



OPTimal strategies to retAIN and re-use water and nutrients in small agricultural catchments across different soil-climatic regions in Europe

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International Interdisciplinary Conference on Land Use and Water Quality, Agriculture and the Environment.
Aarhus, Denmark, 3-6 June, 2025.



This project has received funding from the European Union's Horizon research and innovation program under grant agreement No. 862751



Global warming and demographic growth are expected to intensify droughts and floods in the EU, raising annual damage costs beyond the current €9 billion for droughts and €7.6 billion for floods.



€9 billion



€7,6 billion



References: Aalbers et al., 2023; Camalleri et al., 2020, Dottori et al., 2023; Hari et al., 2020; Naumann et al., 2021.

OPTAIN investigates
Natural/Small Water Retention
Measures - NSWRM), e.g.:

Agricultural measures

- reduced / no tillage
- cover crops
- grassed waterways
- afforestation
- ..

Hydro-morphological measures


- riparian buffer
- constructed wetlands
- detention ponds
- controlled drainage
- ...

in their individual but also
combined effects

PROJECT INFO



 partners from
21 15 countries
across Europe

 partners will
14 contribute with
their own case
study

 million Euro
7 budget

 years duration
5 2020-2025

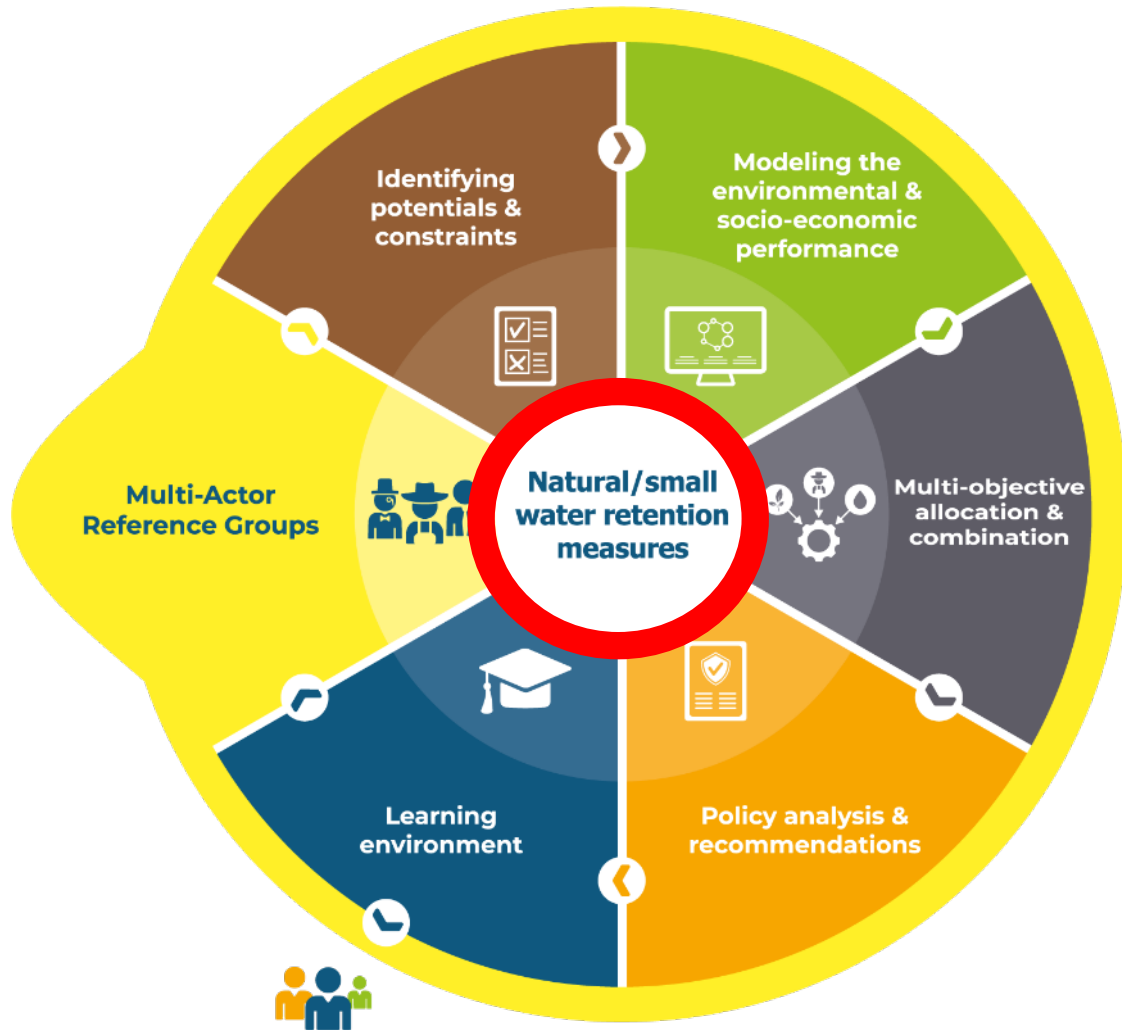


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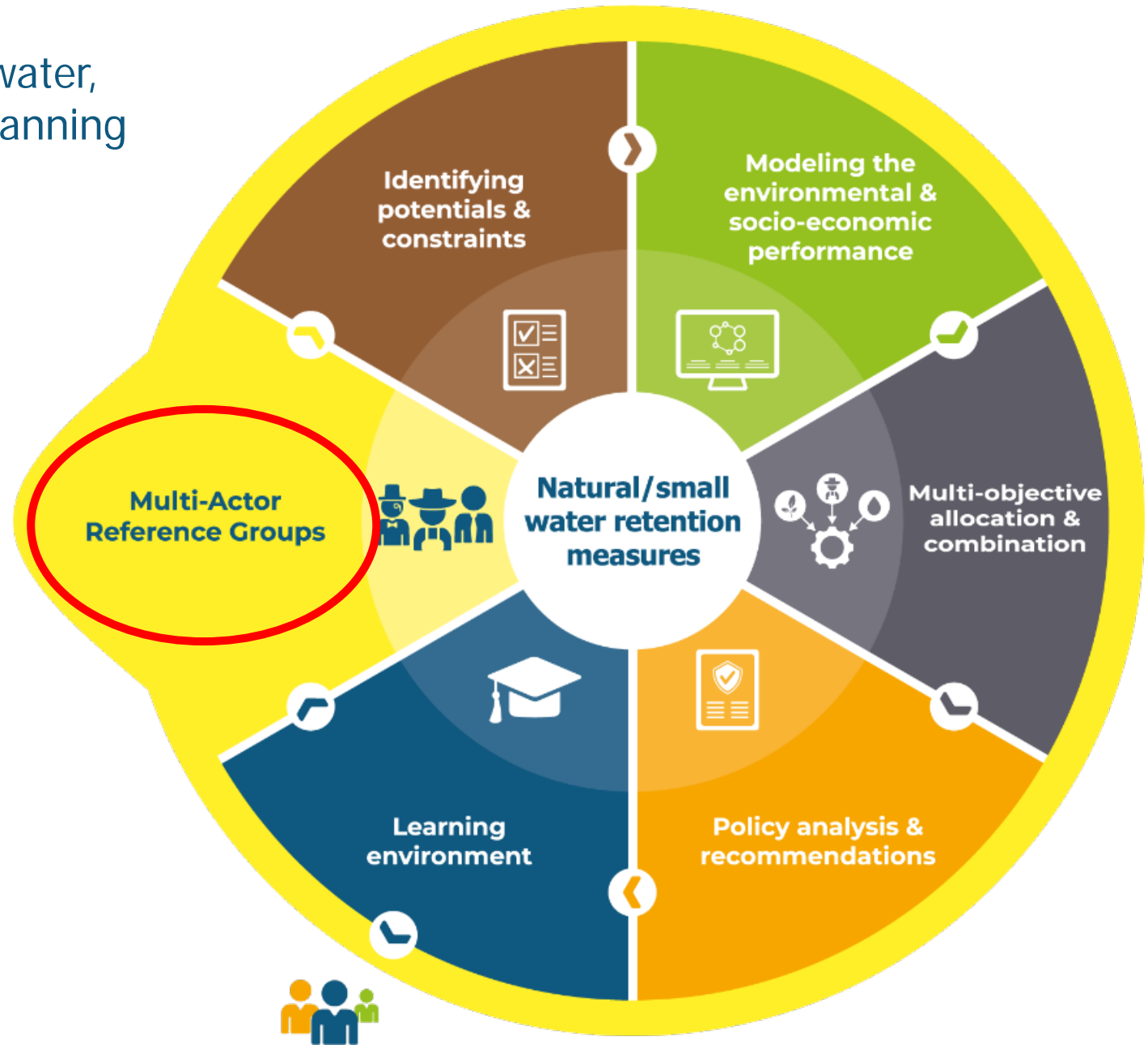
OPTAIN core elements and objectives



- Identify **regional conditions** under which NSWRM perform most efficient
- Identify **optimal combinations & allocations** of NSWRM on **different scales**
- **Fully harmonized approach** across all 14 case studies

Magnier, J., B. Fribourg-Blanc, T. Lemann, F. Witing, W. Critchley & M. Volk (2024): Natural/Small Water Retention Measures: their contribution to ecosystem-based concepts. *Sustainability* 16(3), 1308

