Restoring sponge function to address climate change threats and biodiversity loss

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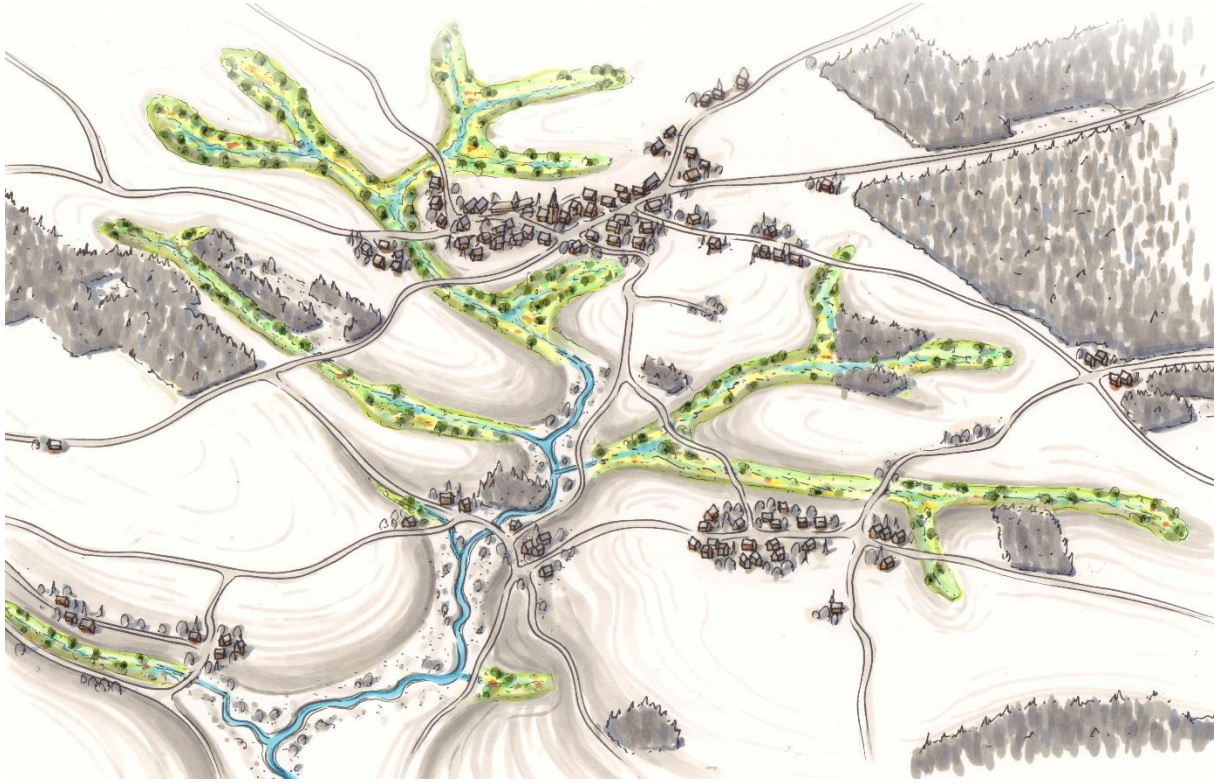
Credits; Jos de Bijl

Sponges in Micro Catchments, Macro Effects

Natural retention in small river catchments as a nature-based solution for flood risks, drought control and biodiversity loss



Visegrad 30-09-2021

Natural Climate Buffers Approach

Types of climate buffers

Ecosystem engineers
Use of organisms to establish sediment and/or slow down waves

Carbon sinks
Carbon sequestration in organic material, formation of marshes and salt marshes

Green air conditioning
Temperature reduction from wetlands in and around the city

Natural sponge
Water retention in natural areas on higher ground

Living coast
Natural dunes with shifting sand, sandbanks and expanding salt marshes as coastal protection

Room for nature and water management
Natural inundation areas store the water when there is heavy precipitation and peak discharge

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Some NWRM can be linked to certain NCB types...

Natural Water Retention Measures (NWRM)

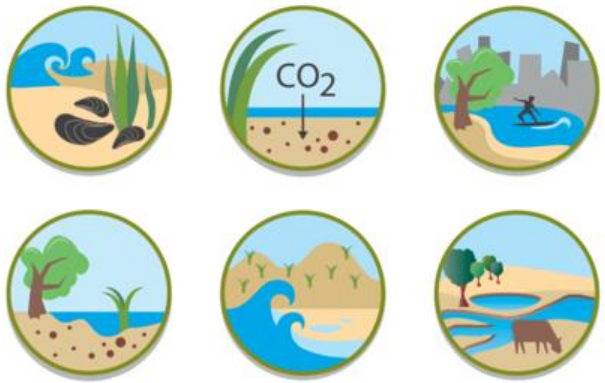
I. Direct modification in ecosystems:

- Rivers and connected wetlands,
- Lakes and connected wetlands,
- Aquifers

II. Change & adaption in land-use & water management practices:

- Agriculture
- Forestry and pastures
- Urban development

Natural Climate Buffer (NCB) concept



... while NCB can be seen as an informative way to illustrate the NbS concept by highlighting the societal aspect of climate change.

