Strengthening and Redesigning European Flood Risk Practices
Towards Appropriate and Resilient Flood Risk Governance Arrangements

A view on more resilient flood risk governance:
key conclusions of the STAR-FLOOD project

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Photo left: Antwerp Scheldt quays (Hannelore Mees, 2014); Photo right: Canal Blaton-Ath, DGO2 (2013)

Preface

This report is the final deliverable of the EU 7th Framework Project STAR-FLOOD (www.starflood.eu). STAR-FLOOD focused on flood risk governance. The project investigated strategies for dealing with flood risks in 18 vulnerable urban regions in six European countries: Belgium, England, France, the Netherlands, Poland and Sweden. The project assesses flood risk governance arrangements from a combined public administration and legal perspective, with the aim to make European regions more resilient to flood risks.

This report constitutes deliverable D6.4, the final document with main research results. The document synthesises the findings derived from all previous research-oriented Work Packages (WPs). WP1 provided an extended problem analysis related to flood risk governance in Europe, WP2 focused on how flood risk governance in Europe can be researched. WP3 formed the empirical core of the project, in which analyses, explanations and evaluations of each country, including three case studies, have been performed. These findings formed the main input for the last two Work Packages of STAR-FLOOD, being WP4 and WP5. WP4 focused on a systematic comparison between the STAR-FLOOD consortium countries and WP5 on the identification of design principles for flood risk governance that enhance societal resilience to flooding, make efficient use of resources and are considered to be legitimate.

The current document provides overall conclusions related to the main research question of STAR-FLOOD being "*What are resilient and appropriate Flood Risk Governance Arrangements (FRGAs) for dealing with flood risks in vulnerable urban agglomerations in Europe?"*

The conclusions pertain to:

- The relevance of adopting a governance perspective on flood risk management.
- The extent to which Flood Risk Management Strategies are being diversified and aligned – which is assumed to lead to increased flood resilience – as well as drivers for and barriers to such a diversification.
- The establishment of bridging processes and mechanisms that facilitate linkages between Flood Risk Management Strategies and help overcome fragmentation.
- The roles of actors involved in flood risk governance and the division of responsibilities between public and private actors, including citizens.
- Observed diversification of rules and regulations relevant for flood risk governance and the challenges related to the development of appropriate rules that are enforceable and enforced.
- The resources needed to ensure that governance enhances societal resilience and is carried out in a legitimate and efficient way; and
- Implications for policy and law at the European, national and regional level.

For a detailed justification and underpinning of each conclusion, the report refers to other relevant STAR-FLOOD deliverables as well as existing scientific literature.

The content of this report may inspire researchers and professionals with an interest in social scientific and legal research into flood risk management and governance, disaster risk reduction and climate change adaptation, including the European Commission, national governments, regional organisations involved in FRM, NGOs and international organisations such as the OECD and the UNISDR.

Yours sincerely,

Prof. Peter Driessen – STAR-FLOOD project coordinator, on behalf of all contributors

Left photo: The marine wall, protection for both the harbour and the city of Le Havre. Source: Le Havre Patrimonial, Port 2000, https://imagesduhavre.wordpress.com; right photo: basins in the upstream section for mitigation strategy. Source: The on-site rural retention basin, CODAH.

Executive Summary

This report presents the key conclusions of the EU FP7 project STAR-FLOOD. This project focused on analysing, explaining and evaluating flood risk governance in six European countries: Belgium, England, France, the Netherlands, Poland and Sweden. Our empirical research was used to inform recommendations for (re)designing flood risk governance arrangements to enhance societal resilience to flooding. The key conclusions are also intended to help derive implications for policies and law at the level of the EU, its member states, regional authorities, and public-private partnerships. In so doing, the report reflects on two starting assumptions of the project (see box 1):

Box 1: STAR-FLOOD's starting assumptions

Assumption 1:
Societal resilience to floods is enhanced if multiple Flood Risk Management Strategies are implemented simultaneously and are aligned.

Assumption 2:
A successful implementation of a diverse, resilient, set of FRSs – requiring a combination of old and new strategies and coordination of different strategies – in a certain area is only possible if these strategies and their coordination are appropriate. They should make efficient use of resources and should be considered legitimate by the actors involved. This is needed to ensure proper institutional embedding given the opportunities and constraints of their physical and social context.

Both starting assumptions have been derived from current debates in literature, policies (including the EU Floods Directive, Directive 2007/60/EC) and practice on flood risk governance in times of increasing flood risks due to urbanisation and the effects of climate change. Risk-based approaches to flood risk management are emerging that address exposure, likelihood and magnitude of flood hazards as well as the consequences should floods occur. While *flood defence* and *flood mitigation* focus on reducing the likelihood and magnitude of flood hazards, *flood prevention* helps to reduce exposure; while *flood preparation* and *recovery* both deal with the potential consequences of floods. Strategies should, however, be implemented in such a way that they fit in their physical and institutional contexts. Our key findings, which have been listed below, provide the building blocks for scrutinising and elaborating the two starting assumptions. Each chapter discusses one key finding, explains the key finding and refers to those STAR-FLOOD products that provide the underlying evidence.

1. **Necessity and importance of a diversification of flood risk management strategies (chapter 3).**
   - Countries differ in their approaches to diversification. In the Netherlands, Poland, France and Belgium, we see a desire to create a back-up layer of contingency. England has been diversified for 65 years, while Sweden is currently diversifying due to climate change concerns;
   - In most cases, the practical on the ground implementation of diversified strategies is lagging behind intentions as laid down in discussions and policy plans;
   - Main drivers for diversification are: policy entrepreneurs; bottom-up initiatives by local stakeholders; a broader discursive shift towards sustainability and resilience; the presence of enforceable rules and regulations; the availability of financial resources; technical improvements; broader shifts 'from government to governance'; and Europeanisation.
   - Main barriers for diversification are: a lack of resources and path dependency.

- Floods as trigger events have been found to contribute both to stability and change, but under different circumstances;
- To be resilient, a country should have the capacity to resist, absorb and recover and to adapt;
- To enhance societal resilience to flooding, diversification of flood risk management strategies (FRMSs) is both necessary and important. Diversity of FRMSs in itself is not enough, though, to guarantee societal resilience, indeed each strategy must be effective in its own right;
- Sufficient investment in each chosen strategy needs to be provided. Spreading of resources leading to an underinvestment in all strategies should be avoided.

2. Establishing connectivity between actors, levels and sectors (chapter 4)

- Diversification of FRM strategies may lead to fragmentation between actors, levels and sectors, causing inefficiencies and ineffectiveness and possibly undermining societal resilience;
- To some extent, fragmentation between sectors may be overcome, provided that further learning, cooperation and exchange within and between countries takes place; however, it is realistic to expect that the problem of fragmentation cannot be fully solved.
- Bridging processes and mechanisms are needed between several FRM strategies, including coordinating actors; procedural duties and instruments; formal rules and regulations; financial and knowledge resources and bridging concepts. Especially spatial planning and the insurance sector could play a vital role in this respect.
- Decentralisation may help in bridging different levels of government to ensure a good combination of top-down and bottom-up governance, however provided that the shifting of financial and executive tasks is accompanied by a shifting of formal powers and resources.

3. The involvement of private parties, including businesses, citizens and NGOs in flood risk governance (chapter 5)

- The involvement of private parties, including businesses, citizens and NGOs in flood risk governance is necessary both for substantive and normative reasons.
- To enhance flood resilience, the input of a diverse set of resources and capacities is needed, which are not all available within governmental institutions. Instead, several private actors on a spectrum from fully private companies to quasi commercial actors (e.g. English utility companies which are privatised but heavily regulated) should be involved. Also citizens are crucial actors in flood risk management. In their capacity of residents they can take actions in and around their own home, e.g. decreasing the amount of hardened surface, and flood proofing their houses.
- In Europe, participation in decision-making is considered important (Aarhus convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters), therefore governments cannot steer exclusively in a top-down fashion but need to involve other actors in decision-making.
- Open, broad (political and societal) debate about the division of responsibilities between public and private actors is needed, leading to more clearly defined roles for governments/businesses/NGOs/citizens.
- We suggest interpreting public-private cooperation as ‘comprehensive multi-actor co-production’ in the sense of further developed forms of participation, public private partnerships

and self-realisation. This interpretation seems more productive than the much more narrow interpretation of 'letting market parties/companies do more in flood risk governance'.

4. Diversification in rules and regulations (chapter 6)

- Diversification of Flood Risk Management Strategies is accompanied by a diversification in *rules and regulations*. However, in some cases a lack of rules can be witnessed, especially in cases in which certain strategies have not yet been implemented to a significant extent.
- The Floods Directive (Directive 2007/60/EC) has facilitated the implementation of FRM strategies in all STAR-FLOOD countries, except England, but especially in those countries where FRM is not yet mature (including Sweden and Poland).
- The current scope of the Floods Directive, which poses non-substantive requirements to EU Member States, is in general appropriate in the sense of being in line with the normative principle of subsidiarity and the existing diversity in terms of existing approaches to flood risk management.
- In International River Basin Districts, the FD could go further in setting forth cooperation requirements between states sharing these Districts and to provide clarity on important concepts in the Directive.
- In other cases of implementing the FD, procedural requirements should be refined and some substantive requirements could be added, so that they force MSs to adopt principles of good flood risk governance. It would also be worthwhile to critically re-evaluate the content of the FD for enforceability by citizens and to make clear what they can ask for in the courts. It was also found that sometimes time pressures arising from the need to timely finalise flood risk management plans restricted the room for manoeuvre of local initiatives.
- According to the subsidiarity principle, devolution of decision-making to the lowest appropriate scale, with collaboration and coordination at the highest level necessary should be strived for. This principle is widely endorsed, not only at the level of the EU but also at the national level in many European countries. The principle is essentially a political choice based on knowledge that multi-level governance works better to create legitimacy and resilience. But this goes with fragmentation and the fragmentation should be addressed in a way that it doesn't hamper effective or legitimate flood risk management.

5. Availability of resources (chapter 7)

- Different types of resources (finance, knowledge, skills, ICT tools, public support) should be mobilised efficiently. At the same time, resource availability should be increased, if possible.
- The availability of resources for different flood risk management strategies differs significantly between countries. The quality of knowledge infrastructure and the structure of funding systems also varies. This may be problematic since the lack of resources was shown to be an important reason for underinvestment in and underdevelopment of FRM strategies.
- An important policy issue for the coming years will be to have political debate and make political choices in order to combine the (perceived and sometimes already legally settled) 'right to be protected' of citizens by public authorities with the decreasing resource base many public authorities are facing.

- Resources may also play a key role in bridging, for instance by ensuring that actors involved have the necessary skills, and that private actors receive sufficient payment to increase their willingness to let their land function as flood storage.

6. Evaluations of flood risk governance in terms of resilience (chapter 8)

- In terms of STAR-FLOOD's first starting assumption, we found that diversification of strategies can be seen as a necessary but not sufficient precondition for enhancing societal resilience to floods.
- We stress that resilience should be disentangled into three capacities: capacity to resist flooding, the capacity to absorb/recover when a flood event occurs and the capacity to adapt to future risks. These are to be seen as different views on desired outcomes for flood risk governance and have been found to be to some extent mutually exclusive (e.g. over-investment in one strategy can be at the expense of investment in other strategies).
- Resilience is closely linked to the notion of appropriateness: desired outcomes in terms of resilient should be considered in light of physical circumstances and existing institutional and social contexts.
- To some extent a high score on one capacity (to resist) may undermine that of other capacities (e.g. absorb and recover).
- The presence (or the absence) of links between strategies has turned out to be a crucial factor explaining countries' achievements in all three capacities.
- Enhancing societal resilience requires sufficient investment in each of these strategies and alertness to the risk of underinvestment of all of them.
- Efforts to improve resource efficiency by increased application of (societal) Cost Benefit Analyses are underway in different countries, albeit to a different extent. These CBAs were found to contribute to resource efficiency, but in some countries were perceived as rather technocratic.
- The researched countries are doing well on access to information and transparency; procedural justice and accountability. The most potential for improvement lies with the criteria of social equity; public participation and acceptability by all actors involved.

7. What is needed to enhance flood resilience and improve efficiency and legitimacy of flood risk governance (chapter9)?

- Design principles pertain both to flood risk governance processes and flood risk governance outcomes.
- Important process-related aspects pertain to: managing expectations and debating acceptable levels of risk; the need for long-term policies; the development of knowledge infrastructures; the involvement of private actors (businesses, NGOs and citizens) in FRM; carrying out flood risk governance at the most appropriate level; adequately prioritising flood risks in spatial planning; clarifying rules and improving follow-up and their enforceability in legal instruments; and the promotion of catchment-based approaches to FRM.
- To improve resilience, there is: i) a need to establish adaptive management to aid the implementation of defence and mitigation measures that can be adjusted to suit changing circumstances; ii) a need to deliver spatial planning in such a way that consequences are prevented and minimised if floods occur; iii) a need for further improving systems for

forecasting, warning and emergency responses that are proactive, risk-based and use collaborative approaches, for instance by optimising the use of ICT (apps); iv) a need to have strategies to recover from flood events available for all citizens while at the same time ensuring that these provide sufficient incentives for citizens to encourage the adoption of prevention and mitigation measures; v) a need for institutional systems that foster learning and innovation.

- Resource efficiency requires that a level of flood risk management is secured that is found acceptable by societal actors at the lowest possible societal costs and against the highest possible societal benefits, looking for synergies, e.g. through multi-use flood alleviation schemes.
- Legitimacy requires that the decision-making process is characterised by a high degree of public participation, social equity and accessibility. The approach should be generally accepted by the public, open and transparent, access to risk information should be ensured, and there should be mechanisms in place to ensure social equity.

8. The relevance of multi-disciplinary comparative research into flood risk governance (chapter 10)

- STAR-FLOOD was set-up as a multi-disciplinary project, combining policy analysis and legal studies and employing a comparative approach from the outset.
- Following this approach has led to systematic and comparable analyses and evaluations, contributing to a good knowledge base for identifying design principles. It was very challenging in that it required a huge coordination effort but on the other hand was very rewarding.
- Follow-up research could focus on additional comparative analyses; more design-oriented action research or detailed case studies that build on the knowledge base developed in STAR-FLOOD. We encourage others to adopt a similar integrative approach as ours. Chapter 10 indicates points of attention for those who wish to engage in such endeavours.

Odra River in Słubice (by Adam Choryński).

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Plenary consortium meeting and Academic Master Class (including field trip) in Antwerp, Belgium, 2-4 April 2014.

1. Introduction

1.1 Flood risk governance in Europe

European countries, especially urban areas, face increasing flood risks due to urbanisation and the effects of climate change (Alfieri *et al.* 2015; Kundzewicz *et al.* submitted; Winsemius *et al.* 2015). Of all the natural hazards in Europe, flooding is the most common, and accounts for the largest number of casualties and highest economic damage (Guha-Sapir *et al.* 2013). Unlike other natural hazards, no European country is free from the risk of flooding. Between 2000 and 2005, Europe suffered nine major flood disasters, which caused 155 casualties and economic losses of more than € 35 billion (Barredo 2007). The 2013 floods in central Europe caused 25 casualties and 15 billion dollar economic damage (according to (re)insurer Munich Re). The Winter 2013/14 flooding in England resulted in 5000 homes flooded and caused 17 casualties and over 2 billion pounds worth of damage. In October 2015 the French Rivièra was severely flooded causing at least 19 casualties and significant damage. These recent events highlight the challenge and importance of improving the flood resilience of societies.

It is increasingly argued that a diversification, coordination and alignment of Flood Risk Management Strategies (FRMSs), including flood risk prevention through pro-active spatial planning, flood defence, flood risk mitigation, flood preparation and flood recovery, will make urban agglomerations more resilient to flood risks (Aerts *et al.* 2008; Hegger *et al.* 2014; Innocenti and Albrito 2011; Van den Brink *et al.* 2011; Wardekker *et al.* 2010; Wesselink *et al.* 2015). Diversification in FRMSs is one of the approaches underlying the EU Floods Directive (Directive 2007/60/EC). Diversification is said to require new Flood Risk Governance Arrangements (FRGAs) that should aid the implementation of the strategies. A definition of key terms used in the STAR-FLOOD project is provided in box 2 below.

Box 2: Key terms used in the STAR-FLOOD project

Flood Risk Governance Arrangement (FRGA) – The arrangement of actors, rules, resources and discourses united under the shared goal of Flood Risk Management (FRM). Thus FRGAs can be thought of as the institutional constellations resulting from an interplay between actors and actor coalitions involved in all policy domains relevant for flood risk management—including water management, spatial planning and disaster management; their dominant discourses; formal and informal rules of the game; and the power and resource base of the actors involved (Hegger *et al.* 2014). FRGAs comprise several sub-Flood Risk Governance Arrangements (sub-FRGAs), being the distinct arrangements of actors, rules, resources and discourses directed towards a distinct goal of FRM, embedded within an overall FRGA. For instance, spatial planning aims to minimise the exposure of people and property to flood risk. Both units of analysis are examined within this research.

Flood Risk Management Strategy (FRMS) – Certain flood risk management measures can be categorised within a distinct strategy, according to their intended goal. Categories include prevention, defence, mitigation, preparation and response, and recovery (Hegger et al. 2014). These strategies address different aspects of the risk equation (exposure, hazard and consequences). Prevention includes those measures that minimise the exposure of people/property to flood risk (e.g. through planning conditions). Defence and mitigation strategies minimise the likelihood and/or magnitude of the flood hazard through the use of measures that either act to resist (e.g. flood wall)

or accommodate water (e.g. flood storage), respectively. Finally, preparation and response and recovery strategies serve to lessen the consequences should a flood event occur.

Bridging mechanisms – organisations, concepts, policy instruments, financial instruments or tools that facilitate alignment and/or integration between public and private actors, policy levels and policy sectors (Matczak *et al.* 2016a; Gilissen *et al.* Submitted).

Besides new FRGAs, a diversification of flood risk management strategies may require changes in existing arrangements and their linking together and alignment (Hegger *et al.* 2014). Efforts at such a diversification are ongoing in several countries and successful to a varying extent. At the same time, some countries like England have been diversified in the sense that all flood risk management strategies have been established for 65 years and all strategies are regarded as equally important at the national scale.

As this report shows, flood risk governance that enhances societal resilience and is considered efficient and legitimate is of pivotal importance. Effective implementation of flood risk management strategies is considered as a necessary precondition for resilience. To understand how change towards more resilient, legitimate and efficient flood risk governance can be brought about, it is crucial to look at how flood risk governance has evolved in the past. This provides insights into how change can be implemented and into potential entry points as well as barriers to change. It was found that Belgium, England, France, the Netherlands, Poland and Sweden differ in the extent to which they managed to diversify and align Flood Risk Management Strategies. Based on a comparison of these countries, some recurring drivers for and barriers to diversification could be identified. In addition to that, the establishment of bridging processes and mechanisms that facilitate linkages between flood risk management strategies and the related actors, rules and sectors as well as linkages within sectors are essential, as is the need to further engage private actors and citizens in flood risk governance (Matczak *et al.* 2016a; Gilissen *et al.* submitted). Current policies and legal systems at the level of the EU, the national and the regional level have been evaluated, and as well as strengths, some opportunities for further improving them have been identified. The goal of this report is to provide an overview of the key conclusions and recommendations of the EU FP7 STAR-FLOOD project in terms of relevant knowledge that may help to develop governance design principles for flood risk governance arrangements and to derive implications for policies and law at the level of the EU, its member states, regional authorities, and public-private partnerships.

1.2 Research aims and questions

STAR-FLOOD's main research question was: "***What are resilient and appropriate Flood Risk Governance Arrangements (FRGAs) for dealing with flood risks in vulnerable urban agglomerations in Europe?"*** The different chapters in this report provide elements of the answer to this main research question. The STAR-FLOOD project investigates how current flood risk governance arrangements can be strengthened or redesigned to enhance societal resilience to flooding. To this end, an assessment has been made as to what extent existing governance arrangements support or constrain the diversification of Flood Risk Management Strategies as well as the extent to which such a diversification of strategies enhances societal resilience to flooding. One of the most encompassing definitions of resilience is the one adopted by the Resilience Alliance, which defines resilience as:

”the ability to absorb disturbances, to be changed and then re-organise and still have the same identity (retain the same basic structure and ways of functioning)” (http://www.resalliance.org/index.php/key_concepts). This definition encompasses multiple capacities of importance for flood resilience, namely the capacity to resist floods, the capacity to absorb floods and to recover from them and the capacity to adapt – including the capacity to learn, improve and experiment – in order to be better prepared for dealing with future floods (Klijn *et al.* 2008; Liao 2012; Mens *et al.* 2011).

In the course of the research, STAR-FLOOD used and reflected upon two starting assumptions:

Box 3: STAR-FLOOD’s starting assumptions

Assumption 1:
Societal resilience to floods is enhanced if multiple Flood Risk Management Strategies are implemented simultaneously and are aligned.

Assumption 2:
A successful implementation of a diverse, resilient, set of FRMSs – requiring a combination of old and new strategies and coordination of different strategies – in a certain area is only possible if these strategies and their coordination are appropriate. They should make efficient use of resources and should be considered legitimate by the actors involved. In so doing, they should ensure proper institutional embedding given the opportunities and constraints of their physical and social context.

Both assumptions reflect current debates in literature and practice, as introduced in section 1.1, regarding a diversification of FRMSs. In these debates it is argued that many countries have a dominant focus on flood defence. It is claimed that not all floods can be prevented and hence that this strategy should be complemented with additional strategies, including flood risk prevention, flood mitigation, flood preparation and flood recovery. Strategies should, however, be implemented in such a way that they fit in their physical and institutional contexts. Important local/regional circumstances that need to be taken into account are: differences in exposure to flood risk; differences in flood experience; differences in normative values; differences in the legal rules governing the distribution of responsibilities and rights to flood protection and differences in the degree of flood awareness present in a society (Ek *et al.* 2016a).

1.3 Research approach and methods

1.3.1 Research approach

To analyse Flood Risk Governance Arrangements, the STAR-FLOOD project draws on the Policy Arrangements Approach (PAA). Policy arrangements have been defined as “a temporary stabilisation of the content and organisation of a policy domain” (Van Tatenhove and Leroy 2000). By studying the development of these policy arrangements over time, the degree of stability or change in these arrangements can be analysed. The PAA claims to link up all relevant dimensions of a policy domain (actors, discourses, rules and resources) and hence enables a study of the policy arrangement as a whole. The approach has been applied in earlier studies of environmental policies, nature conservation and water management (Arts and Van Tatenhove 2006; Van Tatenhove and Leroy 2000; Wiering and Arts 2006). Two features make the approach particularly useful for analysing FRGAs.

First, the approach combines and integrates different concepts within frameworks of policy analysis (e.g. policy network models, discourse analysis, the advocacy coalitions framework and regime theory in international relations) and includes both structure and agency—related elements of institutional analysis, thus choosing a more sociological approach (Giddens 1984). Other approaches are less comprehensive in terms of the dimensions that are included. Second, the approach allows for a certain inclusion of legal factors in the analysis, especially in the rules and resources dimensions. FRGAs can be analysed at different scales, including local, regional, national, transboundary river basin scale, and the international scale.

To help us identify FRGAs, the STAR-FLOOD project refers to the notion of Flood Risk Management Strategies (FRMSs), categorised as prevention, defence, mitigation, preparation and response, and recovery. A number of Flood Risk Management measures can be grouped into these strategies. These five types of strategies include the strategies identified within the EU Floods Directive (Directive 2007/60/EC). The Floods Directive advocates the '3Ps', namely, prevention, protection and preparedness. A strength of this approach is that it acknowledges the temporal element of when certain measures are implemented within the FRM cycle. Building upon this, the Strategies referred to within the STAR-FLOOD project extend this temporal dimension to also account for measures employed within the recovery phase of flooding. Further attention has also been given to the notion of protection, which has been unpicked further and divided into the two strategies of defence and mitigation. Whilst measures employed in these strategies have a shared aim, (i.e. to minimize the likelihood and/or magnitude of the flood hazard), the distinction was justified on the basis that the measures employed within these strategies differ in terms of their treatment of water. Whereas defence measures act to resist and control water, in contrast mitigation measures aim to accommodate water and work with natural processes. Thus there are clear discursive differences between the implementation of defence and mitigation measures. Adopting the risk equation (where risk is a function of exposure * hazard * consequences), the STAR-FLOOD strategies are organized as illustrated in Figure 1:

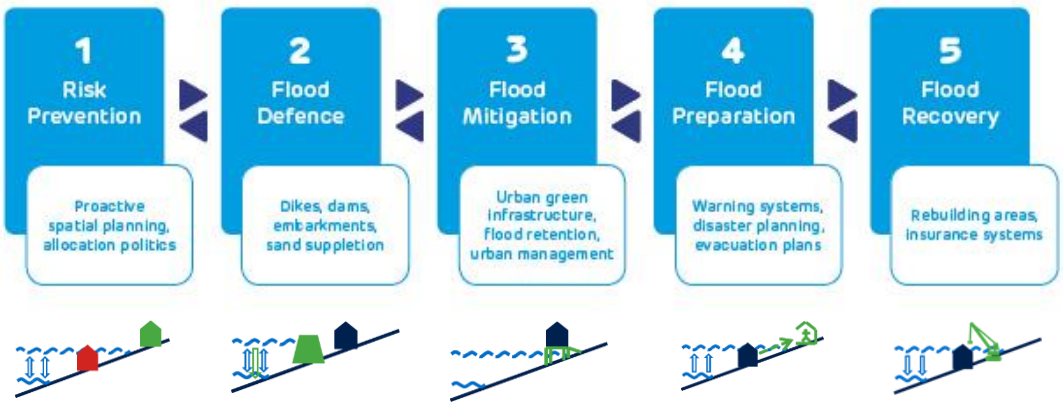

Figure 1: overview of the five Flood Risk Management Strategies identified within STAR-FLOOD

The conclusions reported in this document have been derived from conceptual and empirical work carried out in previous work packages. This work comprises the following steps: (i) analysis of flood risk governance, with a focus on stability and change therein; (ii) explanations for the dynamics (both stability and change) found; (iii) evaluations according to the desired outcomes of societal resilience,

efficiency and legitimacy; and iv) comparison followed by formation of design principles and success conditions.

