Modelling the effectiveness of Natural/Small Water Retention Measures (NSWRM) in Hungary and Lithuania: Similarities and differences

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OPTAIN

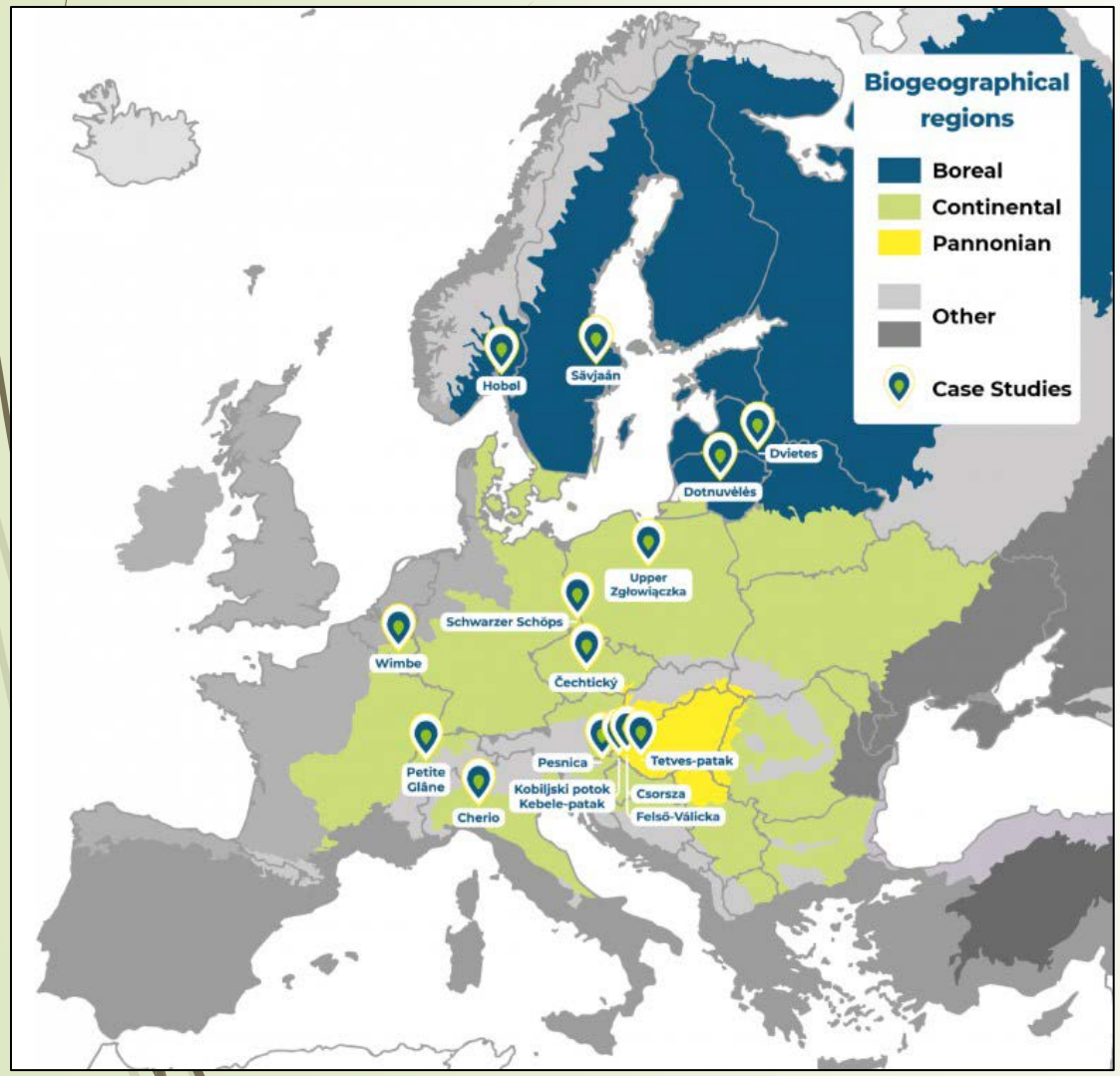
HUN REN

ATK AGRÁRTUDOMÁNYI KUTATÓKÖZPONT

What are the challenges?

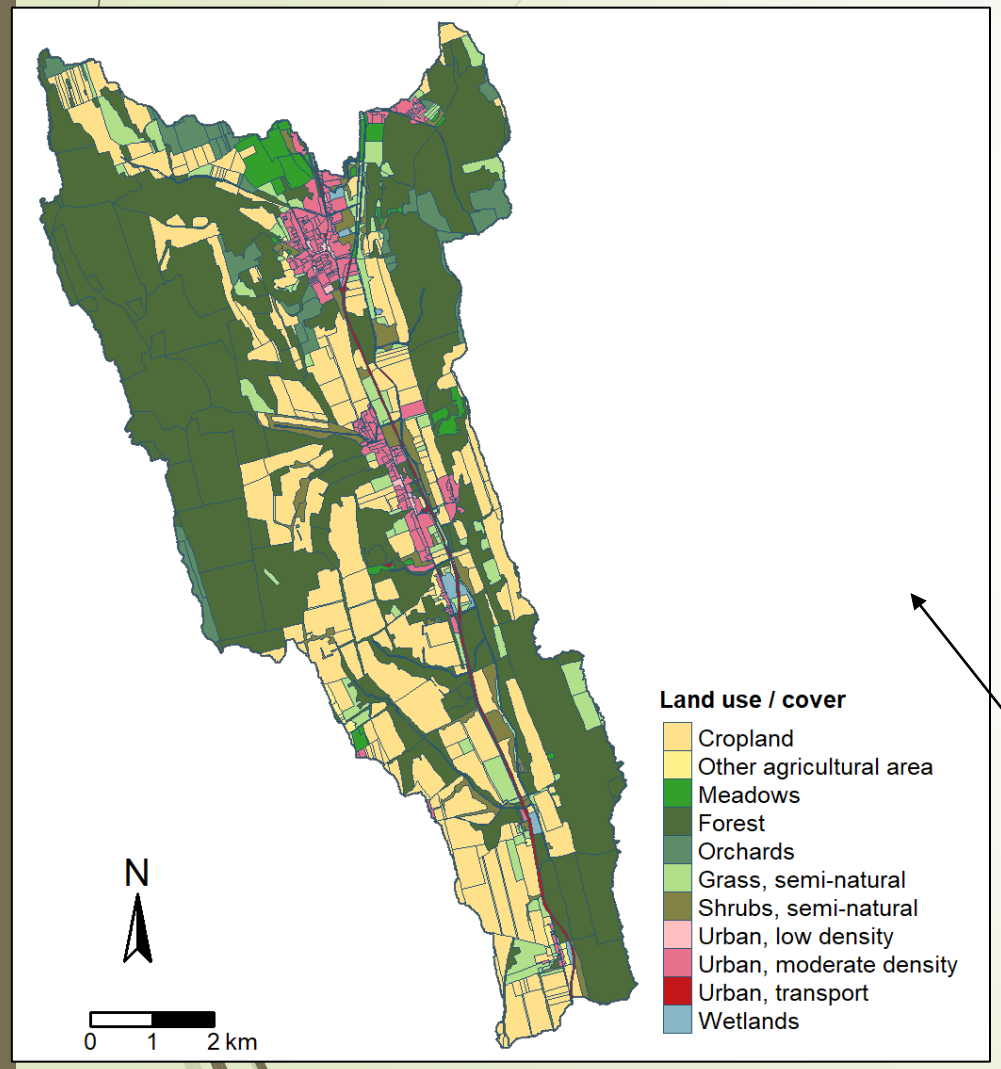
- Frequent extreme weather events.
- Competition for water resources.
- Agricultural and domestic use of water, also environmental demands.
- Sediments and nutrients, along with pesticides are transported to the rivers and eventually to the sea.
- Necessity of more efficient techniques for water and nutrient retention.

The OPTAIN Project

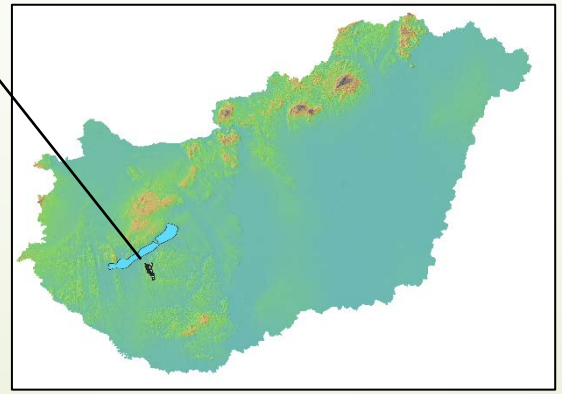


- OPtimal strategies to retAIN and re-use water and nutrients in small agricultural catchments.
- It aims to increase acceptance and better implementation of natural, small, and underutilized retention measures.
- NSWRMs can help mitigate the conflicts between agricultural water uses and other demands.
- Use SWAT+ modelling tool for the simulations.

