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TOWARDS A DIVERSIFICATION OF FLOOD RISK MANAGEMENT IN EUROPE: A REFLECTION ON META-GOVERNANCE CHALLENGES

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ABSTRACT: Because of climate change, extreme weather events and urban sprawl, urban regions have to deal with increasing flood risks. It is argued, both in literature and in practice that these risks can no longer be dealt with by focusing solely on flood defences (building dikes, dams, embankments etc.). Actors at various levels (international, European, national as well as regional) wish for and make efforts at a diversification of Flood Risk Management Strategies (FRMSs). The additional role flood risk prevention by pro-active spatial planning (building permits), flood retention, flood mitigation (e.g. urban green infrastructures, adaptive buildings), flood preparation and flood recovery can play in improving a region's resilience to flooding is widely debated. A diversification of FRMSs will result in governance challenges as existing Flood Risk Governance Arrangements (FRGAs) have to be changed. Scientific literature so far has only addressed each shift – and the necessary institutional preconditions for establishing it – separately, but has failed to address them in combination. Addressing these challenges asks for an innovative vision and approach. It is however not clear under which conditions such an innovative vision and approach can be successful. Our paper therefore aims to explore these conditions. It does so by presenting a research approach consisting of the four steps of i) identifying FRMSs, ii) analyzing, iii) explaining and iv) evaluating FRGAs. The approach will be illustrated with a case study, the application of the Dutch policy concept of multi-layered safety in the city of Dordrecht.

Key Words: Multi-layered safety, Flood Risk Governance, Flood Management, Flood Risk

1. INTRODUCTION

Climate change is expected to result in sea-level rise and to induce more extreme weather events, causing modifications in the frequency, severity and duration of hydro-meteorological hazards (IPCC 2011). Population growth, economic growth, urbanisation and in some cases also soil subsidence (Mitchell 2003) exacerbate these potential consequences. In Europe, flooding, together with landslides, is the most frequently experienced natural hazard, and accounts for the largest number of casualties and most economic damage (Guha-Sapir et al. 2013). Urban areas in particular face increasing flood risks. Between 2000 and 2005, Europe suffered more than 100 floods, including nine major flood disasters. Besides economic losses of more than € 35 billion, these floods also caused 155 casualties. Events causing a high number of fatalities were the floods in Romania in 2005 (85 fatalities) and the 1998 disaster in Slovakia (54 fatalities). Large economic losses were caused by floods in the Elbe basin in 2002 (over EUR 20 billion), in Italy, France and the Swiss Alps in 2000 (around EUR 12 billion), and a series of those in the United Kingdom during the summer of 2007 (accumulated losses exceed EUR 4 billion) (Barredo 2007). Also the 2013 floods in central Europe (14 casualties and significant economic damage) and recent flood experiences in the UK and Serbia demonstrate the actual threat of floods in Europe.

In 2007 the European Union issued its Floods Directive, which requires that Member States take into account the consequences of floods next to their probability (Kellens et al. 2013). The directive primarily stresses the importance of Flood Risk Management Strategies (FRMSs) such as prevention, mitigation and preparedness, but it has been shown that actors in some countries have started to take

into account response and recovery strategies as well (ibid). FRMSs can be defined as approaches for dealing with flood risks which can be distinguished from one another by their focus on the probability of flooding, its consequences or on recovery after a flood has struck. Both at the level of the EU and in EU Member States (e.g. http://www.helpdeskwater.nl/algemene-onderdelen/serviceblok/english/water-and-safety/, accessed 11 February 2014), it is assumed that urban agglomerations vulnerable to flooding will be more resilient to flooding if multiple FRMSs are applied simultaneously and are aligned (Aerts et al. 2008; Wardekker et al. 2010; Van den Brink et al. 2011). We argue that a resilient urban agglomeration is one in which several different FRMSs are applied simultaneously, linked together and aligned, whereby it is assumed that this application and combination of multiple strategies increases society's capacity to cope with flood risks in an effective way. This understanding of resilience comes close to notions of social-ecological and evolutionary resilience (Folke 2006; Steinführer et al. 2009; see Davoudi et al. (2012) for a literature review on the use of the concept of resilience).

