

European flood events and sustainable flood protection management

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Introduction

Climate change is expected to cause an increase in heavy precipitation events in Germany, with river flooding caused by precipitation already being the event with the greatest damage throughout Germany. An example of a flood with particularly great damage happened in 2021 in parts of Germany, the Netherlands and Belgium. Heavy precipitation events will be up to 300 % more frequently by the end of the 21st century and precipitation events that occur over one or more days can take place up to 150 % more frequently over several days. Therefore, it is crucial to prioritize protection concepts, which are already of high importance today, to ensure safety in the future.

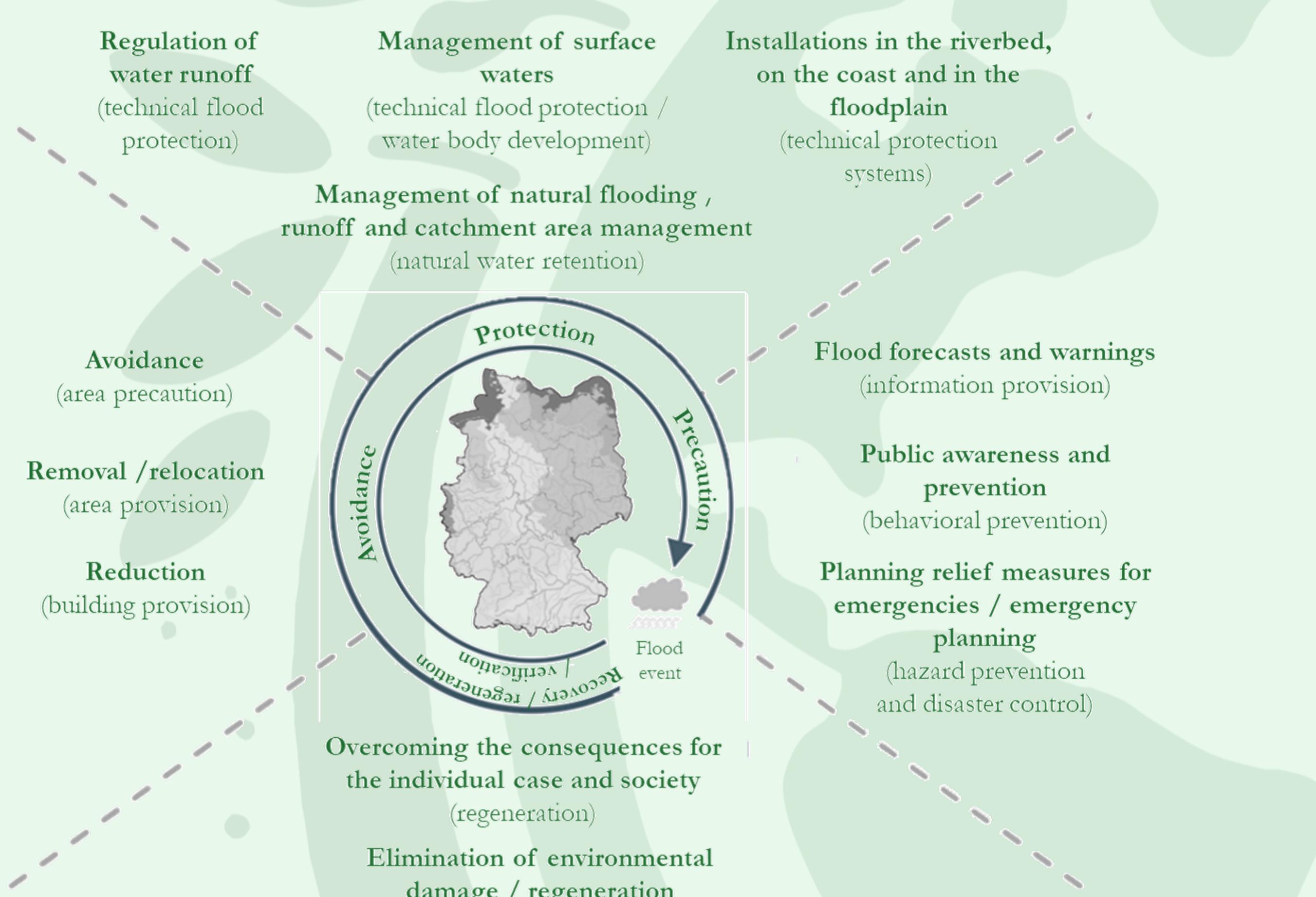


Fig 1: Types of measures and areas of action for flood risk management in the flood risk management cycle (modified according to LAWA 2019).

Results

Floods have various causes, including widespread, continuous, or short-lived heavy rainfall, as well as snowmelt. The flooding in July 2021 was caused by heavy rainfall over an unusually large area. The cyclone "Bernd" released 115 mm rain in 72 h and with previous rain events, the soil was already saturated, leading to excess runoff that caused significant property damage, injuries, and fatalities. In the past, flood prevention strategies mainly focused on dike relocation and flood retention. However, governments have now improved their flood prevention strategies. Figure 2 shows the range of average reductions for the Delta Rhine in its three branches. the greatest reductions in water levels is of the IJssel, which results of the "Space for the river" program.



Discussion

Flood events are a natural part of the hydrological cycle. Flood protection measures aim to reduce peak discharges and water levels. These measures can be categorized as technical and non-technical, and they can be effectively combined. While centralized measures are mainly installed along the water body, like dams and dikes, decentralized measures can be installed in the entire catchment area. They allow to start flood protection at the point where the run-off is accumulating, rather than where the flood wave has already developed. In the Rhine catchment area, which includes the Ahr Valley, the retention volume was increased from 160 million km³ to 340 million km³ between 1995 and 2020. This retention volume attenuates the calculated flood levels, which has a particularly positive effect on the Netherlands, while the decreases around the Ahr Valley, in the Lower Rhine, were relatively small. This may have had an impact on the 2021 event.

