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

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Due to the climate change-related increase in extreme weather events and scenarios such as the flood disaster in Western and Central Europe in July 2021, an increased research effort is necessary in order to better predict the dynamics of such events and consequently create preventive measures. Due to a lack of water retention capacity and insufficient drainage structures, the vulnerability is high in and around of settlements where infrastructures are not sufficiently adapted for extreme precipitation. Since not only the sealed surfaces in urban areas contribute to the development of runoff processes, but the entire catchment area, the process dynamics of the outer areas of settlements must also be increasingly researched.

This study is part of the collaborative project “Urban Flood Resilience - Smart Tools (FloReST)”, which is funded by the German Federal Ministry of Education and Research and is dedicated to the exploration of measures to determine and increase the resilience of existing infrastructures.

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

The connected runoff generating area is mainly used for agriculture. Despite an adapted cultivation method with the no tillage method and a 5-stage crop rotation that ensures a soil cover over the whole year several flooding events occurred due to surface runoff generation. Local farmers have reported that this slope does not always generate surface runoff throughout the year for similar heavy rainfall events. Hence, we hypothesize that not only the precipitation event, but also seasonal effects have an influence on runoff generation under heavy rainfalls. To quantify runoff generation and the causes of its occurrence, the study site will be analysed using the slope specific, physical, deterministic, hydrological model CATFLOW. Heavy rainfall simulations will be used to study the impact of current land use, alternative cultivation methods and decentralized water retention measures in order to understand potential water retention in the area. The simulation model will be calibrated using field studies such as soil sampling and irrigation tests on the study site and in addition on test fields with integrated water retention measures. Water retention measures also have the advantage of providing increased soil moisture during dry periods, thus enhancing agricultural land quality.