Assessing the effectiveness of best management practices in reducing sediment and phosphorous export in a small Swedish agricultural catchment

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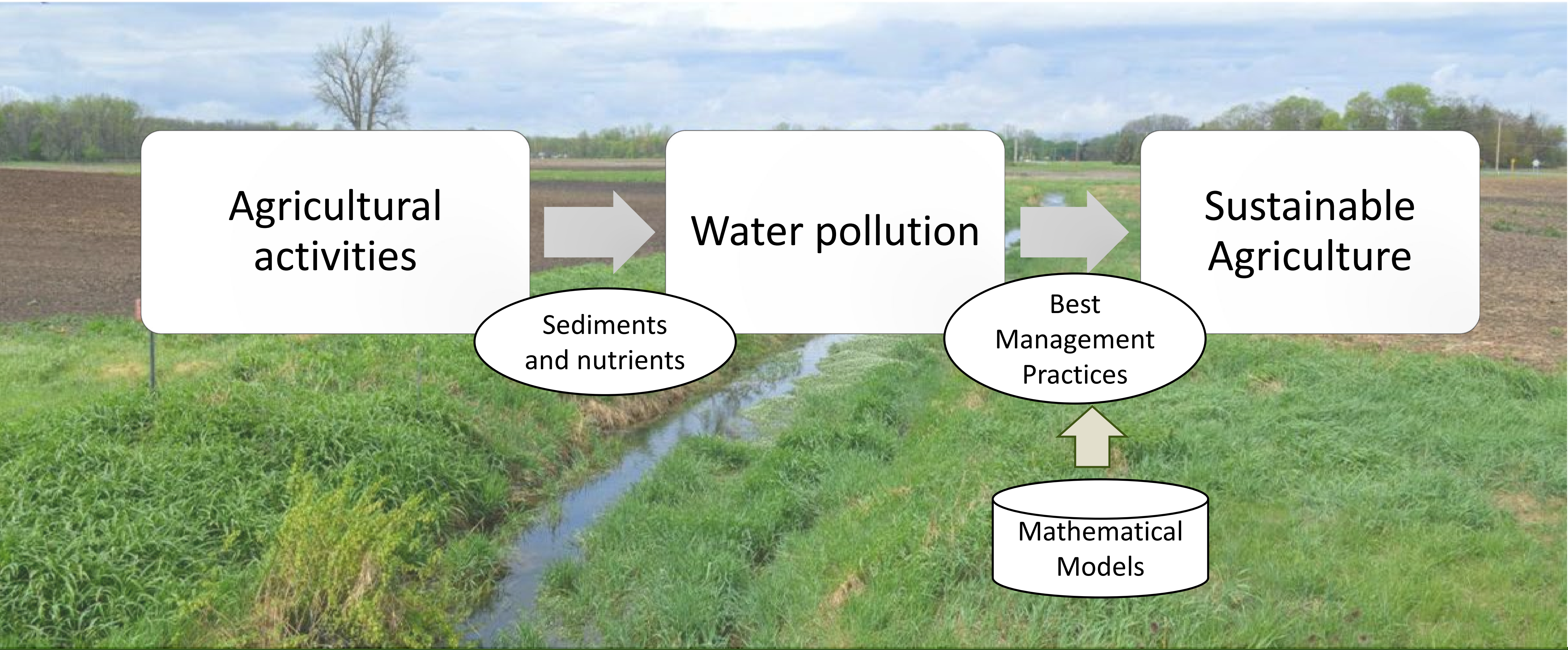
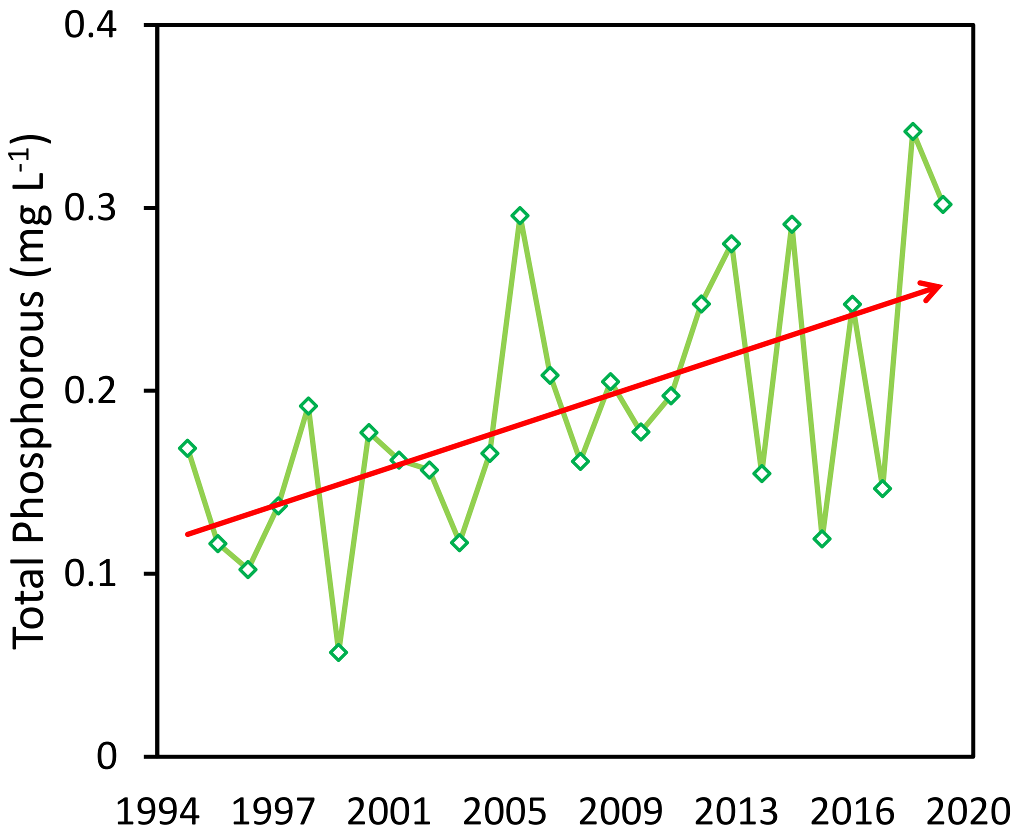