For a long time a natural and technical science perspective has dominated the research on FRMSs in Europe, focusing on, amongst others, risk assessment, future scenarios, technical measures, and early warning systems (http://www.irma-sponge.org; http://www.floodsite.net/; http://www.hydrate.tesaf.unipd.it, accessed 11 February 2014). Many research initiatives have been taken in an effort to address water-related risks (Quevauviller 2011), including research on climate projections, consequences of climate change for water cycles and ecosystems and research into extreme floods (ibid). Although some projects, like NeWater, FLOODsite and CORFU, have addressed social-scientific research questions, social-scientific, governance and legal studies on flood risk management are still rare, fragmented and limited in scope. A systematic comparative analysis of Flood Risk Governance Arrangements (FRGAs) is still absent and especially legal aspects (such as liability, formal competence, regulatory approaches and compliance etc.) have hardly been addressed.

Furthermore, water governance research in general and flood risk governance research in particular can be said to be fragmented in its aims and scopes (Araral and Wang 2013, Wiering and Arts 2006). Some researchers have addressed the question what kind of institutional change is taking place (e.g. Wiering and Arts 2006; Hartmann and Driessen, 2014), but few of them provide encompassing analyses combining multiple dimensions of FRGAs. Also studies focused on *explaining* (e.g. Brouwer and Biermann 2011) or *evaluating* water governance (e.g. Van Buuren et al. 2013) exist, as well as legal analyses (e.g. Van Rijswick & Havekes 2012). But to the best of our knowledge, comparative multidisciplinary studies that combine the steps of analysing, explaining and evaluating Flood Risk Governance Arrangements and their mutual relations are lacking.

Insight in FRGAs – the actors, discourses, rules and resources through which Flood Risk Management Strategies are developed and put into practice – is needed to be able to understand and guide the implementation of a diverse range of FRMSs (Meijerink and Dicke 2008, Wiering and Arts 2006). It can be argued that the implementation of a diversified, resilient, set of FRMSs in a certain area asks for meta-governance as it is only possible if the combination of these strategies are considered legitimate, effective and efficient given the opportunities and constraints of their physical and social context. Whether implementation is indeed done in accordance with these criteria is an empirical question that will be answered differently in different contexts.

This paper aims to make a step towards the formulation of concrete recommendations for achieving legitimate, efficient and effective FRGAs, including guidelines regarding their applicability in different contexts ("design principles" in Ostrom's (1990) terms). It does so by presenting a research approach consisting of the four steps of i) identifying FRMSs (section 2), ii) analysing (section 3), iii) explaining (section 4) and iv) evaluating FRGAs (section 5). The approach will be illustrated with a case study, the application of the Dutch policy concept of multi-layered safety in the city of Dordrecht (section 6 and 7). Section 8 concludes the paper.

2. IDENTIFYING A DIVERSIFICATION IN FLOOD RISK MANAGEMENT STRATEGIES

To protect urban agglomerations from flooding, several types of FRMSs are being discussed and/or implemented in practice. European policies including the Floods Directive distinguish between prevention, protection, preparedness, emergency response, and recovery

(http://ec.europa.eu/environment/water/flood_risk/flood_risk.htm, accessed 19 July 2013). Also several finalised and on-going European projects make a distinction between different types of strategies (Oosterberg et al. 2005; Klijn et al. 2009, Djordjevic et al. 2011, Hegger et al. 2013). Drawing on these categorisations, we distinguish between the five types of FRMSs depicted in table 1. These FRMSs focus on the probability of flooding (Flood Defence); on the potential consequences of flooding (Flood Risk Prevention, Flood Risk Mitigation, Flood Preparation) and on recovery after a flood has struck (Flood Recovery).