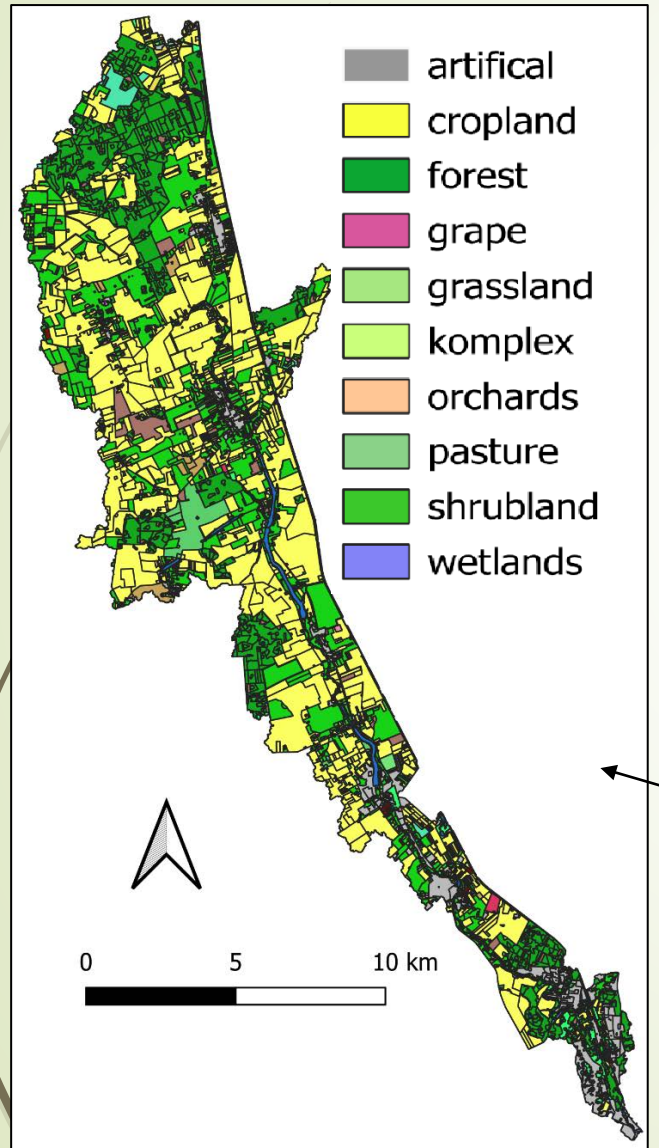
Tetves – General Information



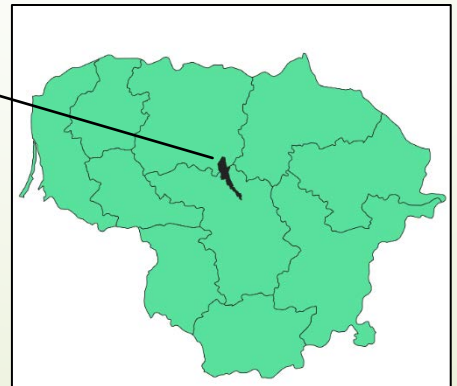
- Pannonian biogeographical region
- Catchment area: 72,36 km^2
- Elevation range: 124-300 m
- Precipitation: 689 mm/year
- Annual mean air temperature: 11.2℃
- Land use: 52 % forest, 31% arable land, 3 % orchards, 5 % grassland and 4 % urban.



