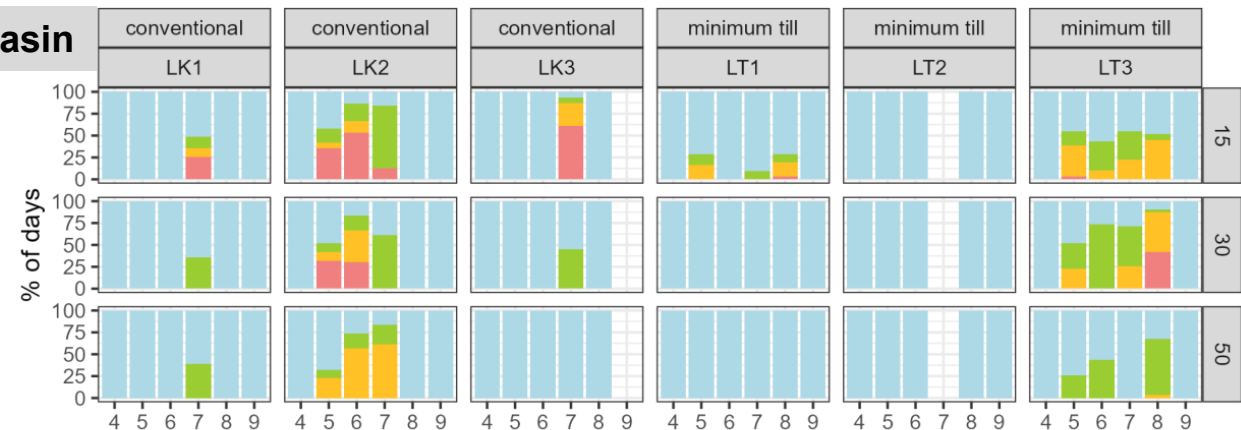
## VIPAVA basin



## LEDAVA basin



## PESNICA basin



Month

# 7

## Soil Erosion

### How much does it cost?

In a few hours conditions change!



According to estimates, with a **loss of 1 ton** of soil:

- The **farmer** loses **€50**,
- The **local community** has costs of **€15-20** for the rehabilitation of various hydrological and transport infrastructure,
- Downstream ?



# 7 SOIL EROSION

28. april 2021



10. Junij 2021



2. June 2022



Erosion = 60 t/HA





# 7 SOIL EROSION





# 7 SOIL EROSION

Conventional tillage Soil herbicide before germination 4,5 t/ha	No-till – herbicide application before germination 0,15 t/ha	No-till – late application after germination 0,08 t/ha	Minimum till – herbicide after germination 1,9 t/ha
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Amount of soil and water lost on a steep field depending on soil cultivation method and herbicide application timing – APPROXIMATELY 1 MONTH AFTER SOWING



# 7 SOIL EROSION

30. SEPTEMBER 2021

ADENGO

glifosat

focus

monsoon



PLOUGHING

Yield (kg/ha | plants/m<sup>2</sup>):

36.266 | 7,10

Erosion (t/ha):

