Hydrologic modelling of seasonal runoff generation during heavy rainfall: Effect of decentralized water retention measures at a floodprone site in Trier (Germany) – A study concept

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(A) Introduction:

Our scope is to analyze the effect of different flood prevention measures on an existing drainage infrastructure, which in the past could not fulfill the purpose of drainage and thus flood damage in the underlying settlement occurred frequently.

Hypotheses:

1. Seasonal plant growth state effects trigger different hydrological response on heavy rainfall

2. soil moisture storage is a critical control on area's runoff reaction

3. hedge stripes reduce runoff response and ensure increased soil moisture during dry periods

The dynamic hydrological processes are analyzed with the field work, as well as with a hydrological model parametrized from collected data.

(B) Study side: A floodprone site with dysfunctional drainage system close to a settlement

- located in Trier Irsch (Germany)
- size: 0.29 km²
- low thickness soils
- mainly agricultural land use
- (5-crop rotation)
- slope parallel cultivation without plowing
- drainage channel leading to a sedimentation basin

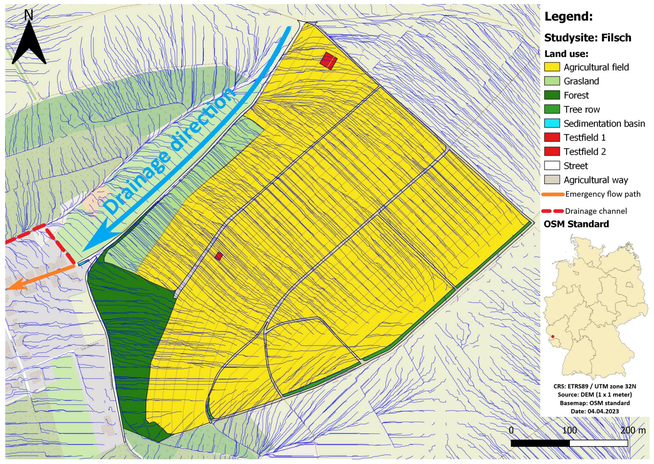


Figure 1: DEM based flow direction and drainage infrastructure

Table 1: Management of 3 parallel lying test plots

Seasonal vegetation cover and soil moisture

Land use management	Spring Veg. cov. / Soil moist.	Summer Veg. cov. / Soil moist.	Autumn Veg. cov. / Soil moist.	Winter Veg. cov. / Soil moist.
5 – crop cycle	covered / wet	covered / dry	covered / humid	covered / wet
Conventional	barren / wet	covered / dry	covered / humid	barren / wet
Uncultivated	covered / wet	covered / dry	covered / humid	covered / wet

(C) Fieldwork: Simulating heavy rainfall events on small-scale plots to identify surface runoff generation processes under varying seasonal soil moisture and plant growth conditions

- soil sampling (grain size distribution)
- soil moisture content (sensor + datalogger)
- sprinkling experiments (runoff)
- macropore distribution

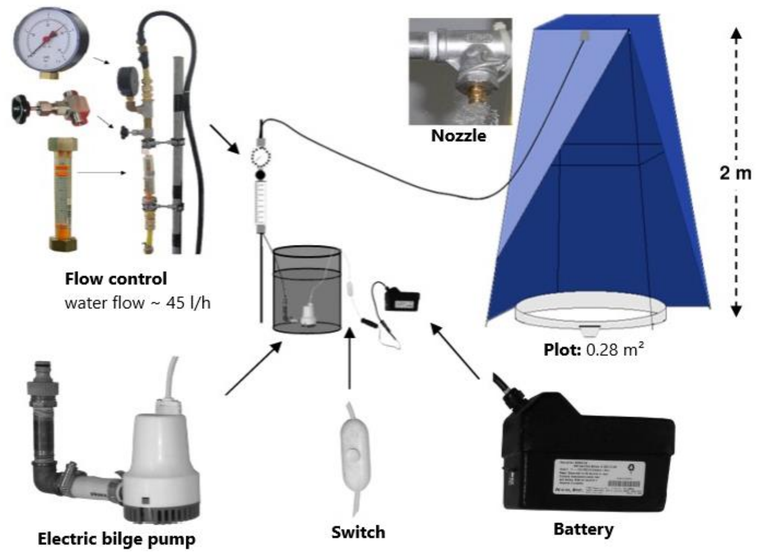


Figure 2: Portable rainfall simulator. Source: modified after Iserloh T. (2013)

(D) Model: Simulating the impact of mitigation measures and soil storage on surface runoff generation processes under heavy rainfall

- simulation of several heavy rainfall events (100a, KOSTRA-DWD)
  → on different soil moisture initial conditions
- different agricultural managements
  → status quo, conventional, uncultivated
- parametrization of hedge strips (different dimensions & positioning)

