Scientific aspects

Content

1. Description of the research programme

1.1 Problem definition, aim and central research questions

Flood risk management requires constant adaptation to changing views and changing circumstances. Climate change puts further pressure on this challenge, especially because the rate of change is uncertain. A way of tackling this uncertainty, is by designing robust and flexible adaptation responses which can cope with the inherent uncertainties related to planning for an unknown future. The design of such responses can be aided by performing scenario analyses (e.g. Foresight UK; Nederland Later, Aandacht voor Veiligheid, Waterplanverkenningen). An alternative approach is by establishing the robustness and flexibility of comprehensive flood risk systems as largely man-made socio-economic-environmental systems, with a focus on the role of the infrastructure (physical measures, such as embankments) and governance arrangements (such as insurance, spatial planning regulations) in place.

The design of robust and flexible policy responses requires due insight in the effectiveness of individual adaptation measures such as flexible barriers, measures to reduce wave attack, innovative embankments, and measures to reduce flood consequences. These belong to the measures currently considered in the Netherlands' FRM policy process (a.o. Deltaprogramma). For decision making, not only the effectiveness of such individual measures must be established, but also their costs and side-effects on social, cultural and natural values, as well as their impact on opportunities for economic development. In view of the uncertainties associated with climate change, however, it is especially relevant to evaluate the robustness of the measures. The first aim of research is therefore to perform an interdisciplinary assessment of these innovative types of measures, also addressing possibilities for multiple use, and with a focus on their robustness.

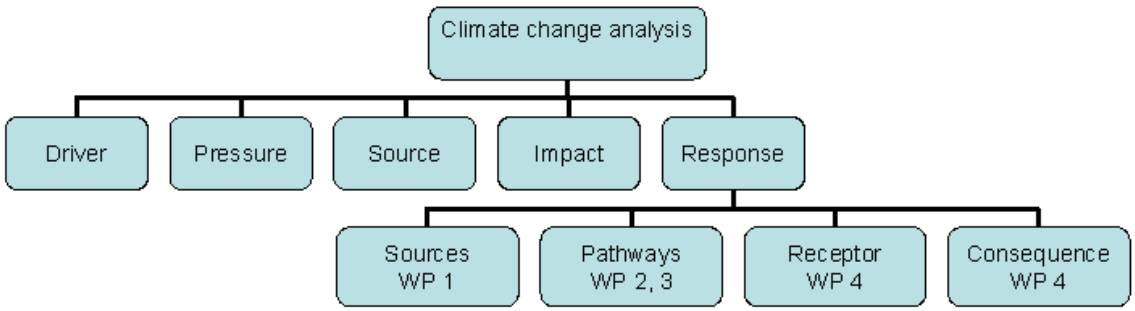
Adapting flood risk management policy to climate change involves not only research into the measures and instruments in isolation, but also an assessment in a wider spatial context, in order to establish whether and where they contribute most to flood risk reduction, whether and where they are societally acceptable and/or whether and where they are preferable from a sustainability point-of-view. These issues require more cross-cutting approaches, comprising an exploration of the concept of robustness, an exploration of impacts on spatial quality, and an analysis of overall flood risk. This involves research into criteria and indicators for safety (economic risk, individual risk, group risk), into robustness of the comprehensive flood risk system, and into the impacts of embankments and structures on the spatial quality of the landscape in the past, present and future.

Establishing the robustness of individual measures or comprehensive flood risk management strategies also requires sufficient insight in the hydraulic loads. This implies the translation of climate change scenarios into meaningful parameters at national and regional levels – such as river discharge and storm surge levels. For some regions, recent research has already produced relevant insight in the likely development of these hydraulic load conditions in the next century (e.g. the Rhine river discharge through GRADE, ACER, collaboration with Nordrhein-Westfalen). We shall use the results of these investigations and – where applicable – seek co-operation with Theme 6 of the Knowledge for Climate programme which elaborates this issue.