39,13

NO-TILL GLIFOSAT

39.893 | 8,60

1,09

NO-TILL FOCUS

33.493 | 9,10

0,81

MINIMUM-TILL MONSOON

40.640 | 9,30

7,74



Cumulative amount of eroded soil per ha from sowing on November 28 to June 7

PLOUGH transversely

7,55 t/ha

PLOUGH longitudinally

26,45 t/ha

NO-TILL

2,45 t/ha

MINIMUM-TILL

17,9 t/ha



Winter wheat  
7. June 2022

ALGE



NO  
ALGE



## 8

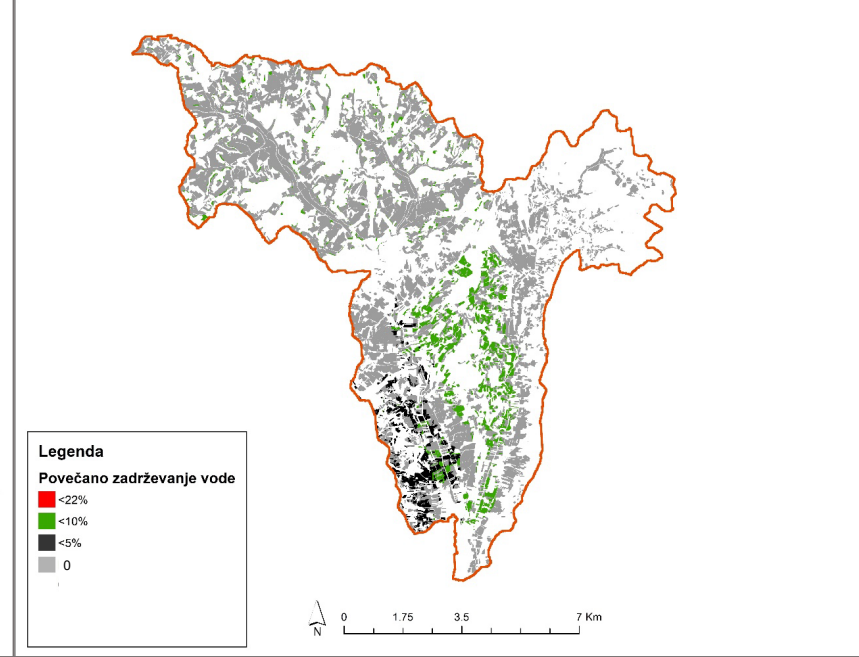
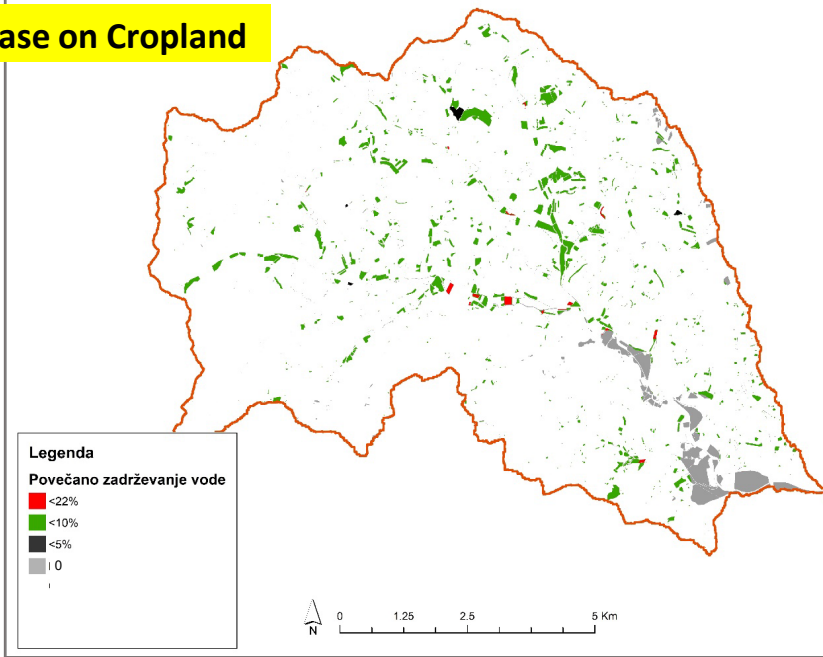
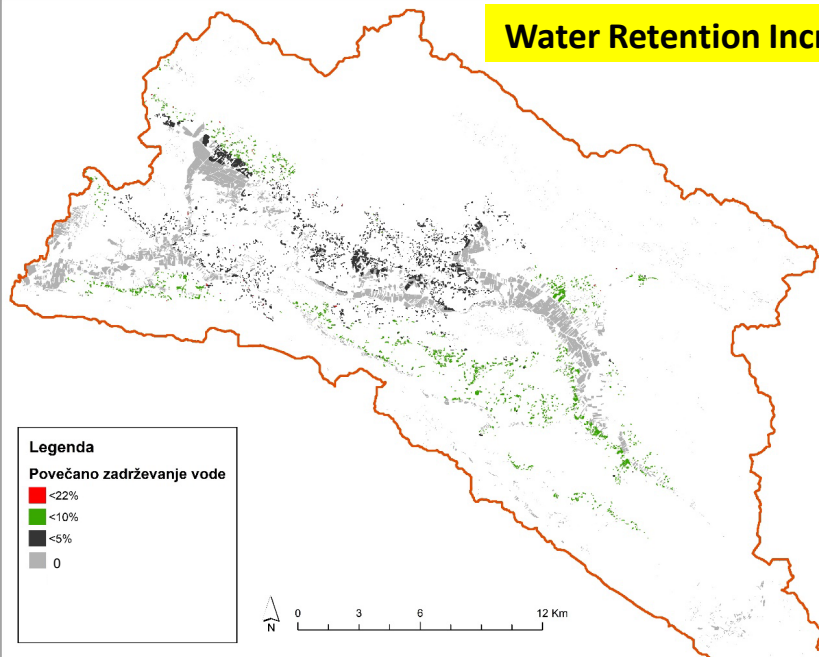
# Modelling economic efficiency of measures