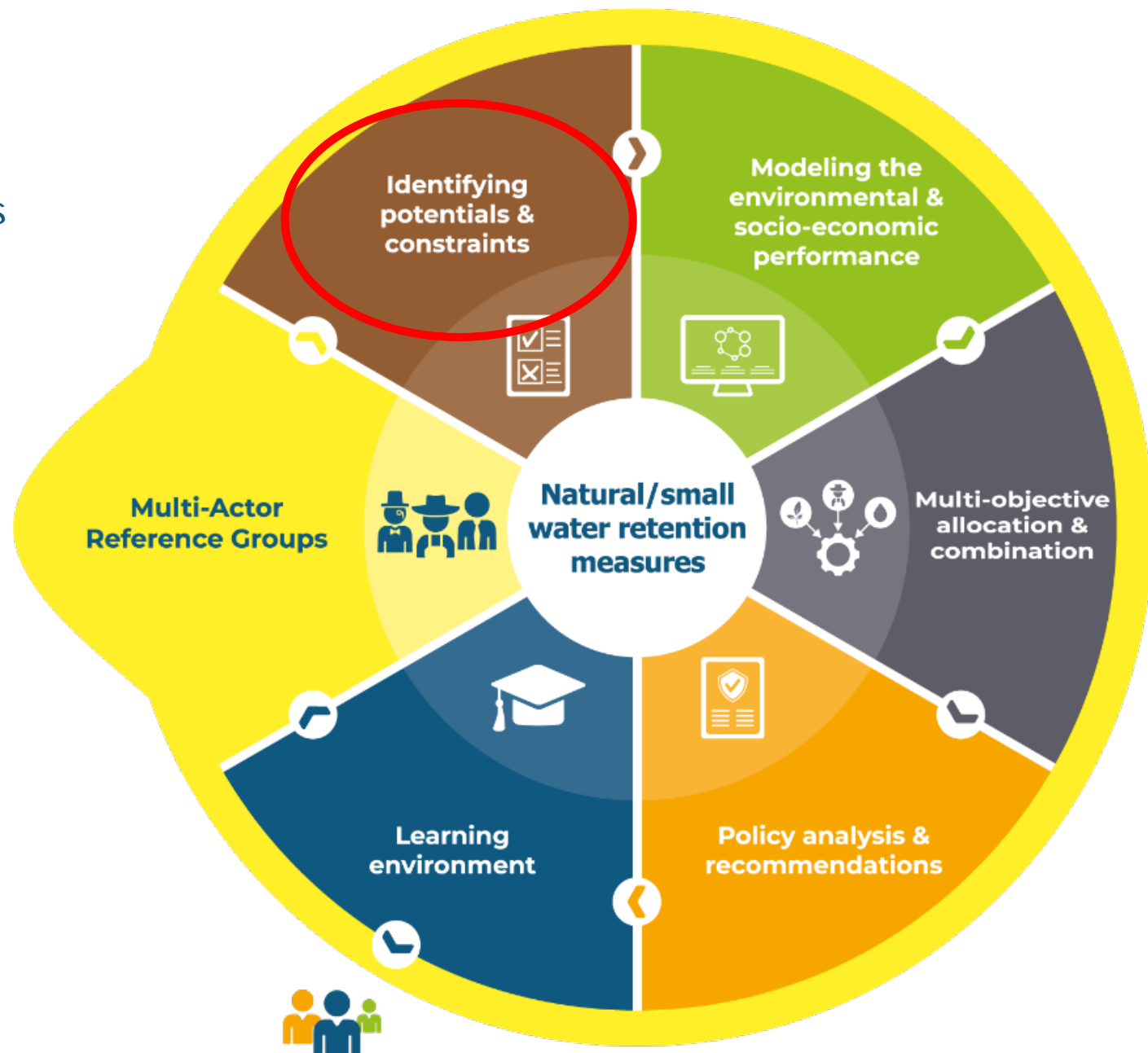
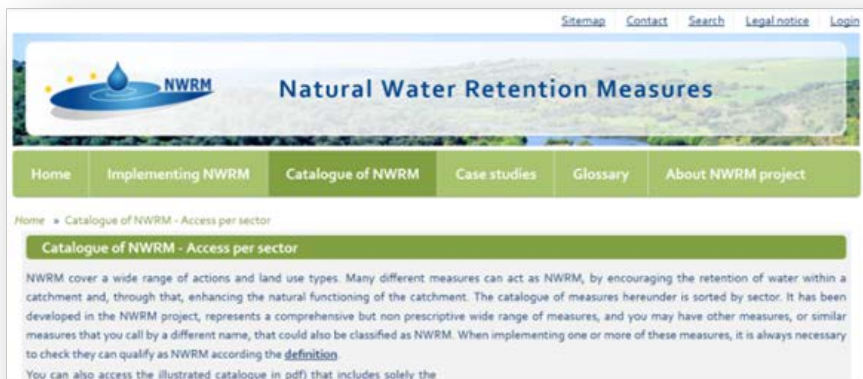
- Stakeholders (>200) from the fields of water, agriculture, soil protection, landscape planning and nature conservation



- Prioritisation and allocation of promising measures
- Documentation of existing example measures in WOCAT-SLM



- Extension of the NWRM catalogue nwrn.eu/measures-catalogue



Example from the German case study:

EXISTING NATURAL/SMALL RETENTION MEASURES



▷ Retention basins (this one is often filled and should be emptied more often and equipped with an outlet to increase its effectiveness)*

Cover crops (here Phacelia)* ◁



▷ Conservation or no-till (here direct seeding of corn)*

Permanently grassed waterways* ◁



▷ Riparian buffers (here on both sides of the stream)*

* Source: LTV, 2018: Report on Phosphorus pollution and mitigation measures in the catchment of Reservoir Quitzdorf

ALLOCATING MEASURES – workshop results

We proposed allocation rules and discussed them with the actors based on a preliminary scenario map.

We agreed on:

Grassed riparian buffer strips

- 12m grassed buffer along channels in cropland; actors also asked to test different buffer widths

Grassed waterways

- Erosive slopes as previously identified from state agency

Retention ponds

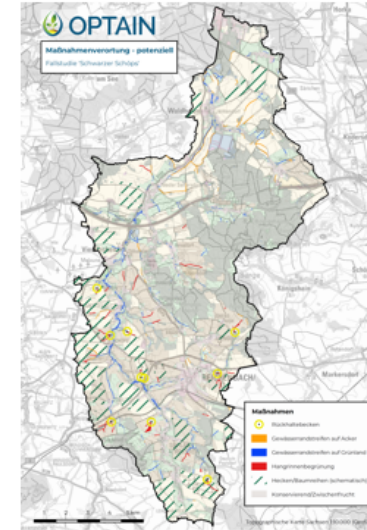
- Allocation at the end of erosive slopes if drainage area is > 50 ha

Hedgerows to subdivide larger fields

- Allocation on large fields with comparably low density of semi-natural habitats (snh) in the surrounding; hedges should follow contour lines, connect to other snh and not cause a split into too small field parcels

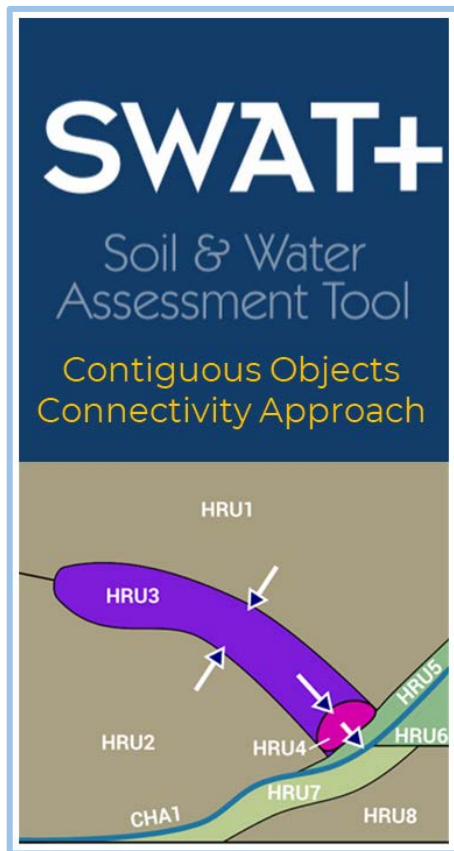
Minimum tillage, cover crops, edge-of-field filter strips