Strategy	Explanation
1. Flood Defence	Flooding can be prevented by infrastructural works, such as dikes, dams, embankments and weirs, upstream retention or giving more space to the river within its current embankments ("keeping water away from people"), mostly referred to as "flood defence" or "structural measures". Main actors: generally governmental water management actors at national/regional level.
2. Flood Risk Prevention	Negative consequences of flooding can be avoided by proactive spatial planning or land use policies ("keeping people away from water"), aimed at building only outside areas that are prone to flooding. Main actors: actors involved in planning processes (governmental actors, private parties). Flood insurance companies may influence planning decisions, for instance by (not) insuring properties in high-risk areas or the use of risk-based premiums (Kunreuther 2008).
3. Flood Risk Mitigation	Consequences of floods can be mitigated by a smart design of the flood-prone area. Measures include spatial orders, constructing flood compartments, or (regulations for) flood-proof building. Main actors: citizens, project developers, water managers and other public and private actors.
4. Flood Preparation	Consequences of floods can also be mitigated by preparing for a flood event. Measures include developing flood warning systems, preparing disaster management and evacuation plans and managing a flood when it occurs. Main actors: governmental organisations like the meteorological office, flood forecasting centres, local and regional governments.
5. Flood Recovery	This strategy facilitates a good and fast recovery after a flood event. Measures include reconstruction or rebuilding plans as well as compensation or insurance systems. Main actors: national governments establishing disaster relief funds, insurance companies as well as the affected citizens themselves.

Table 1: Five types of Flood Risk Management Strategies (FRMSs)

Not each way of diversifying FRMSs will be feasible everywhere. Apart from geographical and technical factors, this feasibility will also depend on the Flood Risk Governance Arrangements through which FRMSs are attempted to be implemented. Countries and regions in the EU have been shown to differ significantly, amongst other things, with regard to administrative structures and cultures, and historical pathways in dealing with floods (Hegger et al. 2013). In addition, diversification of FRMSs may imply that new actors get a role in flood risk management adding complexities and potential conflicts of interest (ibid; Meijerink and Dicke 2008). Thus, efforts at a broadening of FRMSs will likely require new Flood Risk Governance Arrangements, changes in existing ones, or the establishment of links between formerly separate arrangements. A first step in understanding and guiding developments in FRGAs will be to analyse the stability and dynamics therein.

3. ANALYSING STABILITY AND DYNAMICS IN FLOOD RISK GOVERNANCE ARRANGEMENTS

To analyse stability and dynamics in Flood Risk Governance Arrangements, we propose to use 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 dynamics 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 (Van Tatenhove and Leroy 2000; Arts et al. 2006; 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, as is shown in table 1 below, the four dimensions of the PAA allow for the inclusion and integration of legal factors in the analysis.

Flood Risk Governance Arrangements (FRGAs) can be defined as *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. 2013). FRGAs can be analysed at different scales, including local, regional, national and international. Table 1 presents an operationalization of FRGAs based on the four dimensions of the PAA. The indicators specified include indicators previously defined by Wiering and Arts (2006) and – in italic – additional, predominantly legal, factors added by us.

Actors	Discourses	Rules	Power & Resources
Public actors Private actors Coalitions and oppositions	Relevant scientific paradigms and uncertainties Policy programmes, policy objectives and policy concepts Historical metaphors/narratives Policy and legal values and principles	Legislation (including jurisprudence/case law) Constitutional, procedural and substantive norms Legal instruments Legal traditions Informal rules	Legal authority, including the right to regulate property (regulation, compensation and expropriation) Financial power Knowledge Interaction skills

Table 2: The Flood Risks Governance Arrangements concept

Patterns may exist in the relationship between FRMSs and FRGAs. For instance: in Flood Risk Prevention is mainly based on more pro-active spatial measures, requiring a strong role of spatial planning, while Flood Defence, based upon measures like the constructions of dams, dikes and embankments, requires an elaborate water management sector. The involvement of market parties – the public-private divide – differs between the FRMSs and is strongly dependent on the political and constitutional tradition of a state (Meijerink & Dicke 2008, Keessen et al 2013). Private parties often play a role in flood recovery, but in different ways. Obviously, new FRMSs will result in changes in actors, rules, power and discourses. These changes in FRGAs should be analysed longitudinally to acquire insights in the degree of stability and dynamics therein.