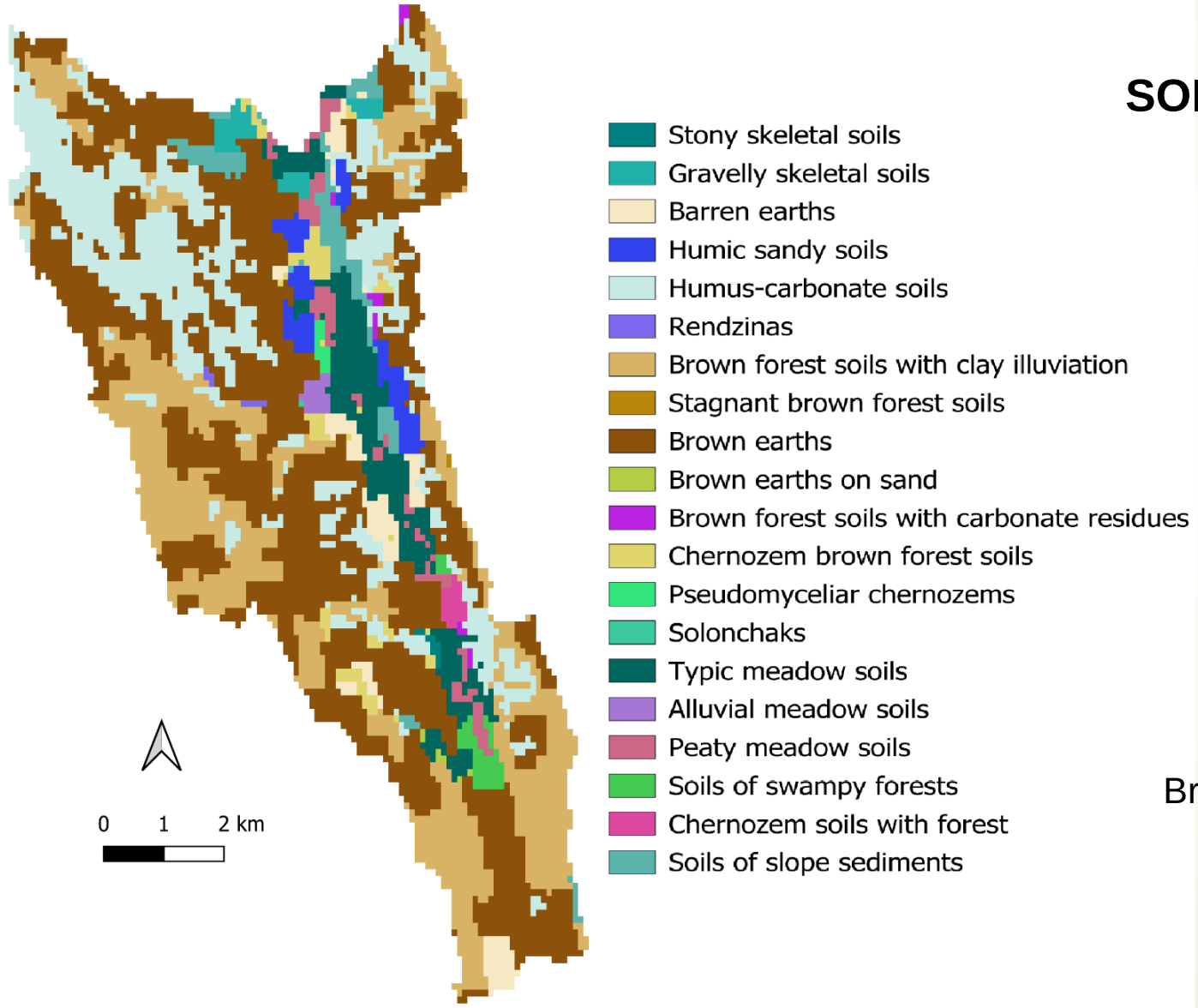
Dotnuvėlė – General Information

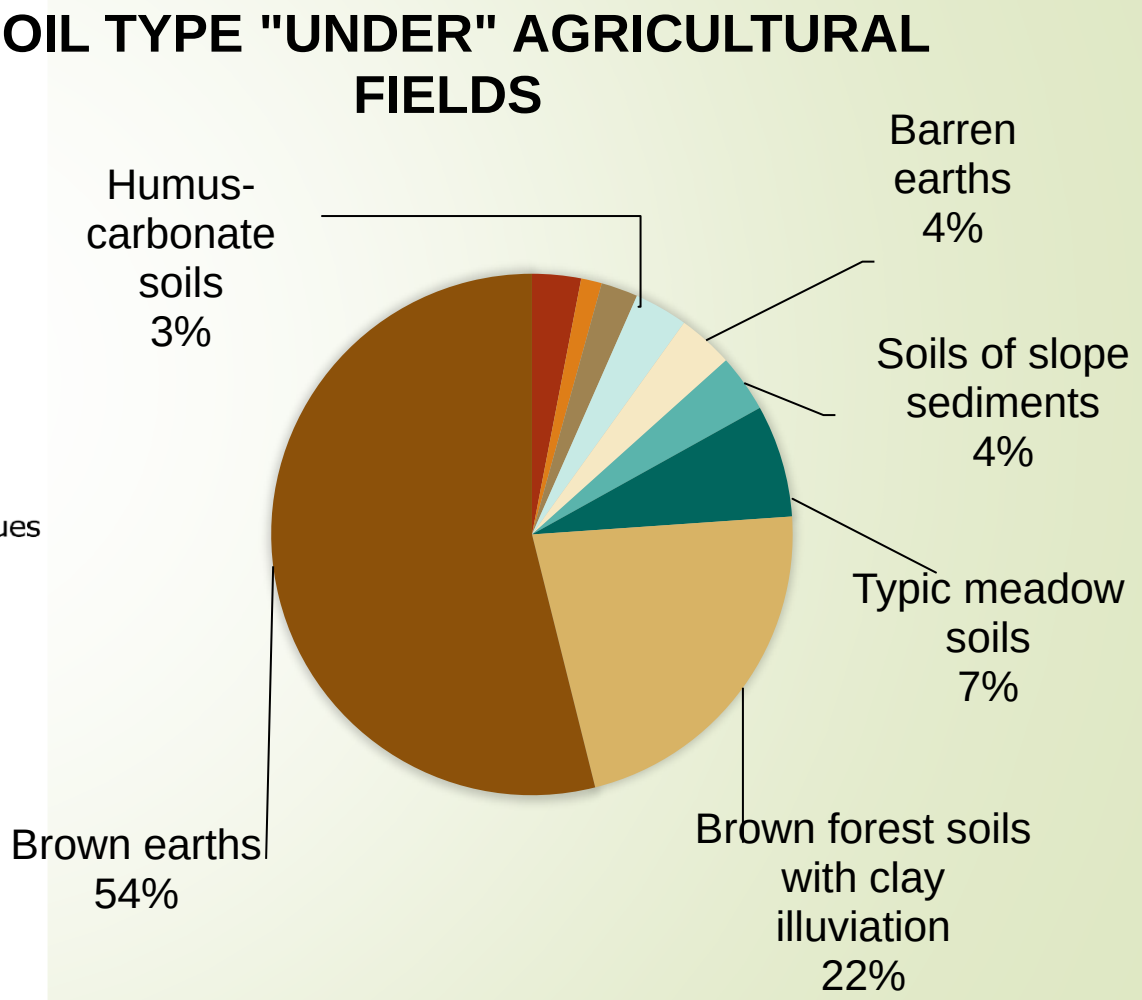


- Boreal biogeographical region
- Catchment area: 176.42 km^2
- Elevation range: 26 – 124 m
- Precipitation: 615 mm/year
- Annual mean air temperature: 7.45°C
- Land use: Dominantly arable land (winter wheat and winter pasture)

