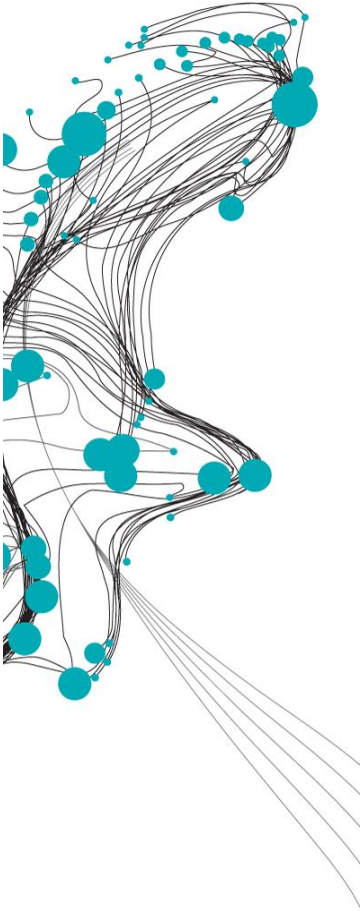


SMART COMBINATIONS: AN ALTERNATIVE TO DIKE REINFORCEMENTS?

APPLICABILITY TO REDUCE FLOOD RISK IN THE NETHERLANDS



The Dutch method to combat flood risks is highly institutionalized, dikes are reinforced to reduce the flood risks without considering other options to prevent or mitigate floods. While other European member states have been able to implement more multi-layered flood safety – thereby improving their flood resilience – the Netherlands does not effectively use other options. This research considers another option: smart combinations, which use a combination of measures of the different layers of the multi-layered flood safety approach, including the prevention of floods (layer 1), spatial planning (layer 2) and emergency response (layer 3). As it is unknown where these smart combinations can be used, and whether they can contribute to reducing the risks, the aim of this research is to identify where and to quantify what potential reduction in flood risk can be achieved with smart combinations.

Based on literature it was found that 43 safety standard segments allow for the implementation of smart combinations. Segment 27-2 – Tholen en St. Philipsland 2 was chosen as case study, see Figure 1. To quantify the effects of the smart combinations of decompartmentalization and improved evacuation procedures in this area, a flooding model that calculates the water levels in each compartment per timestep was set up. With the model parameters adjusted to match safety standard segment 27-2, a water depth- and rise rate map were found, which were input for the mortality and Local Individual Risk (LIR) calculation. The results of the model were validated using the LIWO data and the LIR values found in literature.



Figure 1: Case study area

The removal of the compartmentalizing dike resulted in a flood risk reduction of 26% of the alert value and the lower limit standard, see the compartmentalized and the decompartmentalized situation for the current evacuation percentage of 6% in Figure 2. Parallel to that, a sensitivity analysis of a variation of evacuation percentages was done, to determine the effects of improved evacuation procedures. As shown in Figure 2, improving the conservative evacuation percentage can decrease the LIR further.

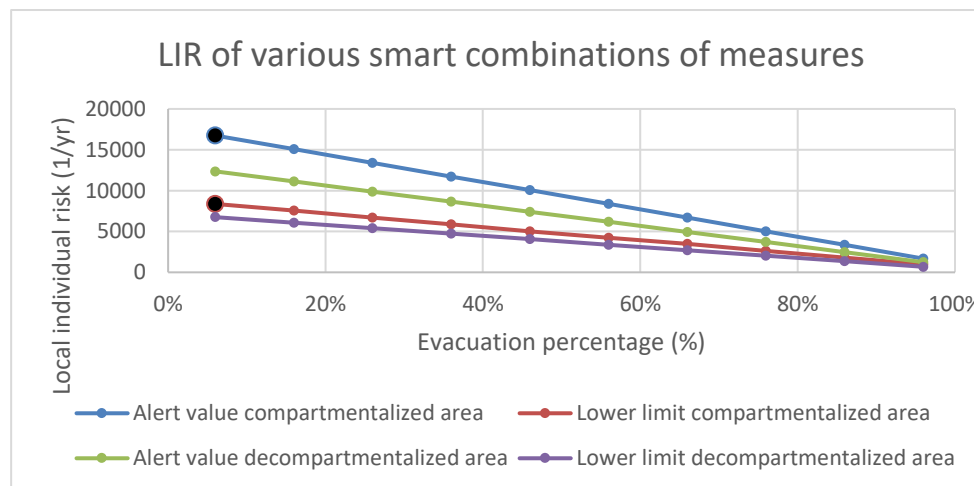


Figure 2: Local Individual Risk aspects for different situations of compartments and evacuation percentages. The black dots indicate the current situation.

From the analysis, it was concluded that there are 43 safety standard segments in the Netherlands where the smart combinations can be effective. Decompartmentalization of a part of dike ring 27 resulted in a decrease of flood risks with 26%, which could be improved by addressing the conservative evacuation percentage as well. Given the right conditions, smart combinations can be used as an alternative or addition to the reinforcements of dikes.

Niek Klein Wolterink

Graduation Date:
13 July 2022

Graduation committee:
University of Twente
Dr. J.J. Warmink
Dr.ir. A. Bomers

Royal HaskoningDHV
Ir. R.J.M. Huting
Ir. M.C.J. Van den Berg
Ir. S.G. Westerhof