Percentage change in gross margin between baseline and alternative agricultural production scenarios

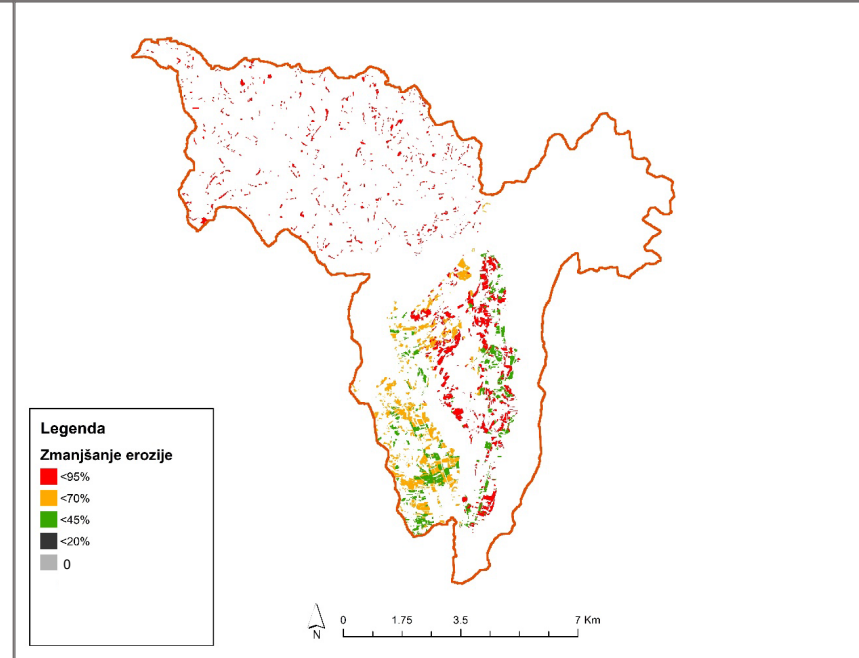
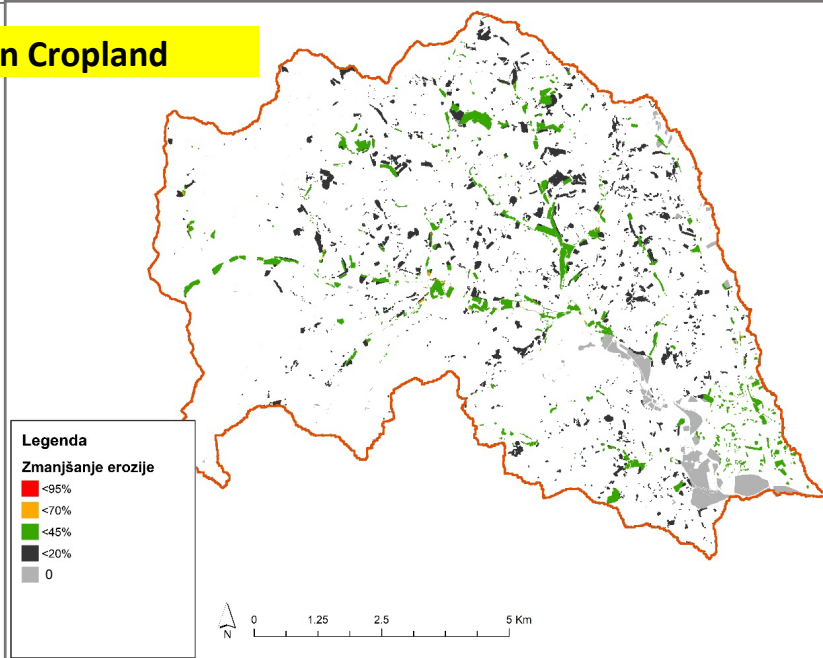
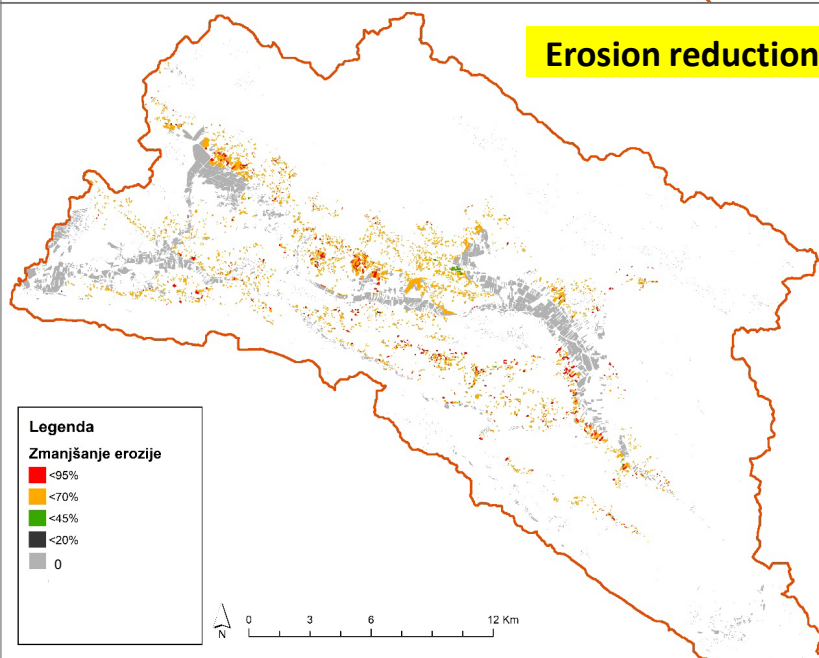
Scenario	Change in average gross margin for scenarios (economic efficiency)					
	Base	Winter cover crops	Buffer strips	Conservational (Min) tillage	Contour tillage	Convert arable land to permanent grassland
Cattle	0%	34%	-16%	-7%	10%	-140%
Pig	0%	-56%	-6%	17%	10%	6%
Crop (Vipava)	0%	1%	-5%	35%	10%	31%
Pig (Pesnica in Ledava)	0%	2%	-7%	48%	10%	-8%