For the **analysis** of flood risk governance, the four dimensions of the flood risk governance arrangements approach (actors, discourses, rules, resources) have been used. Details on the operationalisation of the four dimensions and the indicators used can be found in the main report of WP2 (Larrue *et al.* 2013). An institutional mapping of current FRGAs was complemented with an analysis of the historical dynamics therein. This was done since a thorough understanding of dynamics in policy and governance requires that these dynamics are studied longitudinally, as was shown in various WP2 deliverables (Hegger et al. 2014; Larrue *et al.* 2013).

To acquire understanding of the mechanisms through which flood risk governance changed or remained stable, **explanations** have been made. To do so, insights from prominent theories and frameworks on public policy change have been used: the Multiple Streams Framework (MSF) (Kingdon, 1984; Zahariadis 2007), Punctuated Equilibrium Theory (PET) (True et al. 2007), the Advocacy Coalitions Framework (ACF) (Sabatier and Jenkins–Smith, 1993; Sabatier and Weible 2007), the Institutional Analysis and Development Framework (IAD) (Ostrom 2007); change agency literature (Brouwer and Biermann 2011; Caldwell 2003; Huitema et al. 2011) and discursive theories (Hajer and Versteeg 2005; Jorgensen and Phillips 2002; Schmidt 2008, 2011). These have been translated into five types of explanatory factors: (i) physical circumstances; (ii) physical and social infrastructure; (iii) structural factors; (iv) characteristics of agency and (v) shock events. We have taken into account that these five factors may be found *within* but also *external* to flood-relevant policy domains (an example of the latter concerns e.g. major developments in political culture at the national level). We also bear in mind that each factor may contribute both to stability and to change. STAR-FLOOD's explanatory framework is introduced in more detail in Larrue *et al.* 2013 (WP2 deliverable).

Evaluations of flood risk governance have been made to assess the ways in which current FRGAs enable or constrain societal resilience to flooding in urban areas as well as the efficiency and legitimacy of flood risk governance (see also the reports an deliverables produced in WP2: Alexander *et al.* 2015; Hegger et al. 2014; Larrue et al. 2013). These are normative statements about what flood risk governance should achieve. In order to evaluate the extent to which flood risk governance is achieving these desired outcomes (i.e. resilience, legitimacy and efficiency), we have identified a number of criteria (see table 1.1) to measure these and a range of indicators to operationalise these criteria (see Alexander et al. 2015; Alexander et al., *submitted*). STAR-FLOOD discerned three facets through which societal resilience can be assessed; these include the i) capacity to resist flooding (*i.e.* minimise the likelihood and/or magnitude of the flood hazard), ii) capacity to absorb and recover from a flood event and iii) the capacity to adapt (including the capacity to learn, innovate and improve). Through this aspect of evaluation we examined the starting assumption of the project and examined the extent to which a diversified set of FRMSs are embedded within flood risk governance within each country; and in turn, the extent to which this is shown to support societal resilience to flooding at the national and case study scale. Legitimacy was also approached as a multi-faceted concept and operationalised via several criteria, including *social equity, accountability, transparency, participation, access to information, procedural justice* and *acceptability.* Ultimately flood risk governance should be deemed appropriate, whereby structures of governance and institutions 'fit'

the problem at hand. Rather than imposing notions of good or poor governance, this framework advocates a more context-specific perspective on appropriateness in line with the *logic of appropriateness* described by March and Olsen (2008).

Effectiveness (e.g. of strategies, measures) in terms of problem solving and goal achievement has not been included as a desired outcome in itself. Instead we see it as a necessary condition for societal resilience, effiency and legitimacy.

Table 1.1: Outcomes, criteria and indicators for evaluating flood risk governance (from Alexander et al. 2015)

Desired outcomes of governance	Evaluation criteria	Some example indicators to assess criteria
Societal resilience	Capacity to resist	The assembly of measures/projects/or governance arrangements is shown to have enhanced the ability of the social-environmental system in terms of reducing the likelihood or magnitude of flood hazard.
	Capacity to absorb and recover	The assembly of measures/projects/or governance arrangements is shown to have enhanced the resilience of the social-environmental system in terms of reducing the consequences, enabling the system to absorb and/or quickly recover.
	Capacity to adapt	Opportunities for learning and evidence that 'lessons learned' are implemented.
Efficiency	Economic efficiency	The flood risk governance arrangement or sub-entities of governance (e.g. FRM measures, projects or sub-arrangements) use financial resources in an efficient manner, based on the ratio of desired output(s) to input(s)
	Resource efficiency	Concerns for resource efficiency are widely evident within the flood risk governance arrangement (and delivered activities), as well as within the legal framework and/or are taken into account in amendments and reforms
Legitimacy	Social equity	The distribution of costs and benefits are fully considered within the decision-making process and communicated to those affected
	Accountability	There are opportunities for stakeholders to challenge decisions that have been made and hold decision-makers accountable
	Transparency	The decision-making process is transparent so all can see how decisions were made (e.g. public inquiries)
	Participation	Public participation has been sought through various stages in the decision-making process, based on a model of knowledge exchange
	Access to information	Stakeholders have equal access to relevant information about the problem and how it will be managed
	Procedural justice	The process of resolving disputes is considered to be

Desired outcomes of governance	Evaluation criteria	Some example indicators to assess criteria
		fair
	Acceptability	Decisions are accepted by stakeholders

Identifying governance design principles. Based on the outcomes of analyses, explanations and evaluations, strengths, weaknesses and opportunities and threats for flood risk governance in Belgium, England, France, the Netherlands, Poland and Sweden have been identified and reported in six publicly available country reports, being deliverables of WP3 (Alexander *et al.* 2016; Ek *et al.* 2016; Kaufmann *et al.* 2016; Larrue *et al.* 2016; Matczak *et al.* 2016; Mees *et al.* 2016). In WP4 a comparison of FRMSs, FRGAs and explanatory factors in all countries was made. WP5 identified strengths, weaknesses, opportunities and threats from a more comparative perspective (Ek *et al.* 2016a; Matczak *et al.* 2016a). This has led to the identification of design principles. These include success conditions related to the implementation of strategies – recommendations for actors at national/regional/local level; success conditions related to bridging between domains (e.g. between water management and spatial planning; between water management and disaster management) – and between all levels (EU, national, regional and local); success conditions related to the improvement of European/international legal frameworks and policies (Ek *et al.* 2016).

1.3.2 Research Methods

Empirical research was carried out in six European countries – Belgium, England, France, the Netherlands, Poland and Sweden – and 18 urban agglomerations therein. These countries are interesting since they are all part of the European Union and are currently implementing the EU Floods Directive (FD, 2007/60EC). However, they differ tremendously from one another in terms of physical conditions, actual flood experience, their departure point in terms of the FRMSs and FRGAs that are in place, and their administrative and legal context, amongst other things (Hegger *et al.* 2013). The project has assessed flood risk governance from a combined public administration and legal perspective. Flood risk governance arrangements (actors, discourses, rules and resources) at the national level and at the level of three case studies were analysed, explained and evaluated (Larrue *et al.* 2013). Box 4 provides an overview of the countries and case studies included in the project.

STAR-FLOOD's research approach can be characterised by intensive cross-country and cross-disciplinary dialogue throughout the project. Several research methods were used by policy analysts and legal scholars. Based on jointly developed guidance documents, all partners conducted empirical analyses and evaluations of flood risk governance in their country, both at the national level and at the level of three case studies focusing on specific urban areas that were used to illustrate and further explore developments at the national level. Data collection methods applied in all countries are: desk research (analysis of policy documents, legal texts, case law, literature); semi-structured interviews (70 in Belgium, 61 in England, 64 in France, 45 in the Netherlands, 54 in Poland and 19 in Sweden), legal comparison, and at least one workshop with stakeholders in each country. Next to this there were several occasions in which the comparison of strategies, arrangements and resilience capacities was discussed with all six country teams. Several plenary discussions and discussions in small groups were held throughout the project. Appendix A provides a more detailed overview of the process followed.

Box 4: overview of case studies and rationalities for selection

Three case studies were selected in each country. The aim of the case studies was to gain insight into the overall national approach to flood risk management. For that reason, case studies were chosen that are either exampels of this national approach, or illustrations of a deviation from this approach. A justification for the selection of each case study is given below.

Belgium

- *Antwerpen* – Flanders' biggest city. Example of new measures that aim to create win-win solutions between flood defence and flood mitigation measures; the Scheldt is also a trans-boundary river.
- *Geraardsbergen* and *Lessines* – two small cities on the river Dender, with Geraardsbergen in the Flanders Region and Lessines in the Walloon region. Interesting examples of the implementation of flood prevention instruments.

England

- *Lower Thames* – Opportunity to explore the implementation of a multi-scale flood risk management scheme within the context of Partnership Funding.
- *Hull* – Exploring efforts to integrate surface water mitigation within a defence-reliant regime.
- *Leeds* – Balancing flood risk with economic development through localised cooperation and innovative measures.

France

- *Nevers* – provides an example of the renovation of old protection infrastructures led by a master plan of the intermunicipal body. The city also exemplifies implementation of the national policy, with a few adjustments for the local context.
- *Le Havre* – highlights the role played by the inter-municipal body in identifying innovative solutions for combining risk management and agricultural development, on the one hand, and in challenging the State's expertise and authority in the definition of the marine submersion problem on the other.
- *Nice* – provides two contrasting examples of the local implementation of flood risk policies, on the rives Var and Paillon.

Netherlands

- *Dordrecht* – provides an example of a discourse on the so-called multi-layered safety focusing on probability-reducing and consequence-managing measures.
- *Nijmegen* – is one of 39 Room for the River project sites that adopt a more integrated, eco-system based approach to FRM.
- *Westergouwe/Zuidplaspolder area* – Example of a more or less mainstream approach, i.e. development in high flood risk area, but with adaptation of mitigative solutions.

Poland

- *Slubice* – A border city on the Odra, close to Frankfurt an der Oder (example of trans-boundary flood risk management), highly vulnerable to flooding (located in depression).
- *Poznan County* – an example of a flood-prone area that was not severely hampered by the floods of 1997 and 2002.
- *Wroclaw* – a city severely harmed by the flood of 1997; pilot project and frontrunner.

Sweden

- *Gotenburg* – has experience with flooding and has been working actively with flood risk management for at least 10 years. A large scale flood protection project is underway.
- *Karlstad* – this municipality has experience with flooding and has been working actively with flood risk management for at least 10 years. There is a local flood management programme for Karlstad.
- *Kristianstad* – one of the most flood-prone areas in the country where flood risk management is clearly visible on the local political agenda. Kristianstad has been claimed to be a role model for Swedish flood risk management. Defensive measures have been established.

1.4 Overview of answers to the sub-questions and deliverables

STAR-FLOOD's Description of Work also identified 10 sub-questions, which each provide a building block to answering the main research question. These sub-questions are not addressed in this report as such, but box 5 provides an overview of them. If possible without over-simplifying, a substantive answer to each question has also been provided in the text box.

Box 5: 10 sub-questions addressed within the STAR-FLOOD project

i) Sub-goal 'identifying':

1. What are the main trends in and challenges for flood risk governance in Europe?

This sub-question was mainly addressed in Work Package 1. Several goverance challenges were identified related to each of the four dimensions of the Policy Arrangements Approach used throughout the project (Dieperink *et al.* 2013). The project also highlighted some main insights into the nature of the flood hazard (Green *et al.* 2013) and in Europan flood regulations (Bakker *et al.* 2013).

2. What are the key elements of Flood Risk Management Strategies discussed in the literature?

An overview of key interventions for dealing with the flood hazard is provided in Green *et al.* (2013). An overview of key elements of FRMSs is provided in Dieperink *et al.* (2013). Implementation challenges related to these FRMSs are discussed in Dieperink *et al.* (submitted). Elements of FRMSs discussed in European policies are analysed in Bakker *et al.* (2013).

3. What kind of flood risk governance arrangements are characterised as 'good practice' in scientific and policy literature?

In Dieperink *et al.* (submitted), an overview of theoretical conditions for successful implementation of FRMSs is provided. This paper also identifies eight coordination mechanisms that have proven to be useful for coordinating different strategies.

4. Which Flood Risk Management Strategies are developed and applied in different urban agglomerations in the selected countries?

In all the analysed countries, all the flood risks management strategies (flood risk prevention; flood defence; flood mitigation; flood preparation; and flood recovery) are present but the need for diversification of strategies is evident in all countries except England, where strategies are already diversified. In practice, the implementation of Flood Risk Management Strategies in all countries is lagging behind changing discourses. At the discursive level, the importance of diversification is increasingly emphasised. Practical implementation is often hampered, for instance by path

dependencies, as the subsequent chapters will show with more detailed examples. Also, capacities to realise the implementation of strategies were found to be lacking (Alexander *et al.* 2016; Ek *et al.* 2016; Hegger *et al.* 2013; Kaufmann *et al.* 2016; Larrue *et al.* 2016; Matczak *et al.* 2016, 2016a; Mees *et al.* 2016).

ii) Sub-goal 'analysing':

5. What are the historical dynamics (or the absence thereof) of FRGAs in the selected countries?

While all FRMSs can be identified at least to some extent in each country, countries differ in the extent to which each strategy has been implementetd and for how long. A distinction should be made between (i) countries where diversification is the main approach towards Flood Risk Management as in England. Here, equal importance is attached to all strategies, and the choice for strategies is strategically informed by considerations regarding acceptable levels of risk and the types of flood hazard (e.g. fluvial, coastal) versus (ii) countries in which diversification is seen as the addition of backup strategies to a dominant strategy (e.g. Belgium, France, the Netherlands and Poland) (Alexander *et al.* 2016; Ek *et al.* 2016; Kaufmann *et al.* 2016; Larrue *et al.* 2016; Matczak *et al.* 2016, 2016a; Mees *et al.* 2016).

iii) Sub-goal 'explaining':

6. Which factors explain the FRGAs and their dynamics and what is the relative importance of each factor?

Work Packages 3 and 4 showed that both stability and change in flood risk governance arrangements are caused by dynamics within the national FRGA (e.g. policy entrepreneurs, path dependency). These dynamics influence how countries deal with external driving forces, such as land use changes, overall changes in governance (e.g. decentralisation) and climate change (Matczak *et al.* 2016). A detailed overview of explanatory factors is included in all WP3 reports and in the comparative report in WP4 (Alexander *et al.* 2016; Ek *et al.* 2016; Kaufmann *et al.* 2016; Larrue *et al.* 2016; Matczak *et al.* 2016, 2016a; Mees *et al.* 2016).

iv) Sub-goal 'evaluating':

7. What are the main building blocks to specify the meta-criteria of appropriateness and resilience into an assessment framework for FRGAs, what kind of indicators could be derived from these building blocks and how can these indicators be measured?

STAR-FLOOD discerned three facets through which societal resilience can be assessed; these include i) the capacity to resist flooding (i.e. minimise the likelihood and/or magnitude of the flood hazard), ii) the capacity to absorb and recover from a flood event and iii) the capacity to adapt (including the capacity to learn, innovate and improve). Through this aspect of evaluation we examined the starting assumption of the project and examined the extent to which a diversified set of FRMSs are embedded within flood risk governance within each country; and in turn, the extent to which this is shown to support societal resilience to flooding at the national and case study scale. Legitimacy was also approached as a multi-faceted concept and operationalised via several criteria, including social equity, accountability, transparency, participation, access to information, procedural justice and acceptability (Alexander et al. 2015; Alexander et al., submitted).

9. What are the strengths, weaknesses, opportunities and threats of FRGAs in the selected EU member states in terms of their appropriateness and resilience?

In each Work Package 3 report, an overview has been provided of each country's strengths, weaknesses, opportunities and threats (Alexander *et al.* 2016; Ek *et al.* 2016; Kaufmann *et al.* 2016; Larrue *et al.* 2016; Matczak *et al.* 2016; Mees *et al.* 2016). This has been further specified and compared in Hegger *et al.* (submitted).

9. What are the main similarities and differences between the selected EU Member States in terms of development and performance of FRGAs? What is the scientific and societal importance of these similarities and differences?

An overview of the main similarities and differences between the countries in terms of the development and performance of FRGAs has been provided in Matczak *et al.* (2016a). A comparison of their performance has been provided in Ek *et al.* (2016a) and Hegger *et al.* (submitted).

v) Main goal 'designing':

10. Which design principles can be derived from the analysis, explanation and evaluation of our cases?

Based on all preceding Work Packages, WP 5 identified design principles which have been laid down, amongst other reports, in Ek *et al.* (2016a). Furthermore, a publicly available practitioners' guide has been developed which can be downloaded at www.starflood.eu.

As explained above, this report provides an overview of the project's key conclusions. The reader who is interested in the more detailed results underlying these key conclusions is referred to the reports and papers listed in box 6 below. These are currently available, most of them through www.star-flood.eu and through the online journal portals. Besides that, some material, including a special feature in Ecology and Society and a special issue in the Journal of Flood Risk Management, is still in preparation at the time of writing.

Box 6: Overview of the deliverable reports and journal articles underlying STAR-FLOOD's key conclusions

Work Package 1 – problem analysis of Flood Risk Governance in Europe

Bakker, M. H. N., Green, C., Driessen, P. P. J., Hegger, D. L. T., Delvaux, B., Van Rijswick, H. F. M. W., Suykens, C., Beyers, J. C., Deketelaere, K., Van Doorn-Hoekveld, W., and Dieperink, C. (2013). Flood Risk Management in Europe: European flood regulation, STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-04-2

Dieperink, C., Green, C., Hegger, D. L. T., Driessen, P. P. J., Bakker, M. H. N. , Van Rijswick, H. F. M. W., Crabbé, A., and Ek, K. (2013). Flood Risk Management in Europe: governance challenges related to flood risk management (report no D1.1.2), STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-03-5

Green, C., Dieperink, C., Ek, K., Hegger, D. L. T., Pettersson, M., Priest, S., and Tapsell, S. (2013). Flood Risk Management in Europe: the flood problem and interventions (report no D1.1.1), STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-02-8

Hegger, D. L. T., Green, C., Driessen, P. P. J., Bakker, M. H. N., Dieperink, C., Crabbé, A., Deketelaere, K., Delvaux, B., Suykens, C., Beyers, J. C., Fournier, M., Larrue, C., Manson, C., Van Doorn-Hoekveld, W., Van Rijswick, H. F. M. W., Kundzewicz, Z. W., and Goytia Casermeiro, S. (2013). Flood Risk Management in Europe: Similarities and Differences between the STAR-FLOOD

consortium countries, STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-05-9

Work Package 2 – assessment framework of flood risk governance in Europe

Alexander, M., Priest, S., and Mees, H. *A framework for evaluating flood risk governance. S*ubmitted to *Environmental Science and Policy* (submitted)

Alexander, M., Priest, S. and Mees, H. (2015). Practical guidelines for evaluating flood risk governance. [In] Larrue, C., Hegger, D., Trémorin, J-B (Eds). Researching flood risk governance in Europe: A framework and methodology for assessing flood risk governance. STAR-FLOOD deliverable report (Report No. D2.2.1).

Bruzzone, S., Larrue, C., Van Rijswick, H. F. M. W., Wiering, M. (submitted). Interdisciplinary research between legal and policy scientists in environmental policies: on what terms? Focus on the construction of collaborative communities of researchers.

Larrue, C., Hegger, D. L. T., and Trémorin, J. B. (2013). Researching Flood Risk Policies in Europe: a framework and methodology for assessing Flood Risk Governance (report no D2.2.1), STAR-FLOOD Consortium, Utrecht, the Netherlands, ISBN: 978-94-91933-01-1.

Larrue, C., Hegger, D. L. T., and Trémorin, J. B. (2013). Researching Flood Risk Policies in Europe: background theories (report no D2.2.2), STAR-FLOOD Consortium, Utrecht, the Netherlands, ISBN: 978-94-91933-01-1.

Hegger, D. L. T., Driessen, P. P. J., Dieperink, C., Wiering, M., Raadgever, G. T., Van Rijswick, H. F. M. W. (2014). Assessing stability and dynamics in flood risk governance: an empirically illustrated re-search approach. Water Resources Management 28:4127-4142. http://dx.doi.org/10.1007/s11269-014-0732-x.

Hegger, D. L. T., Van Herten, M. Raadgever, T., Adamson, M., Näslund-Landenmark, B., and Neuhold, C. (2014a). Report of the WG F and STAR-FLOOD Workshop on Objectives, Measures and Prioritisation Workshop.

Work Package 3 – empirical studies in Belgium, England, France, the Netherlands, Poland and Sweden and report of the case study workshops

Alexander, M., Priest, S., Micou, A. P., Tapsell, S., Green, C., Parker, D., and Homewood, S. (2016). Analysing and evaluating flood risk governance in England – Enhancing societal resilience through comprehensive and aligned flood risk governance. STAR-FLOOD Consortium. Flood Hazard Research Centre, Middlesex University. ISBN: 978-94-91933-07-3.

Ek, K., Goytia, S., Pettersson, M., and Spegel, E. (2016). Analysing and evaluating flood risk governance in Sweden - Adaptation to Climate Change? STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-10-3.

Hegger, D. L. T., Bakker, M. H. N., Raadgever, G. T., and Crabbé, A. (2016). D3.1 Country and case study workshop report. STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-12-7.

Kaufmann, M., Van Doorn-Hoekveld, W. J., Gilissen, H. K., and Van Rijswick, H. F. M. W. (2016). Drowning in safety. Analysing and evaluating flood risk governance in the Netherlands. STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-11-0.

Larrue, C. (Ed.), Bruzzone, S., Lévy, L., Gralepois, M., Schellenberger, T., Trémorin, J. B., Fournier, M., Manson, C., and Thuillier, T. (2016). Analysing and evaluating Flood Risk Governance in France: from State Policy to Local Strategies, Tours, France. ISBN: 978-94-91933-08-0.

Matczak, P., Lewandowski, J., Choryński, A., Szwed, M., and Kundzewicz, Z. W. (2016). Flood risk governance in Poland: Looking for strategic planning in a country in transition. STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-09-7.

Mees, H., Suykens, C., Beyers, J. C., Crabbé, A., Delvaux, B., and Deketelaere, K. (2016). Analysing and evaluating flood risk governance in Belgium. Dealing with flood risks in an urbanised and institutionally complex country. University Antwerp, KU Leuven, Belgium. ISBN: 978-94-91933-06-6

Work Package 4

Choryński, A., Raadgever, G. T., and Jadot, J. (2016). D4.2 Experiences with flood risk governance in Europe; a report of international workshops in four European regions. STAR-FLOOD Consortium, Utrecht, the Netherlands.

Gilissen, H. K., Alexander, M., Beyers, J. C., Chmielewski, P., Matczak, P., Pettersson, M., Schellenberger, T., and Suykens, C. (submitted). Bridges over Troubled Waters – An Interdisciplinary Framework for Evaluating the Interconnectedness within Fragmented Flood Risk Management Systems.

Matczak, P., Wiering, M., Lewandowski, J., Schellenberger, T., Trémorin, J. B., Crabbé, A., Ganzevoort, W., Kaufmann, M., Larrue, C., Liefferink, D., and Mees, H. (2016). Comparing flood risk governance in six European countries: strategies, arrangements and institutional dynamics. STAR-FLOOD consortium, Utrecht, the Netherlands.

Wiering, M., Schellenberger, T., Kaufmann, M., Mees, H., Ganzevoort, W., Hegger, D. L. T., Larrue, C., Matczak, P. Varieties of flood risk governance in Europe. How do countries respond to driving forces and what explains institutional change? Submitted.