Learning from other countries is an additional research aim, as the Netherlands is obviously not the only country which has to meet the challenge of climate change. Many countries are intensively engaged in adaptation to climate change, such as the UK (Thames 2100, PPS25, UK Climate Impacts Programme (UKCIP)) and Germany (research programmes RIMAX and VERIS-Elbe; Tideelbeprojekt).

1.2 Programme outline and research approach

Our research programme addresses all the main questions formulated in the Call, arranged in 6 work packages (WPs). We, however, changed the order of the work packages so that they more closely relate to the internationally frequently used frameworks of analysis, namely SPRC (Sources, Pathways, Receptors, Consequences; cf. FLOODsite, 2009) as subdivision under DPSIR (Driver, Pressure, Source, Impact, Response).



As the focus of adaptation lies on policy response, all work packages relate to the R of DPSIR. WP 1 to 4 address various possible responses, respectively on Sources by controlling water levels (WP 1: flexible barrier systems) on Pathways by reducing the risk of wave attack to the integrity of the coast (WP 2: natural buffers) and of high water levels and waves to the integrity of flood protection (WP 3: innovative robust defences) and on Consequences (WP 4: Reducing the exposure of receptors to floods and the very flood consequences).

Work Packages 1, 2, 3 and 4 focus on an interdisciplinary assessment of innovative types of measures, comprising flexible structures (S), measures to reduce the impact of wave attack on dunes (P), innovative embankments (P), and – before and behind the embankments – flood risk zoning (R), building requirements, insurance (C), etc. This involves obtaining insight in the effectiveness of these individual measures and instruments, by systematically investigating to what extent they reduce flood risk to people and property. But also their societal costs and benefits in terms of side-effects on social, cultural and natural values, as well as their impacts on opportunities for multiple land use and economic development will be investigated. Especially the robustness of their performance (including resilience and resistance) and the flexibility of their application will be investigated.

Obviously, all the above-mentioned work packages will refer to work abroad and build on international literature, which requires being connected to international scientific progress and practical experience. Additionally, WP 5 focuses on an explicit comparison of policy and management practice in various countries in order to obtain an upto-date overview of how other countries address the challenge of adapting FRM policy to climate change. This is a step forward from FLOODsite (Samuels et al., 2008) and KLIMINT (Claessen et al., 2008).

Work Package 6 focuses on cross-cutting approaches and concepts, specifically on robustness, flexibility and spatial quality in both urban and countryside settings. In this WP attention shifts from individual measures and instruments towards comprehensive FRM strategies, and to wider normative and spatial contexts. It involves a thorough investigation and operationalisation of the concept of robustness for individual measures as well as for the comprehensive flood risk system. Also, the role and impact of flood barriers and embankments on the quality of the landscape will be assessed, and the opposite: what does the existing landscape demand from the designers of new FRM measures.

1.3 Innovative aspects and scientific output

The research focuses on innovative measures and innovative methods of assessing those. As for the measures, the flexible barrier system and the multi-functional embankments are fully new, or only applied yet in experimental settings. Sand nourishment in coast is already widely applied, but the combination of underwater sand nourishment and dune management focussing on the eolian processes has not been thoroughly studied yet. Damage reduction measures are applied in many countries, but have not gained much interest and attention in the Netherlands yet. Therefore we expect innovations on this point by comparitive studies of practices abroad and confrontation with current views in the Netherlands on these measures. Focus shall lie on insurance and local measures and their effectiveness.

Further innovations are foreseen on frequently used concepts, which are relatively poorly defined, or not in relation to flood risk management. This goes for robustness and spatial quality. News is also expected from our intended interdisciplinary approaches in many fields. Crossing disciplinary borders may well yield unexpected innovations.

As for scientific output, we have planned between 25-30 scientific publications and conference papers, the majority of which will be compiled into almost 6 PhD theses (several only partly within this KfC-theme), whereas the synergy will be demonstrated in a special issue of a journal.