Nature-based Solution (NbS) concept

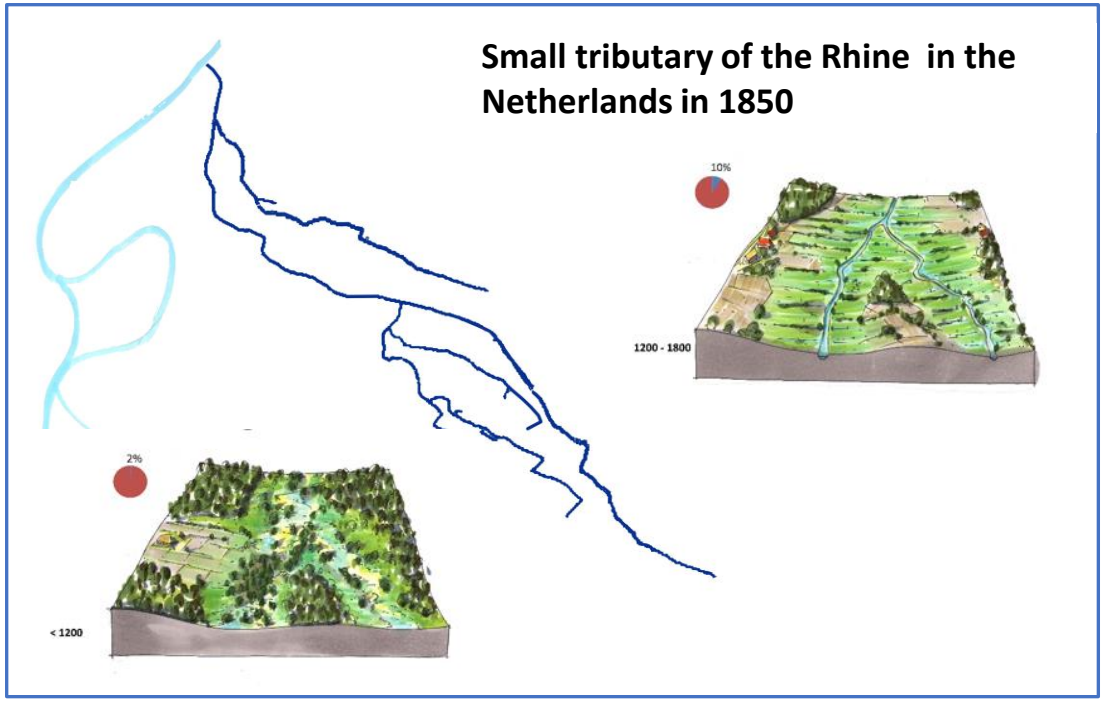
ER	Ecological Restoration
EE	Ecological Engineering
FLR	Forest Landscape Restoration
GI	Green Infrastructure
NI	Natural Infrastructure
EbMgt	Ecosystem-based Management
EbA	Ecosystem-based Adaptation
EbM	Ecosystem-based Mitigation
Eco-DRR	Ecosystem-based Disaster Risk Reduction
CAS	Climate Adaptation Services
AbC	Area-based Conservation

