Model-based evaluation of Natural/Small Water Retention Measures: Insights from the Felső-Válicka case study in Hungary

Piroska Kassai (Hungary)

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HUN REN ATK INSTITUTE FOR SOIL SCIENCES

OPTAIN

SWAT Soil & Water Assessment Tool

NATIONAL LABORATORY FOR WATER SCIENCE AND WATER SECURITY

OPTAIN project

Horizon 2020
OPTAIN (OPtimal strategies to retAIN and re-use water and nutrients in small agricultural catchments across different soil-climatic regions in Europe

Warsaw University of Life Scien (WUL, Poland)

University of Bern, Centre for Development and Environment (UBERN, Switzerland)

Klaipeda University (KU, Lithuania)

Norwegian Institute for Water Research (NIVA, Norway)

University of Ljubljana (UL, Slovenia)

Ghent University, (UGent Belgium)

Research Institute for Soil and Water Conservation (VUMOP, Czech Republic)

Swedish University of Agricultural Sciences (SLU, Sweden)

Norwegian Institute of Bioeconomy Research (NIBIO, Norway)

University of Milan, (UMIL, Italy)

Instytut Technologiczno-Przyrodniczy (ITP, Poland)

General Directorate of Water Management (OVF, Hungary)

Daugavpils University (DU, Latvia)

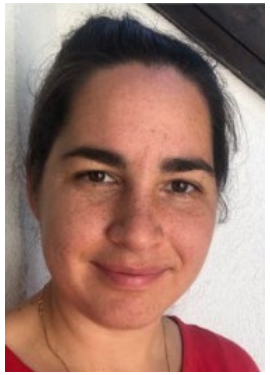
WBF Agroscope (WBF, Switzerland)

Global Water Partnership Central and Eastern Europe (GWP CEE, Slovakia)