1. Introduction

- The study area is one of 21 small agricultural monitoring catchments in Sweden designated for intensive water quality monitoring since 1990.
- High phosphorus losses in the catchment, second highest among the 21 catchments, with an increasing trajectory
- Relatively low nitrogen losses (approx. 3.5 mg/l).
- The Swedish Environmental Protection Agency targets to reduce P levels in watercourses by **50% by 2027** to achieve the European WFD's "**good ecological status**" and ultimately zero eutrophication.



2. Objetives

Evaluate the SWAT model application for simulating streamflow, sediment, and phosphorous loads in catchment C6

Quantify agricultural BMPs effectiveness in reducing sediment and phosphorus (soluble & total) export

3. Methodology

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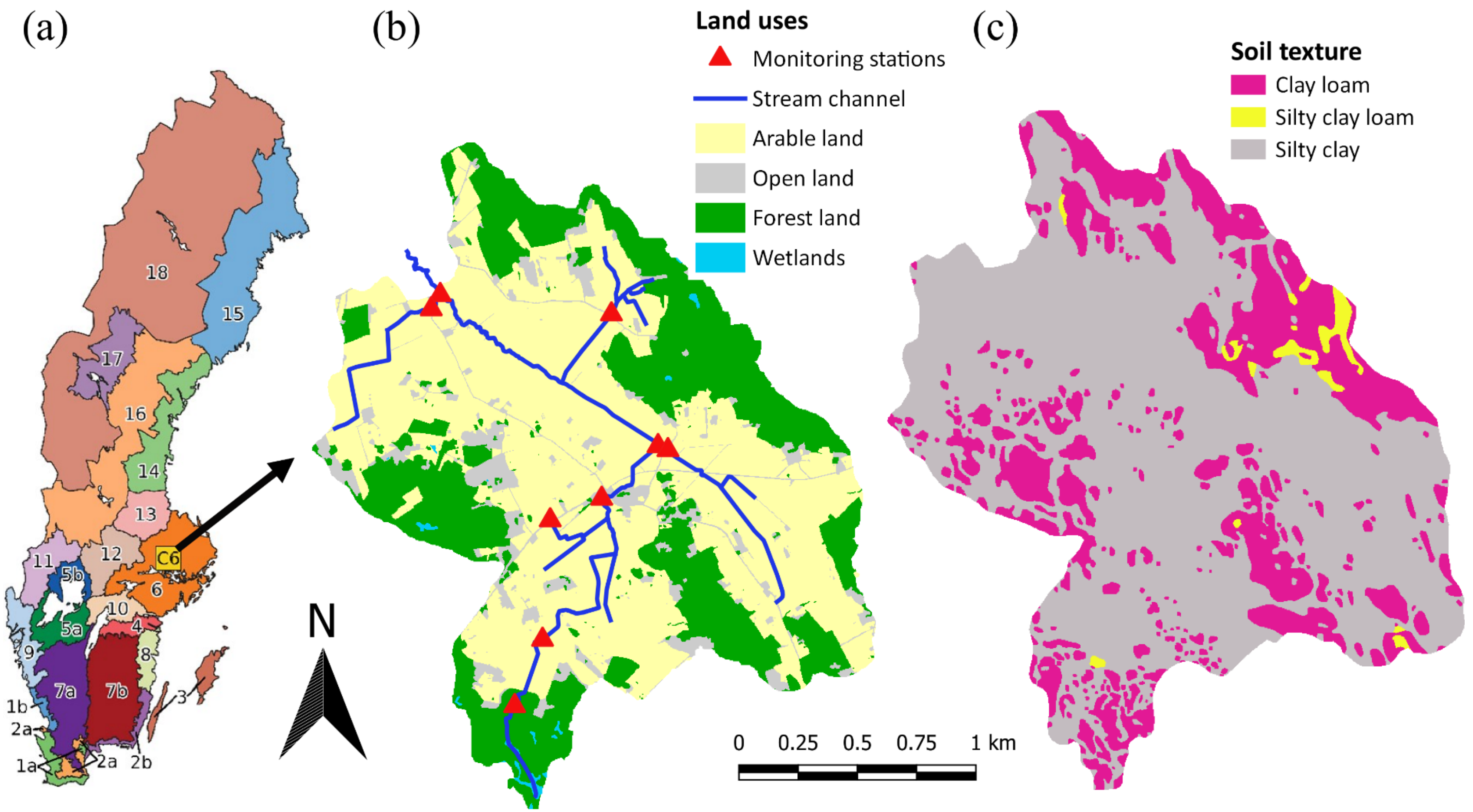
Study Area: Catchment C6



Location: Southeastern Sweden

Area: $33km^2$ (60% agriculture; 35% forest)

Elevation: 10-60m a.s.l.