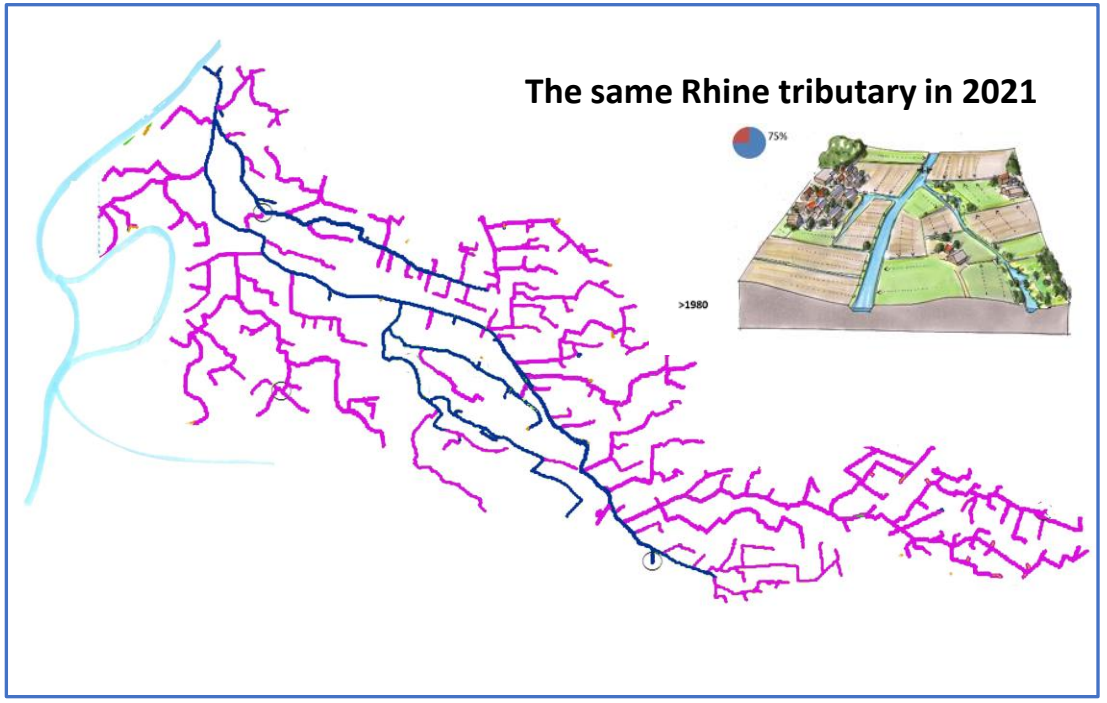
How do micro catchments fit in?

1.Large scale drainage took place at the sloping hills and valleys which discharge their water into (the tributaries of) major rivers like the Rhine.

2.Therefore, water is leaving the upstream catchments quicker than ever before, causing higher flood peaks and longer periods of drought.

3.Modifications of natural river conditions, fertilization, pesticides are the most frequently mentioned pressures causing river ecosystem degradation

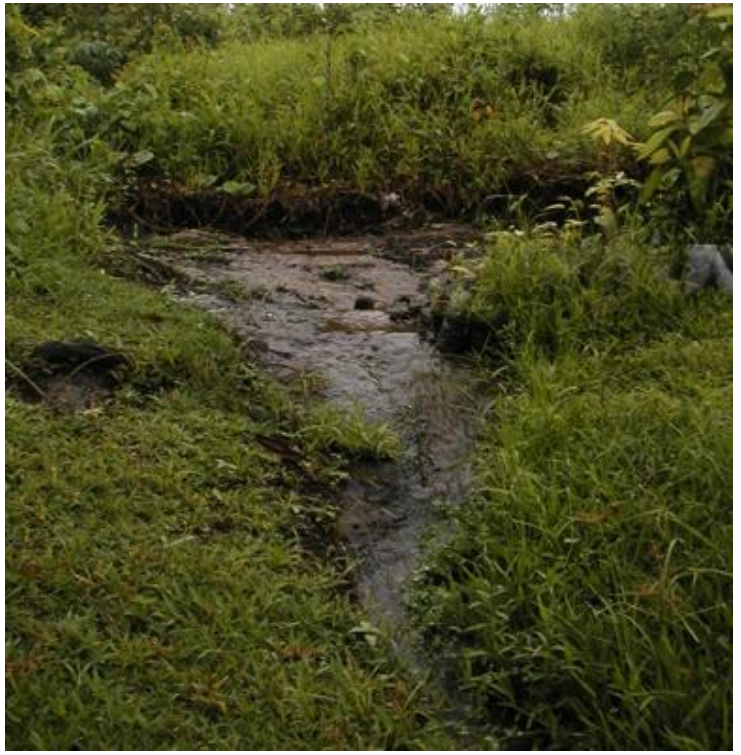




How do Micro Catchments fit in these global challenges?

Upstream micro catchments: Where a natural riverbed is formed by the power of flowing water