Work Package 5

Ek, K. Pettersson, M., Alexander, M., Beyers, J-C., Pardoe, J., Priest, S., Suykens, C., and Van Rijswick, H. F. M. W. (2016a). Best practices and design principles for resilient, efficient and legitimate flood risk governance – Lessons from cross-country comparisons, STAR-FLOOD Consortium, Utrecht, the Netherlands.

Ek, K., Raadgever, G. T., Suykens, C., Bakker, M. H. N., Pettersson, M., and Beyers, J. C. 2016b. An expert panel on design principles for appropriate and resilient flood risk governance – lessons from a workshop in Brussels. STAR-FLOOD consortium, Utrecht, the Netherlands.

Dieperink, C., Hegger, D. L. T., Bakker, M. H. N., Kundzewicz, Z. W., Green, C., Driessen, P. P. J. (submitted). Dealing with recurrent governance challenges in the implementation and alignment of flood risk management strategies: a literature review. Water Resources Management.

Pettersson *et al.* (in preparation). Design principles for improved legitimacy of flood risk governance in Europe.

1.5 Outline of the report

The outline of this report is as follows. Chapter 2 addresses the relevance of adopting a governance perspective on flood risk management. Chapter 3 discusses the extent to which Flood Risk Management Strategies are being diversified – which is assumed to lead to increased flood resilience – as well as drivers for and barriers to such a diversification. Chapter 4 deals with the establishment of bridging processes and mechanisms that facilitate linkages between Flood Risk Management

Strategies and help overcome fragmentation. Chapter 5 discusses the actors involved in flood risk governance and the division of responsibilities between public and private actors, including citizens. Chapter 6 is about observed diversification of rules and regulations relevant for flood risk governance and the challenges related to the development of appropriate rules that are enforceable and enforced. Chapter 7 discusses the resources needed to make flood risk governance more resilient. In chapter 8, our evaluation of the resilience, efficiency and legitimacy of flood risk governance is provided. Implications for policy and law at the European, national and regional level are discussed in chapter 9. Finally, chapter 10 provides our concluding remarks. For a detailed justification and underpinning of each conclusion, each chapter refers other relevant STAR-FLOOD deliverables as well as existing scientific literature.

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2 The relevance of a governance perspective on flood risk management

For a long time a natural and technical science perspective has dominated the research on Flood Risk Management. When the Floods Directive (Directive 2007/60/EC) was being developed, the directive text was drawing significantly on findings from projects carried out within the Sixth Framework Programme (FP6) in the period 2002-2007 (Kundzewicz *et al.* 2015, submitted). In particular, the FLOOD-site project provided a scientific foundation for the directive text adopted in 2007. Subsequent projects provided enhanced knowledge on climate change impacts, e.g. the WATCH project and regional assessments, for instance in the Mediterranean area with the CIRCE project (ibid). In FP7 in 2007-2013, research was more focused on implementation issues, e.g. related to improved early warning of flash floods with the IMPRINTS project, and disentangling the notion of flood resilience within the CORFU project (ibid. See also: Quaevauviller 2011). A graphical depiction of the interrelationships between the projects is provided in figure 2.

Figure 2: overview of integrated projects funded by the European Commission (source: Philippe Quevauviller).

Other issues addressed in previous European research projects included, amongst other things, technologies for improved safety of the built environment (FLOODprobe/SMARTeST); the costs of natural hazards (ConHaz); integrated multi-hazard vulnerability assessment (ENSURE); social capacity building (CapHaz-Net); adaptive water management under uncertainty (NeWater); emergency management (UrbanFlood), risk assessments, future scenarios and technical measures (IRMA SPONGE, FLOODsite and HYDRATE). Although some programmes, like NeWater, have addressed social-scientific research questions, social-scientific, comparative European institutional and legal

studies on flood risk management are still rare, fragmented and limited in scope and are mostly carried out at the national level and within the national legal context.

There is obviously a clear gap in terms of governance-focused research and research expertise from public administration and legal fields. Flood risk management is not only a technical issue of building flood defences and developing flood warning systems. It is also a matter of activating governmental and non-governmenal actors, stimulating fruitful cooperation between these actors, putting the right legal, economic and communicative instruments in place, securing connectivity between relevant policy sectors and between administrative levels, enhancing risk awareness among societal groups, and provoking societal debates on future perspectives and associated transformative pathways. In order to improve flood resilience in the face of urbanisation and climate change, a governance perspective has complemantary insights to offer (Hegger *et al.* 2014; Dieperink *et al.* Submitted). It tests governing actors' abilities to collaborate, tests the presence and efficacy of policy instruments, provides understanding of the mechanisms through which strategies, actors, levels and sectors can be bridged and may inspire changes in societal debates and institutional settings. Change may require specific resources (finance, knowledge), legal changes and/or coordination to ensure a clear division of responsibilities and the presence of a legal framework that enables the implementation and enforcement of newly developed flood risk policies and approaches. All this has to take place in adherence to normative values and principles held in societies, which may include effectiveness, legitimacy, social equity, transparency, subsidiarity and efficiency. A better insight into governance challenges and the conditions that may help address them is relevant for societal actors that have the ambition to diversify FRMSs in order to improve resilience.

To reach the desired outcome of improving societal resilience to flooding, governance is pivotal. This is reflected in adaptive governance literature (e.g. Chaffin *et al.* 2014: 64) in which it is argued that "adaptive governance is essential for dealing with complexity and uncertainty associated with rapid global environmental change. Social ecological systems should be managed holistically to either increase resistance to undesirable change or to transform a system to a more desirable state". Adaptive governance is seen as a precondition for achieving adaptive management (ibid), which can be understood as the enabling of "…a social-ecological system to sustain itself through learning-by-doing and cooperation and to avoid collapse, while enhancing a system's capacity to respond to changing circumstances" (Den Uyl and Driessen 2015: 189). This perspective sees adaptability as a pre-condition of resilient systems, and emphasises change. This literature on adaptive governance often stresses that system resilience will benefit from a variety of pathways or strategies. Scholars stress diversity, polycentricity and flexibility (e.g. Folke *et al.* 2005, Pahl-Wostl *et al.* 2007).

Just like other water-related challenges (e.g. OECD 2014), there is no one-size-fits-all solution for addressing flood risk governance challenges. The STAR-FLOOD project has, however, increased our understanding of flood risk governance practices, explained and evaluated these practices, and – based on these insights – formulated design principles and conditions for improving flood risk governance in different contexts. This was the reason for devising our second starting assumption on appropriateness, i.e. that a successful implementation of a diverse, resilient, set of FRSs – requiring a combination of old and new strategies and coordination of different strategies – in a certain area is only possible if these strategies and their coordination are seen as efficient and legitimate by the

actors involved and hence are properly institutionally embedded given the opportunities and constraints of their physical and social context.

Concretely, the STAR-FLOOD project has developed the following types of contributions to the state or the art of (flood risk) governance and legal literature. It has provided insights into:

- Stimulating and hampering factors for a diversification of flood risk management strategies (see also: Aerts *et al.* 2008; Hegger *et al.* 2014; Innocenti and Albrito 2011; Van den Brink *et al.* 2011; Wardekker *et al.* 2010; Wesselink *et al.* 2015);
- The necessity to coordinate and align these strategies and the importance of bridging mechanisms (see also: Koskenniemi and Leio 2002; Rijke *et al.* 2013; Voss *et al.* 2007);
- The characterisation of flood risk governance arrangements and sub-arrangements in various countries and essential similarities and differences (see also: Bubeck *et al.* 2015; Matczak *et al.* 2016a);
- The functioning and implementation of the Floods Directive in six European countries (see also: Bakker *et al.* 2013; Hartmann and Driessen 2013; Priest *et al.* submitted);
- The necessary interrelationship between flood risk management and spatial planning and between flood risk management and emergency management (see also: Hartmann and Driessen 2013; Gilissen *et al.*, submitted; Kolen and Helsloot 2014);
- How literature on social-ecological resilience can be specified for the floods domain and the factors stimulating and hampering enhanced flood resilience (see also: Alexander *et al.* 2015; Hegger *et al.* submitted; Folke 2006; Klijn *et al.* 2008; Mens *et al.* 2011);
- The functioning of formal rules and regulations and the tension between legal certainty and flexibility (see also: Van Rijswick and Havekes 2012; Goytia *et al.* submitted).
- Divisions of resoponsibilities between public and private parties (the public-private divide) (see also: Meijerink and Dicke 2008; Runhaar *et al.* 2014; Mees *et al.* 2014; Mees *et al.* submitted).

Pictures: group photo at STAR-FLOOD's Academic Master Class in London, 4 and 5 July 2014 (left) and the plenary consortium meeting in Luleå, Sweden, 4 and 5 June 2015 (right).

3. Diversification of Flood Risk Management Strategies – necessity and importance

Key findings:

- Countries differ in their approaches to diversification. In the Netherlands, Poland, France and Belgium, we see a desire to create a back-up layer of contingency. England has been diversified for 65 years, while Sweden is currently diversifying due to climate change concerns;
- In most cases, the practical on the ground implementation of diversified strategies is lagging behind intentions as laid down in discussions and policy plans;
- Main drivers for diversification are: policy entrepreneurs; bottom-up initiatives by local stakeholders; a broader discursive shift towards sustainability and resilience; the presence of enforceable rules and regulations; the availability of financial resources; technical improvements; broader shifts 'from government to governance'; and Europeanisation.
- Main barriers for diversification are: a lack of resources and path dependency.
- Floods as trigger events have been found to contribute both to stability and change, but under different circumstances;
- To be resilient, a country should have the capacity to resist, absorb and recover and to adapt;
- To enhance societal resilience to flooding, diversification of flood risk management strategies (FRMSs) is both necessary and important. Diversity of FRMSs in itself is not enough, though, to guarantee societal resilience, indeed each strategy must be effective in its own right;
- Sufficient investment in each chosen strategy needs to be provided. Spreading of resources leading to an underinvestment in all strategies should be avoided.

3.1 The extent to which diversification is taking place

As mentioned in the introduction chapter, STAR-FLOOD took as its first starting assumption that diversifying and aligning Flood Risk Management Strategies makes countries more resilient to flood risks. As a first step towards scrutinising this assumption, it should be assessed whether and to what extent diversification is actually taking place, both in discourse and in practice. In all countries, the usefulness of diversification is acknowledged, although the extent to which it is actually being realised differs between countries.

At the discursive level, a distinction can be made between England and Sweden on the one hand and the other four countries on the other. In England and Sweden, each of the five FRMSs are deemed as equally important in FRM, thus there is no overtly dominant strategy at the national scale (albeit this may vary under different local conditions). In the Netherlands and Poland, strategies other than flood defence are seen as back-up strategies used for reducing residual risks. The same is true in Belgium and France, although here prevention and mitigation are sometimes applied instead of defence. In these four countries, there is evidence of discursive dominance of certain strategies: a strong prevention discourse in France, a focus on defence in the Netherlands, on emergency management in Poland (also in practice) and on defence, prevention and mitigation in Belgium. The country-specific preference for a particular portfolio of FRM strategies is a result of the physical and institutional context in these countries. Hence, it is not possible to *a priori* determine whether one approach is preferable over the other. Ultimately flood risk governance should be deemed appropriate, whereby structures of governance and institutions 'fit' the problem at hand. Rather

than imposing notions of good or poor governance, this framework advocates a more context-specific perspective on appropriateness in line with the *logic of appropriateness* described by March and Olsen (2008).

In all countries, except England, on the ground implementation of a diversified set of strategies is lagging behind discourses on diversification. While all countries can be said to be diversified in that all strategies have been implemented at least to some extent, especially in Belgium, France, the Netherlands and Poland, there is a relative dominance of the flood defence strategy. Implementation of strategies other than the dominant one is taking place but at a slow pace.

3.2 Drivers for diversification

In all researched countries, we found drivers for diversification. A distinction can be made between specific actor-, discourse-, rules- and resource-related drivers as well as more general and encompassing drivers.

Actor-related drivers

- **Policy entrepreneurs** at several levels of government were found to play a crucial role in putting water safety issues on political agendas, often by exploiting windows of opportunity formed by catalyst floods that helped to facilitate change. For instance, in England policy entrepreneurs have played an important role in establishing 'best practices' in FRM, at both national and local scales (Alexander et al. 2015). Another example is the specially appointed Delta Commissioner leading the Dutch Delta Programme (although this programme was initiated not as a reaction to floods but in anticipation of increased flood risks). But also at local level, we found that a crucial role was played by these policy entrepreneurs in several municipalities in different countries, e.g. in Dordrecht and Wroclaw. Policy entrepreneurs were generally easy to identify since several interviewees pointed to the important role played by them. Traits that were frequently attributed to them were political sensitivity, networking capabilities, the potential to familiarise themselves with the rationalities used by different actors with different interests, their charismatic leadership and their intrinsically motivated drive to improve flood policies.
- **Bottom-up initiatives initiated by local actors**, including local governments and residents. Especially in France, England and the Netherlands, there are examples of such local initiatives. These initiatives hold the promise of exploiting innovative potential in society, ensuring that flood management schemes are tailored to local situations and they can serve as niches, places where learning about innovative flood management options and their implementation is taking place. The rise of bottom-up initiatives can be linked to the devolution of certain responsibilities in FRM, resulting in local actors having more powers to implement different types of measures. Secondly, with stretched resources and strict funding rules in each country, practitioners need to look to alternative measures to address risk, because defence is not an economically viable option in all locations. Thirdly, there is scope for true 'bottom-up' initiatives i.e. community- or household-led initiatives which are actively encouraged in several countries.

Discourse-related drivers

- A discursive shift away from a purely technocratic view of FRM due to the fact that **notions of sustainability and resilience** have been actively discussed (Matczak *et al.* 2016a). Examples of rising alternative discourses include safety or risk-based discourses, integrated flood risk management and eco-system based management, climate change and environment or sustainable development. Also, the concept of 'resilience' itself often promotes community involvement in risk strategies, as seen in England. These discourses can lead to an increasing diversification of arrangements (e.g. the traditionally strong role of prevention in France, or the 'making space for water' discourse in the Netherlands and England, and Belgium strengthening prevention). However, such discourses have varying effects: the climate change debate led to increased attention to FRM and mitigation in Sweden, yet has had little visible impact in Poland, and despite minor changes in discourse has largely maintained the defence dominance in the Netherlands (Matczak *et al.* 2016a).

Rules-related drivers

- **Enforceable rules and regulations**. The Water Assessment in the Flemish region in Belgium was found to be effective in forcing local actors to consider flood risks in urban development as it enables water managers to prohibit the granting of building permits and offers the possibility of making these permits subject to specific conditions (e.g. taking mitigating measures). However, this instrument can only be truly effective when the conditions that are included in the permit pursuant to the conclusion of the water assessment, are consistently followed up in the field and subsequently enforced. Otherwise, competent authorities have no way of knowing whether this instrument is, in fact, effective. The more rules and regulations leave room for interpretation, the more they seem to enable adaptation, as the rules can be interpreted differently if changes in flood risks necessitate this (Goytia *et al.* submitted). On the other hand: the more room for interpretation and policy freedom, the more risk that actors keep on the old and well known track as changes might be more difficult to implement than 'business as usual' and rules that leave more room for interpretation may also be more difficult to enforce. For instance, in the Netherlands, spatial planning authorities always had the power/authority and the legal instruments and a legal duty to take flood risks into account, but they were not willing to use these instruments. The focus always had been on short term profits that go with urban development. The large amount of policy freedom and flexibility resulted in the neglect of flood risks and the minimal use of prevention and mitigation strategies. This changed when more binding rules were developed (Beleidslijn ruimte voor de rivier).

Resource-related drivers

- The availability *of* **financial resources** has proven to be a crucial determinant for diversification, but at the same time previous investment decisions may create path dependencies. In the Netherlands, there is a specially established Delta Fund which receives one billion Euros per year in order to finance improvements in water safety and fresh water supply, but it is still uncertain to what extent these finances are invested in stimulation of diversification. The CatNat recovery mechanism in France finances the Barnier fund (i.e. through retaining a percentage of the sums

collected) which undertakes measures of risk prevention. The CAT-NAT scheme is financed with insurance premiums paid by citizens. This ensures that recovery is a strong strategy in France, next to defence. At the other extreme, we found that resources in Poland are lacking and that the implementation of FRM strategies in this country is dependent on revenues from European funds like the EU Cohesion Fund.

- **Technical improvements** in flood risk management can be seen as an important driver: had there been no improvements in mapping and modelling risks (including improved data and knowledge such as the availability of longer historical records), implementing current spatial planning and insurance systems would be a lot more complicated, even impossible. Beyond FRM, technological progress includes remote sensing, computational power and the availability of modelling tools, amongst other things.

Drivers encompassing several dimensions (actors, discourses, rules, resources) simultaneously

- An important contextual factor is formed by a **more general shift from 'government' to 'governance',** whereby the state is only one steering actor amongst others (Driessen et al. 2012; Van Rijswick and Havekes 2012). This is reflected in the procedural approach of the Floods Directive. In the field of FRM, Europeanisation plays a significant role in this process. An important legislative step in the evolution towards enhanced participation has been the UN Aarhus Convention of 1998, which established the right of individuals and their associations to have access to environmental information and participate in environmental decision-making and to access to the courts. Closely related to this, EU directives such as the EIA directive and the WFD oblige member states to involve the public in FRM decision-making. Particularly in Poland the increase in public participation was strengthened by requirements attached to investments financed by EU funds.
- **Floods as trigger events** also contributed to change. In Poland, the 1997 floods were a trigger to increase attention to crisis management in FRM and to reorganise its structure. Whereas earlier the main competence lay with the national army, it is now divided between State Fire Brigades and provincial, county and municipal emergency planning services, and has thus become a 'multi-level' responsibility. In England, the 1998 floods were a driver for more diversification by way of improved flood warning systems and the launch in 1999 of national annual flood awareness campaigns by the Environment Agency, which continued for around 10 years until they were complemented with more local awareness-raising activities. The floods in 1998 in Flanders and in 2002-03 in Wallonia were also found to be drivers for diversification, and the floods of 2010 led to substantive legislative changes in the Flemish region. In the Netherlands, the near floods in 1993 and 1995 stimulated a shift towards flood risk mitigation through The Room for the River programme and more natural approaches to flood risks. In France, the Xynthia event strengthened the focus on risk on coastal areas, quite forgotten until then.
- **Europeanisation** in terms of the establishment of a single European market, identity and currency has had a mixed influence on diversification and dominance in FRM. In some countries (e.g. the Netherlands), EU directives like the Floods Directive were implemented along the lines of the existing defence-oriented approach, though with a stimulus to faster implement the risk approach in legislation, and as such did little to challenge the defence dominance. In England overall the Floods Directive can be seen to be only causing minor changes or reinforcements to the existing rules governing flood management. In other countries (e.g. Belgium), EU directives

and participation in EU research projects did stimulate increased attention to new approaches to FRM, such as risk-based management and nature-based approaches. Europeanisation can also drive both dominance and diversification within the same country: in Poland, access to EU funds strengthened the focus on defence, but EU directives also introduced or strengthened flood risk mapping and nature-based approaches, in turn reinforcing the position of environmental NGOs. In France it increased the weight of central government power on FRM at local level.

3.3 Barriers to diversification

Regarding barriers to diversification, we found three more general and encompassing barriers:

- A **lack of resources** often formed an important reason for a lack of investments in flood risk governance and for a lack of diversification. For instance, Poland, while lacking resources for flood defence, still sees defence as the most desirable strategy. In Belgium, a lack of resources has been found to impede an effective flood preparation.
- Various mechanisms, which can be grouped together under the heading of **"sunk costs" and "path-dependency".** These terms refer to the fact that any commitments made to dominant strategies (often flood defence) in the past make a diversification to other strategies less likely and desirable. We see that in all countries the past investments in structural defence infrastructure are described as stabilising forces. Existing urban development in flood-prone areas will also make diversification less likely (e.g. as in the West of the Netherlands). High financial investment in flood infrastructure – with its created flood risk expertise in epistemic communities – leads to increasing returns and so-called 'sunk costs'. This decreases the practical possibilities to implement alternative measures (e.g. Poland, France, the Netherlands) and might make further investments in dikes the most cost-efficient solution (e.g. the Netherlands). We also found that the incentive to change regulations (rules) tends to be limited due to high transaction costs when changing administrative arrangements and developing new expertise and infrastructure (resources), although the STAR-FLOOD project also identified examples of rules that were changed relatively easily or that in their existing form already allowed for diversification. This points to an increasing need for those actors who have responsibility, power and instruments to actually use these powers and instruments.
- Third, while **floods** have been shown to play an important role in putting water safety issues on political agendas, as in Poland and all other countries, in some cases they were also found to have a tendency to **mainly reinforce the dominant logic of flood defence** (safety first). Such reasoning has been found amongst other things in the Netherlands and Poland (Kaufmann *et al.* submitted). Seen in this way, floods are not necessarily just a driver for diversification, but also for strengthening specific existing strategies. For instance, the 1998 and 2000 floods in England led to significant improvements to emergency management and flood warning.

3.4 Implications for STAR-FLOOD's starting assumptions[1]

STAR-FLOOD's first starting assumption deals with the question of to what extent having a diversified and aligned set of strategies in place leads to resilience. This question cannot be answered in a straightforward way, but should be approached from at least two perspectives. A first perspective, with which e.g. Liao (2012) would agree, is that diversification of FRM strategies is indeed necessary

[1] The text in this section is largely based on Hegger *et al.* (submitted).

to achieve resilience. Reliance only on flood defence and – seemingly associated – increasing capacity to resist is undesirable when taking into account current and potential future flood risks in times of urbanisation and climate change. An approach solely reliant on resistance is not sufficiently flexible to easily take these new risks into account while at the same time there might be failure of the infrastructure or a flood above design standards. Seen from this perspective, a country like the Netherlands is taking a significant risk because the actual consequences of floods are likely to be dramatic (with a large degree of societal disruption). While part of the risks taken are the result of choices made in the past combined with inescapable physical circumstances, we have also found that e.g. in current planning decisions flood prevention has a relatively low priority compared to other spatial functions. Put in other words, perfect, absolute flood resistance is not possible. A system may withstand load, but not without limits. According to a statistical design concept, defences should withstand a design flood, e.g. 100-year flood, but may fail if the actual flood is much higher. Therefore, at least from the first perspective, a more disaster-conscious society needs to be built. The dominating stance should be to seek safe-fail (safe in failure) in addition to unrealistic fail-safe (safe from failure) solutions, (cf. Kundzewicz and Takeuchi 1999).

From a second perspective, which is a potential criticism on the first perspective, diversification does not (necessarily) guarantee resilience. After all, a retrospective evaluation shows that countries in which all strategies are in place to a large extent and that have a high capacity to absorb and recover and capacity to adapt are not the countries with the lowest casualties and losses, and one could even argue that a resilience approach does not explicitly aim to avoid these. In England, there still seems to be room for improvement in terms of further risk reduction, although this criticism should be viewed in the light of normative viewpoints held in England, in which it has been accepted that some floods may happen while it is intended to resist some other (large) floods. England is more resilient to flooding by having this diversification and flooding has not (yet) caused a complete rethink of flood risk management, which may be indicative that to a great degree the system seems to be working, although it has prompted significant reviews, including the current Government's National Flood Resilience Review.

These observations necessitate us to nuance our starting assumption that diversification leads to more/increased resilience. Diversity of FRMSs in itself is not enough to guarantee societal resilience, indeed each strategy must be effective in its own right. Moreover, the analysis performed by each STAR-FLOOD country demonstrates the importance of effective mechanisms and processes connecting certain FRM strategies, policy domains and actors (as discussed in Matczak *et al.* 2016a). Therefore, returning to the project's starting assumption, it is clear that diversification of FRMSs is only a partial prerequisite for societal resilience. Another crucial observation is that the diversification of FRMSs is motivated by different factors. In the Netherlands, Poland and to some extent France and Belgium, efforts to develop FRMSs beyond flood defence are partly driven by the desire to create a back-up layer of contingency (or 'fail safes') should defence measures fail. This is not the case in England, where diversification simply characterises the approach to flood risk governance that has been established for ca. 65 years. Diversification of FRMSs in Sweden is primarily motivated by an increased number of actual events, combined with the increased risk for floods that is assumed to accompany climate change. We conclude that diversification of FRMSs does not necessarily guarantee resilience but that it may contribute to it as being one of the essential preconditions. However, as we have seen, also other factors increase resilience.

3.5 STAR-FLOOD products supporting this key message

Choryński, A., Raadgever, G. T., and Jadot, J. (2016). D4.2 Experiences with flood risk governance in Europe; a report of international workshops in four European regions. STAR-FLOOD Consortium, Utrecht, the Netherlands.