4. EXPLAINING STABILITY AND DYNAMICS IN FLOOD RISK GOVERNANCE ARRANGEMENTS

After analysing stability and dynamics in FRGAs (*what* happened?), stability and dynamics should also be explained (*why* did it happen?) to find out to what extent they can be changed at will. Literature from the policy sciences points at a wide range of issues that need to be taken into account, including, at least, the importance of structure vs. agency (Capano & Howlett 2009, Giddens 1984), the extent to which change is coming from within or outside a specific governance arrangement (Capano & Howlett 2009) and the degree to which change is conceptualised as incremental or radical

(ibid). As a first step towards an explanatory framework, we propose a distinction between the following four types of explanatory factors:

- *Physical circumstances* (seasonality of rainfall patterns, climate change trends; altitude, gradient, the degree of complexity of river systems) determining the nature and characteristics of flood events. Actors cannot change these physical circumstances at will and changes therein take at least several decades (e.g. climatic conditions) but often millennia (altitude, gradient) to materialise. For the short term, physical circumstances should therefore be seen as unchangeable background conditions contributing more to stability than to dynamics in FRGAs;
- *Physical and social infrastructure* (the presence of dams, dikes, sewer systems, railways, ships, houses; but also educational systems, including handbooks and training facilities, and knowledge infrastructure). In terms of the dimensions of the PAA, physical and social infrastructures can be considered "precipitated resources". Due to large past investments (billions of Euros), they have gained *momentum* (Hughes 1987). This momentum powerfully reinforces path-dependency and lock-in. Infrastructure can be expected to enable some FRMSs by providing the necessary capabilities, but to constrain others. The chance that new FRMSs will actually be implemented is probably enhanced in cases in which the new strategies make use of infrastructures that are already in place;
- *Agency*, or the purposeful actions of knowledgeable and capable agents (e.g. policy entrepreneurs), forms a third explanatory factor (Kingdon 1984, Brouwer & Biermann 2011, Huitema & Meijerink 2010). Agency is generally assumed to be an important contributor to dynamics in governance arrangements (ibid) but it may also be used to obstruct change. It is therefore an empirical question, when, how and why agency contributes to stability in FRGAs and when, how and why it contributes to dynamics therein;
- *Shock events*. Flood consciousness has been shown to vary greatly between regions, predominantly depending on the presence and memory of catastrophic events (e.g. Downs 1972). A flood is an external shock, which creates a disturbance throughout the interconnected ecological, economic and social systems (Green et al. 2011). Shock events may lead to major, but temporary, changes in public opinion or governmental priorities (Downs 1972), accelerating policy change. For instance, in The Netherlands, in 1995, an emergency situation arose because of the threat of dikes being breached due to extremely high water levels in some major rivers. As Driessen and De Gier have shown (1999), this shock event helped the implementation of new legislation and flood defence measures, which had been hoped for by many water professionals for some time. In this specific example, however, the main thrust of the change was acceleration along existing paths and trajectories (flood defence), although a long-standing call to give consideration to natural and historical landscapes was taken into account for the first time. Only a few authors attempted to sketch the conditions in which shock events might contribute to path-breaking change (Dieperink 2000, Wiering 2008).

Through in-depth and more comparative empirical research, we expect it to be possible to gain insight into the relative importance of these explanatory factors, and hence into possible action perspectives. However, literature on policy change suggests that the margins for establishing change are small and that dominant institutional arrangements have some degree of stability, inertia and predictability (Kingdon 1984, Sabatier & Weible 2007). The latter may on one hand facilitate existing FRMSs, thus offering (legal) certainty on the division of risks and responsibilities, but it may on other hand complicate the implementation of new strategies or the establishment of links between different strategies (Pahl-Wostl 2009, Keessen and Van Rijswick 2012). However, before concrete recommendations can be derived, it is first necessary to evaluate FRGAs.

