# A model workflow for land use planning, optimising water re-use and nutrient retention

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**Abstract:** Natural/Small Water Retention Measures (NSWRM), such as conservation tillage, constructed wetlands or riparian buffers, have the capacity to contribute substantially to mitigating the challenges associated with climate change, soil erosion, biodiversity loss and degrading water quality. However, to be effective these measures must be implemented in the right locations and combinations. This presentation describes the coupled-model workflow applied in the EU-H2020 research project OPTAIN (OPtimal strategies to retAIN and re-use water and nutrients in small agricultural catchments across different soil-climatic regions in Europe, https://www.optain.eu/). OPTAIN aims to derive spatially targeted combinations of NSWRMs that maximise water and nutrient retention capacity while minimising trade-offs with potential implementation/maintenance costs and reductions in crop production.

The workflow developed for OPTAIN was applied in a harmonised way across its 14 case study catchments. It begins with (i) identifying NSWRMs that are suitable for the individual catchment and (ii) defining feasible locations for their implementation, in consultation with stakeholders. Then, (iii) specific environmental and economic objectives are identified, before (iv) a series of coupled models are run to simulate catchment processes and optimise NSWRM combinations. The overall workflow concludes with a recommended optimised NSWRM implementation plan agreed to by the stakeholders of each individual catchment.

The central model applied in OPTAIN is the Soil and Water Assessment tool (SWAT+). Seven software packages have been developed for the input data processing and model workflows (Plunge et al. 2024a; Plunge et al. 2024b). SWAT+ is used to simulate all potential implementation plans (>20,000 model runs) and their effects on nutrient, water and sediment flows. For assessing economic objectives, SWAT+ is coupled with a conceptual economic model, while the multi-objective optimisation is performed with the (Constrained Multi-objective Optimization of Land use Allocation) CoMOLA software (Strauch et al. 2019). For the final step of the workflow, the app ParetoPick-R has been developed. Through a range of interactive visualisations, this R-shiny application lets stakeholders explore solutions through an interactive and intuitive user interface. The implementation of an Analytical Hierarchy Process allows stakeholders to identify the final preferred NSWRM implementation plan.

We believe that the OPTAIN coupled model workflow is well suited for applications in climate adaptation, agricultural transformation and ecosystem-based research.

## REFERENCES

Plunge S, Schürz C, Čerkasova N, Strauch M and Piniewski M (2024a) SWAT+ model setup verification tool: SWATdoctR. Environmental Modelling & Software 171, 105878. Doi: https://doi.org/10.1016/j.envsoft.2023.105878.

Plunge S, Szabó B, Strauch M, Čerkasova N, Schürz C and Piniewski M (2024b) SWAT + input data preparation in a scripted workflow: SWATprepR. Environmental Sciences Europe 36(1), 53. Doi: https://doi.org/10.1186/s12302-024-00873-1.

Strauch M, Cord AF, Pätzold C, Lautenbach S, Kaim A, Schweitzer C, Seppelt R and Volk M (2019) Constraints in multi-objective optimization of land use allocation – Repair or penalize? Environmental Modelling & Software 118, 241-251. Doi: https://doi.org/10.1016/j.envsoft.2019.05.003.

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