Dieperink, C., Hegger, D. L. T., Bakker, M. H. N., Kundzewicz, Z. W., Green, C., Driessen, P. P. J. (submitted). Dealing with recurrent governance challenges in the implementation and alignment of flood risk management strategies: a literature review. Water Resources Management.

Ek, K. Pettersson, M., Alexander, M., Beyers, J-C., Pardoe, J., Priest, S., Suykens, C., and Van Rijswick, H. F. M. W. (2016a). Best practices and design principles for resilient, efficient and legitimate flood risk governance – Lessons from cross-country comparisons, STAR-FLOOD Consortium, Utrecht, the Netherlands.

Ek, K., Raadgever, G. T., Suykens, C., Bakker, M. H. N., Pettersson, M., and Beyers, J. C. (2016b). An expert panel on design principles for appropriate and resilient flood risk governance – lessons from a workshop in Brussels. STAR-FLOOD consortium, Utrecht, the Netherlands.

Hegger, D. L. T., Driessen, P. P. J., Wiering, M., Van Rijswick, H. F. M. W., Kundzewicz, Z. W., Matczak, P., Crabbé, A., Raadgever, G. T., Bakker, M. H. N., Priest, S. J., Larrue, C., and Ek, K. (submitted). Toward more flood resilience: is a diversification of FRM strategies the way forward?

Matczak, P., Wiering, M., Lewandowski, J., Schellenberger, T., Trémorin, J. B., Crabbé, A., Ganzevoort, W., Kaufmann, M., Larrue, C., Liefferink, D., Mees, H. (2016). Comparing flood risk governance in six European countries: strategies, arrangements and institutional dynamics. STAR-FLOOD consortium, Utrecht, the Netherlands.

Pettersson *et al.* (in preparation). Design principles for improved legitimacy of flood risk governance in Europe.

Wiering, M., Schellenberger, T., Kaufmann, M., Mees, H., Ganzevoort, W., Hegger, D. L. T., Larrue, C., Matczak, P. Varieties of flood risk governance in Europe. How do countries respond to driving forces and what explains institutional change? Submitted.

Photos: Stormvloedkering, https://beeldbank.rws.nl, Rijkswaterstaat / Joop van Houdt; image of Dordrecht, http://www.preventionweb.net/applications/hfa/lgsat/en/image/href/5474

4 Enhancing connectivity between strategies by bridging actors, levels and sectors

Key findings:

- Diversification of FRM strategies may lead to fragmentation between actors, levels and sectors, causing inefficiencies and ineffectiveness and possibly undermining societal resilience;
- To some extent, fragmentation between sectors may be overcome, provided that further learning, cooperation and exchange within and between countries takes place, however, it is realistic to expect that the problem of fragmentation cannot be fully solved.
- Bridging processes and mechanisms are needed between several FRM strategies, including coordinating actors; procedural duties and instruments; formal rules and regulations; financial and knowledge resources and bridging concepts. Especially spatial planning and the insurance sector could play a vital role in this respect.
- Decentralisation may help in bridging different levels of government to ensure a good combination of top-down and bottom-up governance, however provided that the shifting of financial and executive tasks is accompanied by a shifting of formal powers and resources.

4.1 The link between fragmentation and diversification

Diversification of flood risk management strategies that is appropriately institutionalised seems to be desirable, provided that this is done through an integrated or aligned approach. In an extreme case, this could be done by avoiding fragmentation altogether. In such a case, a single actor, being a public or private entity, organisation, department, group or even individual would be solely responsible for all tasks related to flood risk management. In practice, such an extreme example does not exist and it would be unlikely that it would occur in the future. Instead, different **types of fragmentation** can be identified (Gilissen *et al.* submitted):

- Different actors in different sub flood risk governance arrangements are responsible for different FRM strategies (as in France and Poland).
- Different actors within a sub flood risk governance arrangement are responsible for the same FRM strategy (e.g. different actors for different scale levels, as in England, Belgium and the Netherlands).
- Different actors in different sub flood risk governance arrangements are responsible for the same FRM strategy (e.g. different actors for protection against pluvial and fluvial flooding, as in the Netherlands).
- Different actors within the same sub flood risk governance arrangement are responsible for different FRM strategies (e.g. water managers focusing both on flood defence and flood mitigation, as in Belgium).

In case fragmentation occurs, it is necessary to establish bridging mechanisms: all kinds of interlinkages between actors, aiming to intensify interactions in their pursuit of various FRM strategies in order to cope with the difficulties potentially resulting from fragmentation (ibid).

We found differences in the extent to which countries have managed to implement such an integrated and aligned approach and the degree of fragmentation present. In England, Belgium and Sweden, several sub flood risk governance arrangements have been identified that do not vary widely in terms of their power basis. While the English system consists of numerous actors, different

resources, discourses and levels of governance the level of cooperation between actors, the legal instruments or the informal bridging processes push the English case towards a more integrative approach. A similar finding applies for Belgium, although the federal structure of the country was found to lead to complexity and hence fragmentation. In the Netherlands, we found a relatively dominant water system sub-arrangement. Diversification is taking place mainly within the dominant water system sub-arrangement. Preparation and prevention are being mobilised within this sub-arrangement, but this is less so the case for the recovery strategy. The Dutch multi-hazard oriented safety regions are still operating at a relative distance from the water system sub-arrangement. Especially in France and Poland we found that the actors operating in different sub arrangements are each operating within a relatively narrow scope and bridging mechanisms were found to be lacking or ineffective (Matczak *et al.* 2016a). One of the main examples of fragmentation is that between water management and spatial planning. As will be detailed below, countries differ in the extent to which effective bridging between the two domains is achieved.

We conclude that diversification of FRM strategies may lead to fragmentation and that this in turn may hamper flood resilience and the effectiveness and legitimacy of FRM. In many countries efforts to overcome this fragmentation are underway and bridging processes and mechanisms between actors, sub flood risk governance arrangements and FRM strategies are being developed. This leads us to assume that fragmentation as found in the STAR-FLOOD project may not be seen as permanent but as a stage that several countries have to go through. Coordination of strategies and bridging between them is taking place to an increasing extent. Good practices in overcoming strong fragmentation can be derived from Belgium (Mees *et al.* 2016). This country's administrative system, with much power going to the level of the regions (Flanders, Walloon and Brussels Capital Region) has resulted in fragmentation but also in the development of many bridging mechanisms, some of which will be discussed in subsequent sub-sections. The English system has also been reported to be extremely fragmented and complex in the distribution of FRM responsibilities, but on the other hand it has been shown to be a highly flexible governance arrangement (Alexander *et al.* 2016).

4.2 Bridging between administrative levels: reconciling the need for local flexibility and coordination

We found that in all STAR-FLOOD countries it turned out to be challenging to balance the need for local flexibility and coordination. Too much top-down steering may hamper the possibilities for implementing tailor-made solutions, while too little coordination may hamper learning between regions and also hamper efforts to tackle up-stream/down-stream issues. Some countries seem to be doing a better job in striking a balance. In Sweden, dealing with flood risk is predominantly a local issue (Ek et al. 2016). Sweden knows strong municipal self-governance. This is to some extent to be evaluated as positive, since it allows for flexible and tailor-made approaches, but through a lack of coordination at the national level, there is the risk of several municipalities "reinventing the wheel". Also, counter-intuitively, in France there was found to be much room for local initiatives through inter-municipal cooperation and in particular through local flood action plans (PAPIs) (Larrue et al. 2016).

Some examples of more balanced multi-level governance (MLG) processes were also found. Dutch policy programmes such as the recently finalised 'Room for the River' programme, a national policy programme consisting of 30 projects to increase space for water along several major watercourses in the Netherlands and the Delta Programme, a strategic programme to develop a long-term

perspective on ensuring flood protection and fresh water availability, can be characterised as cooperation between governmental actors at several levels. While this cooperation was not without struggles, the dominant message from studies of these programmes is a positive one (Van Buuren *et al.* 2014). Also in Belgium and England we see mechanisms that enable MLG to take place. In England it is the Environment Agency that maintains a strategic overview of FRM for all types of flooding, while Lead Local Flood Authorities and Internal Drainage Boards amongst other actors have responsibilities for local-scale FRM. In Belgium, the role of spatial planning and environmental departments within municipalities is becoming increasingly important (Mees *et al.* 2016). Coordination of and inspiration to their actions is provided at the level of the regions, in Flanders by the Flemish Environment Agency (VMM), in Wallonia via the river contracts, which operate at sub-basin scale. In Poland, a dominant role is played by governmental actors at the regional and national level, to some extent hampering local flexibility.

These struggles between levels of government are taking place against the background of a broader tendency towards decentralisation. We found that this decentralisation *de facto* often leads to shifting the financial and executive burden from national to local governments, while the national governments keep holding the strings. Instead, FRM needs a good combination of top-down and bottom-up working. On the one hand, at a high level, strategic discussions should be held on, for example, the risks that we as a society are willing to accept, the division of responsibilities in dealing with these risks, etc. On the other hand, more room should be created for bottom-up work: local stakeholders (preferably at hydrological level) draft flood risk plans together, based on their objectives and are hereby supported with funding and expertise from the higher governments (national and EU-level). The river contracts in Wallonia and France could serve here as a good example.

4.3 Bridging between flood risk management strategies

4.3.1 A bridging role for spatial planning: strengthening flood prevention and flood mitigation

Spatial planning is supposed to be holistic and hence integration of flood risk considerations in spatial planning would in principle be conducive to addressing flood risks, in particular by strengthening the strategies of flood prevention and flood mitigation. Spatial planning's task is to organise spatial demands of a society; it needs to promote spaces for economic development, space for housing, for nature etc. Often, the various priorities present come into conflict with FRM. If and how flood risk considerations are taken into account is a matter of priority and requires balancing with all other spatial claims. Such integration of flood issues in spatial planning exists on paper – although more for new building areas (e.g. through the sequential and exception test in England) than for existing areas – but in practice it is not always effective. In all STAR-FLOOD countries we found examples where FRM comes into conflict with other priorities, such as economic development and housing supply. This needs not to be a problem as long as those with a stake in the prioritisation were adequately represented in a well-informed political debate about acceptable levels of risk. However, this is not always the case, implying that flood risks receive insufficient priority. Regulations exist, but they are not always addressing this specific point or the regulations need further development. In general, besides sometimes a lack of powers to enforce we find a lack of enforcement in the sense that existing regulations are not used in accordance with their full potential, for instance in cases in which

spatial planners in principle have the power to regulate development, constrain it or put requirements to it from a floods perspective.

We found some good practices, e.g. the Water Assessment and Signal Areas in Belgium (Mees *et al.* 2016). The Water Assessment has been subject to a substantial reform following an initial negative evaluation after the floods of 2010, which has significantly improved the application of the instrument. Attention is thus paid to the effectiveness of the existing instruments. Enforceability by public and private parties of the instruments is a crucial element in ensuring actual implementation. Also in France, strong policies exist that may prohibit urban development in at risk areas and are actually enforced (e.g. PPRI). As opposed to that, in the Netherlands spatial planning has been found to be too flexible when it comes to addressing flood risks (Kaufmann *et al.* 2016). While flexible rules in principle allow for adaptive policies, in the Netherlands they have been found to be hampering a consideration of flood risks in spatial planning, as there is still a dominant discourse amongst planners that flood managers should have a serving role to planning and should enable spatial development (OECD 2014; Van Rijswick and Havekes 2012; Wiering and Immink 2006).

Besides limited prioritisation, another factor hampering the consideration of flood risks in spatial planning is the lack of exchange of practical knowledge, although this is improving in several countries, a lack of insights in costs and insufficient development of building requirements for flood proof building.

To conclude on this point, we argue that while it would probably be unrealistic to ban development on the floodplain altogether as so much development has already occurred, there is a need to invest in adaptive development and retrofitting existing urban areas at risk of flooding to enhance adaptive capacity (e.g. with Sustainable Urban Drainage Systems).

4.3.2 The role of spatial planning in emergency management: bridging between defence, prevention and preparation

Flood preparation is present in all researched countries. In all countries, a distinction can be made between at least two activities: flood forecasting and emergency management. The former is strongly linked to meteorological services, as is the case in England where the Environment Agency and the MET Office have formed a partnership called the Flood Forecasting Centre. On the other hand, emergency management in all countries is embedded in institutions related to more general crisis management (e.g. Safety Regions in the Netherlands; Local Resilience Forums made up of category 1 and 2 responders in England; the national Contingency agency in Sweden and similar organisations in France, Belgium and Poland). Flood emergency management is embedded within a multi-hazard approach in which similar organisations deal with multiple types of (natural or man-made) hazards. This can in itself be evaluated as positive, since despite the specifics of flood hazards vis-à-vis other hazards, the same types of responses (informing the community, evacuation, providing shelters) are often required.

On the other hand, there is also a need to strengthen the linkages between emergency management and other flood-relevant policy domains. For instance, spatial planning is needed to ensure that the spatial conditions for emergency management are available, including evacuation routes on higher grounds and shelters. The extent to which this is taken into account has been reported to vary

between countries. We also found that in some cases (e.g. in the Netherlands) contingency agencies seem to give relatively low priority to floods vis-à-vis other issues of external safety. Another issue, to be discussed in more detail in the next chapter, is the need to stimulate appropriate behaviour of citizens, which in several countries, especially in Belgium, the Netherlands and Sweden, was found to be relatively low.

4.3.3 Bridging between FRM and the insurance sector: the link between prevention and recovery

Incentives can be created through the insurance/compensation sector to ensure that after floods societies do not simply 'return to normal' but that they learn and adapt to minimise future damages. In principle, there is much potential within the recovery strategy for promoting preventive action, for example in terms of discouraging citizens from living in high-risk areas, and taking mitigation measures, such as adaptive building efforts. We found that there is still much room for improving existing legal frameworks so that these enable a better linking of recovery, prevention and flood mitigation. Possibilities are to promote resilient reinstatement of flood-affected areas through recovery mechanisms and the removal of legal barriers preventing the establishment of link-inducing measures (Suykens *et al.* submitted).

4.4 STAR-FLOOD products supporting the key message

Alexander, M., Priest, S., Micou, A. P., Tapsell, S., Green, C., Parker, D., and S. Homewood. (2016). Analysing and evaluating flood risk governance in England – Enhancing societal resilience through comprehensive and aligned flood risk governance. STAR-FLOOD Consortium. Flood Hazard Research Centre, Middlesex University.

Dieperink, C., Hegger, D. L. T., Bakker, M. H. N., Kundzewicz, Z. W., Green, C., and Driessen, P. P. J. submitted. Dealing with recurrent governance challenges in the implementation and alignment of flood risk management strategies: a literature review. Water Resources Management.

Ek, K., Goytia, S., Pettersson, M., and Spegel, E. (2016), Analysing and evaluating flood risk governance in Sweden – Adaptation to Climate Change? STAR-FLOOD Consortium, Utrecht, the Netherlands.

Gilissen, H. K., Alexander, M., Beyers, J. C., Chmielewski, P., Matczak, P., Pettersson, M., Schellenberger, T., Suykens, C. (submitted). Bridges over Troubled Waters – An Interdisciplinary Framework for Evaluating the Interconnectedness within Fragmented Flood Risk Management Systems.

Kaufmann, M., Van Doorn-Hoekveld, W. J., Gilissen, H. K., and H. F. M. W. Van Rijswick. (2016). Drowning in safety. Analysing and evaluating flood risk governance in the Netherlands. STAR-FLOOD Consortium, Utrecht, the Netherlands

Larrue, C., Bruzzone, S., Lévy, L., Gralepois, M., Schellenberger, T., Trémorin, J. B., Fournier, M., Manson, C., and Thuilier, T. (2016). Analysing and evaluating Flood Risk Governance in France: from State Policy to Local Strategies, Tours, France.

Matczak, P., Lewandowski, J., Choryński, A., Szwed, M., and Kundzewicz, Z. W. (2016). Flood risk governance in Poland: Looking for strategic planning in a country in transition. STAR-FLOOD Consortium, Utrecht, the Netherlands.

Matczak, P., Wiering, M., Lewandowski, J., Schellenberger, T., Trémorin, J. B., Crabbé, A., Ganzevoort, W., Kaufmann, M., Larrue, C., Liefferink, D., and Mees, H. (2016a). Comparing flood risk

governance in six European countries: strategies, arrangements and institutional dynamics. STAR-FLOOD consortium, Utrecht, the Netherlands.

Mees, H., Suykens, C., Beyers, J. C., Crabbé, A., Delvaux, B., and Deketelaere, K. (2016). Analysing and evaluating flood risk governance in Belgium. Dealing with flood risks in an urbanised and institutionally complex country. University Antwerp, KU Leuven, Belgium.

Suykens, C., Priest, S., Van Doorn-Hoekveld, W., Thuillier, T., and Van Rijswick, H. F. M. W. (submitted) Dealing with flood damages: will prevention, mitigation and ex-post compensation provide for a resilient triangle?

Pictures: STAR-FLOOD session at the knowledge conference of the Dutch Delta Programme, Wageningen, 23 April 2013 (left) and presentation at STAR-FLOOD's first expert panel, Brussels, 16 October 2013 (right).

5 The involvement of governments, businesses, NGOs and citizens in flood risk governance

Key findings:

- The involvement of private parties, including businesses, citizens and NGOs in flood risk governance is necessary both for substantive and normative reasons.
- To enhance flood resilience, the input of a diverse set of resources and capacities is needed, which are not all available within governmental institutions. Instead, several private actors on a spectrum from fully private companies to quasi commercial actors (e.g. English utility companies which are privatised but heavily regulated) should be involved. Also citizens are crucial actors in flood risk management. In their capacity of residents they can take actions in and around their own home, e.g. decreasing the amount of hardened surface, and flood proofing their houses.
- In Europe, participation in decision-making is considered important (Aarhus convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters), therefore governments cannot steer exclusively in a top-down fashion but need to involve other actors in decision-making.
- Open, broad (political and societal) debate about the division of responsibilities between public and private actors is needed, leading to more clearly defined roles for governments/businesses/NGOs/citizens.
- We suggest interpreting public-private cooperation as 'comprehensive multi-actor co-production' in the sense of further developed forms of participation, public private partnerships and self-realisation. This interpretation seems more productive than the, much more narrow, interpretation of 'letting market parties/companies do more in flood risk governance'.

5.1 The role of governmental actors in flood risk governance

Governmental actors at different levels of government play a role in flood risk governance. A distinction can be made between actors at the international/European level, national level actors, and actors operating at the regional/local level. As was discussed in section 4.2, STAR-FLOOD countries are engaged in a struggle to achieve a balance between local flexibility and coordination at the national level, with some countries lacking coordination (e.g. Sweden) and others lacking resources at local level to be able to execute the responsibilities attributed to local actors. With some risk of overgeneralisation, it is often local and regional actors that implement FRM measures, while the responsibility for maintaining a strategic overview as well as implementing measures of supra-local importance lies at the national level. At the supra-national level, mostly procedural steering (e.g. EU Floods Directive) and the development of principles and decision-making frameworks (e.g. OECD water governance principles) is taking place.

5.2 The role of businesses in flood risk governance

To enhance flood resilience, the input of a diverse set of resources and capacities is needed, which are not all available within governmental institutions. Instead, several private actors on a spectrum from fully private companies to quasi commercial actors (e.g. English utility companies which are privatised but heavily regulated) should be involved.

A good practice in terms of moving towards public-private cooperation is the Partnership Funding scheme implemented in England in 2012. Grant-in-Aid (GiA), available through the Department for Food, Environment and Rural Affairs (Defra) and administered by the Environment Agency, must be

supported by funding sourced at the local level, via Local Authorities, the private sector or civil society (Defra 2011b); thus the costs for the project are distributed across funding partners according to risk sharing arrangements and defined in a legally-binding contract. This approach means new types of actors, with a financial stake in FRM, can enter into the governance arrangements at the project scale. In those countries where a private insurance mechanism is applicable to support ex-post compensation following floods, a good balance between public rules and private implementation is crucial, and cooperation between the public and private actors is thus indispensable. For example, the legislator/public authorities have an important role to play in setting forth regulations and instruments with the goal of promoting, incentivising or enforcing the uptake of preventative measures or, for example, adaptive building measures by citizens.

5.3 The role of community groups, NGOs and citizens in flood risk governance

Importantly, citizens and NGOs are not always aware of flood risks, their action perspectives in dealing with them and their legal position (e.g. if they are legally entitled to flood protection, which they are in dike-protected areas in the Netherlands, but not in countries like Belgium and England). We see some room for improvement in how flood managers and politicians could communicate flood risks and action perspectives to private actors. We see it as a challenge for flood managers to communicate risks and provide or suggest the options for dealing with them. This includes addressing the question of whether to focus on probability reduction or reduction of consequences as well as considerations regarding how costs and benefits should be divided, in more accessible language. The increasing availability of flood maps, serious games and other (spatial) information systems should facilitate this enhanced risk communication. On the other hand, we also found that citizens sometimes showed limited interest in flood issues, even in cases of large flood risk.

Citizens are, however, crucial actors in flood risk management. In their capacity of residents they can take actions in and around their own homes, e.g. decreasing the amount of hardened surface, and flood proofing their houses. Furthermore, citizens have a right to know the flood risks in their areas (e.g. Floods Directive) and from a democratic legitimacy perspective they should have a say in what is seen as acceptable levels of risks. Moreover, they should be able to protect their interests, e.g. by going to court in case they want to challenge governmental or private actors that negatively affect the flood safety of their property or alternatively, if they are disadvantaged by flood protection measures. For instance, if a decision has been made that some residents would need to evacuate in case of a flood rather than being protected by defence measures, it should be possible to challenge such a decision before a court. Vice versa, the possibility should be offered to go to court to challenge the decision to realise flood protection measures.

In practice, in all countries, we found that authorities at different levels are struggling with how best to engage the public in flood risk management. First of all, albeit to different extents, there is a lack of flood risk awareness in several countries, most notably in the Netherlands, Belgium and Sweden (Kaufmann *et al.* 2016; Mees *et al.* 2016; Ek *et al.* 2016). In these countries, citizens were found to lack concrete knowledge on the potential consequences of flooding for their property, the probability of this occurring and the available options should a flood occur. Flood awareness is more present in France, England and especially Poland, countries that have relatively frequent flood events. Communicating flood risks to citizens is made difficult by the highly technical language of

flood managers (e.g. scientific calculation of return periods or recurrence intervals), which is poorly understood by the public or poorly communicated (Klijn *et al.* 2009). Moreover, in some of the researched countries there is an institutional culture of only consulting/transferring knowledge to the public, as opposed to more two-way communication/participation techniques now encouraged.

Nevertheless, policy makers should consider critically whether flood awareness campaigns are the best investment to enhance citizens' capabilities to prepare for floods. Research shows that the main explanatory factor for appropriate flood risk behaviour is experience with flooding and closeness to water (Matczak *et al.* 2016; Matczak *et al.* 2016a). In countries/regions where floods do not regularly occur, there may come a tendency to wonder whether it pays off at all to invest in trying to raise the public's awareness. Would it not be better instead to develop the crisis coordination strategy in such a way that, during a flood, it can be immediately communicated to residents what they should do? However, because of EU and domestic regulations, such investments are necessary and inescapable from the perspective of having access to information and having the right to know about flood risks. Besides that, risk communication during a crisis will be vastly facilitated pre-event knowledge and awareness. During a crisis so many developments are taking place that it would be difficult to delay such essential things as risk communication, where people are difficult to reach, and who may react irrationally/differently than expected. If nothing else, highly exposed and socially vulnerable groups should be identified (elderly, single-parents, migrants, deprived households etc.) and receive (extra and tailored) risk communication.

In all countries, FRM practitioners interacting with the public reported a tendency of citizens to attribute much responsibility for dealing with floods to governmental actors, adopting a "the government should take care for me" attitude, combined with a preference for engineered flood defence solutions. This was found to a larger extent in the Netherlands, Belgium and Poland than, for instance, in England and France. But strikingly, in France, Belgium and England this attitude runs counter to citizens' legal position when it comes to floods. Whereas in the Netherlands citizens living in dike protected areas have legal rights to flood protection through the Constitution and safety norms established in the Water Act, in France, Belgium and England there is no explicit constitutional legal right to flood protection and powers of flood authorities are permissive in nature. In most countries, these authorities base their decisions regarding acceptable levels of risks on cost-benefit analyses.

The lack of public engagement in the prevention and mitigation of flood damage appears to be a barrier to improving flood resilience. But the pursuit of a more balanced distribution of public-private responsibilities is hindered by the current attitudes among some citizens who consider FRM to be a governmental, rather than an individual, responsibility. In order to make a responsibility shift possible, it is recommendable to make it the result of an open public debate. In the field some positive experiences have been reported at the local level where residents have been included from the beginning of the decision-making process, in which it was discussed which measures against flooding should be taken by whom, thereby providing clarity about the distribution of responsibilities. Examples of this approach can be found in England, with the establishment of Community Flood Emergency Plans. Such a comprehensive co-production of flood-relevant policies by citizens and authorities may help to counteract the tendency to involve citizens only in phases where the main policy measures are already decided by policy makers, and citizens are only

approached as purely executing actors. Involvement in earlier phases can increase complexity but can improve the legitimacy of the whole process. The question can be raised if such a citizen-inclusive approach to flood management would also be worthwhile to pursue when discussing issues such as the level of safety for which a country aims, the concept of appropriate protection within the Floods Directive and the question of whether protection by defence should be replaced by spatial measures or evacuation.