- Allocation on fields with high erosion risk ($USLE K*S*R > 7.5 \text{ t/ha*a}$)

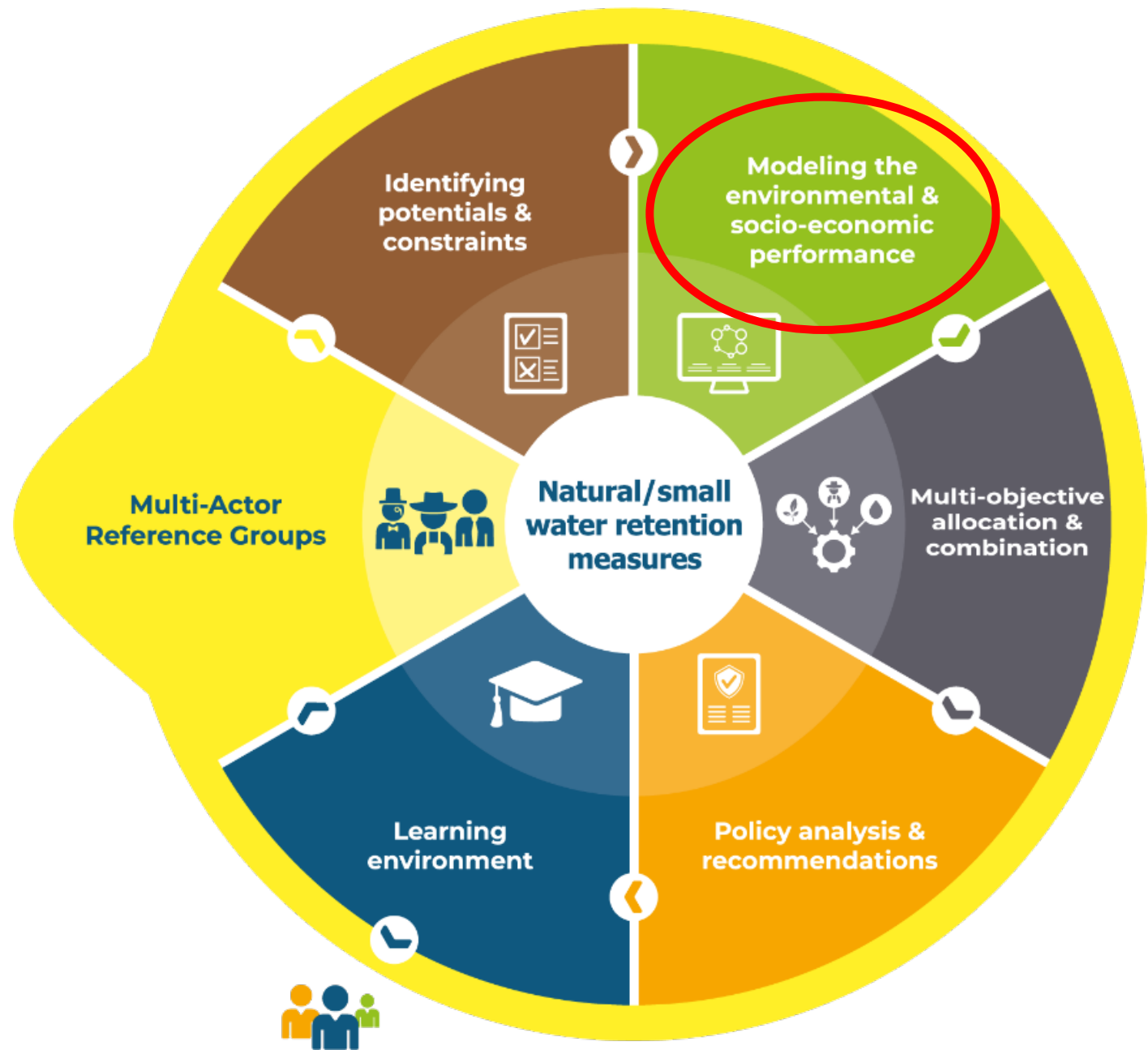
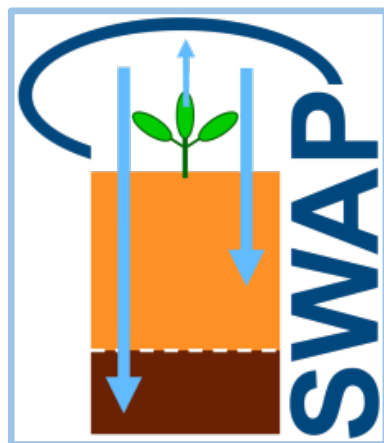


Multi-objective allocation & combination

- Process-based simulation of the effectiveness of selected measures at field and catchment level, including cost accounting