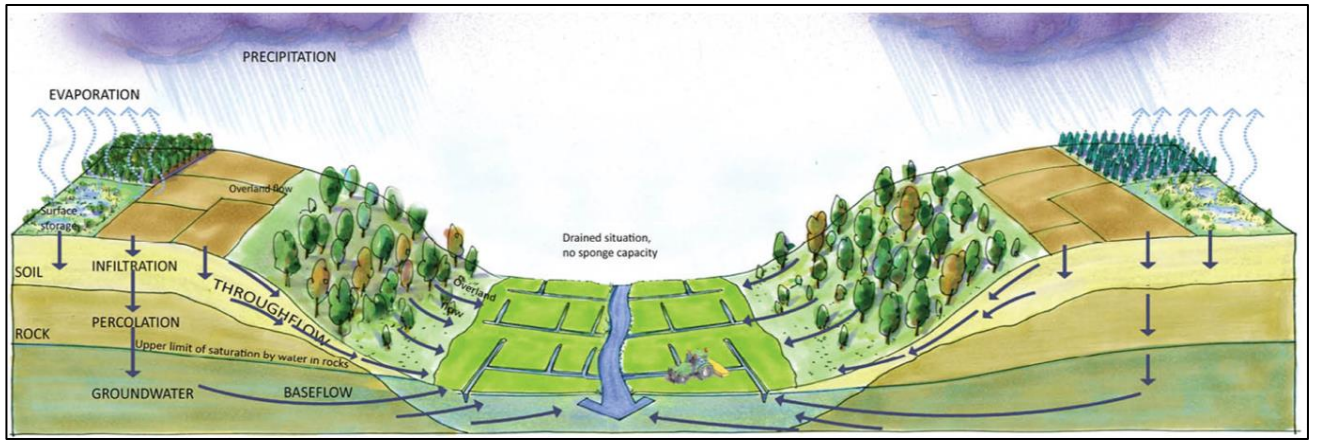
The capillaries of the river catchment

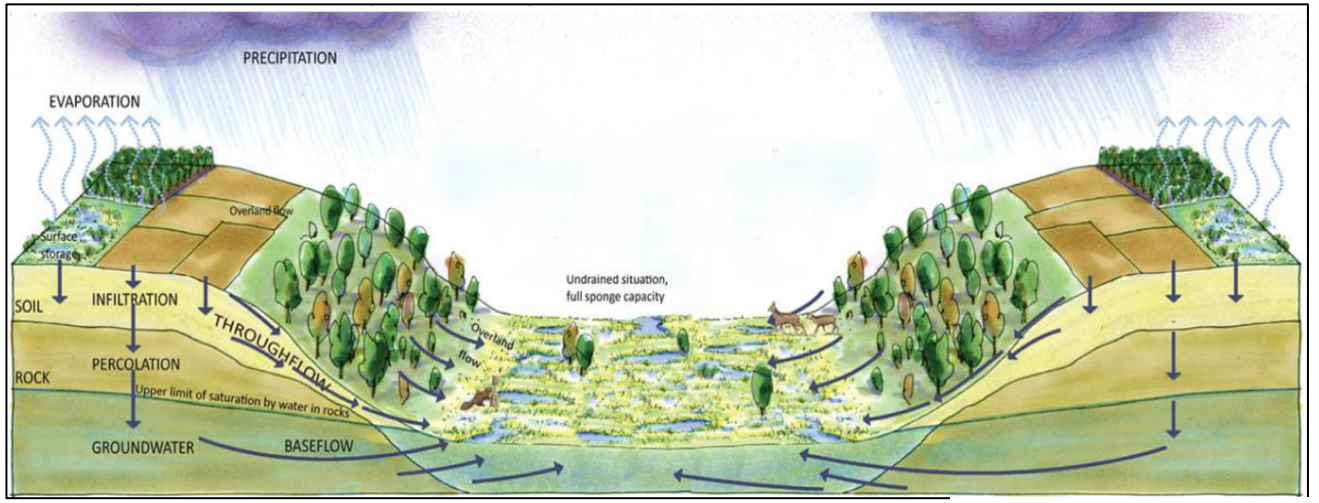


Sponge restoration in upstream catchments

An artist impression of a catchment before...

...and after sponge restoration





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Modelling approach

- Wetlands areas are small (25-100 m length scale) in headwater catchments
- Rhine River Basin size about 160,000 km^2
- Scale differences requires use of hydrological models to bridge different scales:

1. **Microscale** SWAT+ model
2. **Translation step**
3. **Macroscale** WFLOW_sbm model

Upstream Kyll River

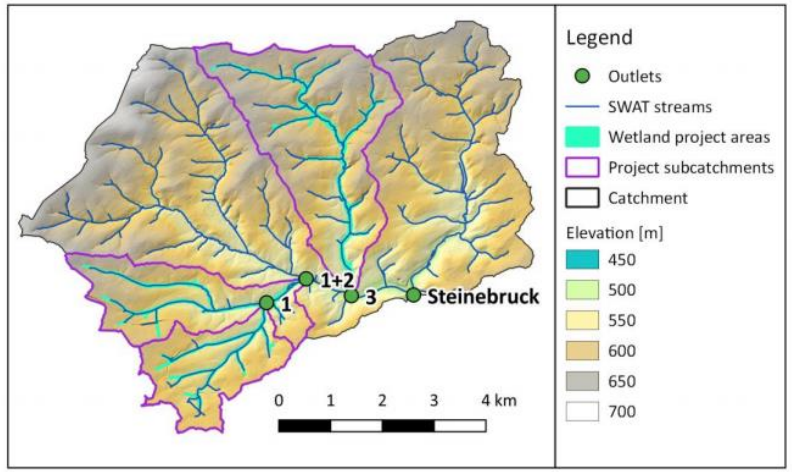


Figure 3. The elevation of the watershed draining to the Steinebrück catchment gauging station in the Kyll river and the delineation of the three project subbasins (Roderbach, Lewertbach) with their outlets. The pre-determined approximate delineation of the wetland project areas is included for reference.