Another example of improving citizen involvement in FRM is the increased use of technology, for instance through smartphone apps, alerts, websites and flood maps (Alexander *et al.* 2016). However, these information platforms leave out certain highly vulnerable groups because they demand a pro-active choice by citizens to search for information. The elderly might not have access or consider searching for this information, single parents might not have time, immigrants/expats might not understand the information if it is only available in the country-specific language, and deprived households might not have smartphones or connections to have constant access to these apps. Mechanisms to foster community engagement are underway. Amongst other countries, in the UK there was found to be an increased focus on self-reliance e.g. through flood action groups. The Environment Agency and Local Authorities are now actively encouraging the formation of such community groups in areas of known flood risk and work with the National Flood Forum to assist and advise groups in their formation and continued functioning. Another good practice in involving the public in flood management is the Flemish duty to inform, implying that sellers of properties have to actively inform potential buyers of flood risks on their property. This information dissemination with regard to the flood-prone character of the location of the building should be undertaken widely, i.e. in all internet publicity, and brochures. This instrument could also be implemented in other countries as well without the necessity to overhaul the existing institutional and legal settings in these countries. It does not require substantial resources for implementation, and promotes risk awareness with citizens in an effective manner.

5.4 Towards multi-actor co-production

As the previous sections have shown, public-private cooperation in flood risk management should be seen as 'multi-actor co-production' in the sense of further developed forms of participation, public private partnerships and self-realisation. This interpretation seems more productive than the, much more narrow, interpretation of 'letting market parties/companies do more in flood risk governance'. Co-production is most outspoken in discourse and practice in England, and is emergent in France and Flanders. By contrast, FRM in the Netherlands and Poland remains almost exclusively reliant on governmental protection measures. Further diversification of FRM strategies as discussed in this report makes it increasingly unlikely that a limited number of governmental actors can oversee and implement complete portfolios of FRM strategies, hence co-production becomes a necessity. Co-production can be seen as a form of bridging between actors and strategies in the sense that governmental actors adopt rules as coordinators and facilitators of FRM strategies and measures rather than that of implementers.

5.5 STAR-FLOOD products supporting the key message

Alexander, M., Priest, S., Micou, A. P., Tapsell, S., Green, C., Parker, D., and S. Homewood. (2016). Analysing and evaluating flood risk governance in England – Enhancing societal resilience

through comprehensive and aligned flood risk governance. STAR-FLOOD Consortium. Flood Hazard Research Centre, Middlesex University.

Dieperink, C., Mees, H., Priest, S., Ek, K., Bruzzone, S., Larrue, C., and Matczak, P. (in preparation). Enhancing urban flood resilience as a multi-level governance challenge, an exploration of required multi-level coordination mechanisms.

Ek, K., Goytia, S., Pettersson, M., and Spegel, E. (2016), Analysing and evaluating flood risk governance in Sweden – Adaptation to Climate Change? STAR-FLOOD Consortium, Utrecht, the Netherlands.

Kaufmann, M., Van Doorn-Hoekveld, W. J., Gilissen, H. K., and H. F. M. W. Van Rijswick. (2016). Drowning in safety. Analysing and evaluating flood risk governance in the Netherlands. STAR-FLOOD Consortium, Utrecht, the Netherlands

Matczak, P., Lewandowski, J., Choryński, A., Szwed, M., and Kundzewicz, Z. W. (2016). Flood risk governance in Poland: Looking for strategic planning in a country in transition. STAR-FLOOD Consortium, Utrecht, the Netherlands.

Mees, H., Suykens, C., Beyers, J. C., Crabbé, A., Delvaux, B., and Deketelaere, K. (2016). Analysing and evaluating flood risk governance in Belgium. Dealing with flood risks in an urbanised and institutionally complex country. University Antwerp, KU Leuven, Belgium.

Mees, H., Crabbé, A., Alexander, M., Kaufmann, M., Bruzzone, S., Lévy, L., and Lewandowski, J. (under review). Co-producing flood risk management through citizen involvement - insights from cross-country comparison in Europe.

Larrue, C., Bruzzone, S., Lévy, L., Gralepois, M., Schellenberger, T., Trémorin, J. B., Fournier, M., Manson, C., and Thuilier, T. (2016). Analysing and evaluating Flood Risk Governance in France: from State Policy to Local Strategies, Tours, France.

Priest, S., Suykens, C., Van Rijswick, H. F. M. W., Schellenberger, T., Goytia, S., Kundzewicz, Z. W., Van Doorn-Hoekveld, W., Beyers, J. C., Homewood, S. (under review). The European Union approach to flood risk management and improving societal resilience: Lessons from the implementation of the Floods Directive in six European countries.

Van Doorn-Hoekveld, W., Goytia, S., Suykens, C., Homewood, S., Thuillier, T., Manson, C., Chmielewski, P., Matczak, P., Van Rijswick, H. F. M. W. Distributional effects of flood risk management - a cross-country comparison of pre-flood compensation (under revision).

Photo left: Thames Barrier (Dries Hegger, 2013); photo right: City of London (Dries Hegger, 2013).

6 Rules and regulations for flood risk governance

Key findings:

- Diversification of Flood Risk Management Strategies is accompanied by a diversification in *rules and regulations*. However, in some cases a lack of rules can be witnessed, especially in cases in which certain strategies have not yet been implemented to a significant extent.
- The Floods Directive (Directive 2007/60/EC) has facilitated the implementation of FRM strategies in all STAR-FLOOD countries, except England, but especially in those countries where FRM is not yet mature (including Sweden and Poland).
- The current scope of the Floods Directive, which poses non-substantive requirements to EU Member States, is in general appropriate in the sense of being in line with the normative principle of subsidiarity and the existing diversity in terms of existing approaches to flood risk management.
- In International River Basin Districts, the FD could go further in setting forth cooperation requirements between states sharing these Districts and to provide clarity on important concepts in the Directive.
- In other cases of implementing the FD, procedural requirements should be refined and some substantive requirements could be added, so that they force MSs to adopt principles of good flood risk governance. It would also be worthwhile to critically re-evaluate the content of the FD for enforceability by citizens and to make clear what they can ask for in the courts. It was also found that sometimes time pressures arising from the need to timely finalise flood risk management plans restricted the room for manoeuvre of local initiatives.
- According to the subsidiarity principle, devolution of decision-making to the lowest appropriate scale, with collaboration and coordination at the highest level necessary should be strived for. This principle is widely endorsed, not only at the level of the EU but also at the national level in many European countries. The principle is essentially a political choice based on knowledge that multi-level governance works better to create legitimacy and resilience. But this goes with fragmentation and the fragmentation should be addressed in a way that it doesn't hamper effective or legitimate flood risk management.

6.1 The implementation of new rules and regulations at the national and regional level

Diversification of FRM strategies goes along with a diversification of rules and regulations related to flood risk governance. On the one hand, diversification makes various existing rules and regulations related to flood-relevant policy domains other than water management relevant for flood risk governance. This holds, for instance, for spatial planning acts and regulations, or regulations related to contingency agencies in the researched countries. On the other hand, efforts at diversification have resulted in the implementation of new, specific rules and regulations and related policy programmes. Examples include the multi-layered safety approach as laid down in the Dutch Delta Programme (see also chapter 4); various spatial planning regulations such as the Water Assessments in Belgium and the Netherlands; specific plans for comprehensive flood protection measures (Hoogwaterbeschermingsprogramme in the Netherlands; Sigma Plan in Belgium); and flood risk prevention plans (PPRIs) in France.

When it comes to the implementation of new rules and regulations at the national and regional level, the following recurring points for improvement were identified, some valid for only some countries, others for several countries:

- There is often a lack of enforceability of rules that stimulate risk prevention through pro-active spatial planning, or it is difficult to apply the correct rules.
- In all countries there is a need to build in flexibility in existing rules and procedures, so that competent authorities can adapt to changing circumstances.
- A financing system for FRM measures should be developed in line with the normative principles for who is responsible. For instance, for the Netherlands the OECD suggested that spatial developers in flood prone areas (or the authorities that agreed with these developments), should pay for flood risk management (OECD 2014a).
- Setting up transparent decision-making processes for flow improvement and (upstream) water retention, involving affected stakeholders both in earlier and later planning stages.
- Finding areas suitable for retention is not only a technocratic exercise but requires also participatory decision-making processes.
- In several countries there is the need to adjust building codes to overcome the legal impossibility for municipalities to enforce most of the structural measures as many of them go beyond national building codes. This could be done by attribution of relevant powers to the local level, or by delegation based on existing acts.
- Responsibilities should be clarified and formalised (e.g. in a national disaster law): who is responsible for prevention, defence, mitigation, preparedness, emergency response and recovery?

6.2 The EU Floods Directive (Directive 2007/60/EC)

The Floods Directive (FD) provides procedural rules which EU Member States have to comply with, including the designation of areas of potential significant flood risk (first completed in 2011), the production of flood hazard and flood risk maps (first completed in 2013) and the production of flood risk management plans (FRMPs, first completed in 2015). It is difficult in many countries to determine what changes have been caused by the Floods Directive and what changes would have occurred anyway. Nevertheless, we have indications that the Floods Directive is providing several positive contributions towards improving flood risk governance, amongst other things through its emphasis on the fact that floods cannot be avoided, although perhaps with the downside that the FD does not oblige or encourage Member States to avoid floods where this could be possible. Especially in new EU Member States such as Poland but also in Sweden, the Floods Directive was found to have had an important agenda setting function in terms of discussing measures belonging to several Flood Risk Management Strategies and stimulating a shift to preventive strategies rather than only reactive strategies such as recovery and defence. The FD has also been shown to legitimise flood management actions by flood managers and the designation of resources for it (Hegger *et al.* 2014a; Matczak *et al.* 2016a). Flood maps and flood risk management plans in several countries have been shown to encourage so-called spatial water governance in which spatial planning is organised in a more water-conscious way (Hartmann and Driessen 2013) at the sub-basin scale. Besides that, the process of implementing the FD has fuelled knowledge exchange between countries, e.g. in the framework of the Working Group on Floods of the Common Implementation Strategy of the Water Framework Directive. For example, a workshop of this group co-organised by STAR-FLOOD has facilitated discussion on the types of objectives and measures and their prioritisation, enabling

countries to learn from those MSs that have progressed furthest (Hegger *et al.* 2014a). Possibly, the fact that the FD is a Directive, thus binding for the Member States, and not merely a strategy has enhanced its impact since now it has the status of a legal instrument instead of a communication or guideline.

On the other hand, we found that France and especially the Netherlands have chosen to implement the FD in what in the Netherlands was literally termed "a sober and expedient way" (Hegger *et al.* 2014a) in order to avoid administrative burdens. This may be explained by the fact that for these two countries the FD was a formalisation of an approach that was already emerging or implemented. It should also be noted that these two countries were the initiators of the FD, already had the policies they would like to see encouraged in place and – lying downstream of several major European rivers – mainly pushed for the FD to further encourage transboundary cooperation and action taking by upstream countries. There is also some anecdotal evidence (Hegger *et al.* 2014a) that Member States may be reluctant to put overly ambitious objectives in their FRMPs in order not to be held accountable for them. This increasingly procedural approach may hamper the access to justice of citizens, as they might not be able to easily challenge the contents of the Plans before the relevant courts in the absence of substantive, binding measures included therein. Strikingly, while the FD explicitly addresses the issue of environmental damage and pollution caused by floods, this was rarely an issue in the countries researched in STAR-FLOOD.

Based on STAR-FLOOD's findings, we conclude that in general the FD's focus on procedural requirements is appropriate in the sense of what seems to be feasible given the large diversity between countries in terms of their physical circumstances, historical pathways in dealing with flood risks and normative principles held. Nevertheless, it must be stated that this focus weakens the legal strength of the FD, since a procedural approach limits the possibilities to hold authorities accountable for ambitious goals in terms of reducing flood risks and does not enable EU citizens to realise flood risk management measures. Furthermore, in specific situations, there is a need for more substantive requirements also to act in accordance with the subsidiarity principle.

Although STAR-FLOOD's findings can be interpreted as an endorsement of the overall logic and scope of the FD, the research has identified several possibilities for improvement, to be possibly taken up in the next implementation round (until 2021). First, procedural requirements should be refined and some substantive requirements could be added, so that they force Member States to adopt principles of good flood risk governance. Such principles include issues such as the ones laid down in OECD's water governance principles: a clear allocation of roles and responsibilities; achieving governance at different appropriate scales; effective cross sectoral coordination; securing hard and soft capacities; ensuring that policy relevant data and information are available; considering the governance financing nexus; having sound regulatory frameworks in place; stimulating the potential to innovate; improving integrity and transparency for greater accountability; engaging all stakeholders and allow for balanced distribution of resource among them; managing trade-offs between users, places and generations; and assessing governance processes and outcomes in order to learn, adjust and improve (OECD 2014). For instance, a substantive requirement regarding the content of Flood Risk Management Plans could be added to explicitly address the issue of responsibilities of actors. Also bridging mechanisms as discussed in chapter 4 could to some extent be included in the FD, for instance the duty of property sellers to inform potential buyers of flood risks as is currently present in England and the Flemish Region as well as in France. Second, it would

be worthwhile to critically re-evaluate the content of the FD for enforceability by citizens and to make clear what they can ask for in the courts. The FD's role could be strengthened if citizens could go to court or otherwise enforce decisions by authorities to assign an area as facing potentially significant flood risk (this has now been decided mostly in a top-down fashion) or to enforce the inclusion of specific objectives and measures in Flood Risk Management Plans. Third, it was found (Larrue *et al.* 2016) that time pressures arising from the need to swiftly finalise flood risk management plans restricted the room for manoeuvre of local initiatives, suggesting that a too stringent enforcement of formal obligations of MSs may be counter-productive. In International River Basin Districts, the FD could go further in setting forth cooperation requirements between states sharing these Districts and to provide clarity on important concepts in the Directive (Priest *et al.* submitted; Suykens 2015). This could also be done by way of preliminary questions to the court of justice. In shared river basins, the fully fledged procedural approach whereby Member States have full discretionary powers and no substantive cooperation requirements to implement FRM strategies and measures would not be justified, since measures promulgated in one country could have visible effects in other countries in the same river basin. The directive could require an overarching FRMP in transboundary situations be undertaken which would include joint key definitions of the key elements (e.g. a significant increase in risk) and ensuring that they are agreed within these transboundary situations). Cooperation requirements should at least include obligations to: exchange knowledge regarding important data such as projected discharge levels of river basins; and inform downstream countries of planned FRM measures and assessing the potential for negative impacts downstream. Other, more far-reaching requirements would be to include the obligation to consider FRM measures at the level of a whole river catchment or to set-up a joint knowledge infrastructure.

6.3 Subsidiarity, responsibilities and coordination

According to the subsidiarity principle, devolution of decision making to the lowest appropriate scale, with collaboration and coordination at the highest level necessary should be strived for. This principle is widely endorsed, not only at the level of the EU but also at the national level in many European countries. The principle is essentially a political choice based on knowledge that multi-level governance works better to create legitimacy and resilience. But this goes with fragmentation and the fragmentation should be addressed in a way that it doesn't hamper effective or legitimate flood risk management. The findings presented in the previous sections should be read in this light. For instance, while the FD is a useful instrument for triggering change, Member States have to decide themselves what to do and how to do this. The force of the directive can be used to enforce more basin cooperation (even though there are political trade-offs). Since countries differ in terms of the formal division of responsibilities and the protection levels offered, a discussion about who is responsible for what is recommended, at the national level as well as at the EU level.

6.4 STAR-FLOOD products supporting the key message

Bakker, M. H. N., Van Herten, M., Hegger, D. L. T., and Driessen, P. P. J. (2016). Report of the three STAR-FLOOD Transdisciplinary Advisory Board meetings. STAR-FLOOD consortium, Utrecht, the Netherlands.

Ek, K. Pettersson, M., Alexander, M., Beyers, J-C., Pardoe, J., Priest, S., Suykens, C., and Van Rijswick, H. F. M. W. (2016a). Best practices and design principles for resilient, efficient and legitimate flood risk governance – Lessons from cross-country comparisons, STAR-FLOOD Consortium, Utrecht, the Netherlands.

Ek, K., Raadgever, G. T., Suykens, C., Bakker, M. H. N., Pettersson, M., and Beyers, J. C. (2016b). An expert panel on design principles for appropriate and resilient flood risk governance – lessons from a workshop in Brussels. STAR-FLOOD consortium, Utrecht, the Netherlands.

Goytia, S., Pettersson, M., Schellenberger, T., Van Doorn-Hoekveld, W., and Priest, S. (under revision) Dealing with change and uncertainty within the regulatory frameworks for flood defence infrastructure in selected European countries.

Hegger, D. L. T., Van Herten, M. Raadgever, T., Adamson, M., Näslund-Landenmark, B., Neuhold, C. (2014a). Report of the WG F and STAR-FLOOD Workshop on Objectives, Measures and Prioritisation Workshop.

Priest, S., Suykens, C., Van Rijswick, H. F. M. W., Schellenberger, T., Goytia, S., Kundzewicz, Z. W., Van Doorn-Hoekveld, W., Beyers, J. C., and Homewood, S. (under review). The European Union approach to flood risk management and improving societal resilience: Lessons from the implementation of the Floods Directive in six European countries.

Suykens, C. (2015). Water Quantity Management in International River Basin Districts: Crystal Clear? In 24 European Energy and Environmental Law Review, 134-143.

Suykens, C., Priest, S., Van Doorn-Hoekveld, W., Thuillier, T., Van Rijswick, H. F. M. W. (submitted). Dealing with flood damages: will prevention, mitigation and ex-post compensation provide for a resilient triangle?

Van Doorn-Hoekveld, W., Goytia, S., Suykens, C., Homewood, S., Thuillier, T., Manson, C., Chmielewski, P., Matczak, P., and Van Rijswick, H. F. M. W. Distributional effects of flood risk management - a cross-country comparison of pre-flood compensation (under revision).

Pictures: city of Nijmegen (left); and field trip to Regional Water Autority 'De Stichtse Rijnlanden' (October 2012, right).

7 Effective and efficient mobilisation of available resources

Key findings:

- Different types of resources (finance, knowledge, skills, ICT tools, public support) should be mobilised efficiently. At the same time, resource availability should be increased, if possible.
- The availability of resources for different flood risk management strategies differs significantly between countries: the quality of knowledge infrastructure and the structure of funding systems also varies. This may be problematic since the lack of resources was shown to be an important reason for underinvestment in and underdevelopment of FRM strategies.
- An important policy issue for the coming years will be to have political debate and make political choices in order to combine the (perceived and sometimes already legally settled) 'right to be protected' of citizens by public authorities with the decreasing resource base many public authorities are facing.
- Resources may also play a key role in bridging, for instance by ensuring that actors involved have the necessary skills, and that private actors receive sufficient payment to increase their willingness to let their land function as flood storage.

7.1 The financial resource base in the six STAR-FLOOD countries

All STAR-FLOOD consortium countries show a wide diversity in terms of the sources of the finances available for different FRM strategies. In all countries, different funding schemes can be identified for different strategies. Flood defences are more often paid for through public schemes, while countries differ, amongst other things, in terms of the sources for their recovery schemes. With some risk of over-simplification, we can say that France and the Netherlands show a general tendency to finance FRM through public funding schemes. In England, even though there is the Partnership Funding approach which aims to encourage private investment, approximately 70% of schemes are still funded through public money. Thus, England has diversified its sources of money but it is still largely publicly funded. Belgium and Sweden can be ranked in between the positions of France/the Netherlands and England. Poland relies much on European funds and, de facto, also on the individual actions of citizens who have to recover from floods.

In the Netherlands, there is a strong publicly funded resource base for flood defence as well as long term funding for measures needed to adapt to climate change, available through the Delta fund. In France, there is a strong recovery system (the so-called CAT-NAT system which is both public and private). England has recent experience with partnership funding schemes, but these are not yet functioning optimally. Poland has a significant lack of resources, while in Sweden there are limited dedicated resources for FRM, which is – mostly – pursued instead through measures that have been established for other public goals (e.g. hydropower dams in Belgium, resources are well-developed in most strategies) but lacking in the preparation strategy.

While the logic behind the FD has been to foster transboundary cooperation and knowledge exchange related to floods, other European policies' logic is to respond to major natural disasters and express European solidarity in disaster-stricken regions within Europe. This was, for instance, the reason for creating the European Solidarity Fund in 2002 (Regulation (EU) 661/2014).

We can conclude that, although various funding mechanisms are in place, in some cases there is still under-investment in particular strategies. At the same time, debate is needed on how scarce financial resources are mobilised. An important policy issue for the coming years will be to have

political debate and make political choices in order to combine the (perceived and sometimes already legally settled) 'right to be protected' of citizens with the decreasing resource base many public authorities are facing and make decisions that societal actors find legitimate. Resources may also play a key role in bridging, for instance by ensuring that actors involved have the necessary skills, and that private actors receive sufficient payment to increase their willingness to let their land function as flood storage.

7.2 Knowledge, skills and attitudes as crucial resources

As highlighted in section 7.1, knowledge and the ability to learn is to be seen as a crucial resource. Continuous improvement through R&D Programmes and knowledge infrastructure has been shown to be important. In terms of these knowledge infrastructures, the Netherlands has been shown to be a frontrunner, amongst other things through the sustained presence of strong water-related knowledge institutes, the setting up of the Delta Programme (a national policy programme focusing on long-term strategies for dealing with floods and fresh water supply) and the presence of dedicated temporary research programmes (e.g. Knowledge for Climate; Water & Climate; Topsector Water). Within such programmes, we see the development of new knowledge, exchange of existing knowledge and joint knowledge production in regional projects (Hegger and Dieperink 2015). England also has extensive knowledge infrastructure, e.g. Defra/EA research & Development programme. The R&D Programme provides the Flood and Coastal Risk Management (FCRM) evidence for policy and operational needs, across the Environment Agency, Defra, Welsh Government, Natural Resources Wales, Lead Local Flood Authorities, Internal Drainage Boards and other operating authorities. The programme develops and synthesises scientific best practice emerging from academia and operational practice both in the UK, Europe and Internationally. This is steered by four Theme Advisory Groups (TAGs), which help identify and prioritise research needs. TAGs comprise up to 20 advisors from across the FCRM stakeholder community, blending topic experts and sector representatives. e.g. Living with Environmental Change (LWEC) – established in 2007 as an innovative partnership of 22 public-sector organisations that fund, carry out and use environmental research, evidence and innovation. Its aim was to provide decision-makers in government, business and society with the knowledge, foresight and tools to mitigate, adapt to and benefit from environmental change (http://fcerm.net/about). In France, every two years a meeting grouping all French actors related to floods is organized by the Ministry of the Environment (Assises nationales des risques naturels). This allows for exchanges of experiences between these actors. Also at national level de CMI Mixt Committee devoted to floods also constitutes a space for exchange of experiences. EU research funding could further stimulate the development of knowledge infrastructures, which can be said to be in need of further development in several countries. Another resource which played a key role in England is the use of formal evaluations of flood policies by leading experts (Alexander *et al.* 2016). An important point of attention is that investments in knowledge development could easily lead to or reinforce path dependency by strengthening epistemic communities related to specific strategies (Matczak *et al.* 2016a).

7.3 STAR-FLOOD products supporting the key message

Alexander, M., Priest, S., Micou, A. P., Tapsell, S., Green, C., Parker, D., and S. Homewood. (2016). Analysing and evaluating flood risk governance in England – Enhancing societal resilience through comprehensive and aligned flood risk governance. STAR-FLOOD Consortium. Flood Hazard Research Centre, Middlesex University. ISBN: 978-94-91933-07-3.

Ek, K., Goytia, S., Pettersson, M., and E. Spegel. (2016), Analysing and evaluating flood risk governance in Sweden - Adaptation to Climate Change? STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-10-3.

Hegger, D. L. T., Bakker, M. H. N., Raadgever, G. T., and Crabbé, A. (2016). D3.1 Country and case study workshop report. STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-12-7.

Kaufmann, M., Van Doorn-Hoekveld, W. J., Gilissen, H. K., and Van Rijswick, H. F. M. W. (2016). Drowning in safety. Analysing and evaluating flood risk governance in the Netherlands. STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-11-0.

Larrue, C., Bruzzone, S., Lévy, L., Gralepois, M., Schellenberger, T., Trémorin, J. B., Fournier, M., Manson, C., and Thuillier, T. (2016). Analysing and evaluating Flood Risk Governance in France: from State Policy to Local Strategies, Tours, France. ISBN: 978-94-91933-08-0.