5. EVALUATING FLOOD RISK GOVERNANCE ARRANGEMENTS

As indicated in the introduction, our research approach is based on the assumptions (i) that a diversification of FRMSs makes urban agglomerations more resilient to flood risks and (ii) that this requires legitimate, efficient and effective FRGAs. It is proposed to use the concepts of resilience, legitimacy, efficiency and effectiveness, first, as *success criteria* for assessing whether and to what extent actors in vulnerable urban regions actually managed to diversify, link and align FRMSs (contributing to resilience) as well as whether the strategies and their coordination were indeed legitimate, efficient and effective. Second, it is necessary to challenge these starting assumptions,

and eventually, nuance them. For instance, in terms of our assumption about resilience, implementation and coordination of all five FRMSs would be an ideal to aspire to. But one can logically assume that this is not always necessary or possible. In a very sparsely populated area it would be less essential to have sound evacuation plans (flood preparation). Legitimacy, efficiency and effectiveness are conceptualised as follows:

- *Legitimacy* (Paavola 2008, Van Buuren et al. 2013) refers to the extent to which governance arrangements secure the rule of law and ensure transparency, accountability and participation of national and regional public and private actors. For instance, is the voice of minority groups heard (e.g. inhabitants of emergency retention areas)? Are governments legally authorized to regulate property rights?
- *Efficiency* refers to the extent to which public and private resources have been used in a cost-efficient way. For instance, do FRGAs adequately deal with uncertainty about the regional consequences of climate change (see also Adger et al. 2003). Also the costs of cooperation and coordination (transaction costs) should be considered. FRMSs should ideally be linked together and aligned in a smart way, minimising the time and effort required for the coordination, but it is still an open question how the latter can best be achieved. In any case, transaction costs should be compared with the benefits of cooperation and coordination. These may include improved safety, avoidance of flood damage but also the possibility to achieve the same safety level or the same standard of economic protection in a more efficient way through smart combinations of FRMSs.
- With e*ffectiveness* we refer to the extent to which flood risks and related vulnerabilities are actually reduced e.g. through a variety of region- and context-specific norms, instruments, processes and strategies. It can be tried to assess what existing FRGAs mean for the risks and vulnerabilities faced by specific actors. Also the role of risk perception (e.g. flood awareness) in this should be looked upon. One could argue that effective FRGAs should ensure both that citizens *are* safe and that they *feel* safe, although flood awareness could also be instrumental in that it may lead to support for new measures (Adger et al. 2003).

Legitimacy, efficiency and effectiveness of FRGAs can be evaluated by confronting normative ideas of what is needed in a specific case with empirical evidence. It is an open question, as to whether required changes in FRGAs in a specific context will be small or large.

6. **FLOOD RISK MANAGEMENT STRATEGIES IN DORDRECHT**

A large part of the Island of Dordrecht (7,000 ha) is protected against flooding by the primary flood defences, with a legally prescribed maximum yearly probability of overtopping of 1:2,000. In The Netherlands, primary flood defences have a legally prescribed safety norm expressed in terms of the probability of overtopping, that is the chance that the flood level becomes higher than a certain specified height. The maximum allowed probability of overtopping is currently specified per dike protected area. Throughout The Netherlands, this probability ranges from 1/250 to 1/10,000 and is intended to be lowest in places where the potential consequences of floods are highest (e.g. 1/10,000 in Zuid-Holland).The remaining 2,000 ha, including the historical port, parts of the historical centre and more recent housing and business areas, are not protected against flooding by law. Protection against flooding in these ‘outside dike areas’ (*buitendijkse gebieden*) is not a government responsibility (more specific of the water authorities), but that of the inhabitants. However, it is the responsibility of the local government to take care of appropriate (“good”) spatial planning that takes flood risks into account, to set building requirements and prepare evacuation plans. Every two years, the embankments in the port area overflow, sometimes with significant economic damage (as in 2012).