Slope: Gentle to flat slope (80% < 2% slope)

Rainfall: 550-600mm annually

Temperature: -21^oC to 28^oC (annual av. $5.5\ ^oC$)

Climate: Baltic (moderately continental climate)

Average surface runoff: 220mm annually

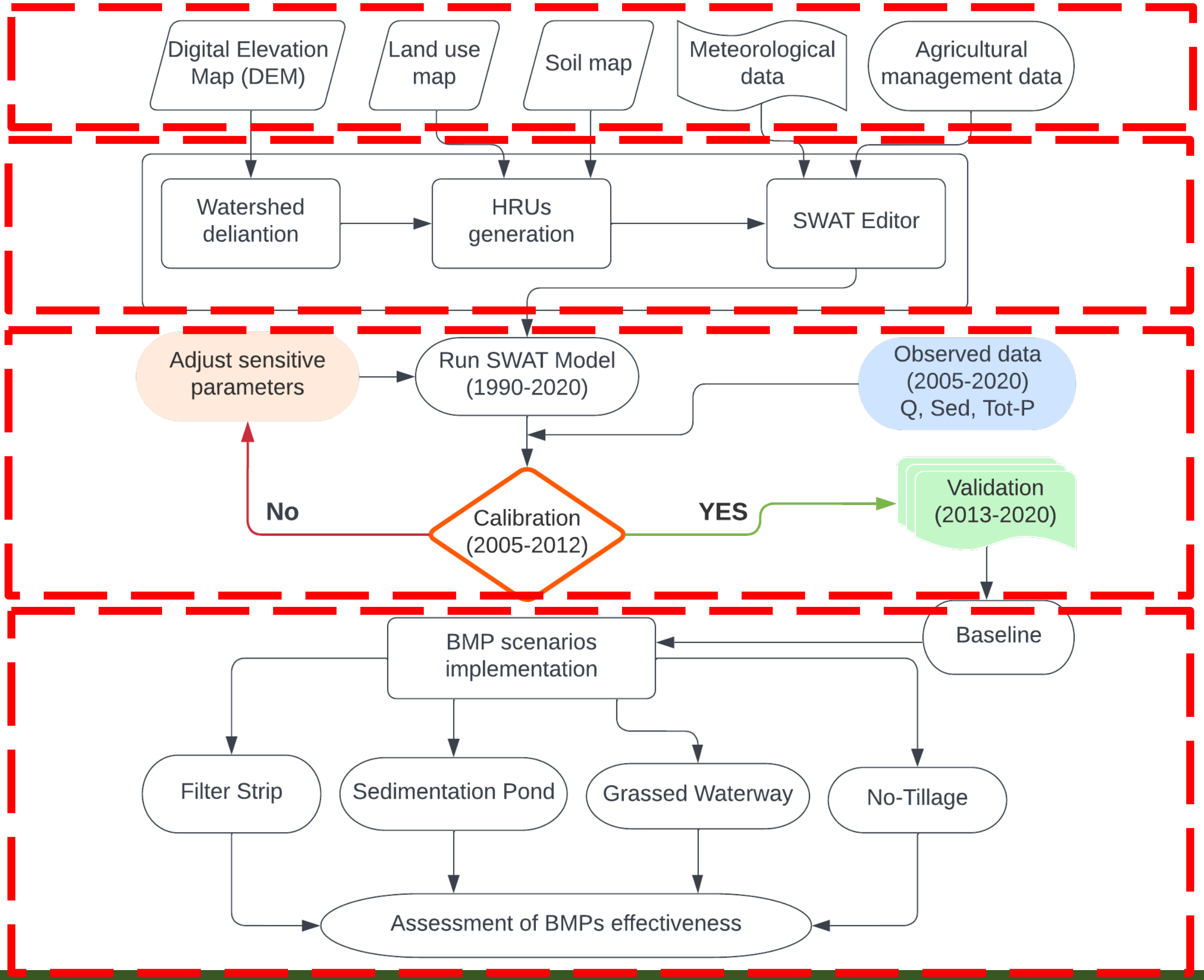
Evapotranspiration: 400-500mm annually

Soil: predominantly clay soils (over 70%); pH = 7.5

Crops: mainly cereals (70% of arable land); Others: Ley, oilseed, oats

3. Methodology

SWAT Model Inputs & Set-Up



Model inputs

Model creation

Subbasins: **32**;
HRUs: **349**

Model evaluation

BMPs scenarios

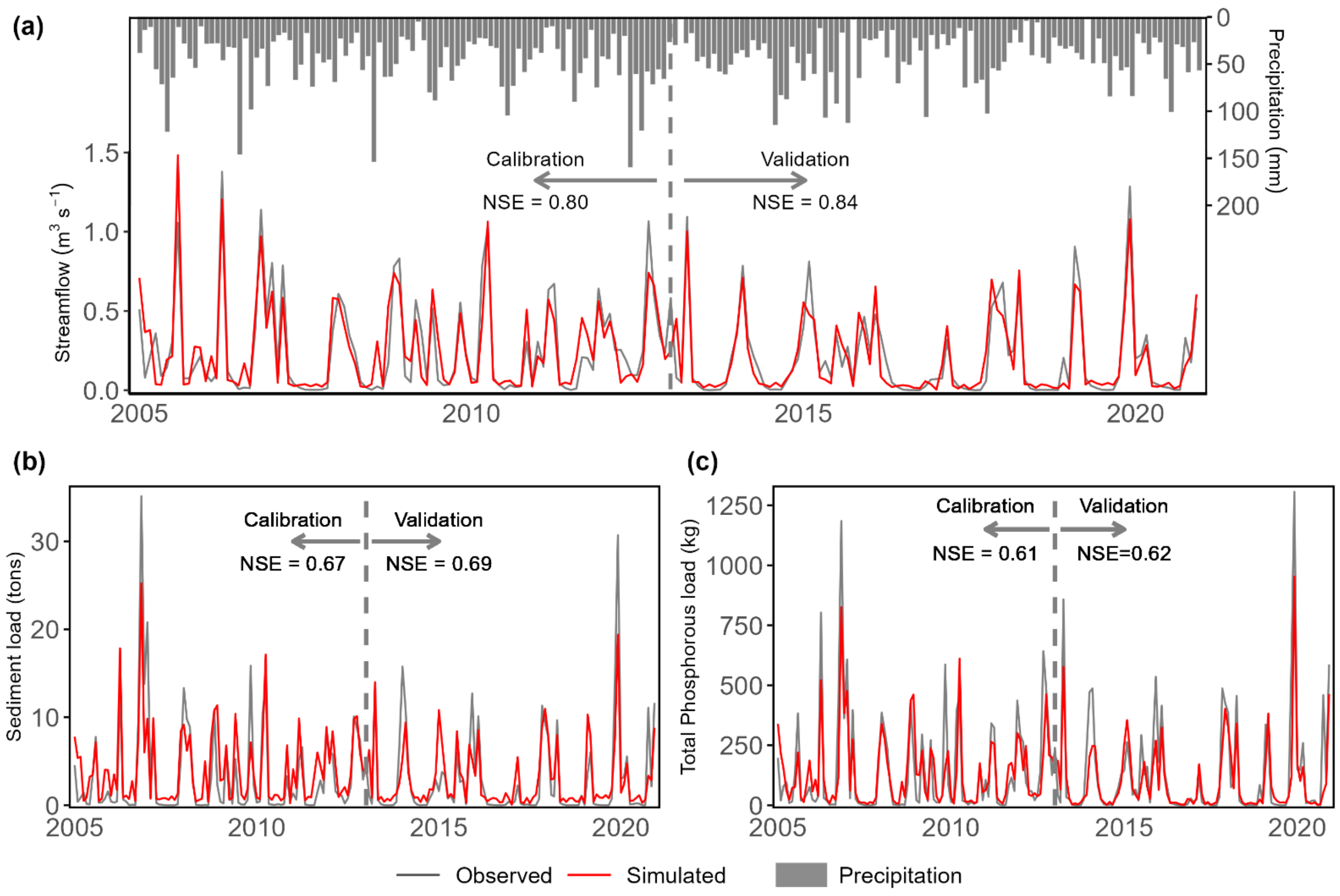
3. Methodology

BMP Scenarios Implementation

BMP scenario	Modified SWAT parameter		
	Parameter	Baseline value (No BMP)	Adjustment value (With BMP)
Filter strip	FILTERW.mgt	0	7.5 (m)
Grassed waterway	CH_COV1.rte	0.25	0.001
	CH_COV2.rte	0.2	0.001
	CH_N2.rte	0.25	0.40
Sedimentation ponds	PND_FR.pnd	0	0.5
	PND_PSA.pnd	5	500
	PND_PVOL.pnd	25	50
	PND_K.pnd	0	0.05
No-tillage (Zero till)	CN2.mgt	Varies*	-10%
	EFFMIX.till.dat	0.95	0.05
	DEPTIL.till.dat	150	25 (mm)

4. Results & Discussions

Model Calibration and validation



Sensitive parameters

Streamflow

- Snow parameters (SFTMP; SMTMP)
- Ground water (GW_DELAY)
- Soil property (SOL_AWC)
- Land use management (CN2)

Sediment

- Channel properties (CH_K2; CH_N2)
- Sediment routing (LAT_SED; SPCON; PRF)

Phosphorous

- Phosphorous uptake by plants(P_UDIS)
- Phosphorous distribution and movement in the soil (PHOSKD; PPERCO; PSP)
- Organic phosphorous levels (RS5)

