

Summary

Flood risk management requires constant adaptation to changing views and changing circumstances. The present rate of climate change is uncertain. Such uncertainties can be tackled by designing robust and flexible adaptation responses. Their design requires insight in the effectiveness of individual adaptation measures, such as flexible structures, measures to reduce wave attack, innovative embankments, and measures to reduce flood consequences.

The main aim of research is to perform an in-depth interdisciplinary assessment of these innovative types of measures. This comprises addressing possibilities for multiple use, a treaty in a larger spatial context, and a focus on robustness and flexibility.

We drafted a research programme which addresses all the main questions formulated in the Call, arranged in 6 work packages. We build on earlier European and Netherlands' research, and add scientific depth and innovation to the more application-oriented research which is presently being carried out in other programmes.

Overview of main research questions on three levels

Climate change urges the Netherlands to reconsider its long-term policy for flood risk management. This requires the assessment of which strategic alternatives are to be preferred, not only from a risk reduction point of view, but broader from the point of view of social equity, economic efficiency and ecological integrity.

To enable such an assessment and the design of a long-term robust FRM policy, the *programme* will 1) develop *methods* for assessing the effectiveness of technical measures and policy instruments to reduce flood risk, for assessing the implications of their implementation for urban and countryside environments, and for assessing the robustness (resilience and resistance) of comprehensive FRM strategies in view of uncertainty about climate change.

Secondly, the *programme* aims to 2) provide *guidelines* for the design of long-term FRM alternatives and individual measures based on effectiveness (flood risk reduction), robustness and contribution to the development of entire regions (multi-functional use, natural values and spatial quality).

Work Package 1 questions whether a system of flexible structures is sufficiently reliable in a setting of river branches and estuaries with multiple openings to the sea, threatened by both rising sea levels and increased river discharges. It takes the Rijnmond area as case study and compares it with the Thames estuary (London) and the Elbe estuary (Hamburg).

Work Package 2 questions the management of coastal dunes under the pressure of a rising sea level and possible changing storm regime. It focuses on the Wadden Islands, which provide a protective barrier to the Wadden Sea and its hinterland.

- ▽ Project 2.1 focuses on the sediment balance, as influenced by beach nourishment and vegetation management and investigates how a robust coastal defense system can be obtained
- ▽ Project 2.2 combines this knowledge with wider knowledge into practical guidelines for the management of sandy coastal zones.

Work Package 3 aims to provide tools for deciding on which type of ‘fail-free’ embankment to opt for in various settings. It will wrap together the wealth of new knowledge and insights from research and practical experience. It builds on case studies from different locations.

- ▽ Project 3.1: develops instruments for decision making (DSS) on multi-functional flood defenses at a local level.
- ▽ Project 3.2 questions the contribution of robust multi-functional flood defences to flood risk reduction at the scale level of entire dike-rings.

Work Package 4 will improve the knowledge on the effectiveness and possibilities of putting a halt to the increase of economic damage potentials. It investigates the efficacy of flood risk zoning and associated building codes in areas with flood protection and without:

- ▽ Project 4.1 questions the potential for flood risk reduction by flood zoning and building codes specifically for an open Rijnmond
- ▽ Project 4.2 questions their potential in general, and focuses on assessing their effectiveness by damage modelling.

Work package 5 has as key question how foreign adaptation policies deal with uncertainties of climate change rate and which FRM measures they successfully apply. It has 4 projects, as follows:

- ▽ Project 5.1 questions the why and the pros and cons of insurance arrangements, starting from a UK perspective but translating to possibilities in the Netherlands.
- ▽ Project 5.2 asks how other European countries deal with the uncertainties of climate change and sea level rise, and what can be learned from that.
- ▽ Project 5.3 describes and assesses damage reduction measures for individual property, based on German experiences but translating to their potential for the Netherlands
- ▽ Project 5.4 wraps up the results of the other projects in this WP and translates these to the Netherlands’ situation

Work package 6 addresses the fundamental issues of how to deal with uncertainties and how to co-create societal value in FRM. More specifically:

- ▽ Project 6.1 asks what robustness means in relation to resilience, resistance, vulnerability, risk, etc., and shall operationalise the concept in the form of a practical method to assess the robustness of FRM strategic alternatives and guidelines for their design.

Summary and overview of the programme

- ▽ Project 6.2 tackles the double-sided question of a) how the network of embankments and dams has influenced the country's character and b) what additional requirements the present character poses to the designers of new flood defenses, with emphasis on countryside environments.
- ▽ Project 6.3 changes the emphasis to urban environments and investigates how flood risk management and (harbour) cities have co-evolved in the past and could develop into the future with a view on urban spatial quality.