The culturally interesting historical city centre lies partly outside, partly inside and partly on top of the dike (see also figure 1) and some houses even function as flood defence themselves. Strengthening this part of the dike – as well as constructive measures just outside the dike – will be problematic as many monumental buildings are situated in the city centre. Within the dike-protected area, old dikes used to divide the island into a few compartments. However, as they are perforated by local roads and other infrastructure they no longer function as flood defence structures. This means that the classical role for flood defence is preferably enlarged with a stronger focus on spatial planning, building requirements and evacuation plans.

Discussions on a broadening of FRMSs in Dordrecht are part of broader discussions on the implementation of the Dutch policy concept of multi-layered safety (MLS), which after its introduction in the National Water Plan of 2009 has become a central element in policy discussions on FRM. The Island of Dordrecht is a pilot area for the implementation of the MLS approach. The municipality of Dordrecht is playing a relatively pro-active role in flood risk management, at least compared to other Dutch municipalities. As evacuation of the full island is problematic – only 15% of the residents could escape the island in case of flooding – Dordrecht seeks for solutions on the island itself. Its residents are said to be well-aware of the area's flood-proneness and have demonstrated a strong social cohesion and an active citizenship, e.g., by helping each other when necessary and showing solidarity from one part of the area to another. This strengthens the idea that using other FRMSs that explicitly need community support would be feasible on the Island of Dordrecht. The idea of creating a self-sustaining Island of Dordrecht by combining multiple FRMSs has been elaborated – together with other possible strategies – as part of a local study for the Delta programme, an encompassing policy programme focused on long-term flood protection and fresh water availability in The Netherlands. The proposed solution is to move from the current situation, to a more differentiated approach that reorganizes the Island of Dordrecht in compartments with different flood safety regimes, tailored to the possibilities of these different areas. Protection levels will differ between the areas. Table 3 below includes the FRMSs introduced in section 2 and subsequently specifies to what extent the identified FRMSs are addressed in the self-sustaining strategy for the Island of Dordrecht.

Strategy	Measures proposed in self-sustaining strategy for the Island of Dordrecht
1. Flood Defence	Tailor made reinforcement of the primary flood defences is foreseen, including an extra strong delta dike for maximum flood risk reduction;
2. Flood Risk Prevention	Reduction of urbanisation in the south of the Island through pro-active spatial planning;
3. Flood Risk Mitigation	Compartmentalisation of the island by restoring and strengthening old dikes; In houses in unembanked areas, flood proofing measures have been taken (e.g. no carpet on the ground floor)
4. Flood Preparation	Use of early warning systems to predict river floods and storm surges Redesign of existing buildings (schools/hotels) as shelters; Building of additional new smart shelters; Lifting or protecting vital infrastructure in zones *outside* the main dike ring; Inhabitants of houses which flood regularly learned how to equip and furnish their house to minimise damage and recover quickly; Inhabitants and authorities work together in disaster management (closable barriers, sand bags); Preparing inhabitants and authorities for evacuation; Creation of elevated evacuation routes (to evacuate 75 % of the residents in the western and southernmost compartments to the safe north-eastern part of the island in case of a flood).
5. Flood Recovery	Public financial compensation system at national level is in place under the 1998 Calamities and Compensation Act (WTS)