4. Results & Discussions

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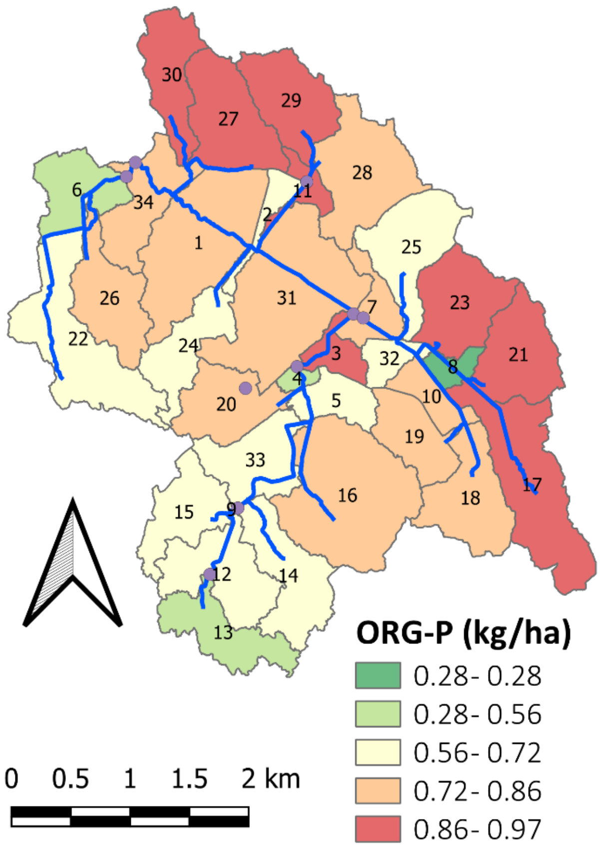
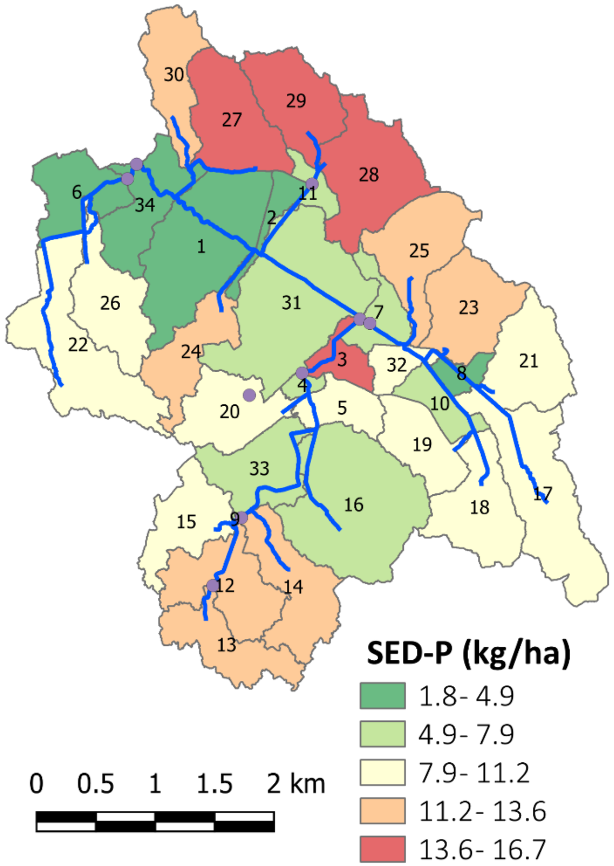
Phosphorous critical areas