Brigitta Szabó - coordinator

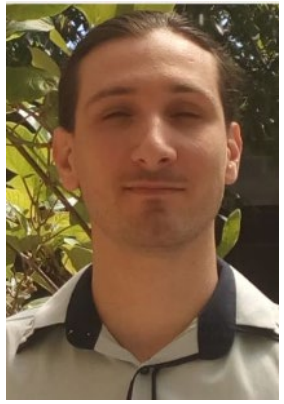
The Hungarian OPTAIN team

János Mészáros



Kinga Farkas-Iványi

Ágota Horel



Péter Braun

Piroska Kassai

Input data: modelling and mapping crop rotation

Policy

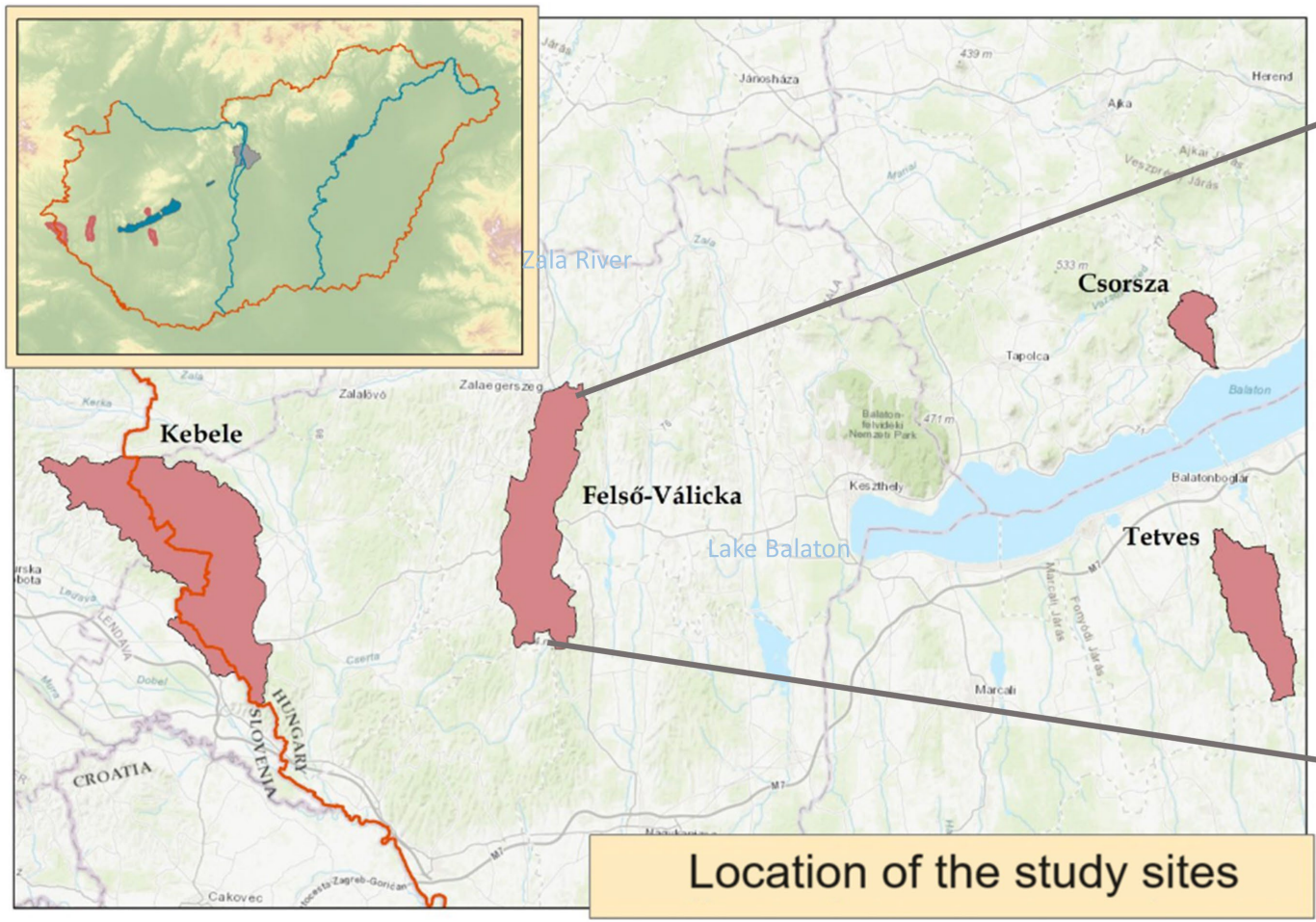
SWAP modeling

SWAT BuildR, SWAT Editor, Calibration

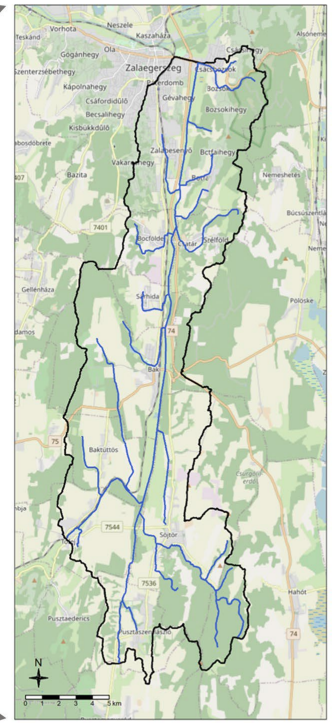
SWATfarmR, Scenarios

Timeline &Tasks

Hungarian case studies



Felső-Válicka



Area: 124 km^2

Felső-Válicka watershed