Agronomics and NSWRM implementation costs based on literature and farm surveys



OPTAINs SWAT+R ecosystem

SWATprepR

SWAT+ input data preparation

SWATdoctR

Model diagnostics tool
for SWAT+ model setups

SWATrunR

Running SWAT simulations in R

SWATmeasR

Implementation of NSWORMs in
SWATbuildR model setups



SWATbuildR

An object connectivity
based SWAT+ model builder

SWATfarmR

Simple rule based management
operation scheduling

SWATtunR

Tuning SWAT+ model parameters

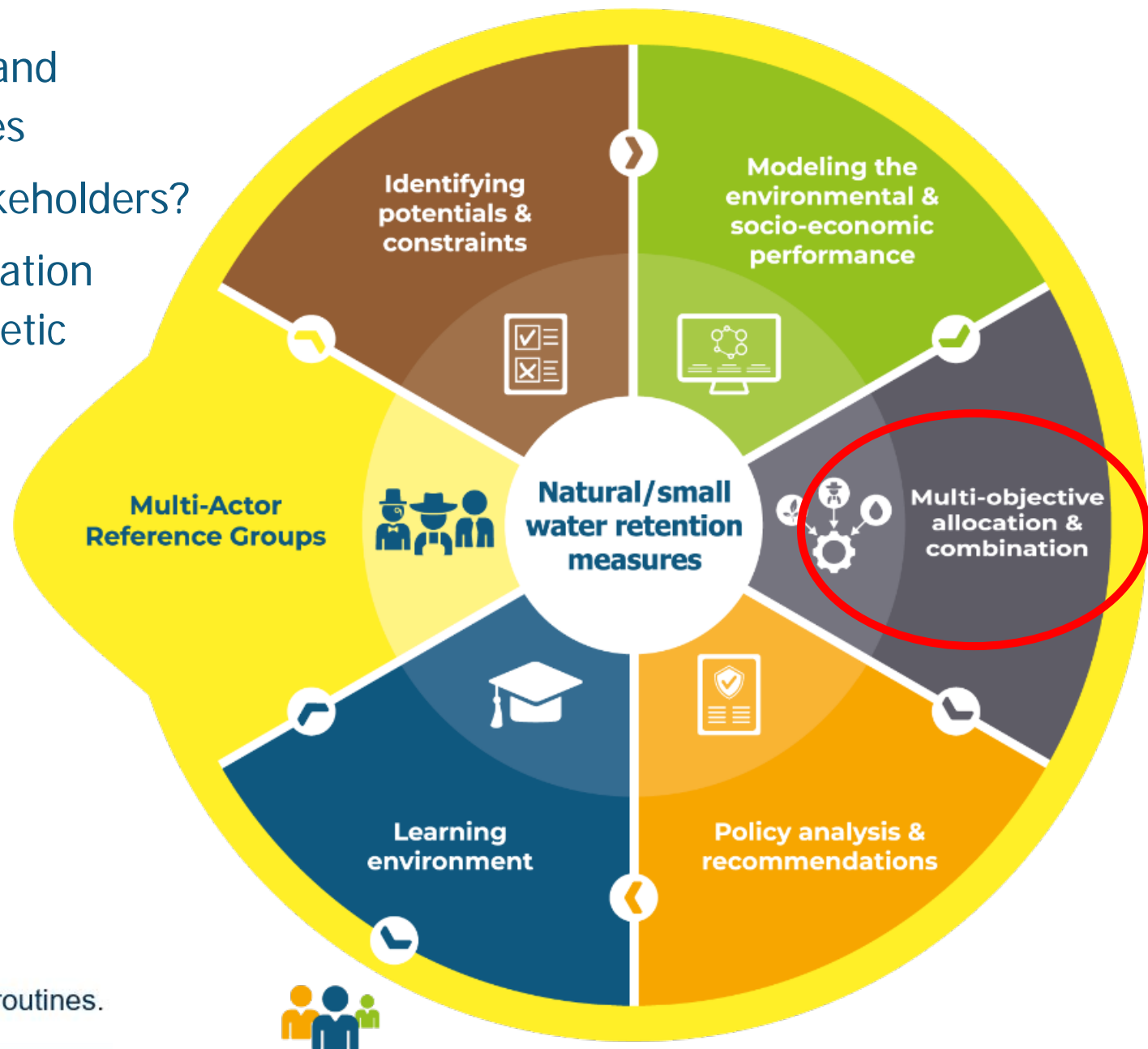
Numerous R packages and workflow scripts
developed to support and harmonize SWAT+
model setups and simulations across case studies

