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Decentralised flood protection in low mountain areas – the Upper Floeha case study

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In the German-Czech border regions throughout the Ore Mountains storm runoff frequently causes severe damage in headwater areas as well as in lower reaches. The fact, that settlements along smaller tributaries (second order rivers) and towns near the receiving water (first order rivers) are affected simultaneously, requires the consideration of measures distributed throughout the entire drainage area. The concept of decentralised flood protection includes a large number of different measures, which are suitable for the application in low mountain ranges, e.g. small, decentralised retarding basins, river revitalisation, reforestation of floodplains or landuse changes.
The presented study is part of the Interreg IIIA research project "DINGHO". Its aim is to show, how decentralised measures can contribute to an improvement of flood protection in low mountain areas using the example of the Upper Floeha watershed. On this background the investigations focus on headwater areas as well as downstream settlements. The study area extends between the town of Olbernhau (Free State of Saxony, Germany) and the large Rauschenbach reservoir, including two main tributaries (Natzschung and Schweinitz), and covers an area of 228 km^2. The geomorphology of the study area is characterised by plateau-like headwater areas with gentle slopes (above $\sim$700 m a.s.l.) and steep and strongly dissected lower reaches.
In a first step the local potentials for the implementation of decentralised measures were investigated on the basis of GIS analyses and field surveys. The second step included the assessment of the efficiency of the decentralised measures by the application of rainfall-runoff-models. Depending on the type of measures two different software packages were used: the model systems NASIM for measures along river courses and WaSiM-ETH for the watershed-wide retention (landuse changes).
Potentials for water retention in small, decentralised retarding basins can be found especially in higher regions with more gentle slopes. Steep valleys in lower reaches are less suitable for such basins due to their steep gradient and the consequential limitation of storage capacities. Along most of the rivers potentials for an afforestation of the valley bottoms in order to increase the surface roughness were identified, but the hydrological effects depend on the shape of the valleys and their gradients. However potentials for river revitalisation are strongly limited. In addition, some areas can be reforested, since they have recently recovered from the SO2 pollution which affected the area until the late 1980s and caused serious forest decline.
The modelling results indicate, that small retarding basins would lead to a reduction of peak discharges of a 100-year return period of up to 45 % at some tributaries and 10 % downstream in Olbernhau. By contrast local effects of the floodplain afforestation remain very low, whereas in Olbernhau a peak reduction of 4.2 % can be achieved. If only the Floeha floodplain with a wide valley and a low gradient is considered for the afforestation, the flood peaks were reduced by 3.5 % in the model. By reforestation of declined forests peak discharge can be reduced by about 13 %.
On the whole the results show, that a significant improvement of flood protection in the Upper Floeha watershed can be achieved through the application of decentralised measures. The reduction of flood peaks includes the Floeha river itself, tributaries and headwater areas. However as far as measures along the rivers are concerned, the extent of the hydrological effects strongly depends on the retention potentials in subareas with more gentle valley gradients, i.e. in higher regions of the study area or along the Floeha valley.