1.4 Relevance of the research programme in an international context

The proposed research builds on experiences in FLOODsite and other EU-FP6 research, and starts where these had to stop because of ending funding. It focuses on flood risk management options, which is a hot issue for climate adaptation for all low-lying coastal countries and countries with large rivers which may have to face changed discharge regimes. This was re-confirmed during the Copenhagen conference in December 2009. It yields the research relevant for all countries with large floodplain areas and/or coastal plains, and especially deltaic areas. This comprises Germany, the UK, Italy (Po valley), Spain (Ebro delta), the countries along the Rhine and Donau, etc., just to mention some in Europe.

But the research is also relevant for other developed or developing countries with lowland areas (USA, China, Bangladesh, Cambodia, Australia, etc.), many of which are already exchanging knowledge and experience on flood risk management, either in bilateral co-operations with members of the consortium (FHRC-Bangladesh, Deltares-USA, Cambodia and China, TU Delft- China and Bangladesh, etc.), or in the contect of the newly established multi-lateral Delta Alliance which was initiated by Wageningen UR and Deltares.

Some of the hotspots areas, especially Rotterdam-Rijnmond, participate in similar initiatives in their endeavour of adaptation options for large cities in coastal and deltaic settings: the Delta Cities Initiative. Particular exchange of knowledge and experience is hence foreseen with Hamburg and London. In London, the Thames2100 is of particular relevance. In Hamburg we will establish links to the Tideelbeprojekt (www.tideelbe.de).

1.5 International cooperation

Our foreign partners in the programme – FHRC and GfZ – are intensively engaged in their respective national programmes, such as Thames 2100, PPS25, UK Climate Impacts Programme (UKCIP) and the German research programmes RIMAX and VERIS-Elbe. They were requested to participate in this proposal because of their respective specific expertise.

FHRC has extensive knowledge on all kinds of non-structural measures and governance arrangements, including insurance and its impact on public behaviour and what that implies for flood damage potential. It will bring in its knowledge on the relationship between governmental regulations and the role of private insurance industries, and reflect on those from a cultural perspective in order to contribute to the establishment of its potential for the Netherlands' situation.

GfZ has put extensive effort lately in research on the pros and cons of local measures (particularly on property), and on their effectiveness to reduce flood damage, especially since the 2002 Elbe flood. It shall combine this knowledge with experiences of flood-proofing buildings in Hamburg and thus contribute to the evaluation of their potential for not-protected areas, such as the active floodplains along Netherlands' rivers (e.g. Meuse) and Rotterdam's harbour.

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2. Interdisciplinarity

The consortium comprises large interdisciplinary research institutes (Deltares, Wageningen UR, GFZ), research groups from technological, environmental and traditional universities covering social sciences, natural sciences and arts, as well as engineering and design. The consortium is complemented by a consultancy firm with intensive contacts with both universities and practice.

The majority of the WP leaders have 'transdisciplinary' backgrounds, e.g environmental science, physical and/ or social geography, civil engineering, urban planning, landscape architecture; where the WP leaders do not have this background, they will be supported by team members with such backgrounds. To this end each WP and each project within a WP is the responsibility of at least 2 consortium members from different disciplinary background, in the case of PhD research in the form of tutoring and advice, or the co-responsibility of the consortium leader.
In each WP and each project specialist team members will be involved when relevant to ensure a comprehensive treatment with a view from various angles (e.g. engineering and ecology, or risk approach and landscape qualities).

3. Coherence between and synthesis of outcomes from the individual work packages

The consortium will organise scientific meetings for the whole consortium at least once a year, where all projects will be presented and thoroughly discussed by all team members. We shall also organise opportunities for stakeholders from the relevant 'hotspots', in order to attune the research to practical questions; on these occasions the consortium shall answer (or discuss) questions from the hotspot areas.

The coherence between the work packages is further pursued by various means.