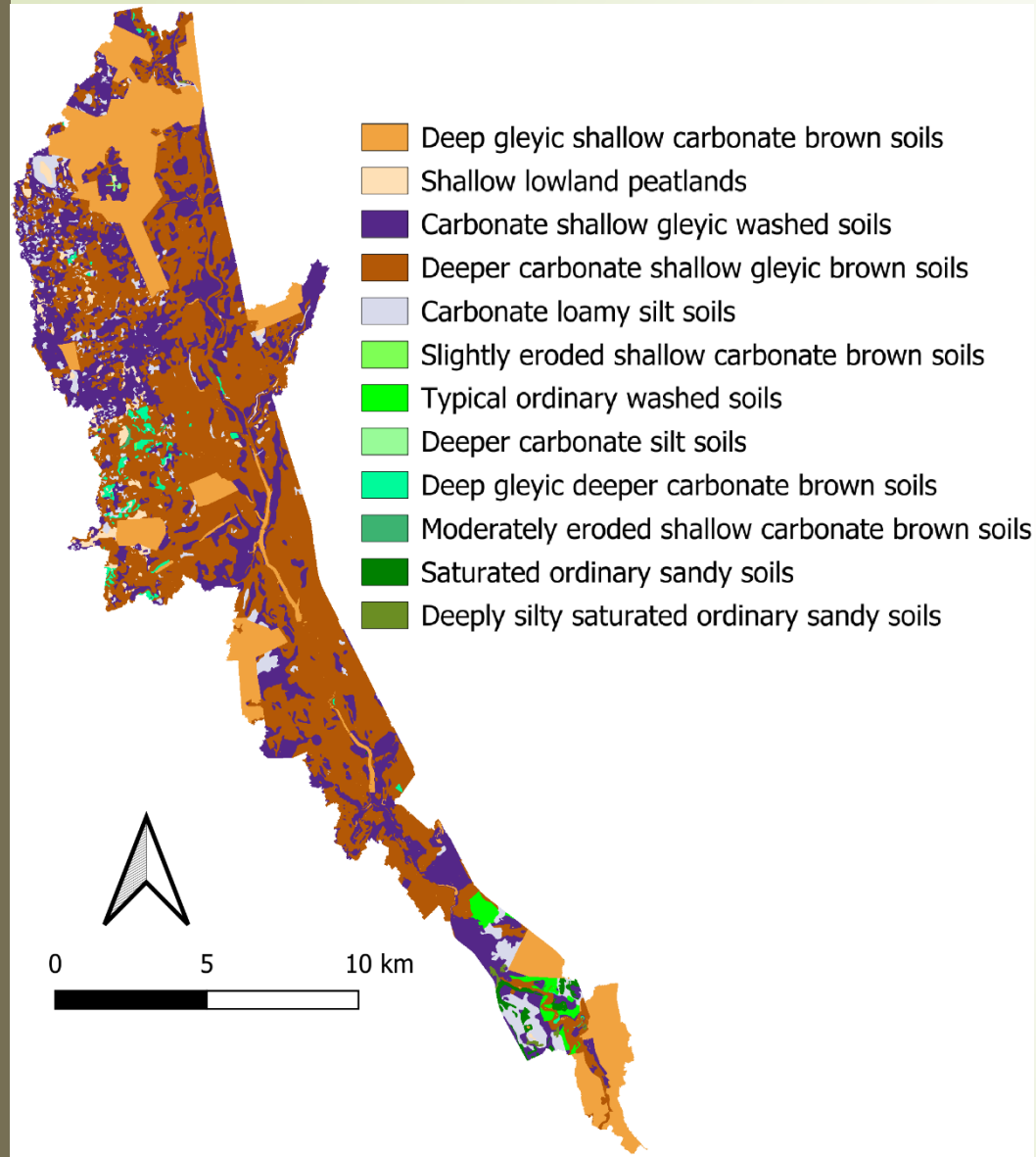


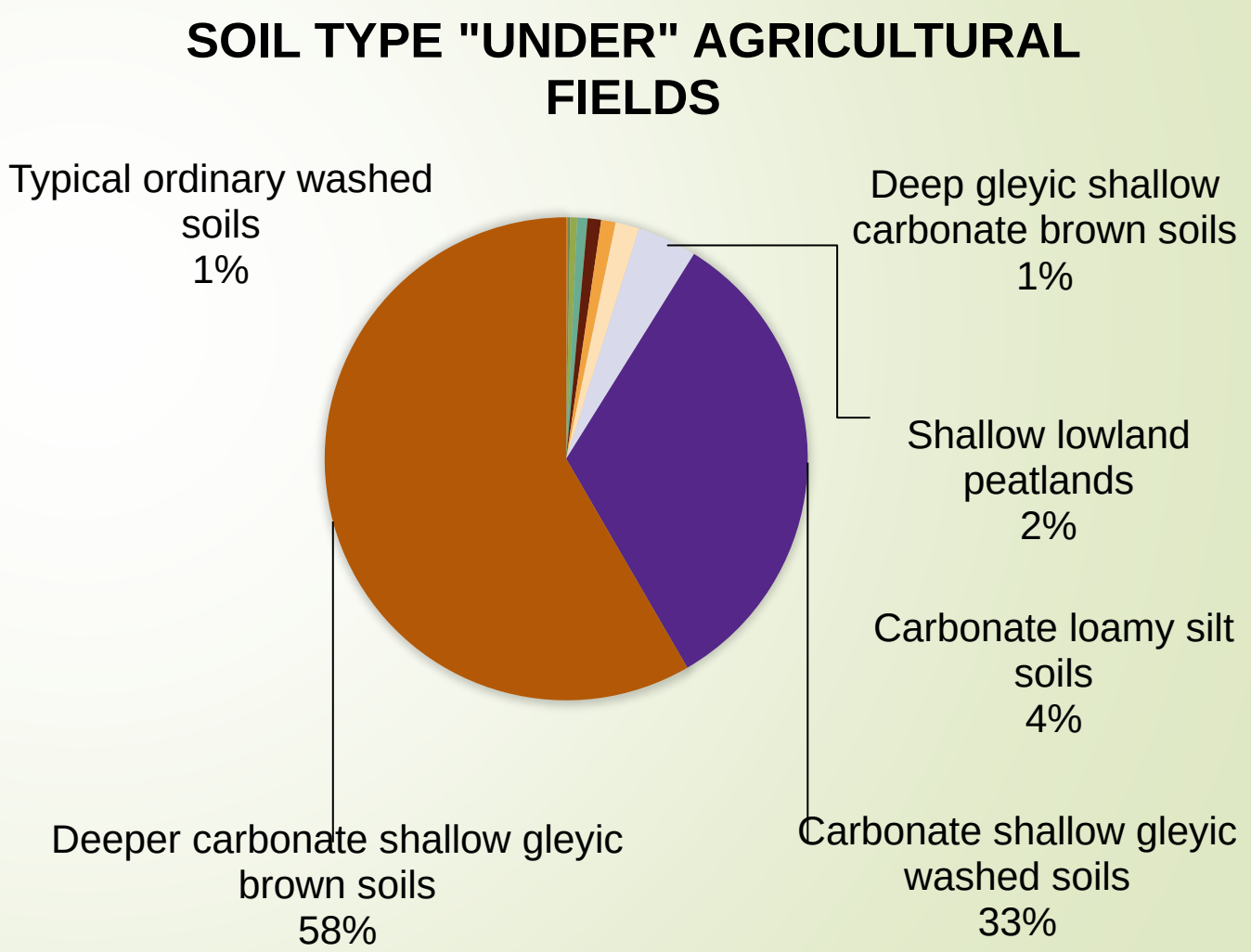
Tetves – Soil Information



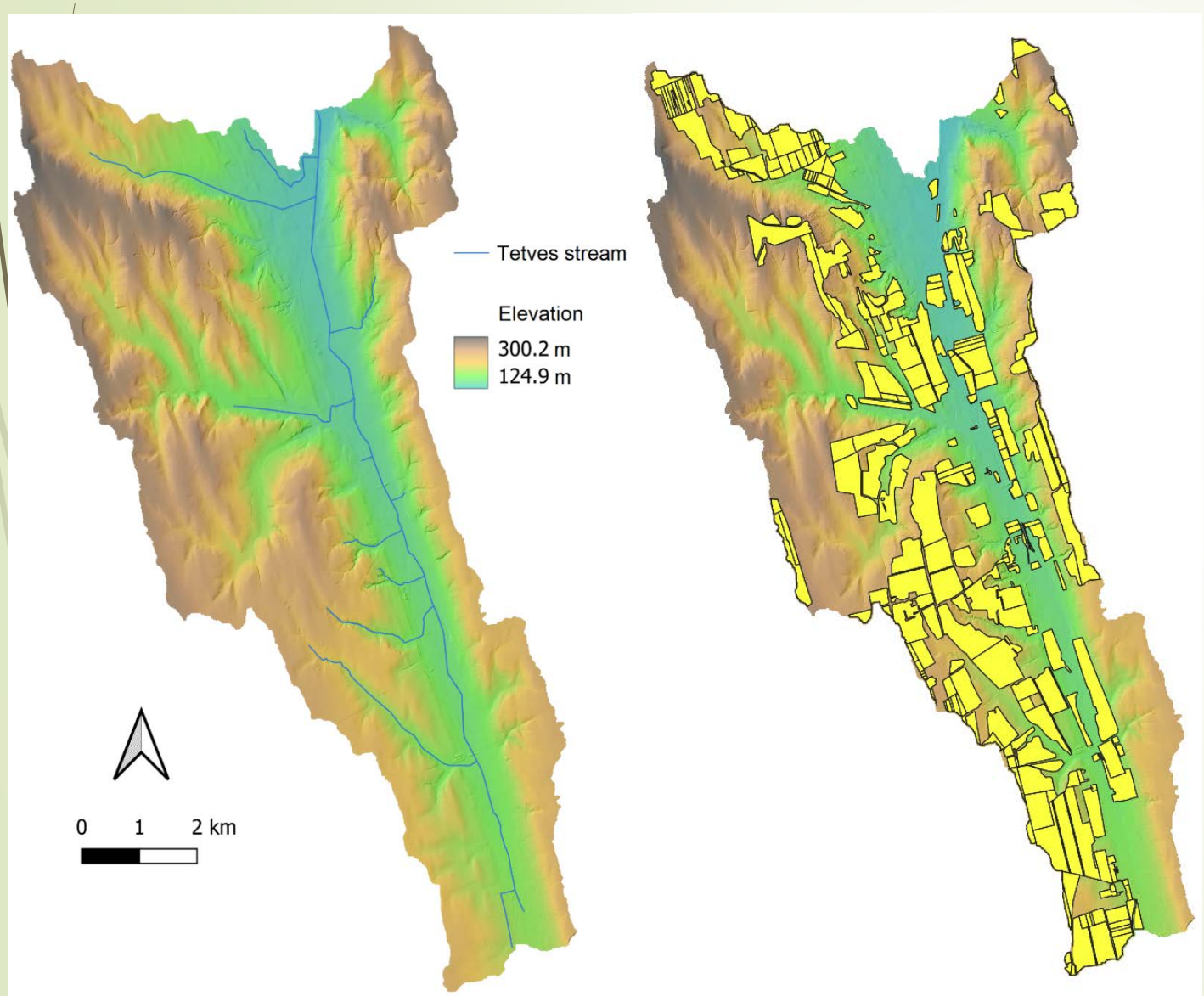


Dotnuvėlė – Soil Information





Tetves – Geographic information



- Hilly landscape
  → **124 m** to **300 m**.

- **high erosion** rates
  → leading to **declining soil quality** and a deteriorating **ecological condition** in the stream.

- Annual average soil loss: **4.037** t/ha
- Total Nitrogen loss: **0.768** kg/ha
- Total Phosphorus loss: **0.203** kg/ha

The simulated data is aligned with the measurements.
Territory marked with yellow is under agricultural management.

Tetves – Applied new measures (NSWRM)

Field dividing buffer strips
0.27% of area

Riparian forest buffer
0.54 % of area

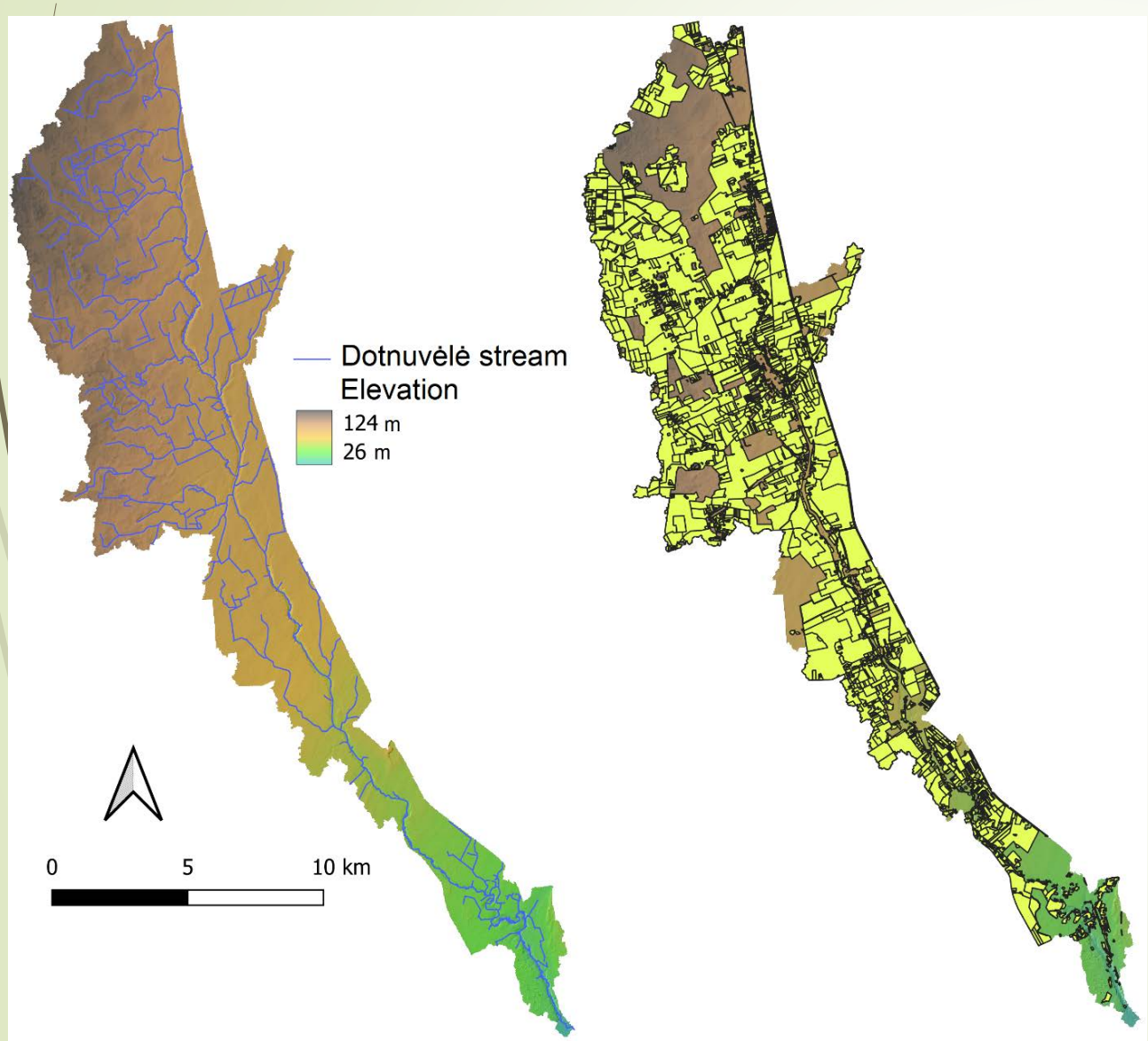
No-till with cover crops
28.52 % of area

Conversion to grassland
12.17% of area

Selection of potential NSWRMs

- Based on suggestions of the Multi-Actor Reference Group – major, farm advisor and local farmers.
- In every case study

Dotnuvėlė – Geographic information



- No significant slopes
  → favorable for agriculture management.