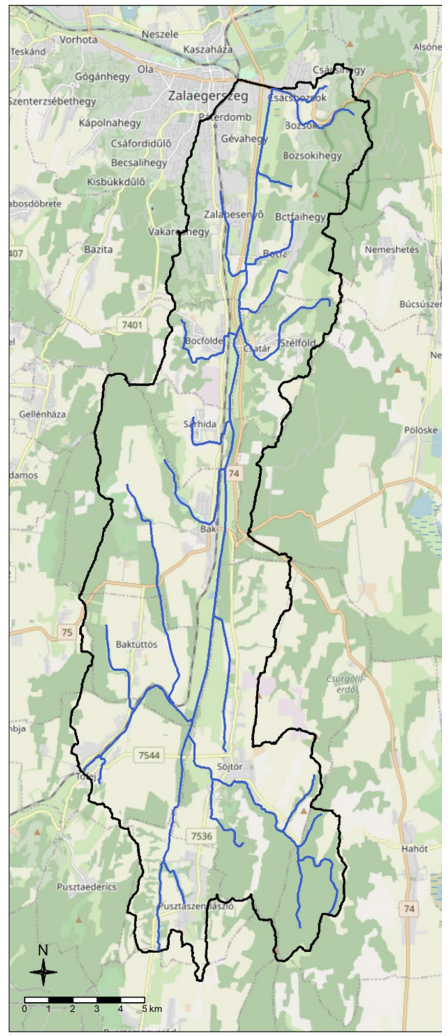
- 27 km long
- 124 km^2 watershed area
- Flows into Zala River (main input of Lake Balaton)

Felső Válicka watershed

Environmental problems:

- soil erosion,
- extreme weather conditions,
- drought with increasing ferquency,
- decrease in soil quality,
- nutrient runoff.

→ decreased crop yield, increased production costs



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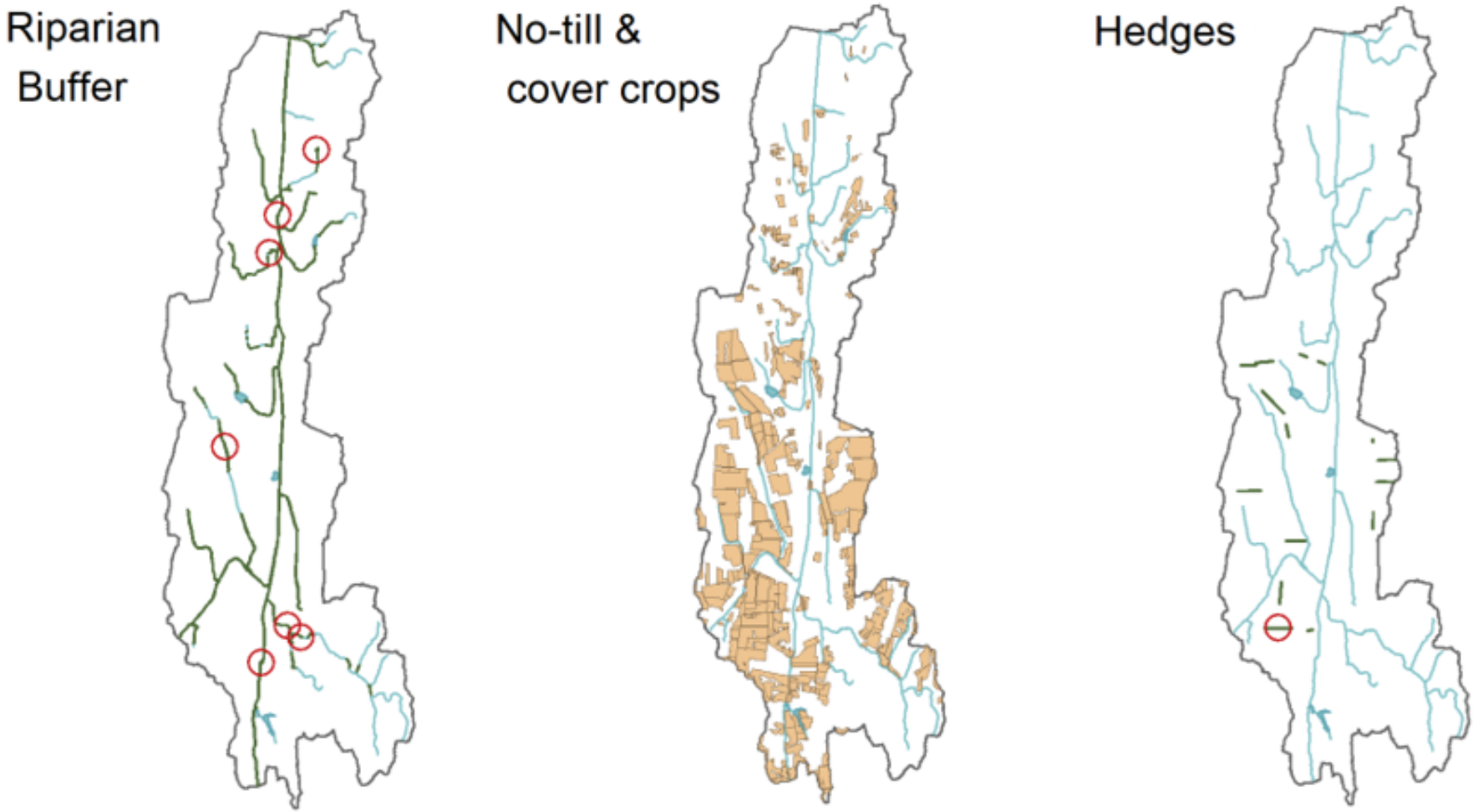
Selected measures