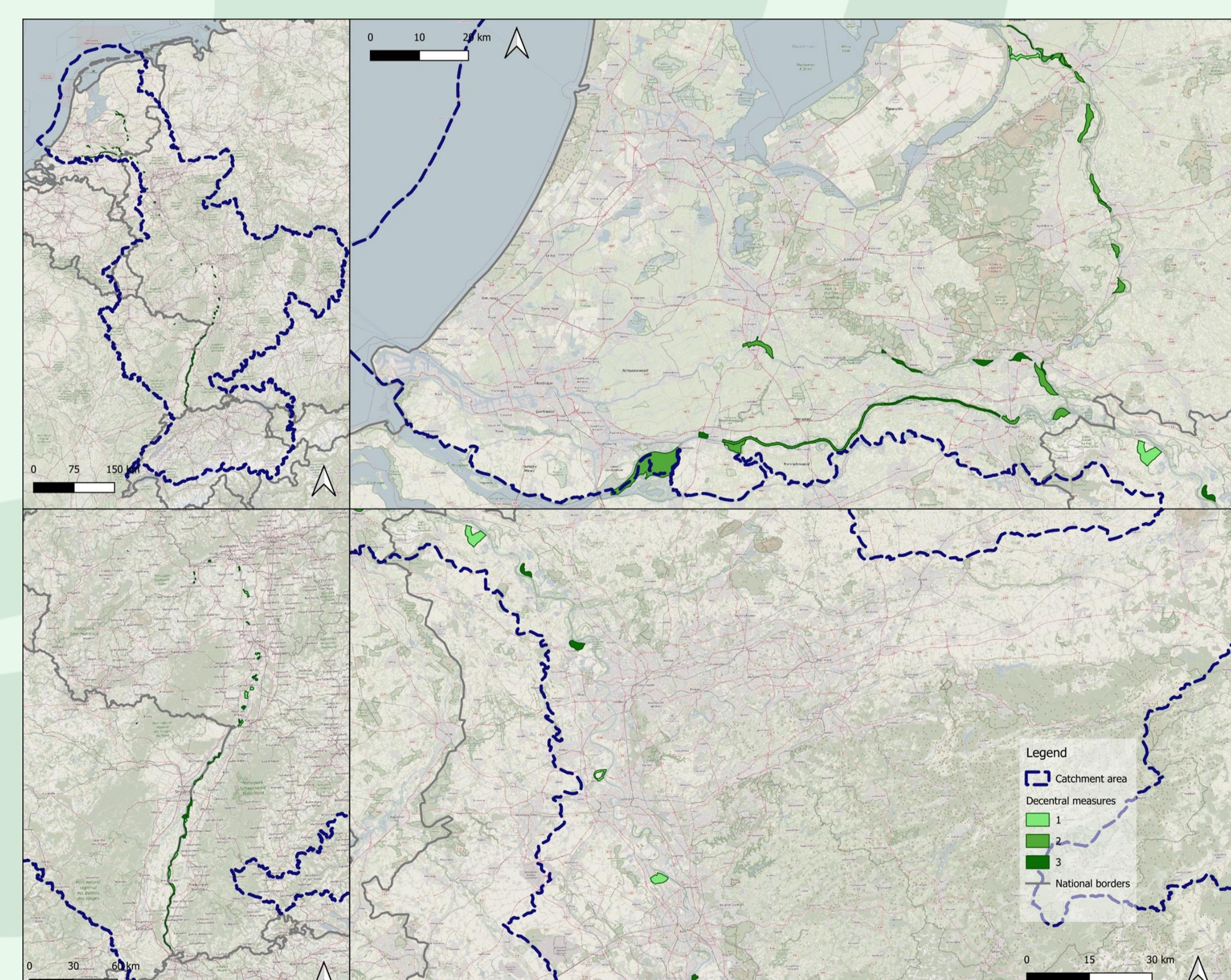


Fig 2: Retention measures in the catchment area of the Rhine. Upper left: Hole catchment area. Upper right: Dutch retention measures. Bottom left: South German catchment area. Bottom right: German catchment area between Bonn and the Dutch border. 1 = planned; 2 = under construction; 3 = existing.



More information
on our website.



Literature

- Bosseler, Bert, Mirko Salomon, Marco Schlüter, and Matteo Rubinato (2021) Living with Urban Flooding: A Continuous Learning Process for Local Municipalities and Lessons Learnt from the 2021 Events in Germany. Water 13.
- Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e. V. (Ed.). (2015) DWA-Regelwerk: Vol. 550. Merkblatt DWA-550 // Merkblatt DWA-M 550 Dezentrale Maßnahmen zur Hochwasserminderung: Dezentrale Maßnahmen zur Hochwasserminderung (1., November 2015). Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall.
- Flussschutzgemeinschaft Rhein (Ed.). (2021). Hochwasserrisikomanagementplan der Flussschutzgemeinschaft Rhein für den Zeitraum 2021 bis 2027: HWRM-Plan für den deutschen Teil der Flussschutzgemeinschaft Rhein.
- Mooij, Johan. (2018) Auenrenaturierung in den Niederlanden und am Niederrhein.
- Thieken, A. H., Bubeck, P., Heidenreich, A., von Keyserlingk, J., Dillenardt, L., and Otto, A. (2023) Performance of the flood warning system in Germany in July 2021 – insights from affected residents. Nat. Hazards Earth Syst. Sci., 23.