- Firstly, by the frameworks of analysis presented under 3A2, namely DPSIR and SPRC. These ensure that no issues are forgotten and that a balance between WPs is achieved.

- Secondly, by applying common concepts for each adaptation measure, e.g. a risk approach, effectiveness in flood risk reduction, multi-functionality, landscape quality, and robustness. The general and specific meaning of these concepts shall be discussed during the yearly scientific meetings, as well as the differences and similarities with other frequently used concepts.

- Thirdly, by the dedicated WP 6 on cross-cutting themes, which unite the measure-specific WPs. In this WP we focus on combinations of measures and comprehensive flood risk management strategies, and will discuss the potential of each measure in context.
- Fourthly, by adopting widely accepted terminology (e.g. 'The Language of Risk' by FLOODsite, 2005) as much as possible, as well as generally accepted approaches and methodologies.
- And finally, by joining data and outcomes amongst those in the research team who investigate the same case study areas and by discussing the outcomes from various disciplinary perspectives.

With respect to this issue of coherence the consortium shall, however, not prescribe an approach which might hinder innovation; sufficient academic freedom of thought, reasoning and exploration is considered quintessential for scientific progress. This implies that we regard scientific debate more fruitful in attaining coherence and convergence of ideas, than strict rules to abide by. We therefore strive for coherence through commitment.

The synthesis of outcomes will be pursued by striving for joint publications as well as by guest-editing a special issue of an international peer-reviewed journal (e.g. Journal for FRM, Global Environmental Change or …) which will encompass the outcomes of the various work packages plus a jointly authored synthesis paper.

4. (Expected) cooperation and coherence with other research themes

With Theme 2 we share an interest in the joint investigation and operationalisation of the concept of robustness for flood risk management as well as drought risk management. This is pursued by the definition of one shared PhDresearch (project 6.1 of this proposal) with is jointly tutored by a promotor (U Twente) from theme 2 and the leader of WP6 of this proposal.

A similar share of interest exists with Theme 3, which is lead by the intended promotor (prof. Van den Brink, Wageningen UR) of the senior researcher who will carry out project 6.2. This project on spatial quality and the design of adaptation measures is partly defined by and co-tutored by the WP6 leader of this proposal.

With Theme 4, we primarily see a delimitation issue, as this proposal also addresses urban environemnets. Where we shall focus on flood risk (e.g. zoning, building codes), Theme 4 will focus on all other adaptation challenges in urban setings.

From Theme 6 we shall primaily draw knowledge on climate change scenario; the other way around we shall participate in specifying 'end-user requirements' on the kind of outputs claimte change scenarios should deliver.

With theme 7 we shall jointly investigate specific hotspots, e.g. robust embankments along the Wadden Sea with theme 7 (Wageningen UR), whereas with Theme 8 we shall jointly address the issue of assessing the economic consequences of flooding (IVM-VUA).