Table 3: Identified FRMSs in Dordrecht

7 DORDRECHT'S FLOOD RISK GOVERNANCE ARRANGEMENTS

7.1 Dynamics in Flood risk governance arrangements

Table 4 provides an overview of dynamics in flood risk governance arrangements in Dordrecht using the four dimensions of the PAA. The table shows that, as part of a broader discursive shift to "building with water, living with water and multi-layered safety", in Dordrecht a *discursive shift* can be witnessed from "battle against the water" to "self-sufficient island of Dordrecht". This discursive shift is mirrored with shifts in *actor coalitions*. The key actors related to the MLS approach in Dordrecht have joined forces and are now collectively searching for possibilities to materialise the discursive shift by mobilising resources and adapting rules of the game. In terms of *resources*, important steps have been made through the generation of important knowledge and capacities: networks have been created between the municipality, other governmental actors and knowledge institutes (a learning

action alliance) in which, amongst others, knowledge on flood consequences has been created. The Delta programme may provide a window of opportunity for the necessary changes in financing arrangements. Also in the *rules of the game* dimension, dynamics can be observed, although there are still open questions pertaining to the need to change formal divisions of responsibilities amongst actors (from water authorities to municipalities) and the necessity of and ways in which existing safety norms could be changed.

Actors	**Role**	**Stability/dynamics**
-Municipality	-Coordinating, responsible for local spatial planning (prevention/mitigation), informing citizens living outside dike-protected areas and management of small-scale disasters;	-Relatively stable, Increasingly involved in debate outside formal responsibility;
-Academic partners	- Participation in "Learning & Action-Alliance";	-Relatively stable, Increasing involvement;
-Regional water authority	-Constructing and maintaining dikes that comply with the standards; - Financing improvements to primary flood defences;	-Relatively stable; -New development, but in accordance with new legislation;
-Emergency services	Dealing with calamities;	-Services have existed for long; role in FRM has become formalised;
-Citizens	Citizens living outside dike-protected areas are responsible themselves for flood mitigation, preparation and recovery;	-Relatively stable in the case of Dordrecht;
-Private companies		
-Ministry of Infrastructure and The Environment & Department of Public Works	-Setting standards for and financing primary flood defences - Responsible for policy and governance development in Delta Programme;	-Relatively stable, but appears to involve regional and local authorities more;
-Province of Zuid-Holland	-Responsible for coordinating water management and spatial planning at provincial level. Influencing water safety policies via spatial planning, currently only in unembanked areas & involvement in compartmentalisation inside dike-protected areas;	-Role seems to be increasing;
-Safety region	-Partnership between authorities and public services with regard to tasks related to firefighting, disaster management, crisis management and medical aid. The safety region has a coordinating role in disaster management and in this capacity collaborates with municipality, regional water authority, and, if needed, province and national government.	-Involvement of safety regions in FRM is relatively new, e.g. co-developing a flood disaster management plan for Dordrecht;
Resources	**Carrier of the resources**	**Stability/dynamics**
-Finances	-Municipality of Dordrecht -Delta Programme "Rijnmond Drechtsteden" -Rijkswaterstaat -Regional water authority -Province (discussions on co-financing spatial planning measures ongoing)	-Relatively new -Relatively new (NB only policy development) -Established practice -Relatively new -Responsible for co-financing management and maintenance. Financing spatial planning measures would be relatively new;
-Knowledge & capacities	-Enthusiastic policymaker within Municipality of Dordrecht	-long employment record at municipality

-(Scientific) expertise	-Delta Programme “Rijnmond Drechtsteden” -Learning & Action-Alliance	-Relatively new -Relatively new
Discourses	**Content**	**Stability/dynamics**
-Policy objectives & measures	-From “battle against the water” to “self-sufficient island of Dordrecht”	-New discourse has been developed
Rules of the game	**Explanation**	**Stability/dynamics**
-Safety norms	-Area-specific safety require changes in legislation, which are currently being discussed; -Lowering safety level of dikes if compensatory measures are taken currently under discussion;	-Stable, but potential changes prepared within Delta Programme -Ibid
-Definition of safety	-Discussions on including the maximum individual risk of dying in a flood, group risks and potential economic damage in the safety standards are currently being discussed	-Ibid
-Division of responsibilities between actors	-Necessity of changes in division of responsibility is still being discussed	-Ibid

