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Challenges to and approaches for water retentive forest management in low mountain ranges in Germany

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The potential of healthy ecosystems in providing a multi-purpose and sustainable approach to Disaster Risk Reduction (DRR) and Climate Change Adaptation is widely acknowledged and, e.g., also highlighted in the latest Adaptation Strategy of the European Commission. However, to what extent an ecosystem can support DRR is largely determined by its condition. This holds also true for forest ecosystems. Their potential in supporting water retention and, therefore, in reducing drought and flood risk is widely recognized. However, often their potential to retain water is impaired by many stressors. Many of them are related directly to the trade-offs that come along with the forest management objectives. This is particularly the case when the ecosystem management's target is to maximize the provision of one Ecosystem Service (ES), such as the provision of timber, which often leads to a considerable decline in the ecosystem's ability to provide other ES, such as water retention. In alpine regions exists, for example, the concept of protective forests where financial interests in timber production are subordinate to address the trade-offs between forest ES. However, this concept has not received much attention in low mountain ranges so far even though they can already cause considerable orographic precipitation.

Within this study, we investigated possible challenges and approaches for increased implementation of water retentive forest management in low mountain ranges. This was exemplarily done for the Rhineland-Palatinate part of the Ahr catchment. 19 investigative semi-structured expert interviews were conducted with 20 actors from the forestry, water, and nature conservations sector which included practitioners, academics, and personnel in higher and lower administrative levels and advisory centers. The qualitative analysis of the interviews has shown that the extreme 2021 floods (return period at minimum 500 years) were a warning shot that sparked interest in the water retention potential of forests at various levels, which was before majorly in the focus to reduce the drought risk on forests. However, several interacting barriers exist, ranging from rather silvicultural to socio-structural challenges. As reported by other research, a key challenge was related to finance. For example, the clearance of dead spruce stands is often financially motivated. However, research shows that this impairs the forest's water retention capacity. Furthermore, a financial bottleneck was observed regarding infrastructural adaptations for enhanced water retention. Our work shows that due to the various potential co-

benefits water retention measures in the forest can potentially profit from different funding mechanisms. Especially from the water sector, funding opportunities are available for measures that might not be covered under current funding schemes from the forest sector. However, a key prerequisite is that observed compound and cascading interactions are addressed. The limited cooperation between the different actors should be enhanced in this regard which will require improved coordination from the respective higher authorities and greater awareness locally.