# 8 Modelling environmental efficiency

## Water Retention Increase on Cropland



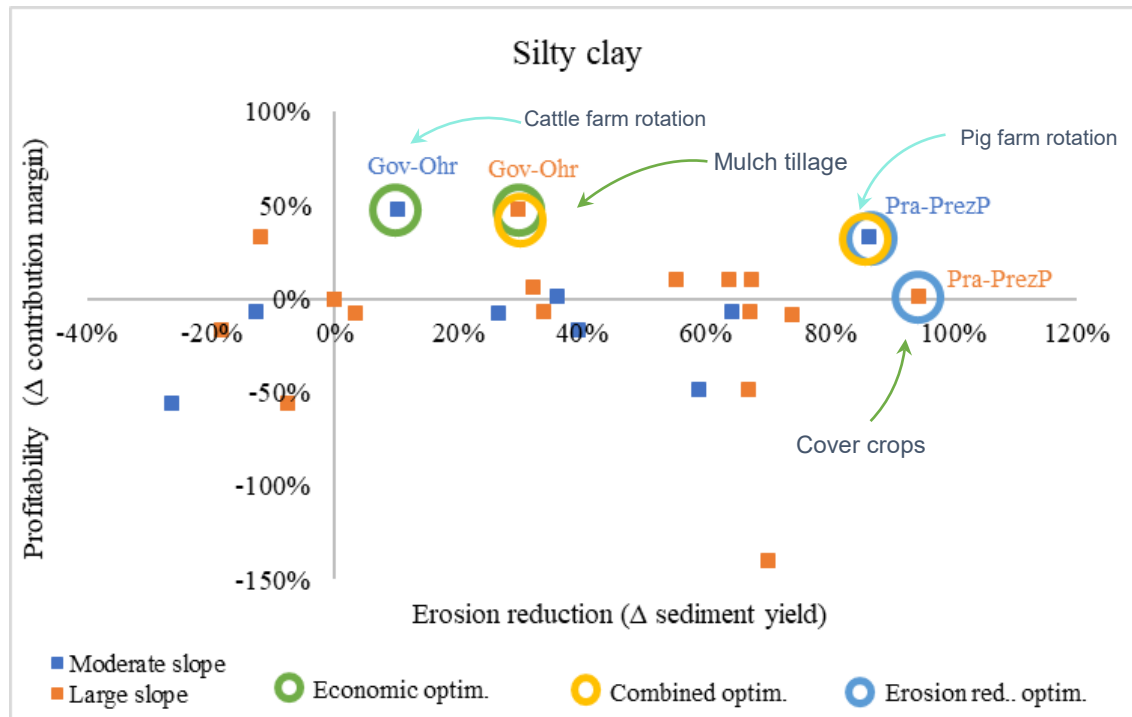
## Erosion reduction on Cropland



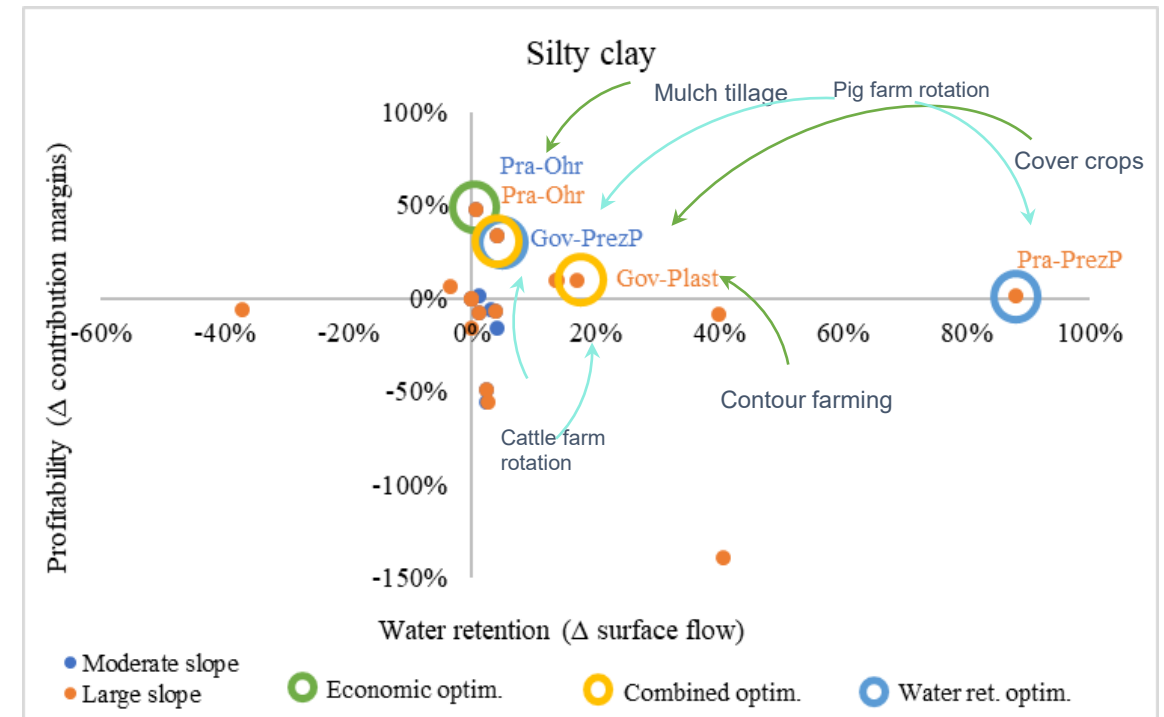
# 9 Optimize environmental and economic efficiency of measures