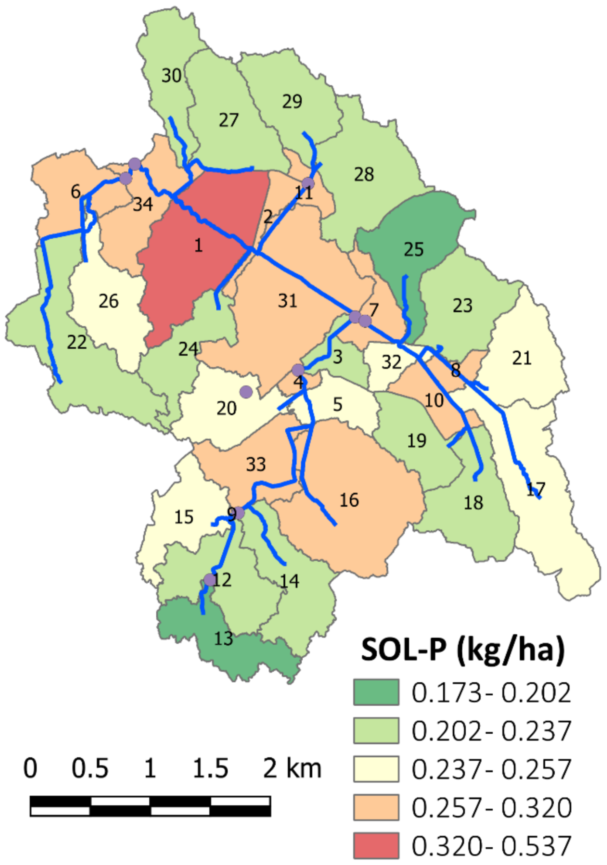
Organic Phosphorous



Sediment Phosphorous



Soluble Phosphorus



4. Results & Discussion

BMP Scenario Results

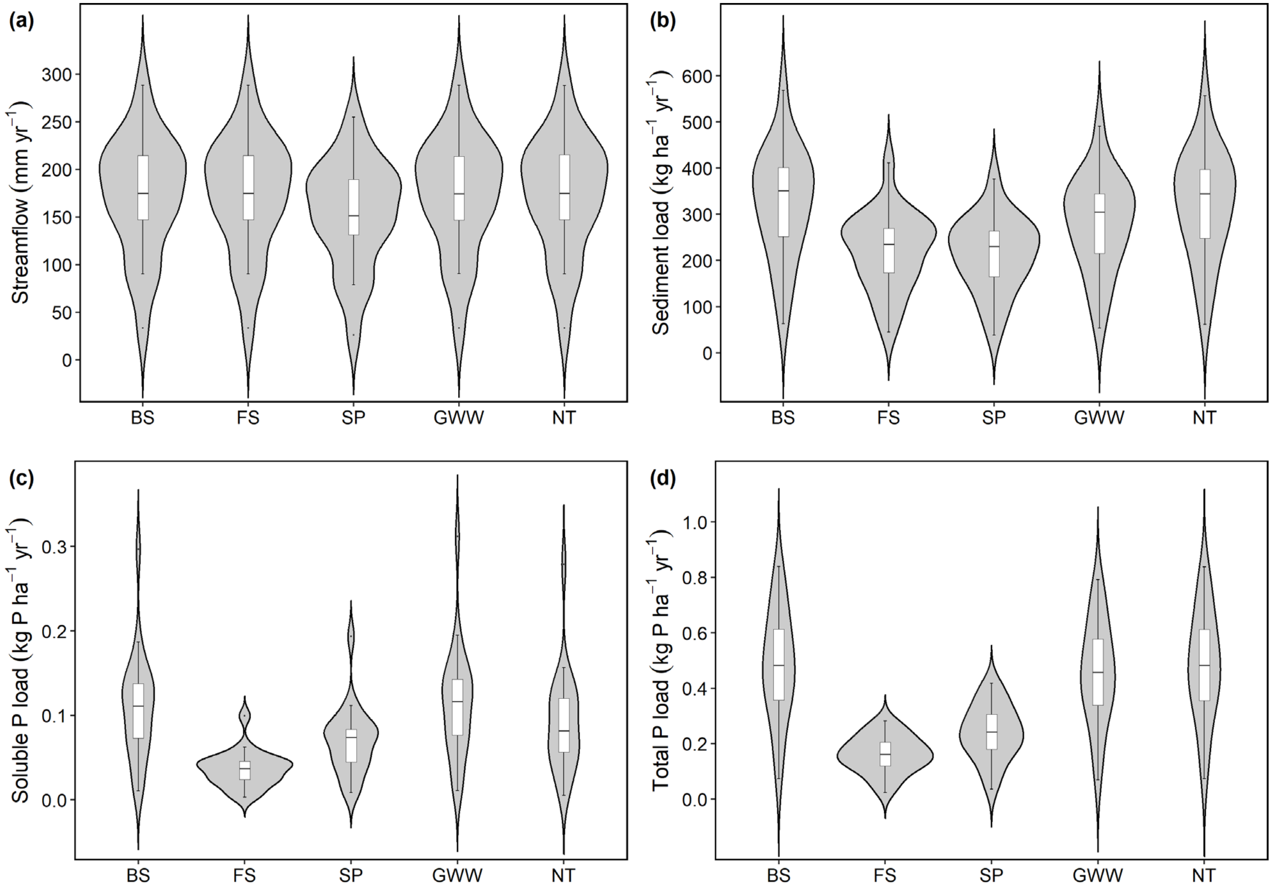