Challenges:

- **Nutrient leaching**
- Old Melioration systems

High Nitrogen load to the river leads to poor water quality.

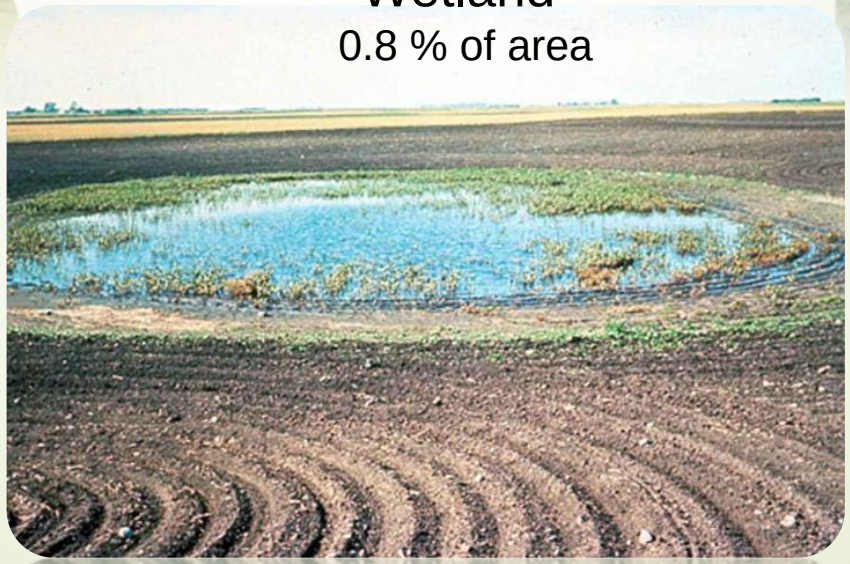
- Annual average soil loss: **0.107** t/ha
- Total Nitrogen loss is **45.719** kg/ha
- Total Phosphorus loss is **0.651** kg/ha

The simulated data is aligned with the official measurements.
Territory marked with yellow is under agricultural management.

Dotnuvėlė - Applied new measures (NSWRM)

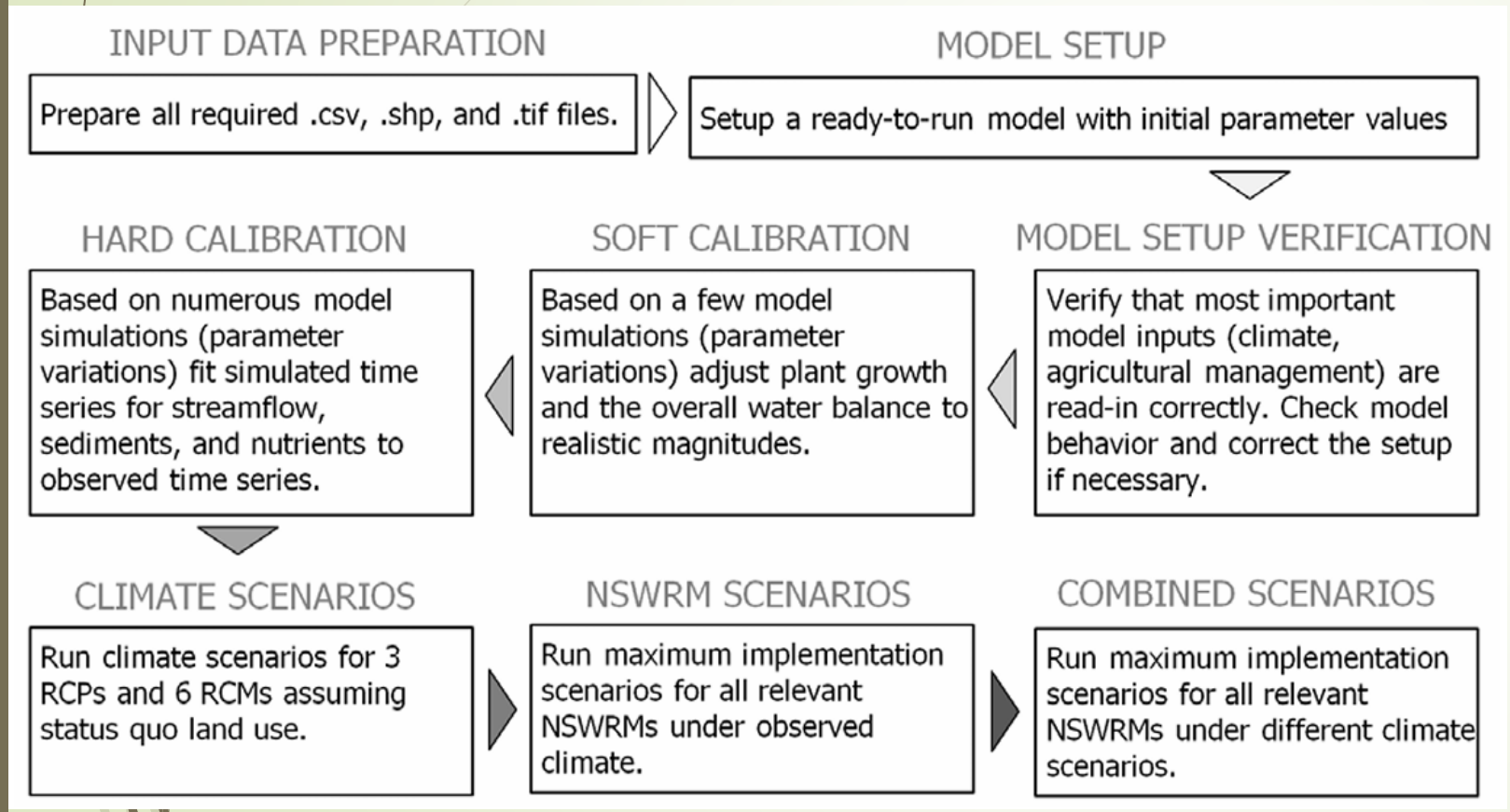
Field dividing buffer strips
0.21 % of area

Wetland
0.8 % of area



Lowtill with cover crops
9.98 % of area

Optain workflow diagram



Green: favourable effect.
Red: unfavourable effect.

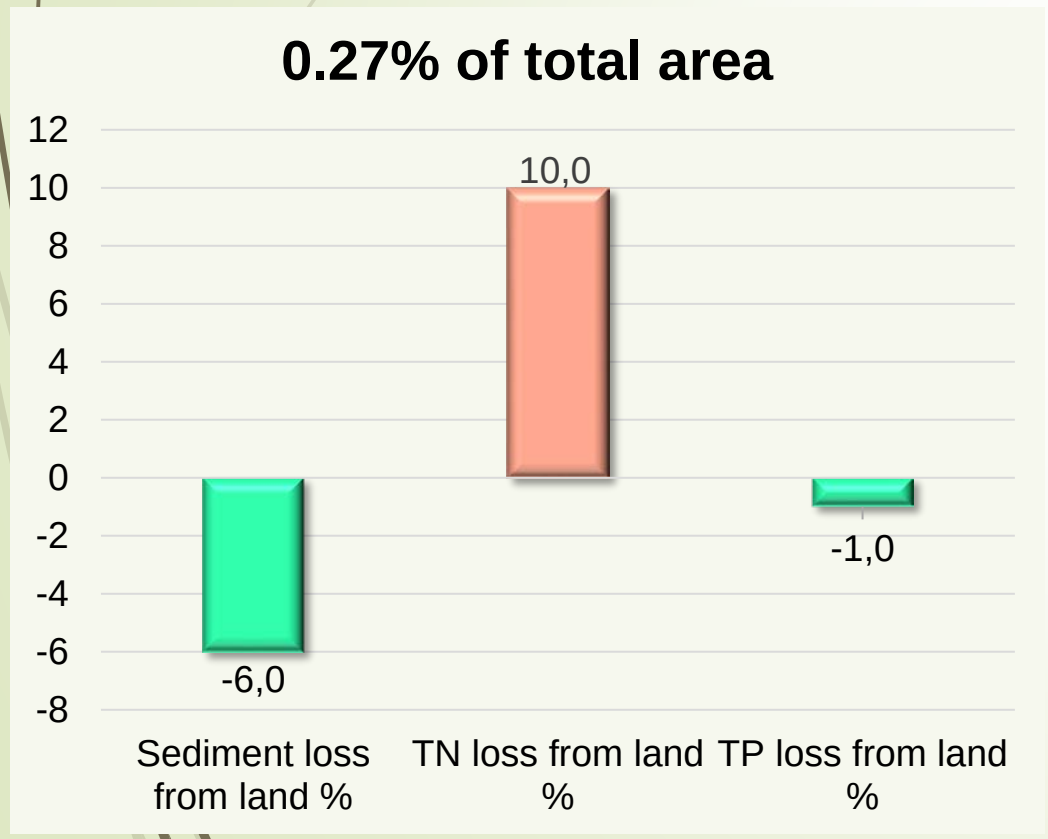
Finally comparing the results for different indicators in the case studies.