- **OPTIMISATION**- to find the best scenario

## Erosion prevention



## Water retention





## 10

*Identifying socio-economic potentials and constraints of measures implementation*



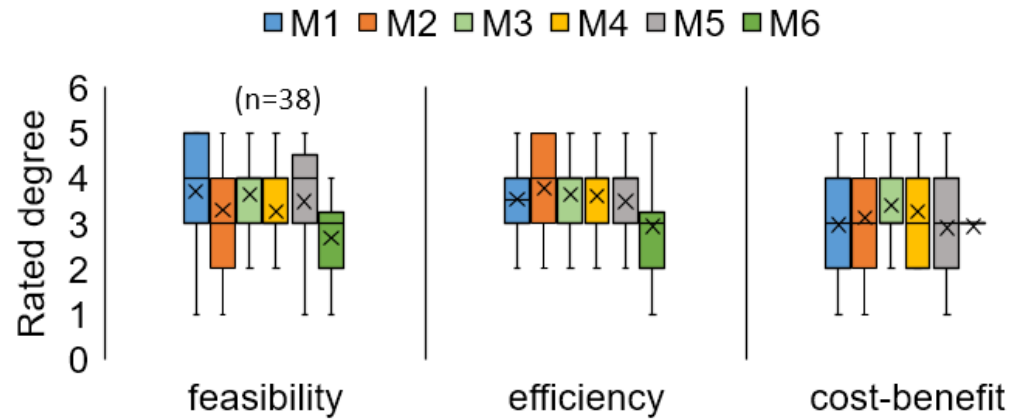
## 10

# Identifying socio-economic potentials and constraints of measures implementation

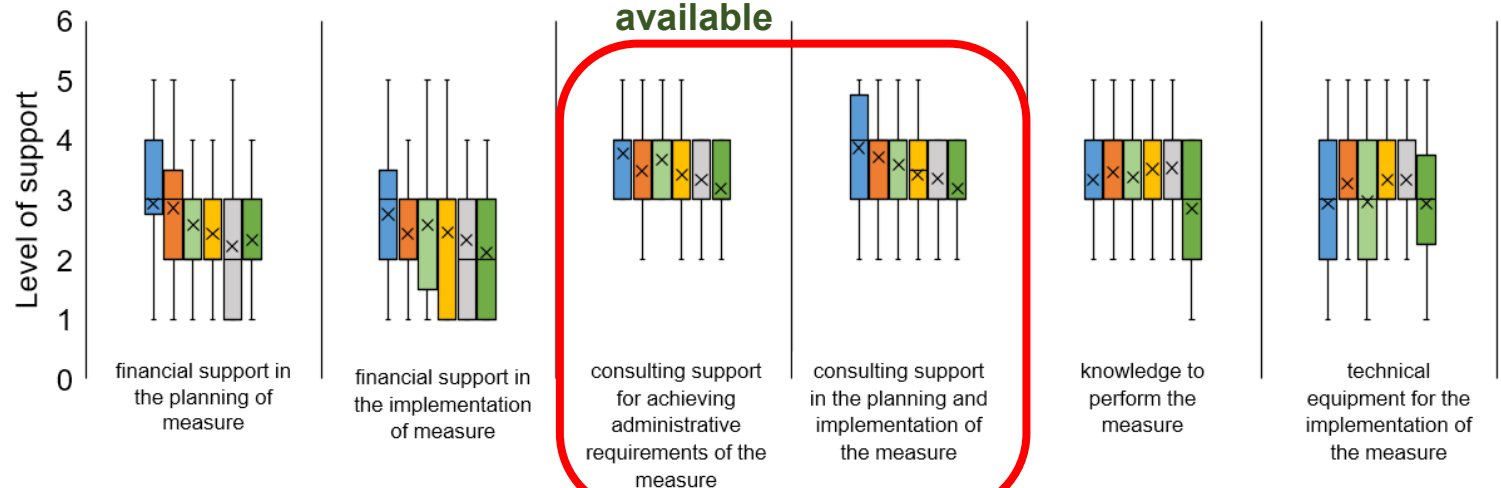
**M1 - Winter cover crops,**  
**M2 - Arable fields at steeper slopes converted to grassland,**  
**M3 - Mulch till,**  
**M4 - Contour tillage,**  
**M5 - Grassed buffer strips,**  
**M6 - Retention ponds**

## Degree of feasibility, efficiency and cost-benefit

(n=38)



## Level of financial support, administrative support, knowledge needed and technical equipment available



## 11

## Systemic approach for the development

- By **hesitating** to introduce sustainable farming practices, we are causing **economic, environmental and farm developmental damage**.
- Neither the farmers nor the local communities know much about the extent of the **damage caused by economically and environmentally outdated/inefficient farming practices**.
- There are **no real environmental and economic assessments** of the presented processes as part of an integrated management system for Slovenia.

# Thank you for attention?

## Acknowledgement:

This research was carried out within the framework of the CRP L4-2625 CeVoTaK project ([web page](#)), funded by the Slovenian Research And Innovation Agency and the Ministry of Agriculture, Forestry and Food, the OPTAIN project funded from the European Union's Horizon 2020 research and innovation program under grant agreement No. 862756 (<https://www.optain.eu/>).