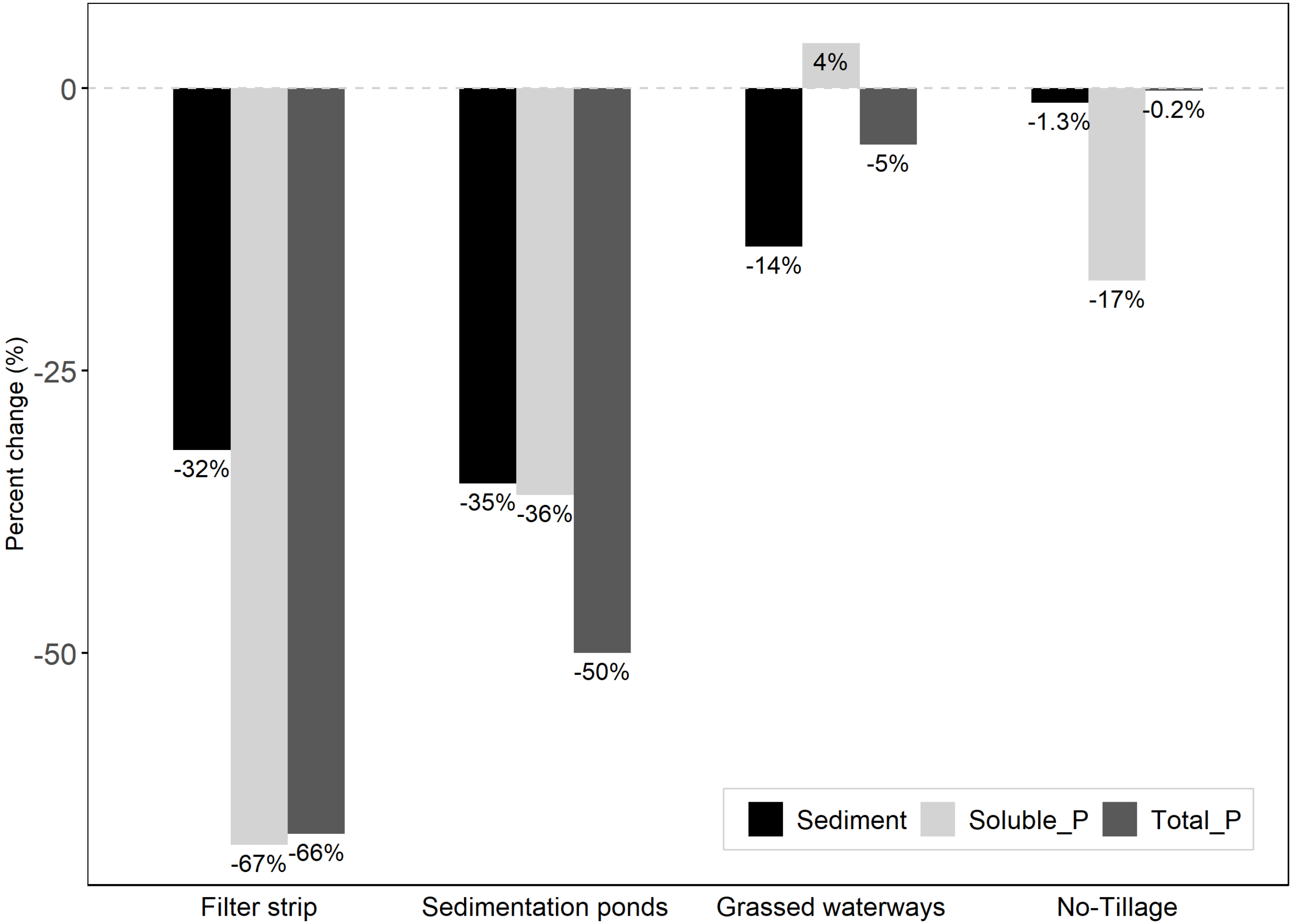
Table: P-values from the Wilcoxon–Mann–Whitney Rank-Sum statistical significance test of average annual values for the BMP scenarios relative to the baseline.