Table 4: Dynamics in FRGAs in Dordrecht

7.2 Explaining stability and dynamics in flood risk governance arrangements in Dordrecht

The emerging broadening of FRMSs and FRGAs in Dordrecht seems to logically follow from developments that have been taking place for some time. The vulnerable geographical location of Dordrecht (*physical circumstances*) combined with existing *infrastructures* – dikes through the old city centre, the presence of inhabitants in unprotected areas, the maintenance situation of existing dikes – are all the consequence of incremental developments in the past. However, the combination of these factors, against the backdrop of climate change effects, has resulted in Dordrecht taking up a very proactive role in flood risk governance, something which is unique for Dutch municipalities. The fact that Dordrecht has actually taken steps on a path towards such diversification is not self-evident, as several barriers against such a shift are present. These barriers include existing safety norms (*social infrastructure*, including substantive rules), but also existing divisions of responsibilities and financing structures (*social infrastructure*, including rules of the game and resources). Drivers for change, on the other hand, include that it is part of one of the regional sub-programmes of the Delta Programme, providing financial resources as well as scientific expertise (social infrastructure). Other drivers are the local support of the municipality – including the presence of a pro-active and (according to the authors) visionary policy maker (*agency*, policy entrepreneurs) and the municipality’s positive experiences in participatory processes with residents.

7.3 Evaluating dynamics in flood risk governance in Dordrecht

Based on the analysis hitherto, Dordrecht seems to be an example in which a diversification of FRMSs can lead to enhanced *resilience*. As it is difficult for Dordrecht to significantly lower the probability of flooding on the whole island, the new self-sustaining strategy increases resilience by decreasing the potentially devastating consequences of a flood. The approaches in Dordrecht at first sight also seem to be *effective*, both in terms of goal achievement and in terms of governments and citizens having the necessary instruments at their disposal to reach these goals. About *legitimacy* we can say that the approaches followed in Dordrecht seem to be endorsed by the actors involved, including residents. Therefore output legitimacy (i.e. acceptance) (Van Buuren et al. 2013) can be assumed to be high. Finally, we can say that the shift from general to area-specific safety standards

as well as the use of many smart combinations of FRMSs as specified in 7.2 seems to be a way to make flood risk management more *efficient*, at least to the impression of those most heavily involved.

7. CONCLUDING REMARKS

The previous sections have introduced a research approach for identifying Flood Risk Management Strategies and analyzing, explaining and evaluating Flood Risk Governance Arrangements. Its usefulness was illustrated by referring to the Dutch discourse on multi-layered safety and its application in the city of Dordrecht. The approach introduced in this paper offers a useful starting point for researching Flood Risk Governance Arrangements. The approach, furthermore, enables the combination – and possibly integration – of various strands of expertise. It brings together public administration and legal expertise, but also allows the combination of descriptive, explanatory and more evaluative strands of policy theories.

As was stated in the introduction section, insights derived from using the approach may contribute to the formulation of concrete recommendations for achieving resilient, legitimate, efficient and effective flood risk governance. From the case of Dordrecht, we could derive some specific interventions, of which it is plausible that they are contributing to an on-going broadening of FRMSs including:

- the municipality's sustained cooperation with various knowledge institutes in a Learning and Action Alliance (actors dimension);
- the presence of a highly dedicated civil servant who can be labelled as a policy entrepreneur (actors/resources);
- discussions on the combination of different strategies (discourses);
- the potential shift from general to area-specific safety standards (rules of the game);
- past investments of the municipality in building and maintaining a good relationship with its citizens (in order to enhance legitimacy) (resources);
- possible availability of earmarked funding from the national government and regional water authorities for enhancing Flood Risk Management practices (resources).

A next step will be further confrontation of the approach with the empirics through collaborative research (Raadgever et al. 2012) to be able to further operationalize the concepts presented in this paper and to carry out comparative case study analyses in different countries. Such a comparison will help identifying examples of (less) successful broadening of FRMSs and drawing lessons regarding their generalizability. We invite other scholars to adopt our approach. Although we specifically tailored the approach to the analysis, explanation and evaluation of flood risk governance, we do foresee possibilities for its application in other empirical domains as well.

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