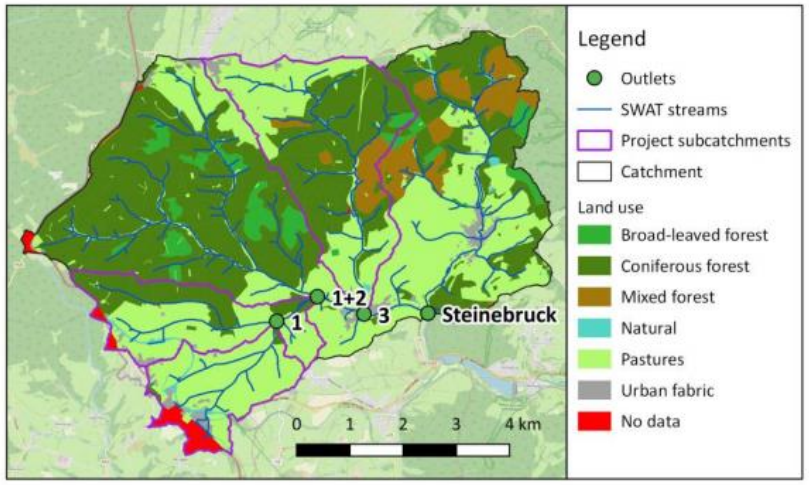


Figure 6. The land use map clipped to the watershed boundary created by SWAT. The red areas fall outside the area for which land use was provided. These have been assigned land use at the adjacent areas for which data were available after verification by satellite imagery.

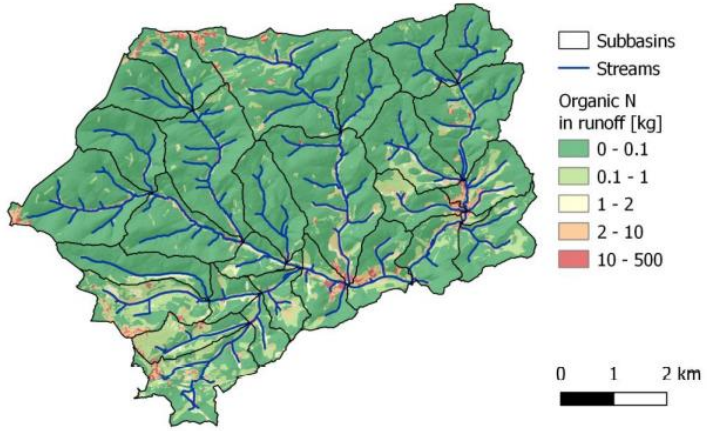


Figure 15. Simulated average annual organic nitrogen exports from the model HRUs.

Conclusion hydrology natural wetland retention

	Steinebrück	Mosel			Rhine		
Wetland restoration intensity	38 %	4 %	19 %	38%	4 %	19%	38%
Annual maximum Peak discharge change	-13%	-0.4%	-2.2%	-4.1%	-0.5%	-1.3%	-1.8%