BMP Scenario	Streamflow	Sediment load	Soluble P load	Total P load
Filter strip	1	0.003	< 0.001	< 0.001
Sedimentation pond	0.202	0.002	0.021	< 0.001
Grassed waterway	0.980	0.161	0.654	0.601
No-Tillage	1	0.723	0.211	0.921

Statistically significant when P-value < 0.05

4. Results & Discussion

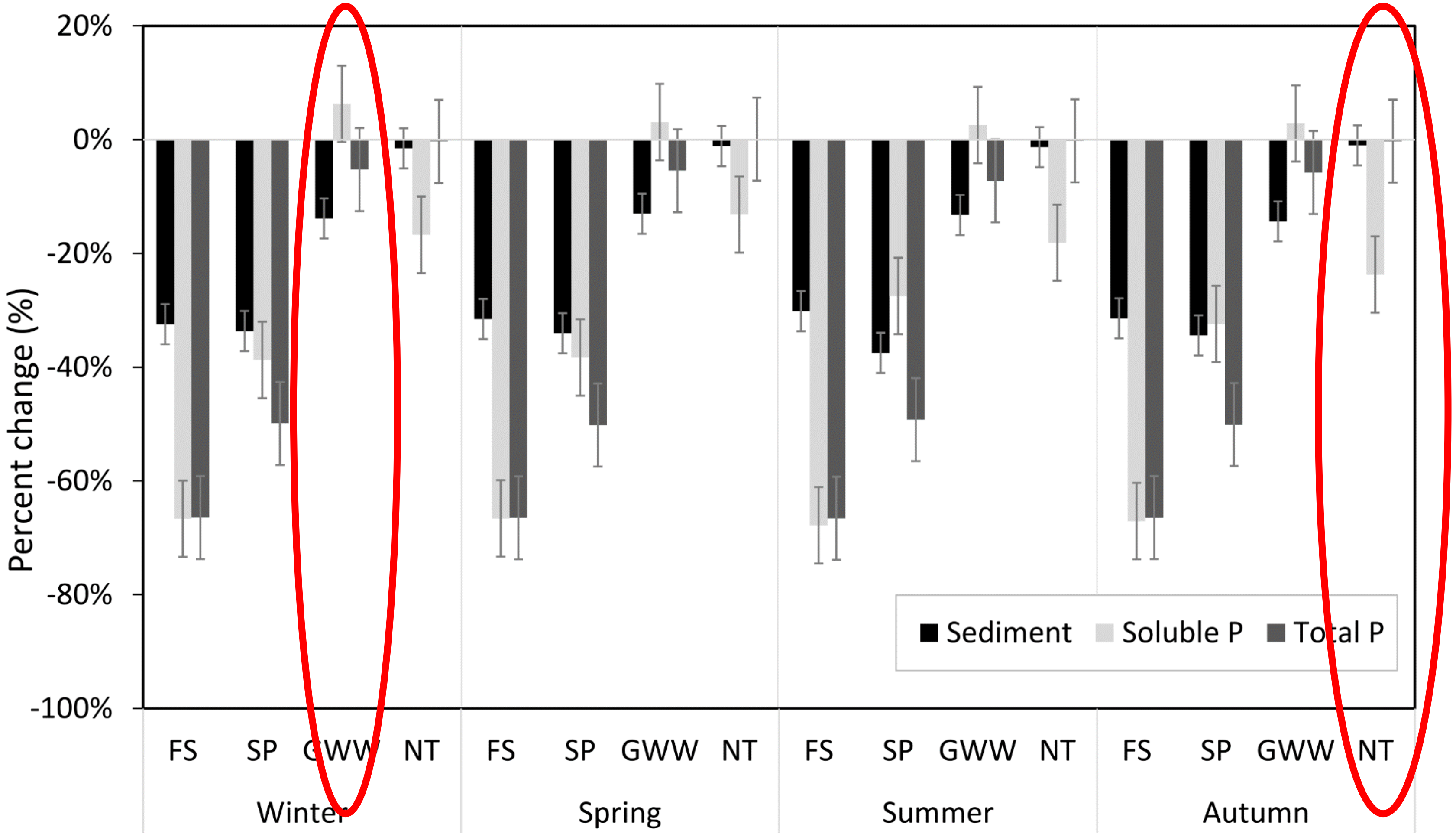
BMP Scenario Results



- Filter strip and sedimentation ponds were very effective
- Grassed waterways and no tillage were less impactful
- Grassed waterways slightly increase soluble P
- No-tillage had no effect on sediment and total P due to the clay soil predominance in the catchment but reduced soluble P
- The effectiveness of sedimentation ponds is dependent on the runoff retention time in the pond
- There was a strong relationship between sediment and total P reduction rates

4. Results & Discussion

Seasonal Analysis: BMPs



- No-Till most effective for Sol-P in Autum (-25%)
- Grassed waterway least effective for Sol-P in winter (+6%)

4. Results & Discussion

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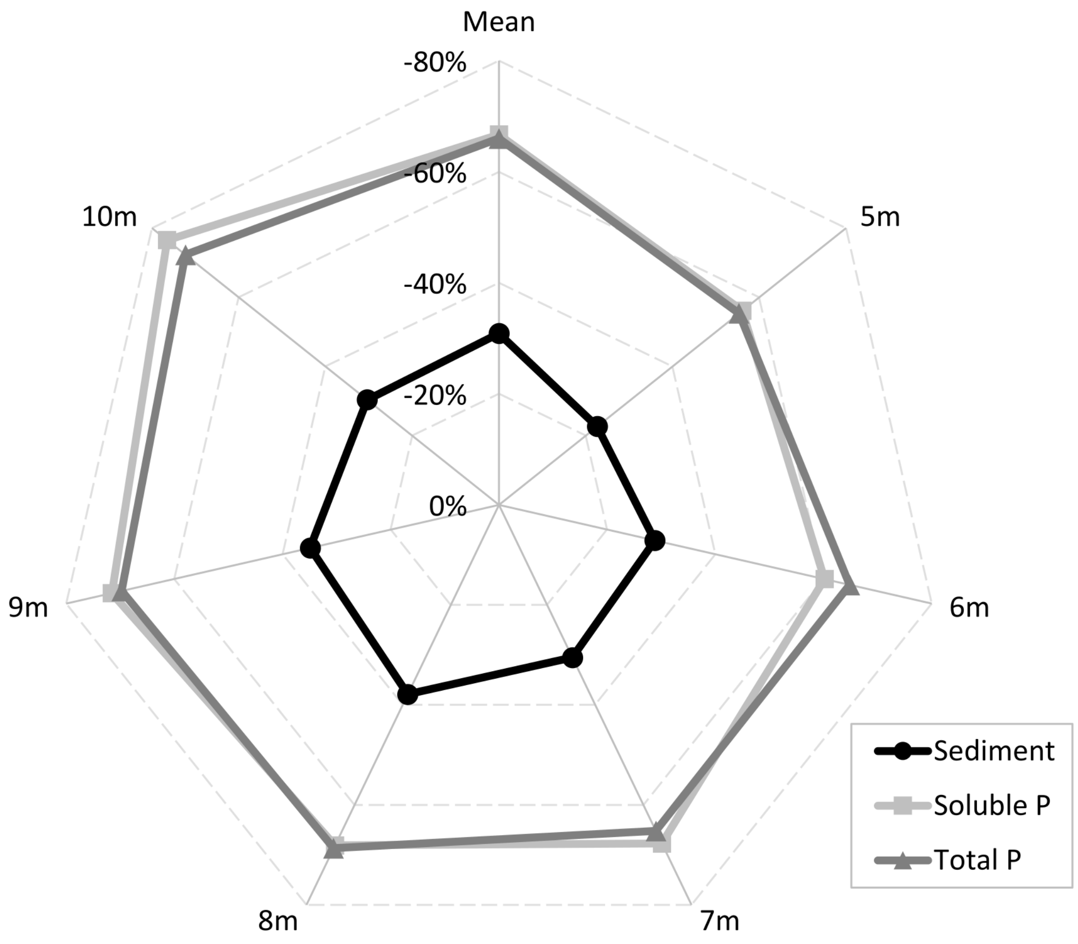
BMP Scenario Analysis: Filter Strip



- Filter strip were more effective in reducing total P (66%) and soluble P (67%) than sediment (37%)
- The effectiveness of filter strip increased with increase in width from 5 to 10m, with 8m being optimal
- Filter strip vegetation facilitate sediment entrapment

5. Conclusion

Conclusion

- The SWAT model simulated streamflow, sediments, and phosphorous loads well, and can thus be applied in the catchment
- Varying effects of BMP implementation in the catchment, with filter strip and sedimentation ponds effectively reducing sediment and phosphorous export
- Sediment could be regarded as the driver of phosphorous export in the catchment
- The effectiveness of filter strip for pollutant reduction increases with increasing filter width
- Future research could explore alternative BMPs and combinations, assess their economic viability and cost-effectiveness

Thank you for your time and attention!

Q&A