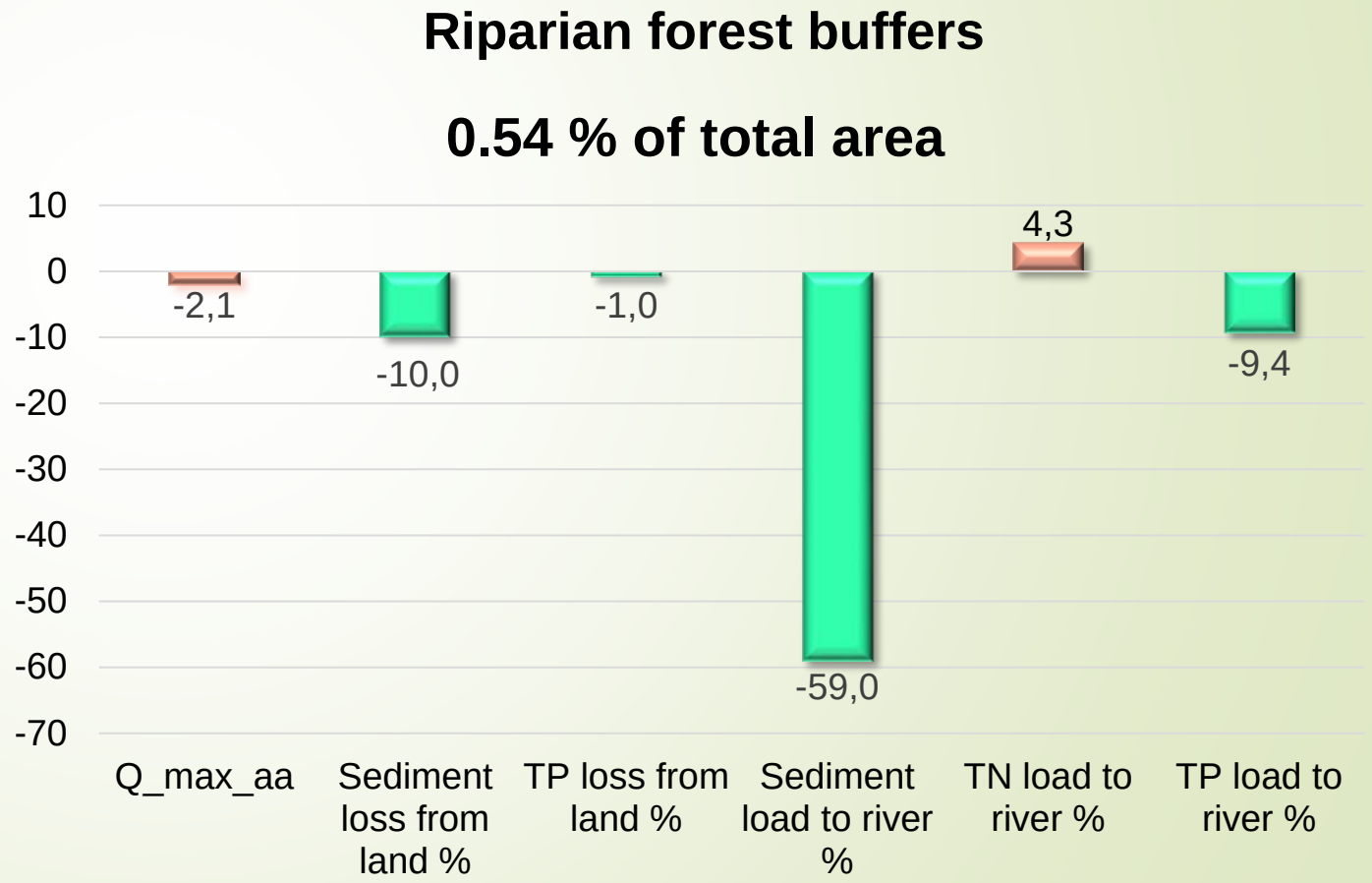
Catchment hydrology
- Average Minimum flow
- Average Maximum flow
- Soil water content

Sediment and nutrient loss from field
- Sediment
- Total Nitrogen
- Total Phosphorus

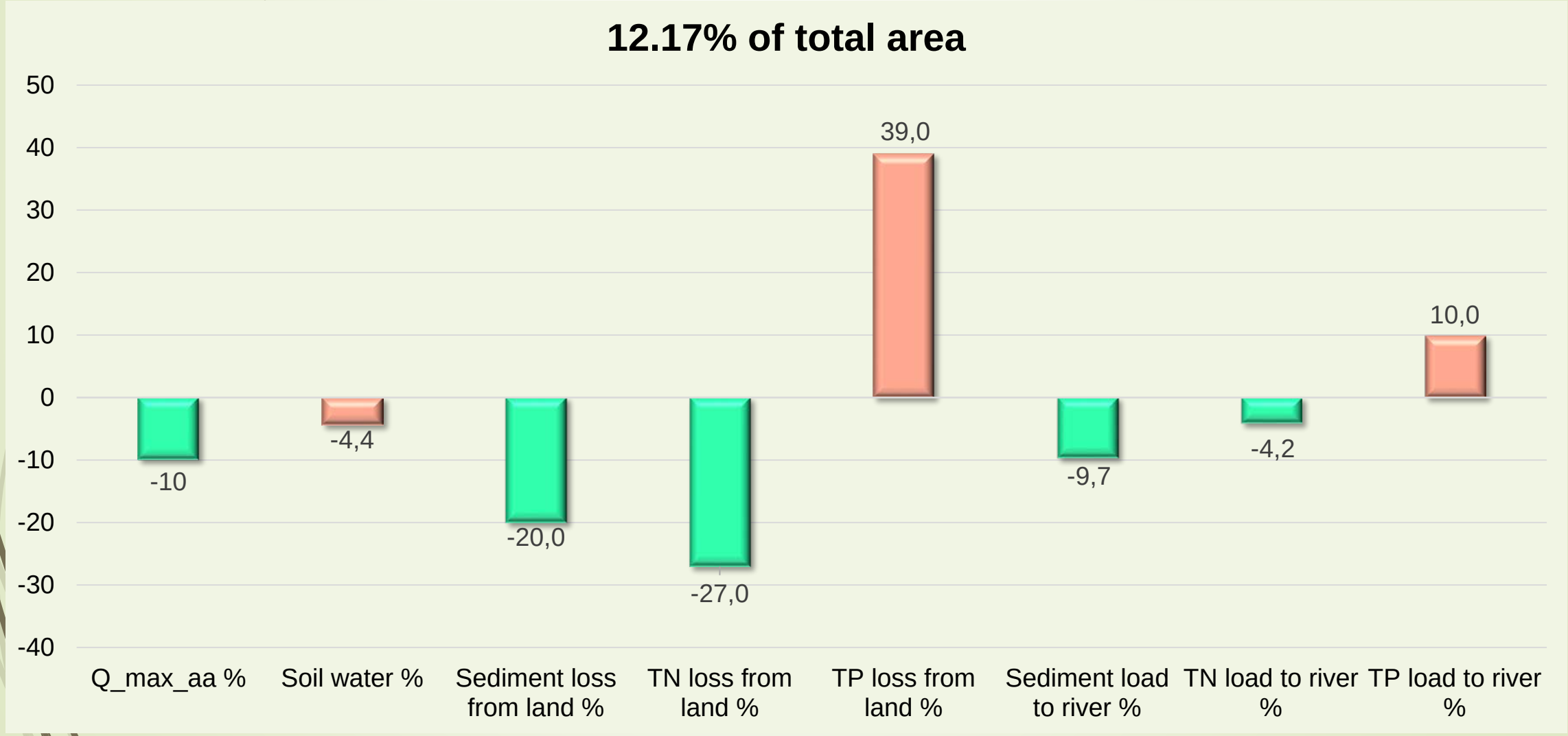
Sediment and nutrient load to river
- Sediment
- Total Nitrogen
- Total Phosphorus