Forested riparian buffers

No-till farming combined with cover crops

Buffer strips or hedges

SWAT+ model setup



Location of measures selected for the NSWRMs scenario analysis.

NSWRM scenarios

Land use change related:

- Buffer strips
- Riparian buffers

Easy to define by replacing the previous land use type with forests

Managemant related:

- No-till farming combined with cover crop

We need to know and define the baseline managment and replace it with no-till management

Definition the baseline management with SWATfarmR

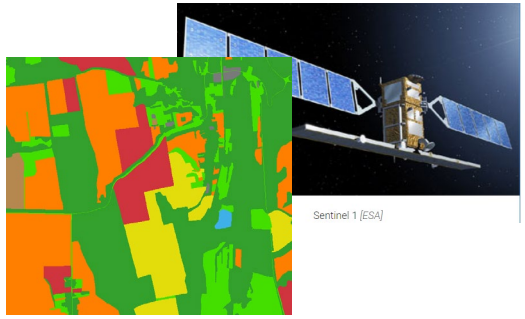
SWATfarmR: **A simple rule-based scheduling of management operations for SWAT**

Enables the implementation of realistic farming practices taking into account the weather conditions in scheduling the management operations.

We can define crop rotation, different tillage practices, fertilizer practices so on.

HRUs are fields/parcels

Input data?

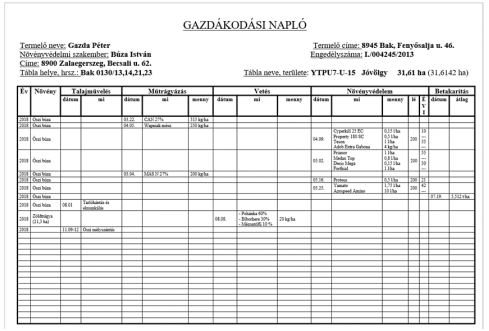


1. Remote-sensing based crop map

	Proportion (%) of harvested area					
	WWHT	CORN	SUNF	WBAR	CANP	ALFA
Statistics for Zala County	28	44	6	6	13	3
Local agricultural company	30	40	5	6	15	4
Derived crop map	42	23	14	0	18	3
Revised crop map	30	38	6	5	18	3

2. Regional statistics

3. Interview with local farmers and farm advisors


GAZDÁKODÁSI NAPLÓ

4. Farm management logbooks

Model setup on the agricultural fields

Baseline

Minimum tillage: on the fields of a large agricultural company (Baki Agrocentrum)

Conventional tillage: on the fields of other small farms

Scenario

No till combined with cover crop: on all agricultural fields

Conventional farming/tillage - baseline

Crop rotation: corn, winter wheat, sunflower, barley, canola (oilseed rape), alfalfa (lucerne)

Cover crop: between a winter crop and a summer crop (e.g. after wheat before corn; in the 50% percent of the potantial cases; farmers kill and turn it into the soil before winter

Tillage: conventional fall ploughing (30 cm deep) after all summer crops (corn, sunflower, canola)