⇒ extremely helpful, also for wider model
community

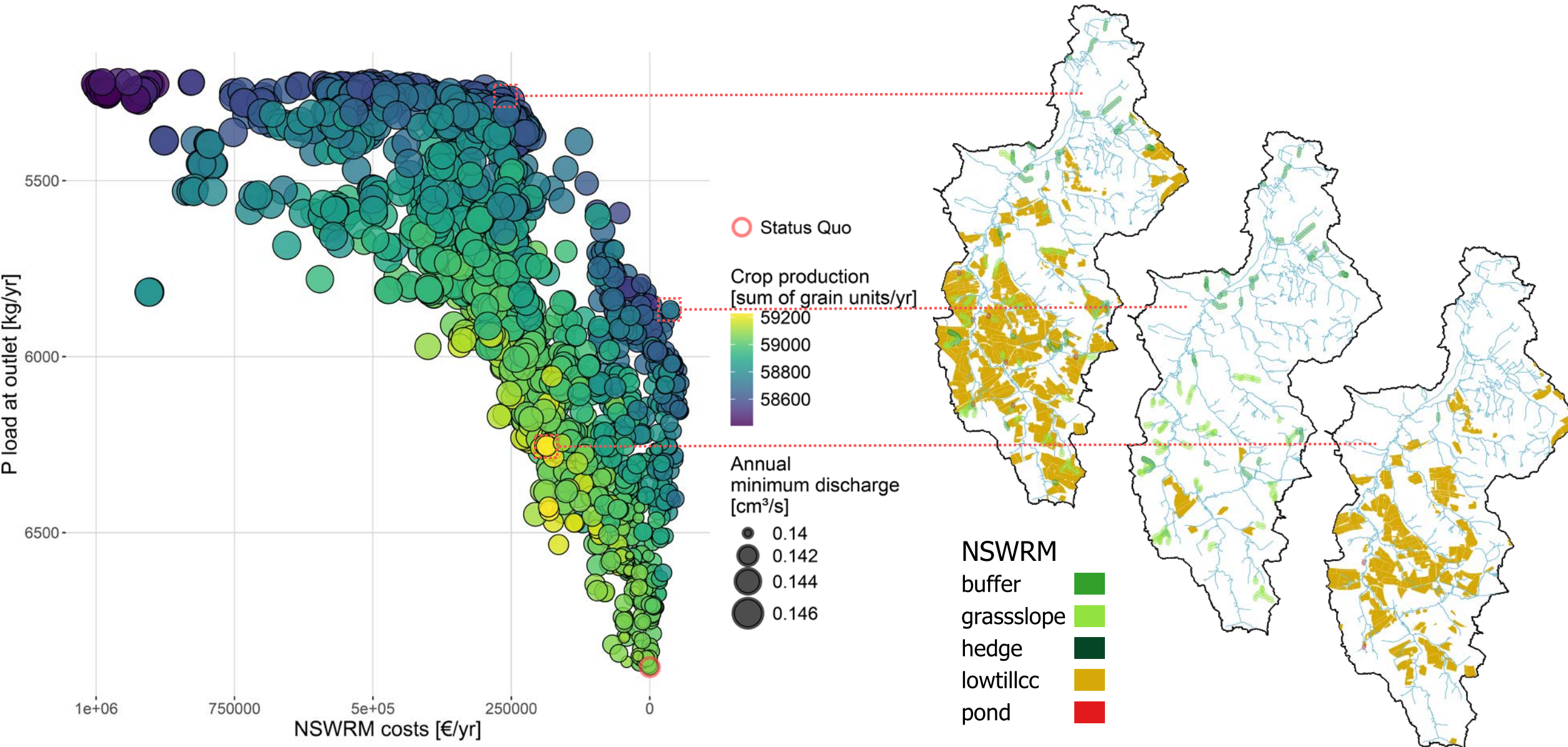
- Search for „optimal“ NSWRM allocation and combination regarding multiple objectives
- Which solutions are favoured by the stakeholders?
- Exploration of Pareto-optimal implementation plans by coupling the models with a genetic optimisation algorithm (NSGA-II)



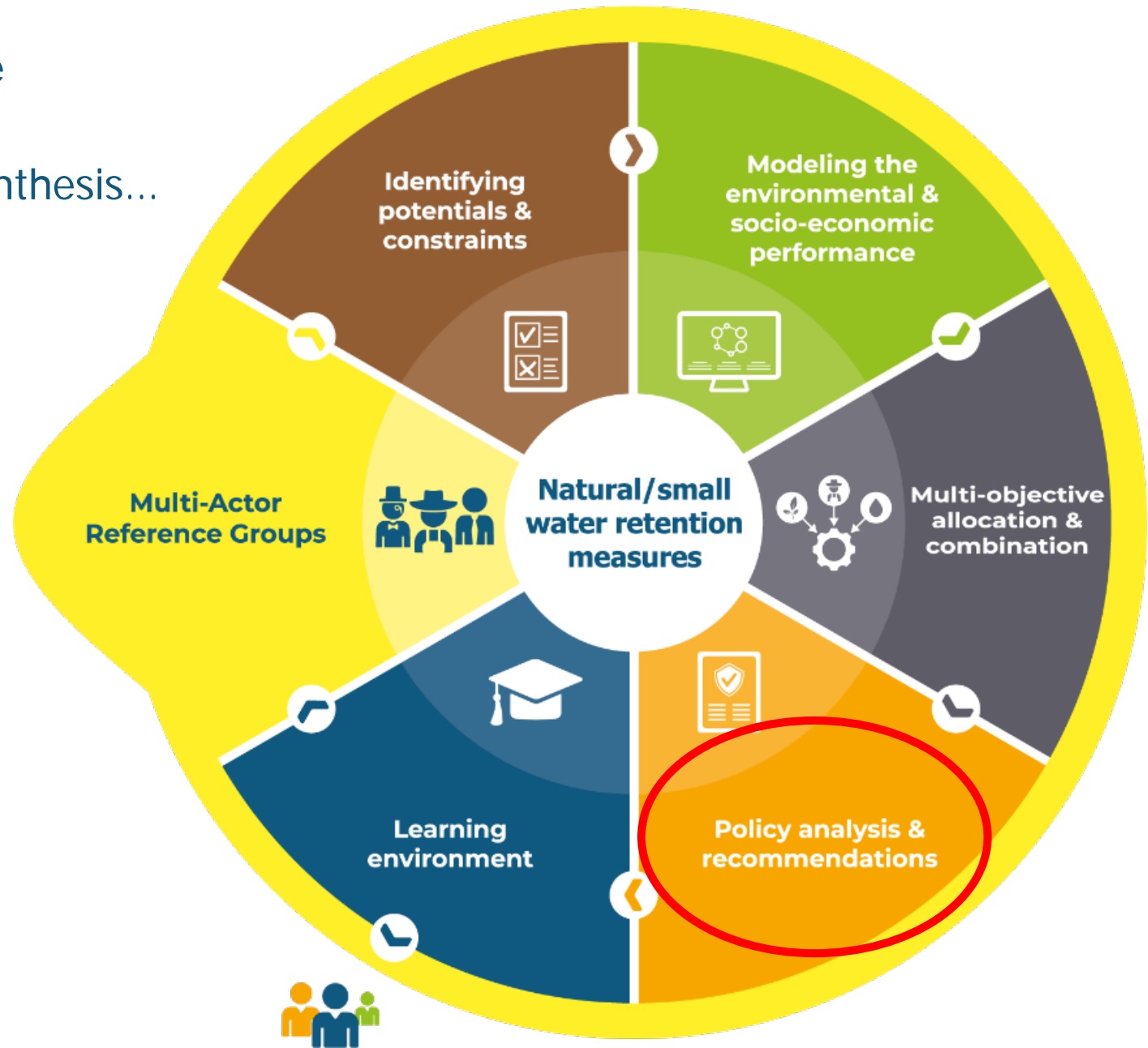
Balancing different needs using multi-objective optimization routines.
Martin Volk