Matczak, P., Lewandowski, J., Choryński, A., Szwed, M., and Kundzewicz, Z. W. (2016). Flood risk governance in Poland: Looking for strategic planning in a country in transition. STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-09-7.

Mees, H., Suykens, C., Beyers, J. C., Crabbé, A., Delvaux, B., and Deketelaere, K. (2016). Analysing and evaluating flood risk governance in Belgium. Dealing with flood risks in an urbanised and institutionally complex country. University Antwerp, KU Leuven, Belgium. ISBN: 978-94-91933-06-6

Case study workshop in Antwerp, 19th June 2014 (Source: Ann Crabbé)

8 Evaluations of flood risk governance in terms of resilience, efficiency and legitimacy

Key findings:

- In terms of STAR-FLOOD's first starting assumption, we found that diversification of strategies can be seen as a necessary but not sufficient precondition for enhancing societal resilience to floods.
- We stress that resilience should be disentangled into three capacities: the capacity to resist flooding, the capacity to absorb/recover when a flood event occurs and the capacity to adapt to future risks. These are to be seen as different views on desired outcomes for flood risk governance and have been found to be to some extent mutually exclusive (e.g. over-investment in one strategy can be at the expense of investment in other strategies).
- Resilience is closely linked to the notion of appropriateness: desired outcomes in terms of resilience should be considered in the light of physical circumstances and existing institutional and social contexts.
- To some extent a high score on one capacity (to resist) may undermine that of other capacities (e.g. absorb and recover).
- The presence (or the absence) of links between strategies has turned out to be a crucial factor explaining countries' achievements in all three capacities.
- Enhancing societal resilience requires sufficient investment in each of these strategies and alertness to the risk of underinvestment in all of them.
- Efforts to improve resource efficiency by increased application of (societal) Cost Benefit Analyses are underway in different countries, albeit to a different extent. These CBAs were found to contribute to resource efficiency, but in some countries were perceived as rather technocratic.
- The researched countries are doing well on access to information and transparency; procedural justice and accountability. The most potential for improvement lies with the criteria of social equity; public participation and acceptability by all actors involved.

8.1 Evaluations of resilience[2]

In STAR-FLOOD, the notion of flood resilience was disentangled into three capacities as criteria for determining the degree of flood resilience, being the capacity to resist, the capacity to absorb and recover and the capacity to adapt (see also table 1.1 in chapter 1). Regarding the first criterion, *capacity to resist*, differences were found between the six countries. the Netherlands, Belgium and France can be characterized by a dominant focus on defences, which functioning can be said to be effective in the sense that they generally live up to the standards set for them. A same dominance is present in Poland, but here effectiveness of flood defences is lacking, as the floods of 1997 and 2010 showed. In Sweden and England, there can be said to be a more holistic approach to FRM in which resistance measures are considered vis-à-vis other types of measures. Measures to store water, both through upstream retention and urban drainage, are being implemented in the Netherlands, France and especially in England and Belgium. In Belgium an increase in the amount of hardened surface is being counterbalanced, while such development is barely counterbalanced in Poland. Although defence was found to be dominant and effective both in the Netherlands and France, they face some or even significant lack of maintenance respectively. This issue is relevant also for other countries,

[2] This text is based on Hegger *et al.* (submitted).

including England. Similarly, Sweden can be said to be dealing flexibly with flood risks with some examples of flood defence infrastructures in some municipalities while temporary small-scale defences are used in many situations. Sweden differs from the other evaluated countries in that flood risks are relatively low, so the need to build resistance through flood defences is very local by nature.

The six countries also vary in terms of their *capacity to absorb and recover*. The Netherlands and Poland rely significantly on the defence strategy, thus resistance is the main focus. In the Netherlands, development of mitigation (which is also a resistance capacity) and preparation measures backs up the dominant defence strategy. These measures are receiving increasing but still limited attention in the Delta Programme, a national programme on flood management and fresh water supply, through the Multi-Layered Safety approach which explicitly aims to diversify flood risk management strategies. England has a sophisticated flood warning and crisis management system. Poland has made significant improvement in terms of this flood preparation, while this strategy can be said to still need further development in the Netherlands, Belgium and France.

The *capacity to recover* requires resources to be applied after a disturbance. It comprises financial resources as well as material ones and institutional ability. The main systems are public disaster funds and insurance systems, or hybrid mechanisms. Such systems are in place in all countries, although they are governed in different ways (e.g. through public or private mechanisms). In terms of available resources in relation to flood risks, France seems to do well, while Poland seems to be at risk. In Belgium, ex-post compensation procedures improved with the inclusion of flood events in fire policies.

Flood risk governance in the investigated countries finally differs in its *capacity to adapt*. In all countries we witness some changes in recent decades, indicating that all are adaptive to some extent. All countries have stronger and weaker points in relation to their adaptive capacity. England seems to have most strengths compared to the other countries, with relatively well-developed flood awareness of citizens and a strong learning culture. Hence, adaptive capacity in England can be said to be high. This, by the way, does not mean that flood risks are reduced, damage is diminished or that citizens feel protected but rather that they are used to floods and used to deal with the damage. Other countries show a more mixed view in terms of their strengths and weaknesses and hence their adaptive capacity can be said to be moderate. Belgium, France, Sweden and especially the Netherlands report a relatively low flood awareness of citizens, an important aspect of adaptive capacity, while flood awareness in Poland, due to catastrophic floods in 1997 and 2010, is high. Established systems for learning are in place in the Netherlands, France and Belgium. Other aspects of adaptive capacity found in the research include: (i) the presence of systems for risk analysis: in Sweden and the Netherlands, established systems for risk analysis are in place, in the Netherlands focusing on the maintenance of flood defences, in Sweden focusing on multiple risks, including floods; (ii) the ability of civil servants to react flexibly to changes in the legal system and in political constellations. This was found in Belgium and Poland.

We found that none of the researched countries can be regarded as resilience champions in that a very high degree of resilience was found for all three capacities. Instead, we see that the Netherlands have a very high ‘capacity to resist’, Belgium and France a very high ‘capacity to absorb and recover’, while England is especially strong on capacity to adapt. Poland and Sweden’s achievements are

lower, scores in Poland from low to medium-high, and in Sweden from medium to high, in individual categories. In Poland significant progress has been made in capacity to adapt by establishing the crisis management system. With some risk of over-simplification, it seems that the implementation of a more diverse portfolio of strategies contributes to a higher capacity to absorb and to adapt, obviously provided that the strategies have been implemented effectively and have been aligned.

In terms of policy implications, we argue that a thorough and broad analysis of the flood risks and potential measures against them is necessary in different countries. Every strategy needs to be considered in such an analysis. In the end, the country needs to be able to resist, absorb and recover from flooding. However, a full suite of strategies can only ensure resilience if each strategy is implemented effectively. Diversification should not lead to an underinvestment in all strategies. Furthermore, it is crucial that lock-in effects are avoided as much as possible, so that different strategies could be applied in the future, e.g. by not building a flood retention zone now but making sure it remains unbuilt so it can be developed as one in the future.

8.2 Evaluation of efficiency[3]

In the analyses performed within the STAR-FLOOD project, we have focused on whether there is empirical evidence indicating that efficiency is an important issue in flood risk management in each country; whether concerns for resource efficiency are widely applied within the flood risk governance arrangement and/or taken into account in decision-making (see also table 1.1). In general, a regular practice of analysing the societal costs and benefits has been interpreted as an enhancing factor for resource efficiency.

The frequency at which cost benefit analyses are used differs across the analysed countries: while there are well-established practices in England, and analyses are becoming increasingly common in all countries (e.g. the Netherlands, Sweden and parts of Belgium (Flanders)), such analyses still seem to be less frequently applied in France. In Poland, although standard cost-benefit analysis procedures are applied to particular projects, funding spent for flood risk governance is fragmented and the vested interests of administration and business groups play an important role in resource allocation. This makes an analysis of resource efficiency in Poland difficult.

In the STAR-FLOOD countries, decisions to invest in permanent defence structures are generally preceded by an assessment of the expected benefits and costs of the project. Challenges may for instance be related to how monetary values are estimated for the expected future benefits in terms of reduced flood risk. Permanent flood defences are high-cost investments with a long life span, while their expected benefits are associated with significant uncertainties. If investment decisions are not based on long-term, forward planning also taking possible impacts of climate change into account the resource efficiency may well be challenged.

However, although cost benefit analyses could potentially contribute to increased transparency and knowledge about the costs and benefits associated with different flood risk management strategies, concerns have been raised by local authorities, for instance in Flanders, Belgium, that cost benefit analysis is a technocratic manner of decision-making that they have little insight into. In Poland, there is a focus on gaining additional funds through realising investments in flood defence, which has

[3] This text is largely based on section 2.2 of Ek *et al.* 2016a.

created a short-term oriented budget maximisation, rather than using resources where they are most needed. There is also a lack of adequate and coherent data, which constitutes an obstacle to conducting comprehensive and independent evaluations of the resource efficiency of flood risk management. An overly rigid use of cost benefit analyses may thus come at the expense of reduced legitimacy. On the other hand, if flood risk management is using financial, physical and/or human resources in an inefficient way, or if it is difficult to trace how money is being spent, this may also have a negative impact on the legitimacy of flood risk management.

Different examples of potentially beneficial measures or instruments that have not been implemented as a result of inflexibilities in decision-making and/or legislation are mentioned as factors possibly restricting resource efficiency. For example, in some countries (England, Sweden and the Netherlands) small-scale property based measures, such as so-called check valves, are currently underutilised and property owners have limited or no incentives to invest in such measures (e.g. the costs in case of floods are spread out across all insured or protected parties).

8.3 Evaluation of legitimacy[4]

In the context of evaluating the current (and to some extent past) FRGAs from the perspective of legitimacy, the Aarhus Convention and the European legislative framework play an important role. However, within the STAR-FLOOD project, the multi-faceted concept of legitimacy was interpreted not only from a legal point of view, but also from a social science point of view. This approach led to the development of a range of specific criteria in order to assess the extent to which flood risk governance arrangements can be described as legitimate (see Alexander *et al.* 2015). As indicated in the introduction, seven criteria for evaluating the legitimacy of flood risk governance have been identified: social equity; access to information and transparency; procedural justice and accountability; public participation and acceptability (see also table 1.1). Each criterion will now be discussed in turn.

- **Social equity** – In the researched countries, systems range from a strongly prevailing solidarity principle in France, to a market-based insurance system in England, implying that a number of (potential) tensions concerning social equity can be distinguished. A first tension, connected to the solidarity principle, manifests itself in the ex-post compensation sphere, where citizens who are not at risk of flooding are often also contributing to the compensation of others. Similarly, social equity issues have been identified when it comes to beneficiaries of defensive measures. Some citizens, e.g. in the Netherlands, are entitled to different levels of flood protection to others, while at the same time the presence of flood protection encourages further urban development. On the other hand, it can be said to be in the interest of all citizens that the economically most important areas in a country receive the highest level of flood protection.
- **Access to information and transparency** – In general, access to information and transparency do not seem to be problematic in the STAR-FLOOD countries. All countries have implemented the Aarhus Convention into their own legal system and make legislation and policy documents available to the wider public. In Sweden for instance, all official documents are in principle public. Everyone may request and study them, without having to provide information regarding identity or purpose for the request. In general, since the implementation of legal instruments

[4] This text is largely based on section 2.3 of Ek *et al.* 2016a.

such as the Aarhus Convention, the availability to the public of flood risk information has improved, and for instance in England, both public awareness of flood risks and transparency in policy decisions on flood risk management has increased. Transparency is also enhanced by independent reviews and responses to significant flood events, such as the thorough evaluation of the November 2010 floods in the Flemish Region by the Coordination Committee on Integrated Water Policy and the accompanying policy recommendations.

- **Procedural justice and accountability** – In relation to the EU Floods Directive, stakeholders' access to justice, in terms of enforcing their rights to participate in or challenge decisions, is limited. Citizens can only enforce their right to have Flood Risk Management Plans actually established and not that the Flood Risk Management is appropriate (see case ECJ C-237/07 Janecek (2008)). Citizens do not have other recourses with respect to substantive issues stemming from the FD (Keessen and Van Rijswick 2012). For access to justice, each country relies on national rules. In Belgium, the Netherlands and Sweden, access to administrative courts is relatively inexpensive, and court decisions from the highest administrative courts are available in a relatively short time span. However, litigation costs and judicial backlog, resulting in judicial proceedings extending over longer periods of time, were identified as constraining factors to achieving procedural justice. In Poland, for instance, there is a discrepancy between the lack of resources from civil society to go to court and the dominant position of the administration and investors. Moreover, this constraining factor is further enhanced by judicial backlog and the general lack of trust in Polish state institutions. Also in England, there are discussions on the existence (in practice) of social inequities regarding access to justice, for instance issues concerning financial costs involved, and restrictions being made to legal aid are raised.
- **Public participation** – The Aarhus Convention holds the obligation for Parties to provide for early public participation, when all options are open and effective public participation can take place. The public participation procedures must hereby include reasonable timeframes for the different phases, allowing sufficient time for informing the public and for the public to prepare and participate effectively during environmental decision-making (art. 6, 3-4). Moreover, each Party must ensure that due account is taken in the decision of the outcome of the public participation (article 6, 8) (Fritzmauric 2010). Participation is also included in the Floods Directive. However, the requirements are vague and there are no specific guidelines on what constitutes effective participation or on the objectives of active citizen participation. There is thus a large variability across Member States in terms of the implementation of these requirements.
- **Acceptability** – Legitimacy also implies that the decisions and the processes involved in decision-making are accepted by stakeholders. Acceptability is therefore an important aspect of the legitimacy of any FRGA. However, it is difficult to quantify in a precise manner as it very much relates to perceptions of stakeholders. There are objective indicators, however, to identify what the constraining factors related to acceptability are and how it can be improved. In all STAR-FLOOD countries, acceptability could be improved, in the first instance through raising awareness of the population to flood risks and the implications thereof (see chapter 5).

8.4 STAR-FLOOD products supporting the key message

Ek, K. Pettersson, M., Alexander, M., Beyers, J-C., Pardoe, J., Priest, S., Suykens, C., and Van Rijswick, H. F. M. W. (2016a). Best practices and design principles for resilient, efficient and legitimate flood risk governance – Lessons from cross-country comparisons, STAR-FLOOD Consortium, Utrecht, the Netherlands.

Ek, K., Raadgever, G. T., Suykens, C., Bakker, M. H. N., Pettersson, M., and Beyers, J. C. (2016b). An expert panel on design principles for appropriate and resilient flood risk governance – lessons from a workshop in Brussels. STAR-FLOOD consortium, Utrecht, the Netherlands.

Hegger, D. L. T., Driessen, P. P. J., Wiering, M., Van Rijswick, H. F. M. W., Kundzewicz, Z. W., Matczak, P., Crabbé, A., Raadgever, G. T., Bakker, M. H. N., Priest, S. J., Larrue, C., and Ek, K. (submitted). Toward more flood resilience: is a diversification of FRM strategies the way forward?

Pettersson *et al.* (in preparation). Design principles for improved legitimacy of flood risk governance in Europe.

Pictures: visit to Thames Barrier (April 2013); consortium meeting in London (April 2013); boat excursion in Luleå, June 2016.

9 Implications for policies and law from the European to the local level

Key findings:

- Design principles pertain both to flood risk governance processes and flood risk governance outcomes.
- Important process-related aspects pertain to: managing expectations and debating acceptable levels of risk; the need for long-term policies; the development of knowledge infrastructures; the involvement of private actors (businesses, NGOs and citizens) in FRM; carrying out flood risk governance at the most appropriate level; adequately prioritising flood risks in spatial planning; clarifying rules and improving follow-up and their enforceability in legal instruments; and the promotion of catchment-based approaches to FRM.
- To improve resilience, there is: i) a need to establish adaptive management to aid the implementation of defence and mitigation measures that can be adjusted to suit changing circumstances; ii) a need to deliver spatial planning in such a way that consequences are prevented and minimised if floods occur; iii) a need for further improving systems for forecasting, warning and emergency responses that are proactive, risk-based and use collaborative approaches, for instance by optimising the use of ICT (apps); iv) a need for having strategies to recover from flood events available for all citizens while at the same time ensuring that these provide sufficient incentives for citizens to encourage the adoption of prevention and mitigation measures; v) a need for institutional systems that foster learning and innovation.
- Resource efficiency requires that a level of flood risk management is secured that is found acceptable by societal actors at the lowest possible societal costs and against the highest possible societal benefits, looking for synergies, e.g. through multi-use flood alleviation schemes.
- Legitimacy requires that the decision-making process is characterised by a high degree of public participation, social equity and accessibility. The approach should be generally accepted by the public, open and transparent, access to risk information should be ensured, and there should be mechanisms in place to ensure social equity.

9.1 Introduction

Based on results of the evaluation of flood risk governance in terms of the extent to which it enhances societal resilience to flooding, resource efficiency and legitimacy, success conditions have been identified (Ek *et al.* 2016a) which can be formulated as design principles. Key terms are defined in box 7 below.

Box 7: defining successful flood risk governance; success conditions and design principles (see Ek *et al.* 2016a)

'Successful' flood risk governance is understood as governance that achieves the desired outcomes of resilience, efficiency and legitimacy.

Success conditions are those institutions, procedures, rule-types, resources etc. that need to be in place in order to successfully deliver different aspects of flood risk governance. These can be translated into concrete recommendations.

Design principles are understood as sub-objectives which are supposed to contribute to the achievement of overall goals.

We make a distinction between design principles for improving flood risk governance processes on the one hand, and more specific design principles and good practices related to each of the three

desired outcomes (societal resilience to flooding, resource efficiency and legitimacy) on the other hand. The former will be discussed in section 9.2. These are more encompassing than the latter, since they are not only dealing with the question of how specific desired outcomes can be reached, but also with the question of which outcomes are desired by and for whom? Furthermore, these recommendations may be conducive to several desired outcomes simultaneously. The more specific principles in sub-section 9.3, on the other hand, focus more on the 'how' question.

9.2 Design principles for improving flood risk governance processes

This section discusses eight design principles for improving flood risk governance processes. After introducing each principle, challenges related to its implementation are discussed, as well as concrete recommendations for addressing these challenges.

Societal actors, including public authorities, businesses, community groups and NGOs should be clear about the flood risks they are facing, the level of protection that is present and about how responsibilities for handling them have been divided.

Societal actors generally endorse this principle. It is also a principle to which public authorities need to comply in order to act in line with the Aarhus Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters. Implementing it is, however, challenging, as chapter 5 has shown. Public authorities are still struggling with how to undertake risk communication, and in several countries a lack of risk awareness amongst private parties has been witnessed. Amongst other things, following flood events it is tempting for politicians to promote a 'defence paradigm', yet this is sometimes at odds with national policy and academic consensus that a risk-based approach is the best way forward. In order to deal with this challenge, we recommend the following:

- Politicians and decision makers at different governmental levels should make the effort to pro-actively communicate which levels of flood risk, both in terms of probability and potential consequences, societal actors are facing. They furthermore need to make explicit to what level of support by authorities societal actors are currently entitled both by law and by custom. This will bring debate on acceptable levels of risk and the question of who is responsible for dealing with them into the open and ensure that businesses, community groups and citizens know what to expect.
- We recommend having on open, broad (political and societal) debate about shifting responsibilities between public and private actors. The outcome of the debate should lead to more clearly defined roles for governments/citizens, to be laid down in documents that are open for public consultation and public scrutiny.
- Public acceptance of FRM policy is challenged by the occurrence of flood events and subsequent 'politicisation of floods'. As we have shown in chapter 5, authorities cannot wait for risk communication until a flood occurs. On the other hand, although very challenging, improving "water consciousness" should be continuously on the agenda.
- Managing societal expectations is key. There is a need to promote consistency in communication from the EU, national to local scale.

Flood-relevant policies should adopt a forward planning approach and take into account future changes, including climate change.

- Climate change projections should be embedded in FRM policy (and vice versa) to support forward-planning, e.g. in national policy strategies, planning documents through to the design of defence schemes (e.g. adaptive management is advocated). A long-term strategic approach (ca. 50 to 100 years) to decision-making is needed that enables adaptability and flexibility (because of uncertainty) to ensure that future risks and uncertainties are accounted for.

Knowledge infrastructures should be developed, and joint knowledge production processes and cultures of learning should be stimulated.

Institutional cultures for learning appear to be well-established within several STAR-FLOOD countries, but there are limited opportunities for exchanging these lessons within and between countries, especially between research and practitioner communities. Conferences, workshops and research consortiums are one way of transferring knowledge but often exclude practitioners. The outputs from projects, such as policy briefs and the Practitioner Guidebook developed within STAR-FLOOD, provide an important means of disseminating research findings in an accessible way, but do not enable the active exchange of ideas and dialogue. Hence, to further stimulate joint learning, we recommend:

- To establish a flood risk governance knowledge exchange platform, nationally and internationally

Private actors, including business, community groups and citizens should adopt partial responsibility for their own risk.

As chapter 5 has shown, engagement of private parties is needed, both for substantive and for normative reasons. Also public-private synergies in the context of recovery are relevant, e.g. in Belgium where private insurance is dominant, with a public fall-back mechanism. Here, cooperation between the two entities is important. A lack of risk awareness, a lack of incentives for engaging in FRM and, often, the existence of specific rights or customs regarding divisions of responsibilities is hampering public-private cooperation. Also, while the European Commission has a large interest in stimulating public-private partnerships, in our research we did not find many examples of these and hence further insights regarding how state-business and state-society partnerships should be designed, how they could be useful and how they could enhance capability are still needed. In some cases, partnerships may even have negative effects (even more stakeholders). To address these challenges, we recommend:

- To interpret public-private cooperation as 'multi-actor coproduction'. This includes co-planning whereby citizens participate in the decision-making process of FRM measures, e.g., development of river basin management plan, emergency plan; co-delivery: participation of citizens in the implementation of FRM measures, e.g., flood protection measures at household-level; and comprehensive co-production: participation of citizens in both the decision-making and implementation of FRM measures, e.g., development of FRM plan in cooperation with residents, whereby both citizens and authorities are responsible for the implementation of certain measures (Mees *et al.* submitted). Co-production can be set up in the pursuit of societal resilience, but also to increase efficiency and distribute responsibilities more equitably.

Flood risks should be dealt with at multiple scales and flood risk governance should take place at the most appropriate level.

A multi-scale approach is needed as well as efforts to mitigate flooding at the property and community scale, either through the implementation of property-level measures to enhance capacities to resist flooding, or through preparatory activities to enhance capacities to respond and recover. To achieve this aim, the subsidiarity principle is often adhered to. This principle implies that governance should take place at most appropriate level, being the lowest level possible, but the highest level necessary. Applying subsidiarity is challenging, however. On one side, in some cases flood risk management within European countries still follows a strong top-down approach, complicating the development of approaches tailored to local situations. On the other side, subsidiarity is easily equated with 'decentralisation'. However, decentralisation is only subsidiarity to the extent that devolution of powers to lower levels of government can be said to be appropriate and is accompanied with devolution of the necessary resources. In order to achieve the right balance between bottom-up and top-down steering, we recommend the following:

- National governments and the EU have an important role to play by **supporting** (funding & expertise) and **approving** flood risk policy planning at regional level (preferably within hydrological boundaries). Local, tailor-made solutions should be **stimulated** and **facilitated** since these are often the best way of detangling multi-actor, multi-sector and multi-level governance problems in flood risk governance.
- The EU should support local developments by providing a subsidy system for stakeholder platforms at catchment scale. These platforms include all relevant stakeholders in the sub-catchment and draft a flood risk management plan based on their objectives, which is (financially) supported by EU/national governments (see also: Benson *et al.* 2012).

Flood risks should be taken into account in spatial planning and receive the level of priority that is in line with what society considers acceptable levels of risk.

As was shown in chapter 4, taking flood risks into account in spatial planning is challenging for different reasons. There are different experiences witht he extent to which local leaders give sufficient priority to flood risks. While there are good examples of policy entrepreneurs promoting a water sensitive approach to urban development (e.g. in Dordrecht) also counter-examples can be given, and in France the mayor of a small seaside village was even sentenced to four years in prison for behaving irresponsibly towards flood risks. The STAR-FLOOD project has furthermore found that there is an intricate link between the strategies of flood recovery and those of flood prevention and mitigation. It was found that in some cases strong recovery mechanisms may dis-incentivise prevention and mitigation, and that recovery systems should focus on preventive and mitigation measures at individual property level. For instance, the CAT-NAT system in France has been found to discourage prevention. Also in Belgium, risk prevention is promoted through the legislative insurance framework, which discourages building in high-risk areas. Moreover, we cannot ignore the legacy of past decision-making or the fact that extensive development has already taken place in areas at flood risk. In order to make next steps in reconciling flood management and spatial planning, we recommend:

- To use flood zones to direct planning decisions.
- To discourage future development in areas at high risk of flooding.