CN2 (runoff curve number)	'rc_strow_g'
cons_prac (USLE P, slope lenghts)	'up_down_slope'
ov_mann (overland Manning's n value)	'convtill_nores'

name	cn_a	cn_b	cn_c	cn_d
rc_strow_g	67.00000	78.00000	85.00000	89.00000

name	usle_p	slp_len_max	description
up_down_slope	1.00000	121.00000	Up_and_down_slope

name	ovn_mean	ovn_min	ovn_max
convtill_nores	0.09000	0.06000	0.12000

Minimum tillage - baseline

Crop rotation: corn, winter wheat, sunflower, barley, canola (oilseed rape), alfalfa (lucerne)

Cover crop: between a winter crop and a summer crop (e.g. after wheat before corn; in the 50% percent of the potential cases; farmers kill and turn it into the soil before spring

Tillage: conventional fall ploughing (30 cm deep) only after corn, deep ripper/subsoiler after and before all other crops

cn2	'rc_strow_g'
cons_prac	'cross_slope'
ov_mann	'chisplow_res'

name	cn_a	cn_b	cn_c	cn_d
rc_strow_g	67.00000	78.00000	85.00000	89.00000

name	usle_p	slp_len_max	description
cross_slope	0.75000	121.00000	Cross_slope_tillage

name	ovn_mean	ovn_min	ovn_max
chisplow_res	0.13000	0.10000	0.16000

No-till combined with cover crop - scenario

Crop rotation: corn, winter wheat, sunflower, barley, canola (oilseed rape), alfalfa (lucerne)

Cover crop: between a winter crop and a summer crop in 100% percent of the potantial cases; farmers do not turn it into the soil before winter, they keep it to the next crop

Tillage: no ploughing, all tillage operation are restricted to a direct driller (zerotill)

cn2	'legr_cont_g'
cons_prac	'contour_farming'
ov_mann	'notill_2-9res'

name	cn_a	cn_b	cn_c	cn_d
legr_cont_g	55.00000	69.00000	78.00000	83.00000

name	usle_p	slp_len_max	description
contour_farming	0.50000	121.00000	Contour_tillage