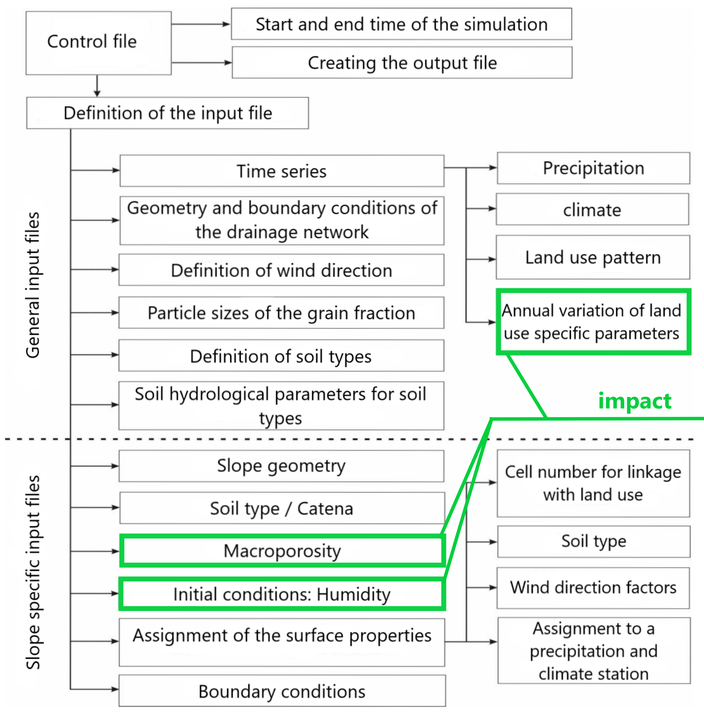
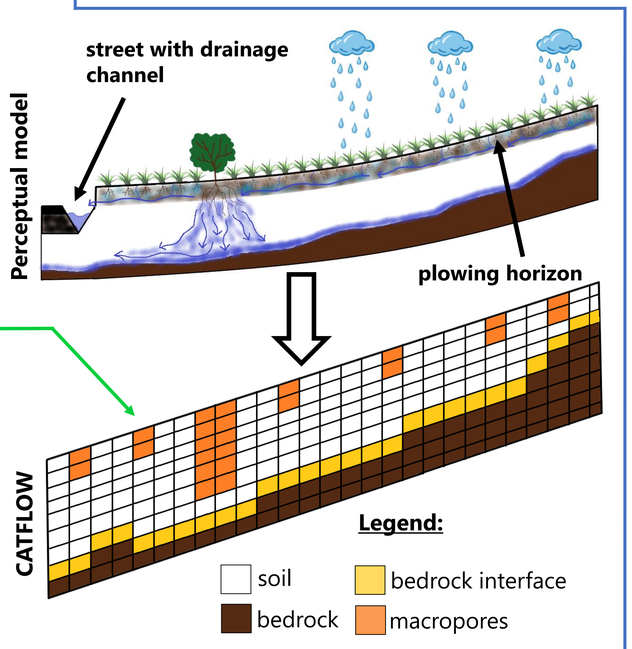
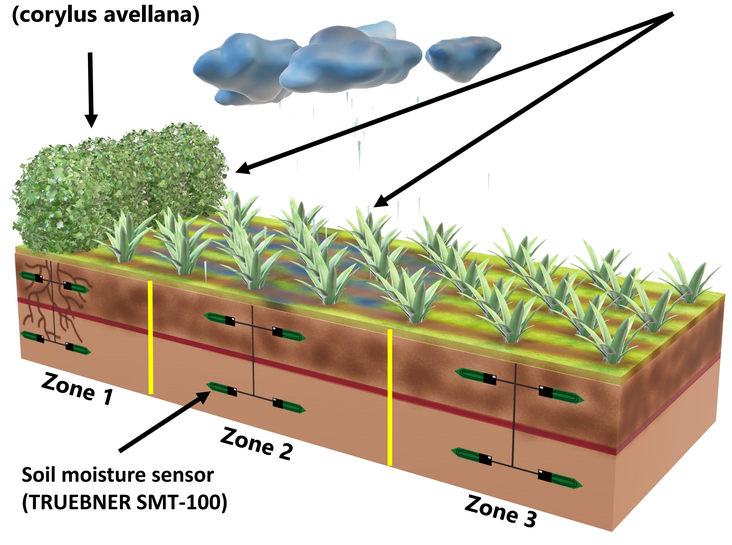


Figure 3: Workflow CATFLOW model. Source: CATFLOW user guide (2007)





Experiment location in each test plot
Zone 1: sprinkler experiments
Zone 2: sprinkler experiments
Zone 3: no experiments

(E) Expected results:

- effect of hedge stripes and agricultural management on soil moisture and runoff generation dynamics
- effect of hedge stripes on soil moisture under drought conditions
- runoff generation under different KOSTRA-DWD heavy rainfall scenarios, seasons and initial soil moisture conditions

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