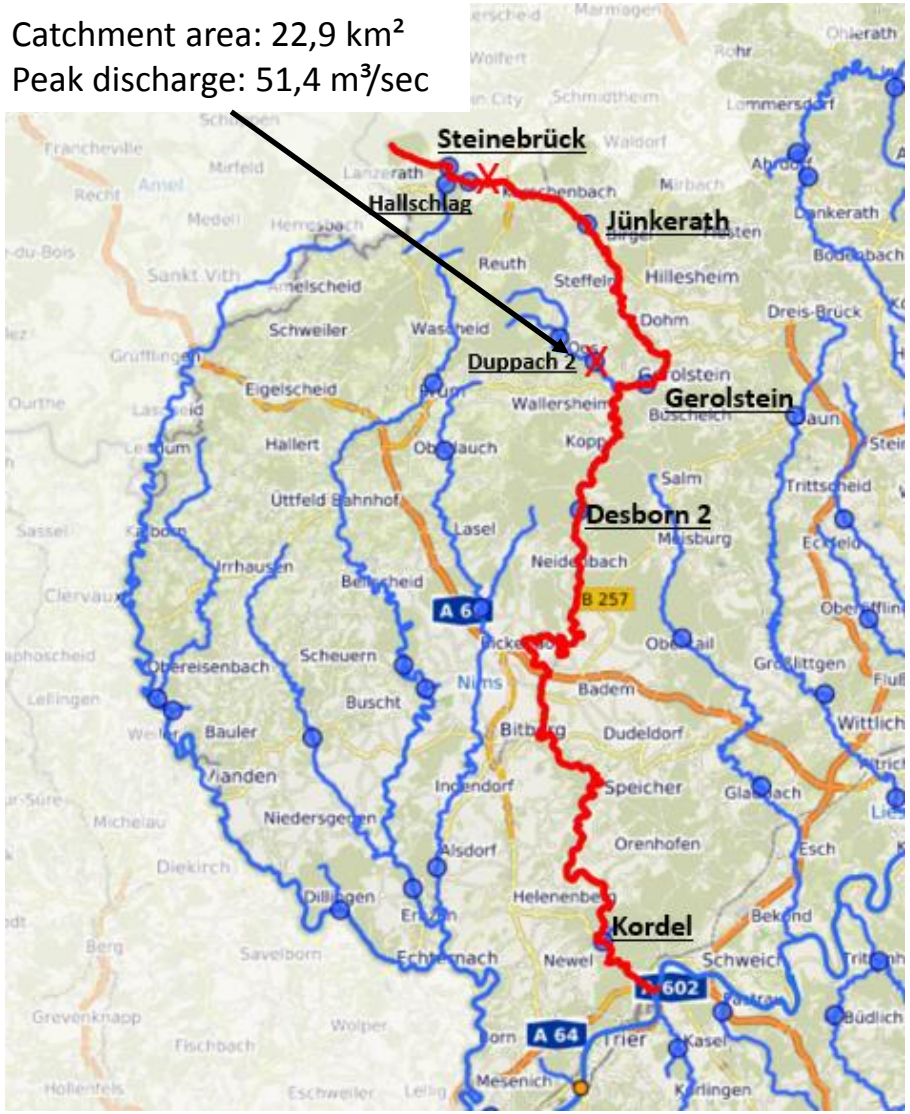
- Wetland restoration in headwater catchments of the Mosel and Rhine River Basins lead to reduced peak flows
- Strongest reductions at microscale
- Wetland restoration in Germany is able to decrease annual peak discharges in The Netherlands by 1,8 % at a restoration intensity of 38%.
- 10 – 30 % higher baseflow
  in dry periods in Steinebrück catchment