name	ovn_mean	ovn_min	ovn_max
notill_2-9res	0.30000	0.17000	0.47000

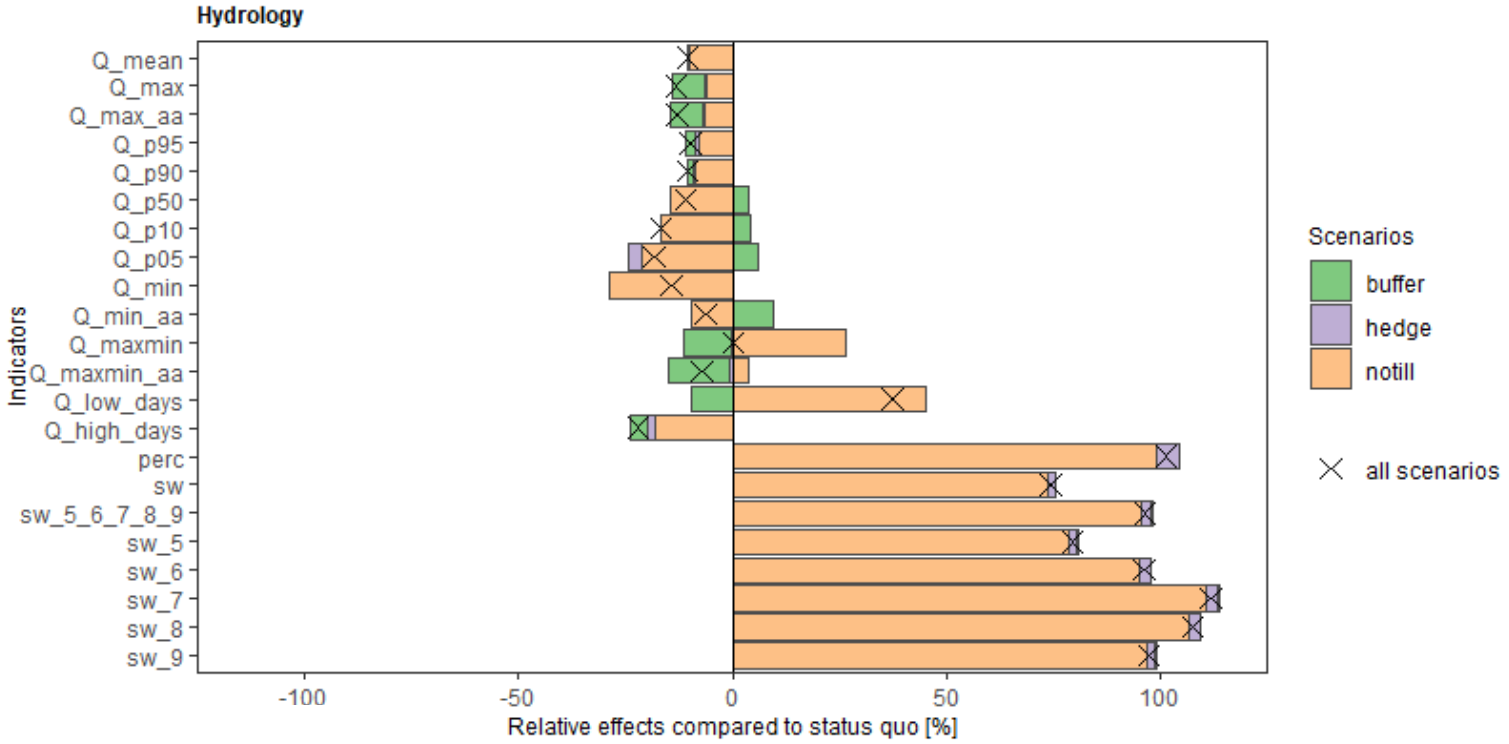
Land use related scenarios

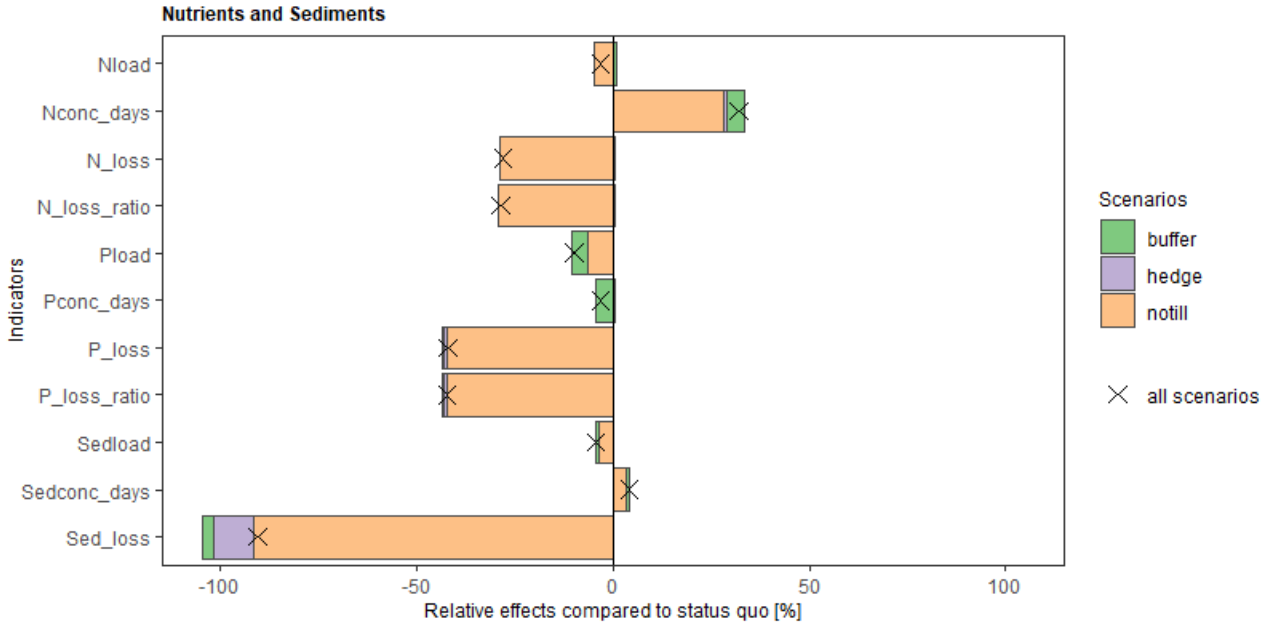
nswrm	plnt_com	mgt	cn2	cons_prac	ov_mann	tile	lum_dtl
buffer	frst_com		wood_f	up_down_slope	forest_heavy		
hedge	frst_com		wood_f	up_down_slope	forest_heavy		