- To put provisions in place for cases in which development in flood risk areas cannot be avoided. It should be made clear who is responsible for damage (this could be the project developers who have a stake in developing an area), and it needs to be ensured that development is adaptive (e.g. raised floor heights, use of SUDS) to minimise future damages should a flood occur.
- Strategies for 'retrofitting adaptation' are required.
- If no further development is allowed in an area, this may lead to unintended consequences such as economic and social deterioration. Policy makers should be aware of these consequences and should develop novel ways of fair burden sharing.

Formal flood-relevant rules and regulations should be clear for all involved, enforceable and enforced.

As we have seen, amongst other things in chapter 6, there is sometimes a lack of clarity of rules. Legal frameworks could more explicitly mention when and for what they are applicable. This is especially needed with regard to the development of the multi layered safety of combined strategies. Furthermore, what is needed is enforcement of the rules we have, for instance, as we have seen, in the field of spatial planning. In some countries, changes in legislation have proven to be a problem in itself. This is exemplified by Poland, a country that after the transition of 1989 went through massive administrative and legal changes. To improve the working of rules and regulations, we recommend:

- To improve enforcement mechanisms in spatial planning through legal instruments. This also requires political will to enforce legislation (see the next design principle), increased powers within competent authorities and detailed guidance on building on the floodplain, to name a few. Legal frameworks should pay as much attention to the scope of the legal instrument as to how the instrument should be implemented, followed up and what the consequences are in the case of non-compliance.
- There is a need to establish incentives for better cooperation between actors operating within distinct spatial planning and FRM policy domains (e.g. as seen in England) and deliver a more integrated approach.

More experience should be gained with applying catchment-based approaches to FRM

The value of applying cross-sectoral Catchment-Based Approaches (CaBA) currently encouraged in water and environmental policy continues to be debated in the FRM field. Further evidence is required to demonstrate the effectiveness of this approach for alleviating flood risk and its potential for maximising the efficient use of resources.In principle, there are various opportunities for trans-boundary flood risk governance to lead to more flood resilience. Adopting the normative starting point that flood risks should not only be addressed locally but also considered at the basin scale, trans-boundary flood risk governance is desirable and moreover required by the Floods Directive and one of the reasons for EU action. STAR-FLOOD, admittedly, has not explicitly addressed transboundary flood risk governance (e.g. the work of the Rhine, Meuse and Scheldt commissions) as such but has focused on flood risk governance at the country and case study level. Nevertheless, we find it surprising that we came across relatively few examples of transboundary FRG, and there still seems to be much room for improvement in terms of enhancing trans-boundary cooperation in flood risk management. Hence, we recommend the following:

- Public and private actors at different levels need to initiate, carry out and facilitate practical experiments and engage in knowledge exchange regarding the further stimulation of catchment-based approaches to FRM.

9.3 Design principles for improving flood risk governance outcomes[5]

Specific design principles for enhancing the desired outcomes of resilience, efficiency and legitimacy as discussed in chapter 1 have been formulated. These have been identified within Work Package 5 of STAR-FLOOD (see also: Ek *et al.* 2016a). In this Work Package, the country-specific evaluations of resilience, efficiency and legitimacy were compared and based on this a number of factors that support or constrain societal resilience to flooding amongst the STAR-FLOOD countries have been revealed.

Resilience should be disentangled into the capacity to resist, to absorb and recover, and to learn and innovate (see also chapter 1). Table 9.1 provides an overview of the three capacities and the related design principles (left-hand column). For each design principle, success conditions (see p. 55 for a definition) have been identified. The right-hand column provides some concrete examples of good practices that were found to increase the chance of meeting the success conditions.

[5] This text is largely based on chapter 3 of Ek *et al.* 2016a.

Table 9.1: Design principles, success conditions and examples related to enhancing societal resilience to floods (Ek *et al.* 2016a)

Design principles for flood risk governance to enhance the capacity to resist	Conditions for success	Good practices
Selected flood risk management measures (e.g. defence and mitigation) should be tailored to local circumstances (e.g. risk, vulnerability, institutional and economic context)	- Sufficient resources are provided (power, knowledge and financial), also for maintaining and improving existing defence structure - Legislation and decision-making allows/supports adaptability - Cooperation, in particular between defence and prevention and between defence and mitigation management, is supported - Long term forward planning is supported - Actors (citizens) are incentivized to undertake risk-reducing measures	- Partnership funding (England is a good example of where resources have been diversified to support the implementation of more defence and mitigation-based measures - Action Programme for Flood Prevention (France) - Water assessment (Belgium and the Netherlands) - Long-term investment strategy (England) is a good example of long-term forward planning of financial resources - Delta Programme (the Netherlands)

Design principles for flood risk governance to enhance the capacity to absorb and recover	Conditions for success	
Flood risk (prevention) should be incorporated within spatial planning decision-making to i. discourage development in known areas of flood risk, ii. ensure that development in at-risk areas is adaptive, and iii. ensure that development does not heighten risk	- Sufficient resources are provided (power, knowledge and financial) - Legislation and decision-making allows/supports adaptability - Legislation contains mechanisms to ensure implementation of spatial planning measures (enforcement) - Cooperation, in particular between defence and prevention and between defence and mitigation management, is supported	- Water assessment (Belgium) - Water test (the Netherlands) - Building regulations (Sweden) - Zoning system (France)

Systems for forecasting and warning (preparation) should be effective and warnings should be transmitted with sufficient lead time.	- Sufficient resources are provided (power, knowledge and financial), also for investments in forecasting technology. - Formal responsibilities are established for the communication of flood warnings - Multiple pathways for disseminating flood warnings are available. - Community risk-awareness and preparedness are promoted.	- Use of new technologies (e.g. England and the Netherlands)
Effective and proactive arrangements are in place to enhance emergency preparation and response to flooding	- Requirements to assess and monitor local risks, to inform emergency planning are established. - Mechanisms for up-scaling and downscaling emergency response are established - Arrangements are in place to facilitate inter-organizational working. Roles and responsibilities are clear.	- Flood rehearsals (e.g. the Netherlands) - Flood leaders programme (Poland) - Dike armies (the Netherlands)
Strategies to recover from flood events should be available for all citizens, and should entice flood risk prevention	- Systems for compensation for flood damage (after severe floods) are in place	- Large variation; solidarity principle v. beneficiary pays - Belgium: risk differentiation approach - France: CAT-NAT and Barnier Fund
Design principles for flood risk governance to enhance the capacity to learn, innovate and improve practices	- **Conditions for success**	-
Opportunities for social and institutional learning should be created	- Mechanisms are in place to facilitate knowledge exchange, sharing experiences and best practices - There is a clear strategy and investment in Research and	- Adaptive planning and programme cycles (the Netherlands) - Independent public inquiries (e.g. England) - Learning from international experiences

	Development programmes.	(Belgium, the Netherlands)

Table 9.2 provides an overview of design principles and success conditions for improving **resource efficiency**. The right-hand column provides some concrete examples.

Table 9.2: design principles, success conditions and examples for improving resource efficiency (Ek *et al.* 2016a)

Design principle for resource efficient flood risk governance	Conditions for success	Good Practices
Flood risk management should secure the level of flood risk reduction that is found acceptable at the lowest possible societal cost	- The process demonstrates due concern for matters related to resource efficiency - Actors (citizens) are incentivized to undertake risk-reducing measures	- Well-developed practices for CBA, also for non-monetary impacts (e.g. England)

Table 9.3 provides an overview of design principles and success conditions for improving **legitimacy**. The right-hand column provides some concrete examples.

Table 9.3: design principles, success conditions and examples for improving legitimacy (Ek *et al.* 2016a)

Design principles for legitimate flood risk governance	Conditions for success	
The decision-making process should be characterised by a high degree of public participation, social equity and perceived accessibility	- The process demonstrates due concern for matters related to social equity - Stakeholder involvement for informed and outcome-oriented contributions to the design and implementation of flood risk management strategies and measures are guaranteed - Attention is paid to under-represented categories and newcomers, including property developers and institutional investors - The process and outcomes of stakeholder engagement are regularly evaluated in order to foster learning and improvement (also in terms of use of resources) - Information about the way in	- Mechanisms for "pushing" warnings and "pulling" vulnerable people in advance (England) - Community engagement (England) - Duty to inform (Belgium)

Design principles for legitimate flood risk governance	Conditions for success	
	which and to what effect resources are spent on the management of flood risk is publicly available - The process for decision-making is determined by including: a) The expected use of stakeholders' input; b) Plans for mitigating power imbalances between different stakeholder-groups (e.g. experts vs. non-experts) and reducing the risk that the consultation process is taken over by overly loud or over-represented groups	
Mechanisms/arrangements are in place to ensure accountability	- Decision-making in FRM is subject to independent reviews and public scrutiny - Decision-makers can be held accountable	- Independent reviews (England)
Citizens are aware of their rights and responsibilities in connection with the planning and implementation of Flood Risk Management measures.	- Citizens are informed of their responsibilities - Citizens are informed of how they can carry out their responsibility in practice	- Multi-layered safety (Belgium) - Duty to inform (Belgium)
The FRGA is characterised as transparent i.e. the decision-making process, outcome and impact of this process are made visible for all stakeholders	- All policy and legislation relating to flood risk governance is publically available - FRM is subject to public and/or independent inquiries to evaluate its performance	- Principle of public access (Sweden)
Mechanisms/arrangements are in place to ensure access and delivery of procedural justice	- There are opportunities for stakeholders to challenge decisions made by public authorities and seek justice - The process of resolving disputes is considered to be just	- Low costs for litigation (Belgium, Sweden, the Netherlands)

9.4 Overall recommendations on appropriate and resilient flood risk governance arrangements

As argued in chapter 2, social scientific and legal research, especially governance research, on FRM had received limited attention vis-à-vis natural science research. Adopting a governance perspective has been shown to provide important complementary insights that may help to improve FRM approaches in different countries. As we discussed in this report, improving societal resilience to floods implies increasing the capacity to resist, to absorb and recover and to adapt. This makes demands on the flood risk governance arrangements that are put in place to realise these desired outcomes of flood risk governance. For that reason, STAR-FLOOD's main research question, addressed throughout this report, was: "what are appropriate and resilient flood risk governance arrangements for dealing with flood risks in vulnerable urban agglomerations in Europe?". In response to this main research question, the following overall recommendations can be formulated:

- While we can endorse approaches aimed at diversification of flood risk management strategies based on our research, these approaches should **fit within the existing national and local context**. As we have shown in chapter 3, countries differ in their approaches to diversification. In the Netherlands, Poland, France and Belgium, we see a desire to create a back-up layer of contingency. England has been diversified for 65 years, while Sweden is currently diversifying due to climate change concerns. These existing approaches form the starting point and need to be taken into account to provide the contextual understanding necessary for governance changes to be implemented.
- Steering at different levels of government (EU, national, regional/local and trans-boundary) is necessary, but with a clear division of tasks and responsibilities. Besides that, the role of citizens, NGOs and businesses should be considered (see chapter 5). Increased experimentation with public-private partnerships is needed to demonstrate the ability and effectiveness of these partnerships within FRM.
- There is a need to develop connectivity between different flood risk management strategies, between governmental levels and between flood-relevant policy domains such as spatial planning and crisis management. A better coordinated and complementary (rather than undermining) suite of strategies will ensure effective flood risk management. As we have shown in chapter 4, this requires different types of bridging mechanisms: coordinating actors; procedural duties and instruments; formal rules and regulations; financial and knowledge resources and bridging concepts.
- Linked to the point above, diversification of flood risk management strategies needs to be accompanied with suitable investments in the development of these strategies. Financial investments and other resources inputted into one strategy should not lead to under-investment in other strategies. Diversification also implies investments in legal frameworks, for instance building requirements in the field of spatial planning or emergency management frameworks.
- Legitimacy is a well-established principle of good governance and seen as essential for effective governance. As we have shown in chapter 8 and 9, this requires enhancement of public participation in policy making and increased flood awareness of citizens. Greater attention in policies and legislation needs to be paid to how effective participation, rather than consultation, can be delivered.
- Flood risk governance arrangements require long-term planning (visioning) to underscore adaptive approaches and to enable the sustainable use of resources. The short-term measures

should be delivered part of this longer-term perspective on flood risk management. Proactive, rather than reactive responses, to flooding are required.

- The Floods Directive has a greater role to play in stimulating the development of appropriate flood risk governance arrangements that increase societal resilience to floods. For instance, for the next implementation round of the FD, a substantive requirement regarding the content of Flood Risk Management Plans should be added to explicitly address the issue of responsibilities of actors. Bridging mechanisms as discussed in chapter 4 could also to some extent be included in the FD, for instance the duty of property sellers to inform potential buyers of flood risks (as is currently the case in the Flemish Region). Second, it would be worthwhile to critically re-evaluate the content of the FD for enforceability by citizens and to make clear what they can ask for in the courts. Furthermore, the FD should further stimulate transboundary flood risk governance according to the suggestions laid down in chapter 6.

Overall, our research has shown that there are **no one size fits all solutions.** Besides physical/geographical factors, historical flood risk management, societal and cultural norms, administrative and legal frameworks are all important factors that influence flood risk management and governance. Contextual, historical and contemporary flood risk debates all have implications for how policies and legal frameworks should be shaped and, as chapters 6 and 7 have shown, the desirable scope of European policies and funding schemes.

9.5 STAR-FLOOD products supporting the key message

Ek, K. Pettersson, M., Alexander, M., Beyers, J-C., Pardoe, J., Priest, S., Suykens, C., and Van Rijswick, H. F. M. W. (2016a). Best practices and design principles for resilient, efficient and legitimate flood risk governance – Lessons from cross-country comparisons, STAR-FLOOD Consortium, Utrecht, the Netherlands.

Ek, K., Raadgever, G. T., Suykens, C., Bakker, M. H. N., Pettersson, M., Beyers, J. C. (2016b). An expert panel on design principles for appropriate and resilient flood risk governance – lessons from a workshop in Brussels. STAR-FLOOD consortium, Utrecht, the Netherlands.

Pettersson *et al.* (in preparation). Design principles for improved legitimacy of flood risk governance in Europe.

Priest, S., Suykens, C., Van Rijswick, H. F. M. W., Schellenberger, T., Goytia, S., Kundzewicz, Z. W., Van Doorn-Hoekveld, W., Beyers, J. C., and Homewood, S. (under review). The European Union approach to flood risk management and improving societal resilience: Lessons from the implementation of the Floods Directive in six European countries.

Pictures: a view of Antwerp (left; by Dries Hegger); excursion to the city of Antwerp (right).

10 Concluding remarks

10.1 Reflection on STAR-FLOOD's research approach

10.1.1 Key features of the approach

As mentioned in the introduction, STAR-FLOOD's research approach has the following key features:

- The project combined social-scientific and legal approaches, achieving dialogue and synergy between multiple disciplines.
- The project made comparisons between countries and case studies, whereby all researchers used a similar framework for analysis, explanation and evaluation.
- The work was carried out in close cooperation with stakeholders at the European, national, regional and local level. Throughout the project they were involved in workshops (e.g. case study workshops in each country, two expert panels; four international workshops and various additional sessions at conferences) and over three hundred interviews. During the project, the scope of the workshops shifted from collecting information and identifying the knowledge needs of stakeholders towards disseminating research findings and validating research results.

In order to achieve dialogue between the involved disciplines, maximise comparability of the findings and link the research to policy and practice, we chose for intensive forms of cooperation. Researchers within the project had frequent exchanges of ideas with other researchers, both within and across the participating countries; the coordinator provided frequent feedback on draft products produced by all (including through several visits to all partners); a common conceptual and methodological starting point was developed in Work Package 2, with the Policy Arrangements Approach as an overall framework for combining the input of researchers from various disciplines; and as appendix 1 shows, meetings were held very frequently, both in the form of plenary consortium meetings and in the form of Academic Master Classes (AMCs). Besides that, also frequent workshops with stakeholders were held, as reported in Choryński *et al.* (2016); Ek *et al.* (2016b); Hegger *et al.* (2014a); and Hegger *et al.* (2016). Overall the approach used appeared to be very fruitful, but also time consuming.

10.1.2 Strenghts and points for improvement of the research approach

The STARFLOOD approach was evaluated by the partners during the final consortium meeting (March 2016). Based on this evaluation, the following strengths and points of improvement were identified.

Strengths of STAR-FLOOD's research approach

Partners and coordinator shared the overall impression of a successful and well-coordinated project. Strong points that were emphasised by several partners are:

- **Intensive interactions** between the involved researchers, including workshops and meetings in different cities. Researchers indicated that these intensive interactions fostered mutual understanding, amongst other things in terms of each other's disciplinary approaches and of the specificities of FRM systems in the different countries. An atmosphere was created in

which such issues are not taken for granted, but on the other hand questioned along with approaches from other countries.

- **Learning and training by junior researchers**. The various forms of cooperation, in particular the Academic Master Classes, were highly valued. These provided the junior researchers in the project with training in various relevant research skills, including: theoretical approaches for policy and legal analysis; public administration and legal approaches for evaluating governance; skills in setting up comparative research; doing discourse analysis; setting up workshops; and writing and publishing papers.
- **Good complementarities**. The different disciplines involved in the project as well as the specific expertise of some partners were seen as complementary and enriching.
- **Good atmosphere**. All in all, the atmosphere of working together was evaluated as very positive.
- **Strict intermediary deadlines.** An approach was chosen in which partners had to make available intermediary products at specific moments, to allow for frequent exchange and feedback. In general, this approach was endorsed.

Points of improvement

Partners indicated the following points of improvement:

- Be **stricter on key definitions** early stage of the project. Key definitions of important concepts were discussed frequently. Amongst other things, a glossary of key terms was developed by the coordinator with input from all partners, providing an overview of different interpretations of concepts. Halfway the project, in April 2014, this document was finalised and included for each concept a recommended interpretation for the purpose of the STAR-FLOOD project. The development of this glossary was endorsed, but it was suggested that later projects could come up with a recommended definition in an earlier stage in the project to minimise conceptual confusion.
- **Start earlier with comparisons, lessons/recommendations** (more iterative process). While benchmarks for country comparison were on the agenda from the beginning onwards, it can be recommended to also start with the substantive comparison from the outset. Country-comparison (WP4) and the identification of design principles (WP5) should be given a larger role vis-à-vis country-specific analysis (WP3 in STAR-FLOOD).
- **Discuss the conceptual approach and the substantive issues covered in the project simultaneously.** In Work Package 2 and at the beginning of Work Package 3, much discussion was held on the conceptual approach and the precise scope of the empirical research. Only after closure on these issues was achieved, the discussion shifted to the more substantive policy and legal issues of the project. We recommend to discuss and address both issues simultaneously, as these discussions may enrich each other.
- **Make early agreements on how to deal with differences in disciplinary reporting and publication styles**. It was ensured that the country reports (WP3) would remain relatively concise, to provide readers with easy access to the key findings. This constituted a tension, however with the need to discuss legal information in some detail. Part of the legal information in STAR-FLOOD is now not included in the WP3 reports, but in background documents that are not publicly available. Although this information is present in journal

articles written on the basis of the empirical research, it would also be advisable to include the legal background information, for instance as appendices to the reports or in an online resource.

- **Provide even more structure to facilitate the interdisciplinary approach**. It was suggested that even more concrete structure could be offered to achieve more integration between policy analysts and legal scholars, for instance through case workshops, field trips, debates with practitioners etc.
- **Be more lenient regarding the content and scope of intermediary products in an early stage of the project.** Strict intermediate deadlines were evaluated as positive, but in an early stage the things to deliver could be more general (e.g. template) instead of lengthy texts, in order to avoid large time investments in products that require substantial revisions afterwards.
- **Involve end-users in the project in an earlier stage**. While intensive workshops with end-users were held throughout the project, valorisation of research and dissemination of findings will even be more enhanced if end-users are also involved as partners in the project from the start.

10.1.3 Overall recommendations for future European projects

Based on our experiences as discussed in the preceding two sub-sections, we conclude that interdisciplinary comparative and complementary research that leads to innovative insights requires the intensive forms of cooperation and the high degree of coordination as pursued in the STAR-FLOOD project. Intensive exchanges were necessary to ensure that all researchers were taking a common conceptual and methodological starting point, that integration between social science and legal research was achieved, that the country-specific deliverables are of excellent quality and to a large extent comparable, and that a common framework for comparison and identification of design principles was used. In hindsight, it can be said that the ambition to arrive at cumulative, coherent and comparable research was challenging, required much coordination effort, but was on the other hand also extremely rewarding as it enabled us to truly adopt an integrated and comparative perspective and to arrive at nuanced findings as detailed in all STAR-FLOOD deliverables. To summarise, based on our experience we argue that project proposals for large integrated European projects (e.g. within Horizon 2020) should have the following characteristics in order to maximise the chance for success. A proposal should:

- Decide between two mutually exclusive approaches in terms of the **structure of Work Packages**. WPs can be organised according to concrete overall steps in the research (e.g. assessment framework; empirical research; comparison; design) instead of according to specific disciplinary or issue-oriented activities. While the former approach, the one followed in STAR-FLOOD, is in our view more ambitious and rewarding, applicants should be aware that it requires strong coordination efforts and may at times be challenging.
- Identify concrete actions to achieve intensive **knowledge exchange between countries and disciplines** as well as **training activities for junior researchers**.
- Identify specific **moments at which decisions will be made** regarding important issues such as the definitions of key concepts, the main features of the conceptual approach used, the scope of the empirical research, and the table of contents of specific deliverables and provide a justification for the timing.
- Involve **end-users** as partners in the project from the outset.

- Design an **approach in which country and case study analyses and their comparison co-evolve through an iterative process**.

10.2 Issues for further research

All key governance issues mentioned in section 9.4 deserve to be addressed in more detail in follow-up research. In particular, we see the following three clusters of potential follow-up research: (i) validation, application and further specification of STAR-FLOOD's research findings in real-life contexts; (ii) follow-up research on specific aspects of flood risk governance that were shown to be important as well as research in countries and regions other than the STAR-FLOOD countries; (iii) application of the research approach followed in STAR-FLOOD in other empirical domains. Each of these three clusters will now be discussed in turn.

(i) Validation, application and further specification of STAR-FLOOD's research findings

Within STAR-FLOOD, design principles were identified based on the findings of the empirical research. The design framework developed in STAR-FLOOD can be used for more design-oriented research efforts, in which possible improvements in FRM are studied by proposing concrete governance options to actors in the field and discussing and refining these together with them. Specifically, research and experimenting into public-private arrangements at the regional/local level should be further pursued. Also the exchange of good practices between countries and even between regions in single countries has proven to be especially inspiring both for researchers and for actors implementing FRM in practice. We therefore suggest the following:

- To further pursue **knowledge co-creation projects** in which researchers collaborate with other societal actors around concrete local and regional FRM issues. In so doing, specific attention should be paid to the role of long-term visioning and imagination in this, as it was shown to enhance risk communication and the adoption of a long term perspective.
- The design principles developed in STAR-FLOOD could be further developed into a more direct **hypotheses testing approach**.
- Design-oriented research can be carried out by **participating in INTERREG projects** with a specific regional focus.
- Specific follow-up research that sets forth mechanisms in countries and at EU level for improving FRG in specific countries can be carried out.
- Follow up research on **trans-boundary flood risk management** and the improvement of the Floods Directive in this regard; including the development of shared concepts and the assessment and eventual further development of legal instruments for transboundary cooperation.
- Follow up research on the **effectiveness and legitimacy of the procedural governance approach taken in the Floods Directive**.
- Follow up research on the effectiveness and depth of the at this moment rather generic **participation requirements** in the Floods Directive.

(ii) Follow-up research on specific aspects of flood risk governance that were shown to be important as well as research in countries and regions other than the STAR-FLOOD countries

Empirical research as carried out within STAR-FLOOD can be further extended to countries, regions and catchments regions not included in the STAR-FLOOD project. This will lead to cumulative research and complementary insights and good practices. This research should put more emphasis on the occurrence and performance of different forms of multi-level governance as well as aspects related to trans-boundary flood risk governance. In follow-up research, the following specific aspects could be addressed further:

- **Social vulnerabilities of different societal groups in relation to multiple hazards**.
- Specific governance challenges related to the implementation of **flood mitigation/resilient architecture** and the role of spatial planning therein could be addressed in more detail.
- The issue of **budget cuts of public authorities and how this impacts FRM** could be addressed in some detail.
- The **power and effectiveness of different types of bridging mechanisms** that may help to improve links between flood risk management strategies and may avoid blurred responsibilities.
- The role of critical infrastructure in flood events and how private actors operating them acted in case of a flood.