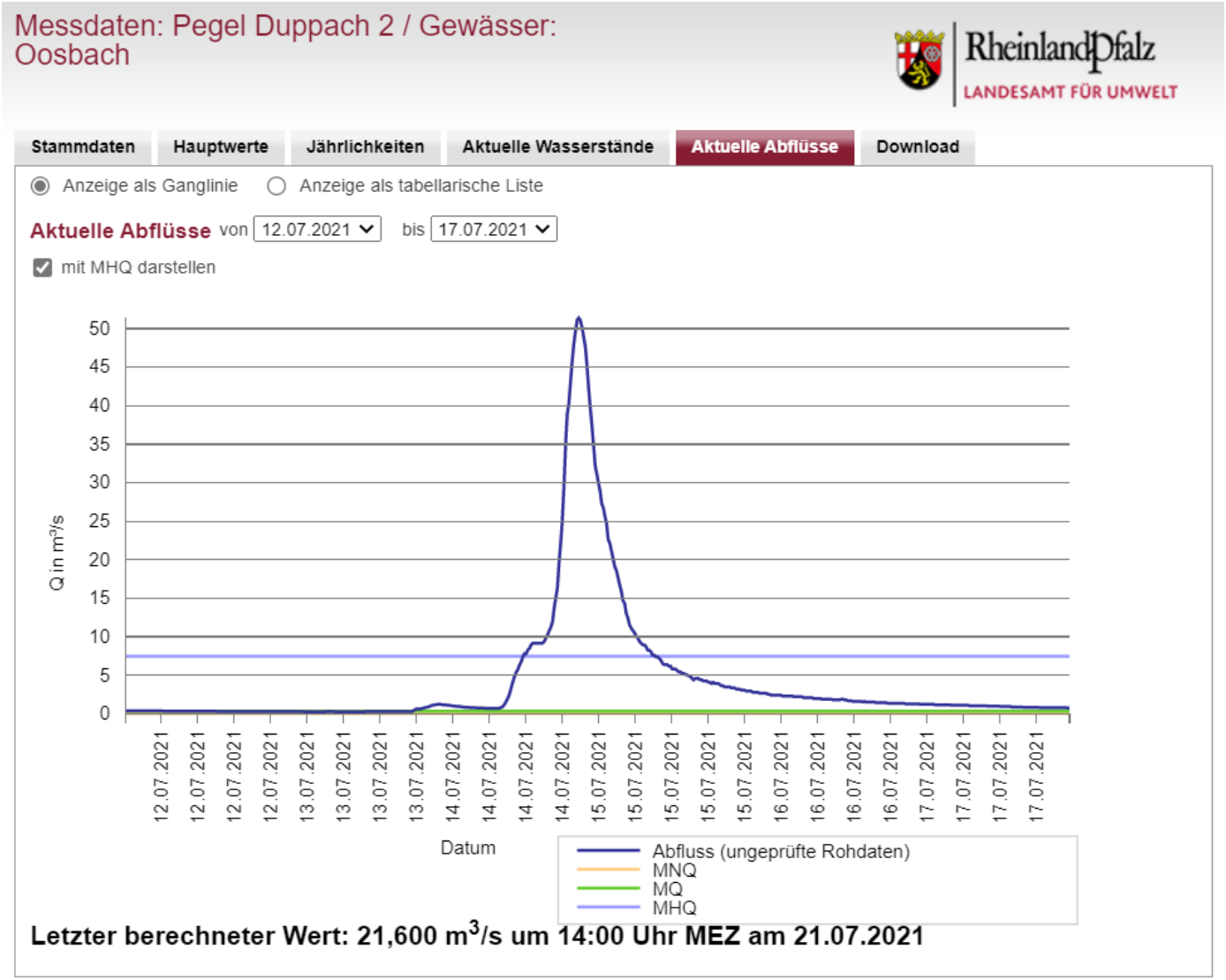
Social costs flood event July 2021

- Devastating flood event in July 2021 in the Kyll river (pictures are from Kyllburg) and other middle mountain areas in Germany and Belgium
- Social and Financial costs are not yet estimated but are enormous
- First analyses show that upstream micro catchments contributed more to the peak flow downstream then one would expect given their catchment size.

Micro Catchments, macro discharges
Discharge Duppach 2: Tributary Kyll

Catchment area: 22,9 km²
Peak discharge: 51,4 m³/sec





Fast component in peak discharge

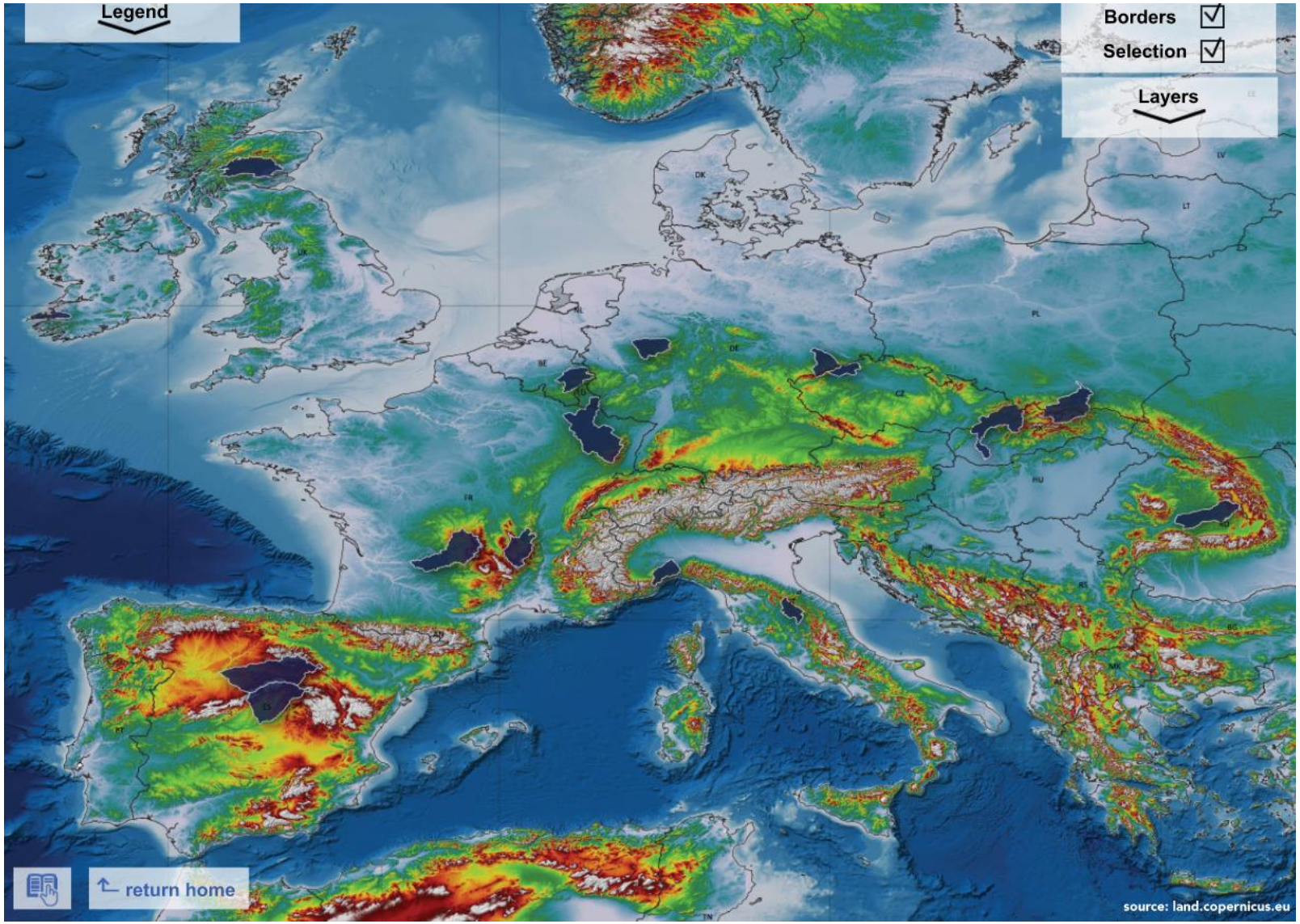
Paved and unpaved roads seem to be the drainage systems during intense summer rain events