Tetves: Buffer measure effectiveness

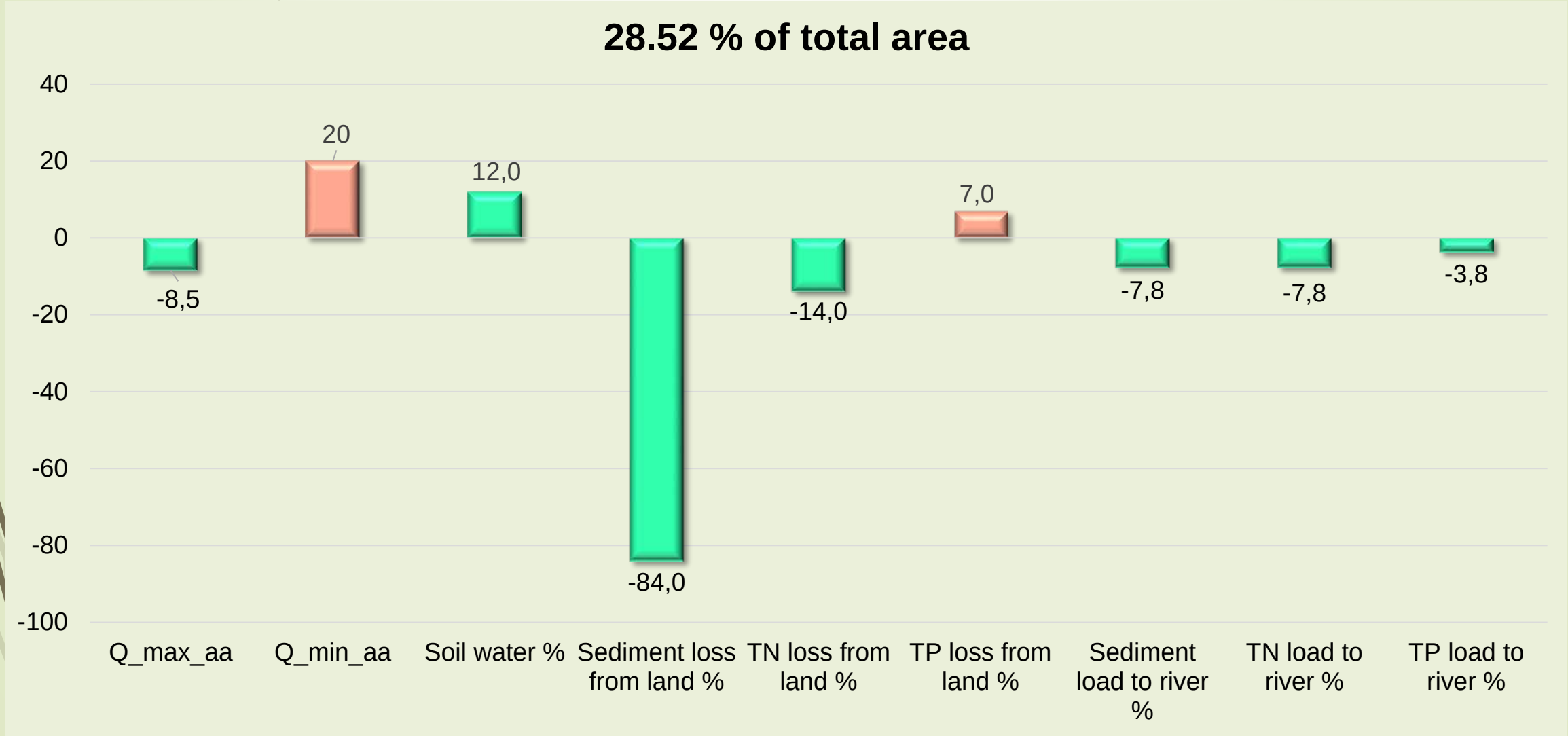




Tetves – Conversion to grassland



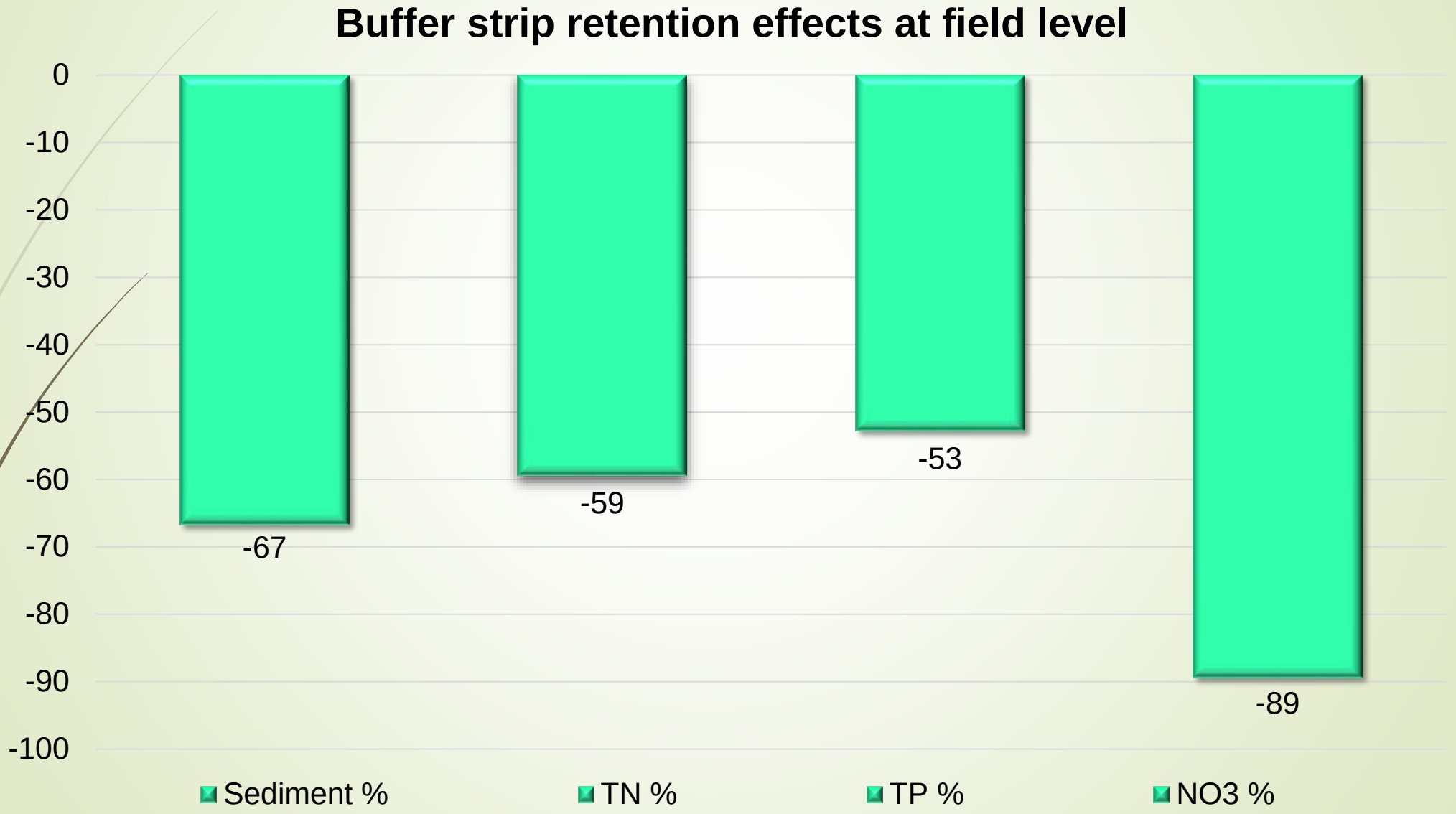
Tetves – No-till with cover crops



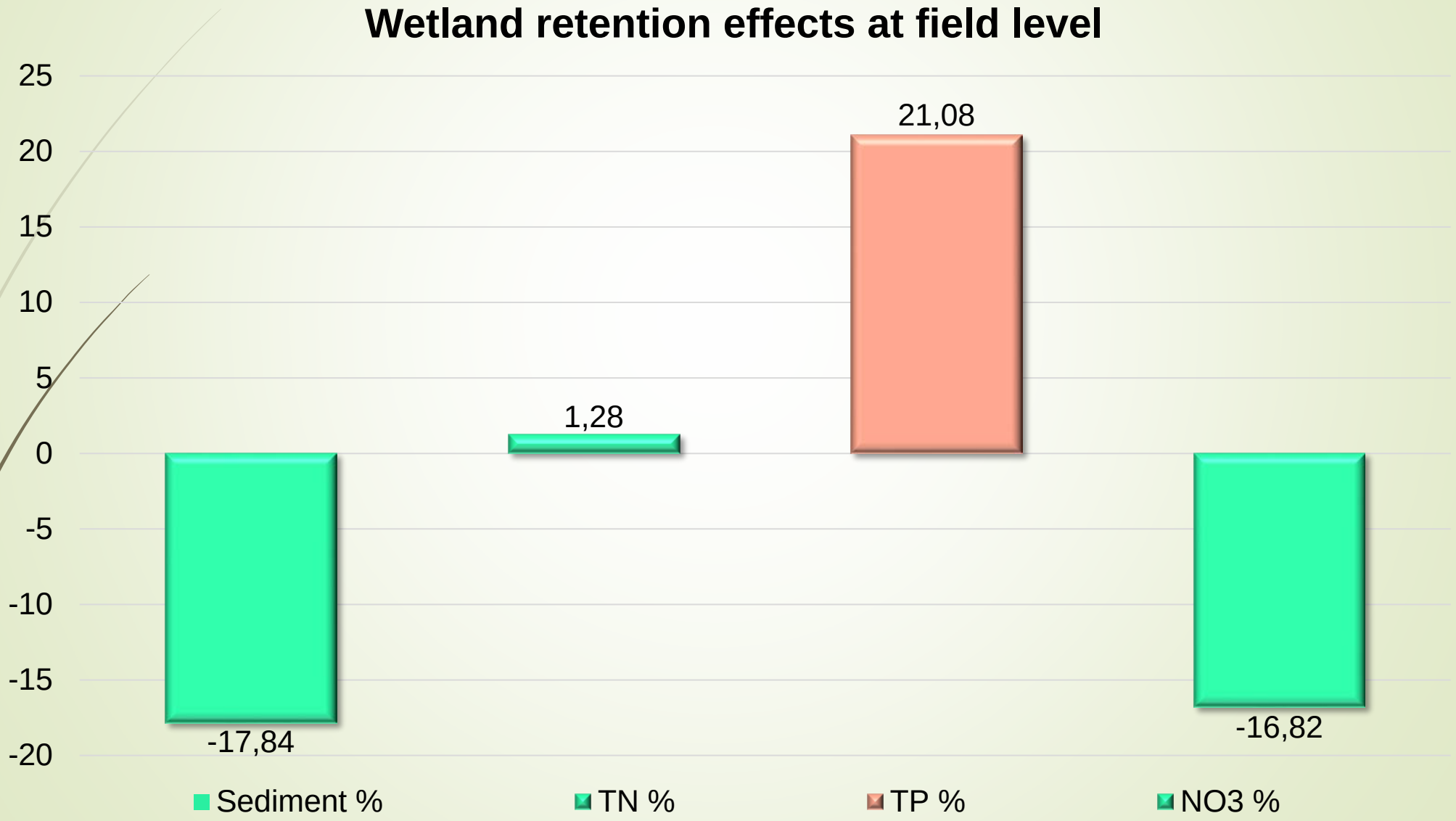
Dotnuvėlė – effect at watershed level

Catchment hydrology	Buffer strip	Wetland	Low till with cover crops
Maximum flow %	0.0	-1.1	0.4
Soil water %	0.0	0.0	0.1
Sediment and nutrient loss from field	**Buffer strip**	**Wetland**	**Low till with cover crops**
Sediment loss from field %	0.0	0.0	-19.0
Nitrogen loss from field %	-0.2	-0.2	-1.3
Phosphorus loss from field %	-0.4	-0.4	1.7
Sediment and nutrient load to river	**Buffer strip**	**Wetland**	**Low till with cover crops**
Sediment load to river %	0.0	-0.6	-3.3
Nitrogen load to river %	0.0	-0.7	0.3
Phosphorus load to river %	-0.1	-0.7	0.5
% of total area	**0.21**	**0.8**	**9.98**

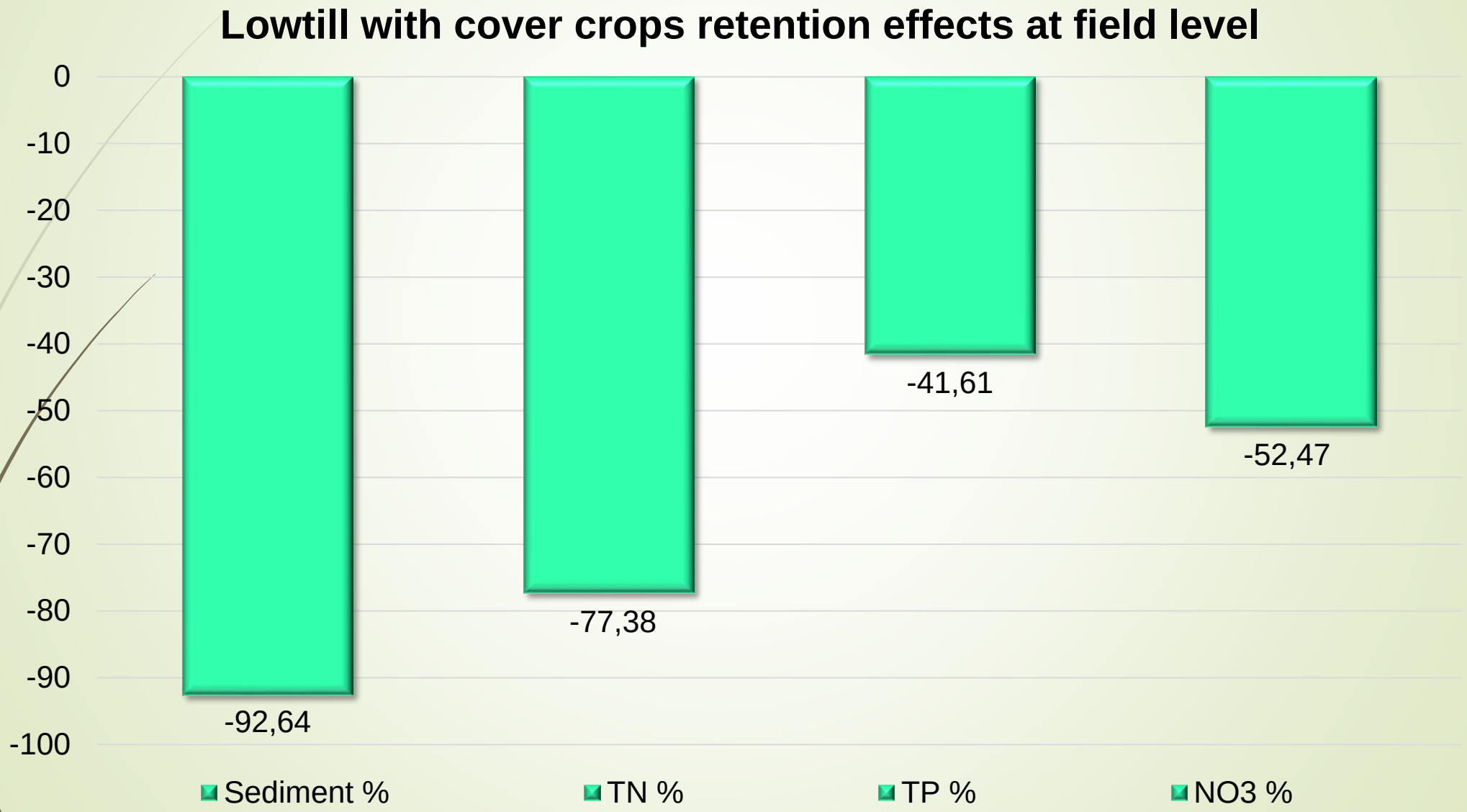
Dotnuvėlė - Loss from fields I.



Dotnuvėlė - Loss from fields II.



Dotnuvėlė - Loss from fields III.



Dotnuvėlė - Tetves

- **Buffer strips:** has a high projected favourable impact on all analysed indicators. Especially in reducing nitrate loss at field level.
- **Wetlands:** Reduces the sediment and nitrate loss, but increase the total Nitrogen and Total Phosphorus load.
- **Low-till with cover crops:** has a high projected favourable impact on all analysed indicators. Especially in reducing sediment loss.

- **Field-dividing forest buffers**: effective in reducing P loss connected to sediments and sediment loss.
- **Riparian forest buffers**: has high efficiency in reducing P load, effective to decrease sediment loss and has low implementation area need.
- **No-till with cover crops**: has a high projected favourable impact on all analysed indicators.
- **Cropland to grassland:** effectively decreases sediment load and sediment loss, but area of arable land significantly decreases.

- Thank you for your attention!
  - Acknowledgement

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