(iii) Application of the research approach followed in STAR-FLOOD in other empirical domains

STAR-FLOOD's research approach for carrying out a comparative social science/legal study into governance issues can be applied to other empirical domains. For instance, the following topics could be addressed through an approach that is similar to the one used in STAR-FLOOD:

- Research on drought.
- Climate adaptation in cities and regions.
- Nature-based approaches for multi-hazard issues.
- Integrated approaches to sustainable cities and regions (including green regions, green transformations).
- Integrated multi-hazard and disaster risk reduction research.
- Flooding as a cause of pollution.

Case study workshop in Poznań, Poland, 25th June 2015 (source: A. Choryński).

References

Aerts, J. C. J. H., Botzen, W., Van Der Veen, A., Krykow, J., and Werners, S. (2008). Dealing with uncertainty in flood management through diversification. *Ecology and Society* 13(1):41.

Alexander, M., Priest, S., and Mees, H. (2015) Practical guidelines for evaluating flood risk governance. [In] Larrue, C., Hegger, D., Trémorin, J-B (Eds). Researching flood risk governance in Europe: A framework and methodology for assessing flood risk governance. STAR-FLOOD deliverable report (Report No. D2.2.1).

Alexander, M., Priest, S., and Mees, H. (submitted). A framework for evaluating flood risk governance.

Alexander, M., Priest, S., Micou, A. P., Tapsell, S., Green, C., Parker, D., and S. Homewood. (2016). Analysing and evaluating flood risk governance in England – Enhancing societal resilience through comprehensive and aligned flood risk governance. STAR-FLOOD Consortium. Flood Hazard Research Centre, Middlesex University.

Alfieri, L., Burek, P., Feyen, L., Forzieri, G. (2015). Global warming increases the frequency of river floods in Europe. *Hydrology and Earth System Sciences* 19: 2247-2260. doi:10.5194/hess-19-2247-2015.

Arts, B., and Van Tatenhove, J. P. M. (2006). Political Modernisation. In Institutional Dynamics in Environmental Governance. Dordrecht: Springer, pp. 21–43.

Bakker, M. H. N., Van Herten, M., Hegger, D. L. T., Driessen, P. P. J. (2016). Report of the three STAR-FLOOD Transdisciplinary Advisory Board meetings. STAR-FLOOD consortium, Utrecht, the Netherlands.

Bakker, M. H. N., Green, C., Driessen, P. P. J., Hegger, D. L. T., Delvaux, B., Van Rijswick, H. F. M. W., Suykens, C., Beyers, J. C., Deketelaere, K., Van Doorn-Hoekveld, W., and Dieperink, C. (2013). Flood Risk Management in Europe: European flood regulation, STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-04-2.

Barredo, J. I. (2007). Major flood disasters in Europe: 1950-2005. Nat Hazards 42(1):125-148.

Benson, D., Jordan, A., and Huitema, D. (2012). Involving the Public in Catchment Management: An Analysis of the Scope for Learning Lessons from Abroad. Environmental Policy and Governance, 22(1), pp.42–54. Available at: http://doi.wiley.com/10.1002/eet.593

Brouwer, S., and Biermann, F. (2011). Towards adaptive management: examining the strategies of policy entrepreneurs in Dutch water management. Ecology and society, 16, 5. http://dx.doi.org/10.5751/ES–04315–160405

Bubeck, P., Kreibich, H., Penning-Rowsell, E. C., Botzen, W. J. W., de Moel, H., Klijn, F. (2015). Explaining differences in flood management approaches in Europe and in the USA – a comparative analysis, Journal of Flood Risk Management. DOI: 10.1111/jfr3.12151.

Caldwell, R. (2003). Models of change agency: a fourfold classification. British Journal of Management, 14, 131–142. doi: 10.1111/1467-8551.00270.

Chaffin, B. C., Gosnell, H., and Cosens, B. A. (2014). A decade of adaptive governance scholarship: synthesis and future directions. Ecology and Society 19(3):56.

Choryński, A., Raadgever, G. T., and Jadot, J. (2016). D4.2 Experiences with flood risk governance in Europe; a report of international workshops in four European regions. STAR-FLOOD Consortium, Utrecht, the Netherlands.

Den Uyl, R. M., and P. P. J. Driessen. (2015). Evaluating governance for sustainable development – Insights from experiences in the Dutch fen landscape. Journal of Environmental Management 163:186-203. http://dx.doi.org/10.1016/j.jenvman.2015.08.022

Department for Environment, Food and Rural Affairs (Defra) (2011b) Flood and coastal resilience partnership funding: An introductory guide. Available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182524/flood-coastal-resilience-intro-guide.pdf (accessed 10/08/2015)

Dieperink, C., Green, C., Hegger, D. L. T., Driessen, P. P. J., Bakker, M. H. N., Van Rijswick, H. F. M. W., Crabbé, A., Ek, K. (2013), Flood Risk Management in Europe: governance challenges related to flood risk management (report no D1.1.2), STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-03-5.

Dieperink, C., Hegger, D. L. T., Bakker, M. H. N., Kundzewicz, Z. W., Green, C., and Driessen, P. P. J. (submitted). Dealing with recurrent governance challenges in the implementation and alignment of flood risk management strategies: a literature review. Water Resources Management.

Driessen, P. P. J., Dieperink, C., Van Laerhoven, F., Runhaar, H. A. C., and Vermeulen, W. J. V. (2012) Towards a conceptual framework for the study of shifts in modes of environmental governance – Experiences from the Netherlands. Environmental Policy and Governance. 22. p143-160.

Ek, K., Goytia, S., Pettersson, M., and Spegel, E. (2016), Analysing and evaluating flood risk governance in Sweden – Adaptation to Climate Change? STAR-FLOOD Consortium, Utrecht, the Netherlands.

Ek, K. Pettersson, M., Alexander, M., Beyers, J-C., Pardoe, J., Priest, S., Suykens, C., and van Rijswick, H. F. M. W. (2016a). Best practices and design principles for resilient, efficient and legitimate flood risk governance – Lessons from cross-country comparisons, STAR-FLOOD Consortium, Utrecht, the Netherlands.

Ek, K., Raadgever, G. T., Suykens, C., Bakker, M. H. N., Pettersson, M., Beyers, J.C. (2016b). An expert panel on design principles for appropriate and resilient flood risk governance – lessons from a workshop in Brussels. STAR-FLOOD consortium, Utrecht, the Netherlands.

Folke, C. (2006). Resilience: the emergence of a perspective for social-ecological systems analyses. *Global Environmental Change* 16:253-267. http://dx.doi.org/10.1016/j.gloenvcha.2006.04.002.

Folke, C., Hahn, T., Olsson, P., and Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30:441-473. http://dx.doi.org/10.1146/annurev.energy.30.050504.144511

Giddens, A. (1984). The Constitution of Society – outline of the theory of structuration. University of California Press.

Gilissen, H. K., Alexander, M., Matczak, P., Pettersson, M., Bruzzone, S. (under review). A framework for evaluating the effectiveness of flood emergency management systems in Europe.

Gilissen, H. K., Alexander, M., Beyers, J. C., Chmielewski, P., Matczak, P., Pettersson, M., Schellenberger, T., Suykens, C. (submitted). Bridges over Troubled Waters – An Interdisciplinary Framework for Evaluating the Interconnectedness within Fragmented Flood Risk Management Systems.

Goytia, S., Pettersson, M., Schellenberger, T., Van Doorn-Hoekveld, W., Priest, S. (submitted). Dealing with change and uncertainty within the regulatory frameworks for flood defense infrastructure in selected European countries.

Green, C, Dieperink, C, Ek, K, Hegger, D. L. T, Pettersson, M, Priest, S, Tapsell, S. (2013). Flood Risk Management in Europe: the flood problem and interventions (report no D1.1.1), STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-02-8

Guha-Sapir D, Hoyois Ph., Below. R. (2013). Annual Disaster Statistical Review 2012: The Numbers and Trends. CRED, Brussels.

Hartmann, T., Driessen, P. P. J. (2013). The flood risk management plan: towards spatial water governance. *Journal of Flood Risk Management*. DOI: 10.1111/jfr3.12077.

Hajer, M., and Versteeg, W. (2005). A decade of discourse analysis of environmental politics: achievements, challenges, perspectives. *Journal of Environmental Policy & Planning*. 7, 175–184. doi:10.1080/15239080500339646.

Hegger, D. L. T., and C. Dieperink. (2015). Joint knowledge production for climate change adaptation: what is in it for science?. Ecology and Society 20(4):1. http://dx.doi.org/10.5751/ES-07929-200401

Hegger, D. L. T., Driessen, P.P.J., Dieperink, C., Wiering, M., Raadgever, G.T., Van Rijswick, H.F.M.W. (2014). Assessing stability and dynamics in flood risk governance: an empirically illustrated research approach. *Water Resources Management* 28:4127-4142. http://dx.doi.org/10.1007/s11269-014-0732-x.

Hegger, D. L. T., Driessen, P. P. J., Wiering, M., Van Rijswick, H. F. M. W., Kundzewicz, Z. W., Matczak, P., Crabbé, A., Raadgever, G. T., Bakker, M. H. N., Priest, S. J., Larrue, C., Ek, K. (submitted). Toward more flood resilience: is a diversification of FRM strategies the way forward?

Hegger, D. L. T., Green, C., Driessen, P. P. J., Bakker, M. H. N., Dieperink, C, Crabbé, A, Deketelaere, K., Delvaux, B., Suykens, C., Beyers, J. C., Fournier, M., Larrue, C., Manson, C., Van Doorn-Hoekveld, W., Van Rijswick, H. F. M. W., Kundzewicz, Z. W., and Goytia Casermeiro, S. (2013). Flood Risk Management in Europe: Similarities and Differences between the STAR-FLOOD consortium countries, STAR-FLOOD Consortium, Utrecht, the Netherlands. ISBN: 978-94-91933-05-9

Hegger, D. L. T., Van Herten, M. Raadgever, T., Adamson, M., Näslund-Landenmark, B., Neuhold, C. (2014a). Report of the WG F and STAR-FLOOD Workshop on Objectives, Measures and Prioritisation Workshop.

Huitema, D., Lebel, L., and Meijerink, S. (2011). The strategies of policy entrepreneurs in water transitions around the world. *Water policy*, 13, 717–733. doi:10.2166/wp.2011.107.

Innocenti, D., Albrito, P. (2011). Reducing the risks posed by natural hazards and climate change: the need for a participatory dialogue between the scientific community and policy makers. *Environmental Science & Policy* 14:730-733. doi:10.1016/j.envsci.2010.12.010.

Jorgensen, M., and Phillips, L. J. (2002). Discourse analysis as theory and method. London/New Delhi: Thousand Oaks/Sage.

Kaufmann, M., Van Doorn-Hoekveld, W. J., Gilissen, H. K., and H. F. M. W. Van Rijswick. (2016). Drowning in safety. Analysing and evaluating flood risk governance in the Netherlands. STAR-FLOOD Consortium, Utrecht, the Netherlands

Kingdon, J. (1984), Agendas, Alternatives, and Public Policies, Little, Brown, Boston.

Klijn, F., Samuels, P. Van Os, A. (2008). Towards flood risk management in the EU: state of affairs with examples from various European countries. International Journal of River Basin Management 6:307-321. http://dx.doi.org/10.1080/15715124.2008.9635358http://dx.doi.org/10.1080/15715124.2008.9635358http://dx.doi.org/10.1080/15715124.2008.9635358

Klijn, F., De Bruijn, K., Ölfert, A., Penning-Rowsell, E., Simm, J., Wallis, M. (2009). Flood risk assessment and flood risk management; an introduction and guidance based on experiences and findings of FLOODsite (an EU-funded integrated project), FLOODsite consortium.

Kolen B., and Helsloot, I. (2014). Decision-making and evacuation planning for flood risk management in the Netherlands. *Disasters* 38(3):610-635. http://dx.doi.org/10.1111/disa.12059.

Koskenniemi, M., and Leino, P. (2002). Fragmentation of International Law? Postmodern Anxieties. *Leiden Journal of International Law* 15(3): 553-579.

Kundzewicz, Z. W., Krysanova, V., Dankers, R., Hirabayashi, Y., Kanae, S., Hattermann, F., Huang, S., Milly, C., Stoffel, M., Driessen, P. P. J., Matczak, P., Quevauviller, P., Schellnhuber, H. J. (submitted). Differences in projections of changes in flood hazard in Europe - their causes and consequences for decision making. *Climatic Change*.

Larrue, C., Hegger, D. L. T, and Trémorin, J. B (2013). Researching Flood Risk Policies in Europe: a framework and methodology for assessing Flood Risk Governance (report no D2.2.1), STAR-FLOOD Consortium, Utrecht, the Netherlands, ISBN: 978-94-91933-01-1.

Larrue, C., Bruzzone, S., Lévy, L., Gralepois, M., Schellenberger, T., Trémorin, J. B., Fournier, M., Manson, C., and Thuilier, T. (2016). Analysing and evaluating Flood Risk Governance in France: from State Policy to Local Strategies, Tours, France.

Liao, K. (2012). A theory on urban resilience to floods—a basis for alternative planning practices. Ecology and Society 17(4):48.

March, J. G., and Olsen, J. P. (2008), The logic of appropriateness, in: Moren, M, Rein, M and Goodin, R.E (eds) The Oxford Handbook of Public Policy, Oxford University Press, Oxford, pp. 689-708.

Matczak, P., Lewandowski, J., Choryński, A., Szwed, M., and Kundzewicz, Z. W. (2016). Flood risk governance in Poland: Looking for strategic planning in a country in transition. STAR-FLOOD Consortium, Utrecht, the Netherlands.

Matczak, P., Wiering, M., Lewandowski, J., Schellenberger, T., Trémorin, J. B., Crabbé, A., Ganzevoort, W., Kaufmann, M., Larrue, C., Liefferink, D., Mees, H. (2016a). Comparing flood risk governance in six European countries: strategies, arrangements and institutional dynamics. STAR-FLOOD consortium, Utrecht, the Netherlands.

Mees, H., Crabbé, A., Alexander, M., Kaufmann, M., Bruzzone, S., Lévy, L., Lewandowski, J. (submitted). Co-producing flood risk management through citizen involvement - insights from cross-country comparison in Europe.

Mees, H., Suykens, C., Beyers, J. C., Crabbé, A., Delvaux, B., and Deketelaere, K. (2016). Analysing and evaluating flood risk governance in Belgium. Dealing with flood risks in an urbanised and institutionally complex country. University Antwerp, KU Leuven, Belgium.

Mees, H. L. P., Driessen, P. P. J., Runhaar, H. A. C. (2014). Legitimate and adaptive flood risk governance beyond the dikes: the cases of Hamburg, Helsinki and Rotterdam. Regional Environmental Change 14:671-682.

Meijerink, S., and Dicke, W. (2008). Shifts in the Public-Private Divide in Flood Management. International Journal of Water Resources Development 24(4), 499-512. doi:10.1080/07900620801921363.

Mens, M., Klijn, F., De Bruijn, K. M., Van Beek, E. (2011). The meaning of system robustness for flood risk management. Environmental Science and Policy 14:1121-1131. http://dx.doi.org/10.1016/j.envsci.2011.08.003

OECD (2014). OECD Principles on Water Governance. OECD, Paris, 2014.

OECD (2014a). Water Governance in the Netherlands: Fit for the Future? OECD Studies on Water, OECD Publishing. http://dx.doi.org/10.1787/9789264102637-en.

Ostrom, E. (2007). Institutional Rational Choice, an assessment of the Institutional Analysis and Development framework. In P.A. Sabatier (Ed.), Theories of the Policy Process (pp. 21-64). Boulder: Westview Press.

Pahl-Wostl, C., Sendzimir, J., Jeffrey, J., Aerts, J., Bergkamp, G., and Cross, K. (2007). Managing change toward adaptive water management through social learning. Ecology and Society 12(2):30. http://www.ecologyandsociety.org/vol12/iss2/art30/.

Priest, S., Suykens, C., Van Rijswick, H. F. M. W., Schellenberger, T., Goytia, S., Kundzewicz, Z. W., Van Doorn-Hoekveld, W., Beyers, J. C., Homewood, S. (under review). The European Union approach to flood risk management and improving societal resilience: Lessons from the implementation of the Floods Directive in six European countries.

Quevauviller, P. (2011). Adapting to climate change: reducing water-related risks in Europe – EU policy and research considerations. *Environmental Science and Policy* 14: 722-729.

Rijke J., Van Herk S., and Zevenbergen, C. (2013). Towards integrated river basin management: Governance lessons from Room for the river. In: Klijn, F., Schweckendiek, T. Comprehensive flood risk management. London, Taylor and Francis Group, pp. 1033-1043. http://dx.doi.org/10.1201/b13715-149.

Runhaar, H. A. C., Gilissen, H. K., Uittenbroek, C. J., Mees, H. L. P., and Van Rijswick, H. F. M. W. (2014). Publieke en/of private verantwoordelijkheden voor klimaatadaptatie – Een juridisch-bestuurlijke analyse en eerste beoordeling, Copernicus Institute of Sustainable Development/Utrecht Centre for Water, Oceans and Sustainability Law, Utrecht, the Netherlands, 2014.

Sabatier, P. A., and Jenkins–Smith, H. C. (1993). Policy change and learning: an advocacy coalition approach. Boulder: Westview Press.

Sabatier, P., and Weible, C. M. (2007). The Advocacy Coalition Framework: Innovations and Clarifications, in: Sabatier, P.A (ed) Theories of the policy process, Westview Press, Davis CA

Schmidt, V. A. (2008). Discursive institutionalism: the explanatory power of ideas and discourse. Annual Review of Political Science, 11, 303–326. doi: 10.1146/annurev.polisci.11.060606.135342

Schmidt, V. A. (2011). Speaking of change: why discourse is key to dynamics of policy transformation. Critical Policy Studies, 5, 106–126. doi:10.1080/19460171.2011.576520

True, J. L., Jones, B. D., and Baumgartner, F. R. (2007). Punctuated-equilibrium theory: explaining stability and change in public policymaking, in: Sabatier, P.A. (ed) Theories of the policy process, Westview Press, Davis CA

Van Buuren, A., Teisman, G. R., Verkerk, J., Eldering, M. (2014). Samen verder werken aan de delta: de governance van het nationaal Deltaprogramma na 2014. Rotterdam: Erasmus University.

Van Den Brink, M., Termeer, C. A. J. M., Meijerink, S. (2011). Are Dutch water safety institutions prepared for climate change? *Journal of Water and Climate Change* 2:272-287.

Van Rijswick, H. F. M. W., and Havekes, H. (2012). European and Dutch Water Law, Europa Law Publishing, Groningen, The Netherlands.

Van Tatenhove, J. P. M. and Leroy, P. (2000). The institutionalisation of environmental politics. In Political Modernisation and the Environment. Dordrecht: Kluwer Academic Publishers.

Voß, J. P., Newig, J., Kastens, B., Monstadt, J., Nölting, B. (2007). Steering for Sustainable Development: a Typology of Problems and Strategies with respect to Ambivalence, Uncertainty and Distributed Power. *Journal of Environmental Policy & Planning* 9(3-4): 193-212, DOI: 10.1080/15239080701622881.

Wardekker, J. A., A. De Jong, J. M. Knoop, and Van der Sluijs, J. P. (2010). Operationalising a resilience approach to adapting an urban delta to uncertain climate changes. Technological Forecasting and Social Change 77:987-998. http://dx.doi.org/10.1016/j.techfore.2009.11.005

Wesselink, A., Warner, J., Syed, A., Chan, F., Duc Tran, D., Huq, H., Huthoff, F., Le Thuy, F., Le Thuy, N., Pinter, N., Van Staveren, M., Wester, P., Zegwaard, A. (2015). Trends in flood risk management in deltas around the world: are we going 'soft'? International Journal of Water Governance 3(4).

Winsemius, H. C., Aerts, J. C. J. H., Van Beek, L. P. H., Bierkens, M. F. P., Bouwman, A., Jongman, B., Kwadijk, J. C. J., Ligtvoet, W., Lucas, P.L., Van Vuuren, D. P., and Ward, P. J. (2015). Global drivers of future river flood risk. *Nature Climate Change*. DOI:10.1038/NCLIMATE2893.

Wiering, M., and Arts, B. (2006). Discursive shifts in Dutch river management: "deep" institutional change or adaptation strategy? In R. S. E. W. Leuven , A. M. J., Smits, A. J. M., and van der Velde, G., eds. Living Rivers: Trends and Challenges in Science and Management SE - 22. Developments in Hydrobiology. Springer Netherlands.

Wiering, M., and Immink, I. (2006). When water management meets spatial planning: a policy-arrangements perspective. Environment and planning C: government and policy 24:423-438. http://dx.doi.org/10.1068/c0417j

Wiering, M., Schellenberger, T., Kaufmann, M., Mees, H., Ganzevoort, W., Hegger, D. L. T., Larrue, C., and Matczak, P. Varieties of flood risk governance in Europe. How do countries respond to driving forces and what explains institutional change? Submitted.

Zahariadis, N. (2007). The Multiple Streams Framework; Structure, Limitations, Prospects, in: Sabatier, P.A (ed), Theories of the policy process, Westview Press, Davis CA

Swedish case study workshop (Göteborg, 28th February 2015)

Appendix 1: overview of the process followed in the STAR-FLOOD project

Box A1 below provides an overview of the main meetings and workshops held in the context of WP3 when the majority of the empirical work was carried out.

Box A1: overview of meetings and workshops held in the context of WP3

Plenary consortium meetings and Academic Master Classes held during WP3 (one AMC was held during WP2)

Where?	When?	Who?	Main topics covered (selection)
Tours	October 2013	Whole consortium (AMC and plenary consortium meeting)	Discuss analytical framework and methods; discuss and approve work plan of WP3
Utrecht	December 2013	Junior researchers (AMC)	Exchange of country level analyses; training in qualitative data collection and analysis and in comparative case study analysis
Antwerp	April 2014	Whole consortium (AMC and plenary consortium meeting)	Discuss country level analyses; training in doing discourse analysis
London	July 2014	Junior researchers (AMC)	Discuss results of first case studies per country, discuss plans for case study 2 and 3; training in organising workshops; discuss plans for special feature
Leuven	September 2014	Junior researchers (AMC)	Further discussion on publication plans and on initial key findings per country
Nijmegen	October 2014	Whole consortium (plenary consortium meeting)	Discuss results of second case studies & overall progress; discuss detailed outline of final WP3 reports
Utrecht	January 2015	Junior researchers (AMC)	Discuss first draft of first two chapters of the final WP3 reports; training in writing and publishing scientific papers
Luleå	June 2015	Whole consortium (plenary consortium meeting)	Discuss "90%" versions of the WP3 reports

Bilateral feedback meetings

-one "Tour d'Europe" in June/July 2014 to discuss key findings and work in progress (visits to all partners by Dries Hegger, Peter Driessen and Marloes Bakker);

-one "Tour d'Europe" in March/April 2015 to discuss 90% versions of all WP3 reports (visits to and feedback to all partners by Dries Hegger, Peter Driessen, Marloes Bakker, Ann Crabbé and Marleen van Rijswick).

Case study workshops

Country	# of workshops	Topics covered
Belgium	3	One national workshop, one on the case study of Antwerp and one on the case studies of Geraardsbergen and Lessines
England	2	One workshop discussing the national level results with a

		smaller circle of experts and a second knowledge-exchange event with current and past flood risk professionals
France	1	Expanding on the themes of “integrated management”; “decentralisation” and “the role of citizens in flood management”
Netherlands	2	One workshop to validatethe results of the case study Nijmegen and discuss its broader implications regarding the integration for water management and spatial planning (and emergency management); one workshop on the role of risk communication and the public in flood risk management
Poland	1	Corroborating overall research findings
Sweden	1	Corroborating overall research findings

All partners read and commented on multiple draft products of other WPs and of other countries. Besides drafts of the documents that were ultimately submitted as official deliverables to the EC, these draft products included more comprehensive and detailed documents providing an overview of all collected data. Some of these will be used in work to be written after the project’s formal end, including eventual book publications per country (for England, Poland and maybe the Netherlands and Belgium), a special feature in the journal Ecology and Society (in progress) and a special issue in the Journal of Flood Risk Management (commitment by the journal confirmed). There is also commitment from the Journal of European Environmental and Planning Law for an issue on how to bridge spatial planning and flood risk management.

We inductively derived key issues from the empirical findings. During WP4 and WP5 a matrix was also used to be able to make a more systematic comparison between the countries. For more detailed information on the methods used, the reader is referred to the six country reports (Alexander *et al.* 2016; Ek *et al.* 2016; Kaufmann *et al.* 2016; Larrue *et al.* 2016; Matczak *et al.* 2016; Mees *et al.* 2016) and the report of the case study workshops, expert panels, international workshops and TAB meetings (Hegger *et al.* 2014a; Bakker *et al.* 2016; Ek *et al.* 2016; Chorynski *et al.* 2016). Especially the two expert panels and the four international workshops helped to assess the external validity of the project and suggest that in general the recommendations and design principles identified in STAR-FLOOD are also relevant for other European countries that were not directly studied.

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