Policy contributions, a crucial part of the business case

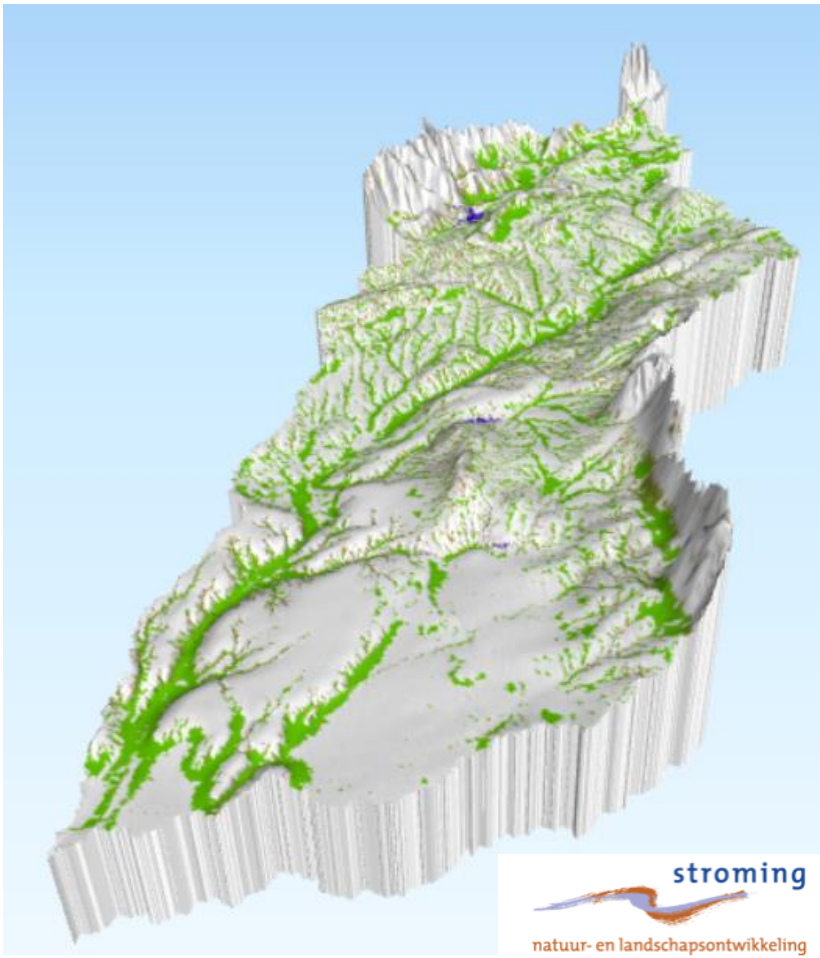
Policy	Contribution
Habitats Directive	Development of wetlands, including peat, alluvial forests and peat,
Birds Directive	Breeding and feeding grounds for songbirds, waders, waterfowl,
Climate/Green Deal	CO2 sequestration and at the same time creating new income for farmers/landowners through compensation of recreation
Water Framework Directive	Restoration of hydrological integrity of river systems, improved condition for fish migration and spawning, improved water quality
Common Agricultural Policy	Regreening of CAP
Trans-European Network for Green Infrastructure	Contribution to TEN-G

Table 6.4. EU policies to which restoration of natural retention capacity contributes.

Extended river catchments common in European Rivers



https://media.stroming.nl/sponges/



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Thank You!

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