## 2 Inter-sectoral cooperation

- Form inter-ministry and inter-sectoral groups to strategically integrate agro-environmental objectives.
- Increase collaboration among municipalities on sub-basin district for integrated strategies, mutual learning and capacity building.
- Appoint responsible secretary for effective multi-level governance processes on sub-basin levels.

## 1 Harmonized agro-environmental policy

- More frequently applied cross-referencing between directives.
- Stronger consideration of projected climate change impacts.

## 3 Financial and technical support schemes

- Design attractive multipurpose financial schemes that closely align with landscape vulnerability conditions.
- Improve technical support to end-users in acquiring permits and placing NSWRM measures.
- Improve landownership structure locally at critical parts of catchments. It will help overcome some of the obstacles to NSWRM implementation related to management responsibility.

## 4 Competent administration and accessible data

- Run certified training programmes for NSWRM implementation.
- Simplify NSWRM implementation procedures and improve process support to end-users.
- Improve monitoring programmes and enable up-to-date user-friendly data services.

## 5 Education, awareness raising and communication

- Public financing of professional facilitators for accelerating implementation of measures.
- Engage stakeholders in decision-making and planning processes.
- Strongly engage stakeholders in demonstrations, field visits and pilot studies.
- Target and tailor communication, diversify communication channels.
- Invest in awareness raising to improve understanding of the challenges ahead.