Results

No till with cc.:

- Flow parameters decreased slightly
- Soil water content increased significantly

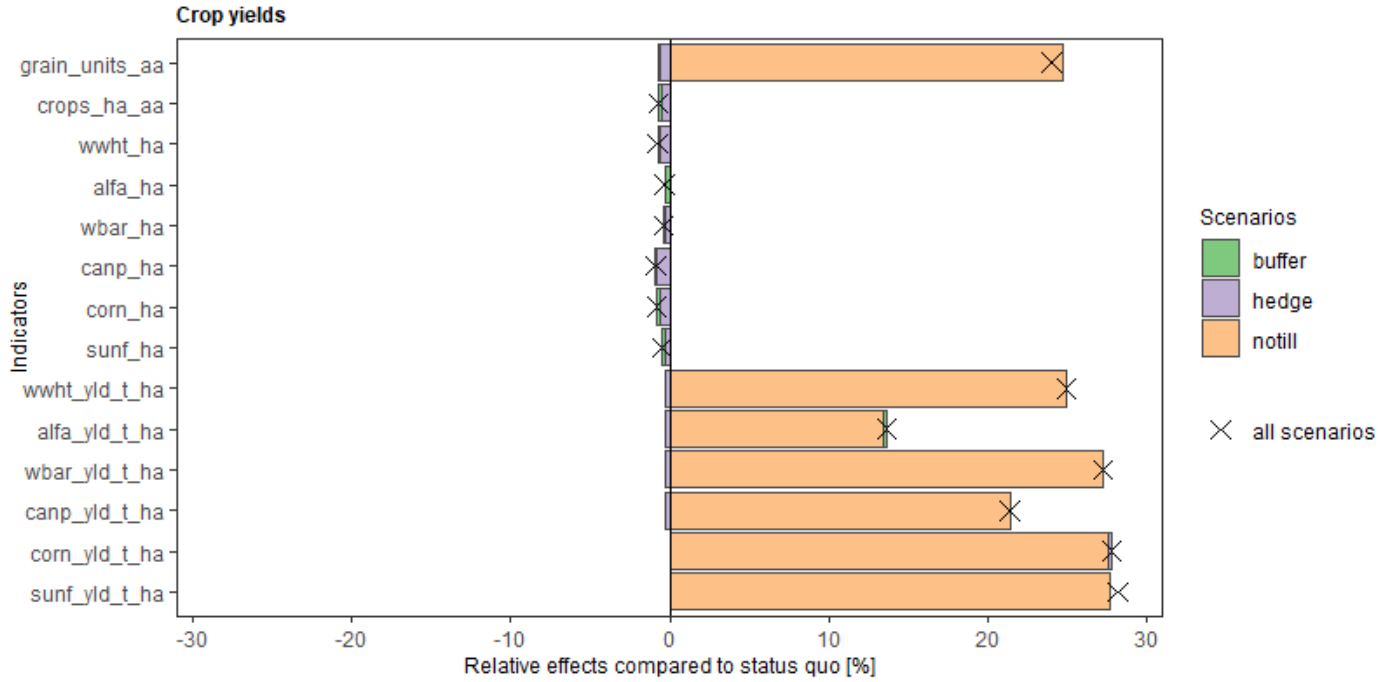




No till with cc.:

- Almost all nutrient and sediment indicators decreased

Results



No-till combined with cover crops has a positive projected influence on crop yield

Future work

- Testing other variety of managment scenarios: cover crop with conventional tillage, keeping cover crop different (shorter) period on the fields, no till with less cover crop

- Testing different landuse lum parameter settings

Thank you for your attention!