Pareto-optimal implementation plans (Schwarzer Schöps)



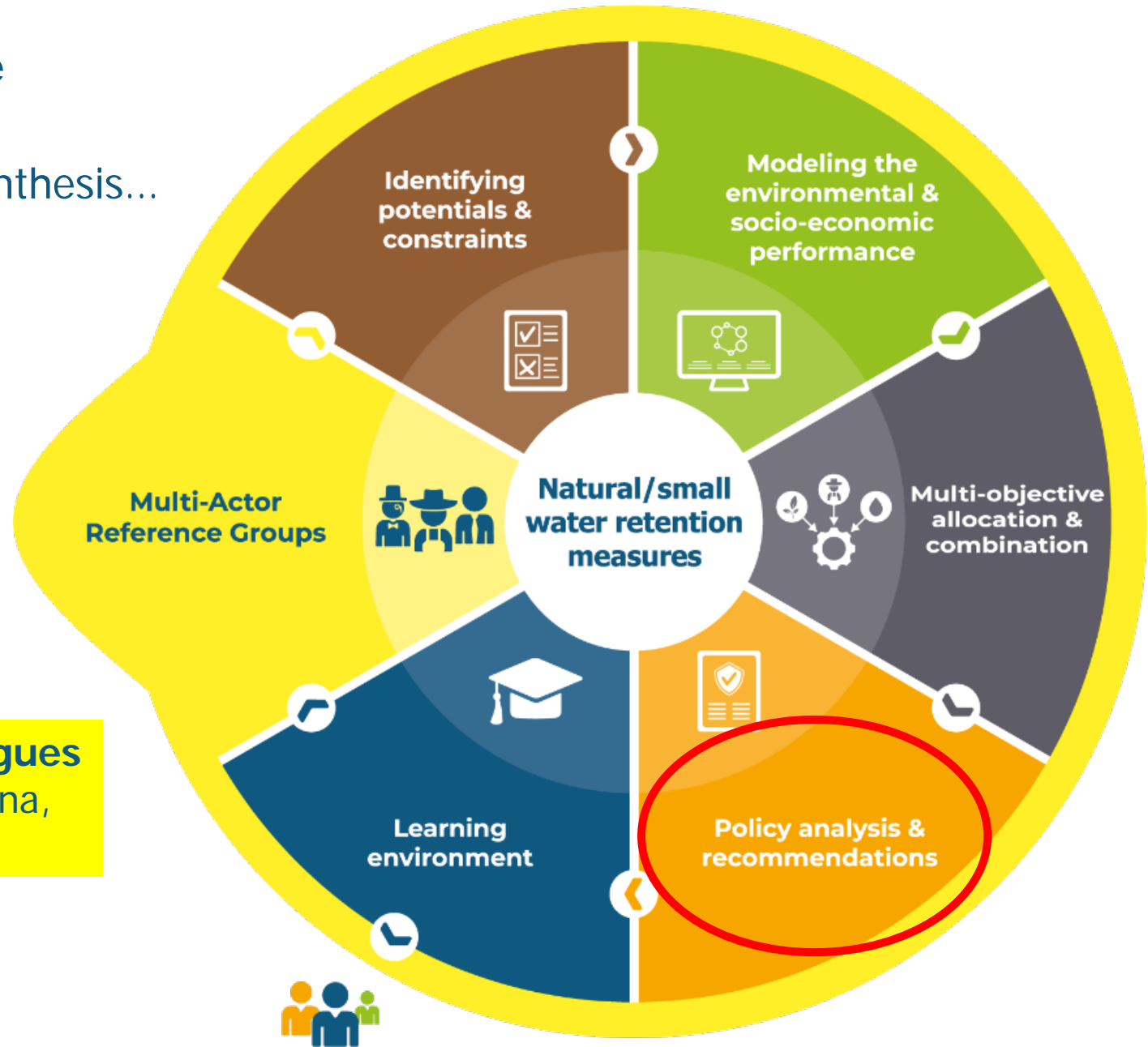
- What needs to be done to promote the implementation of effective measures?
- Stakeholder interviews, policy brief, synthesis...



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..in addition Regional Dialogues (so far in Bosnia and Herzegovina, Slovenia, and Hungary!)