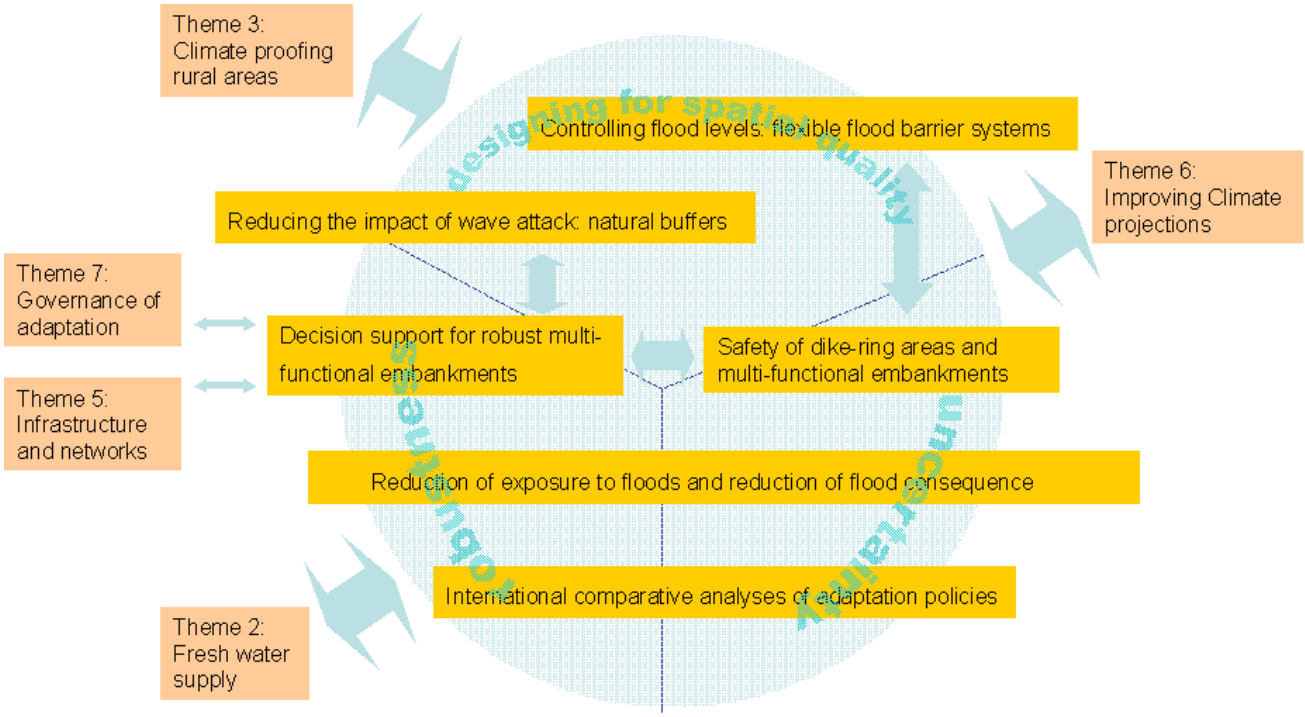

Figure: Co-operation between work packages and with other themes

5. Connection to finalized and current projects in KfC and other research programmes

We shall closely connect to KfC-projects where relevant, viz:

- COM23 'Water resilient building',
- CS09 'Modeling and reconstructing precipitation and flood frequency in the Meuse catchment during the late Holocene',
- HSRR02 ' Definitiestudie Waterveiligheid buitendijks gebied',
- HSRR03b 'Afsluitbaar open Rijnmond - Waterfront Rijnmond',
- A07 'Adaptations to extreme events in transboundary river basins',
- A09 'Financial arrangements for disaster losses under climate change',
- HSGR07 'Klimaatbestendige dijk langs de Nederrijn',
- HSWZ05 'Integrated climate adaptation in the Eemsdelta as motor for ecological quality and living environment',
- HSRR06 'Veilige en goed ingepaste hoofdwaterkeringen'.

As for research programmed in the Wadden Academy, we connect to their research agenda with WP 2 and WP 3 (project 3.1) which are related to research which is foreseen in the programme ‘Dynamiek’ which will be submitted for financing by the ‘Waddenfonds’

We connect to Building with Nature by tuning our work in WP2 en WP3 (project 3.1) to complement the knowledge developed in that programme.

We connect to Platform Klimaatdijk by regularly supplying research results about multifunctional flood defences (from amongst others WP 3 and WP 6), such that also practitioners gain easy access to the most recent scientific results.

At national level, the consortium shall connect to the applied research for the Delta Programme, BOA-research for the Ministry of Public Works and Water Management, and the STOWA-research programme Delta-proof. As these are still under construction, it is difficult to be more specific at this moment, but likely projects are Delta Programme Waterveiligheid (previously WV21), Delta Programme Large Rivers, Delta Programme SW delta, Delta Programme Rijnmond, BOA Deltadijken, VNK, AVV, Delta-proof (and whatever else which we have now missed).