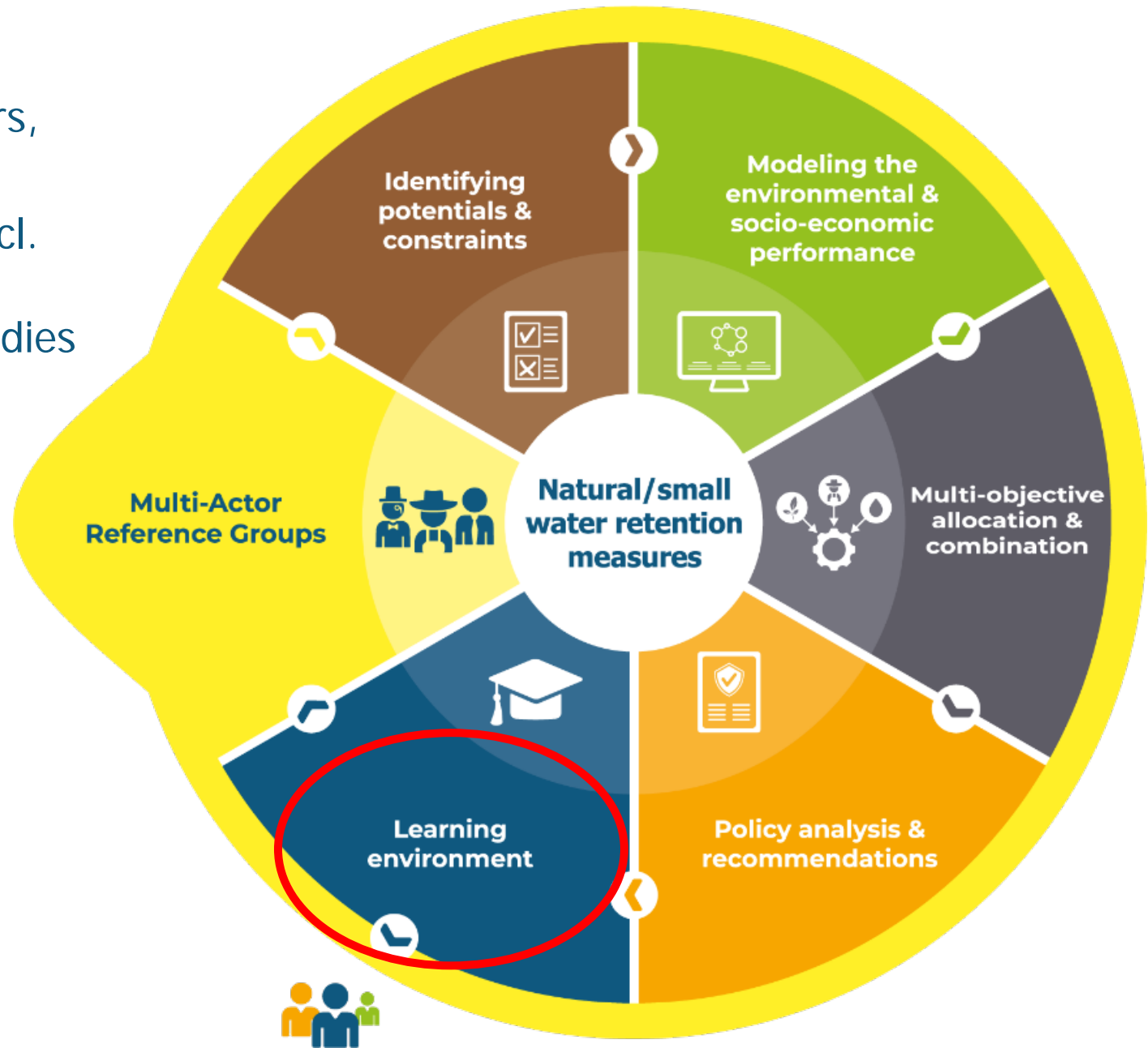
- Webseite (www.optain.eu), Newsletter, Leaflets, Social media, Videos, Webinars, Reports, Paper, etc.
- Learning Environment (le.optain.eu) incl. ParetoPick-R App for exploring the optimisation results of various case studies

Home Learn About Case studies&Measures Policies(KP) Expert & Scientific Area Explorative Tools Media Center

OPTAIN Learning Environment

Knowledge Pathways		
<p>Agri-advisors</p> <p>Guidance on implementing and adapting NSWRM policies at the regional level to meet local environmental and agricultural challenges.</p> <p>Go to Pathway</p>	<p>Civil society</p> <p>Practical resources and strategies for support farmers in adopting NSWRM to enhance sustainability and productivity.</p> <p>Go to Pathway</p>	<p>Decision makers</p> <p>Policy frameworks and strategies for effective NSWRM adoption, with emphasis on coordination across governance levels and policy harmonization</p> <p>Go to Pathway</p>
<p>Regional authorities</p> <p>Guidance on implementing and adapting NSWRM policies to address environmental and agricultural challenges at local, regional, and national scales.</p> <p>Go to Pathway</p>	<p>Scientific and academic communities</p> <p>Tools, methodologies, and case studies that advance the understanding and innovation of NSWRM in research and academic contexts.</p> <p>Go to Pathway</p>	<p>Agricultural practices</p> <p>Natural Small Water Retention Measures (NSWRM) that align with sustainable farming techniques, improving soil health and agricultural productivity while fostering resilience.</p> <p>Go to Pathway</p>
<p>Implementation costs</p> <p>Affordable and practical NSWRM options, supported by financial incentives and cost-effective strategies for land and water management.</p> <p>Go to Pathway</p>	<p>Flooding</p> <p>Solutions to manage excess water, reduce flood risks, and protect agricultural land from the impacts of extreme weather events.</p> <p>Go to Pathway</p>	<p>Water and soil pollution</p> <p>Techniques to address agricultural pollution and its impact on water and soil quality through natural water retention measures.</p> <p>Go to Pathway</p>

Still in progress...



Summary

- OPTAIN analyses nature-based/small-scale water retention measures in individual and combined effects
- OPTAIN documents, models, optimises, interacts and recommends
- It doesn't have to be many measures, but the right ones in the right place!

See many more OPTAIN-related presentations at this workshop!!

**Thank you for your
attention!**



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**Natural / Small
Water
Retention
Measures
(NSWRM)**

Examples:

Agricultural measures - maintenance and restoration of grasslands, buffer strips, soil conservation practices, green cover, mulching, crop management, etc.

Hydro-morphological measures - basins, ponds, wetlands, restoration of natural infiltration, riparian buffers, stream re-naturalisation, etc.

Small technical measures - related to drainage infrastructures and the recovery/re-use of water (e.g. dual systems) and nutrients (drainage channel bio reactors, etc.)

Measures which positively affect water availability and use efficiency of the agricultural production

Of course overlaps with other ecosystem-based concepts, such as GI, SLM, EbA, NbS