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A framework for evaluating the effectiveness of flood emergency management systems in Europe

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ABSTRACT. Society is faced with a range of contemporary threats to everyday life, from natural and technological hazards to accidents and terrorism. These are embodied within integrated emergency management arrangements that are designed to enhance preparedness and response to such incidents, and in turn facilitate a prompt recovery. Such arrangements must be inherently dynamic and evolve as new threats emerge or as existing threats change. An example of the latter is the changing nature of flooding, which is projected to increase in both frequency and severity with climate change. Recognizing this evolving threat, we focus on the evaluation of the effectiveness of domestic Flood Emergency Management Systems (FEMS) as components of integrated emergency management arrangements. Despite the extensive body of literature that documents success conditions of so-called effective emergency management more broadly, there have been only a few attempts to construct a comprehensive evaluation framework to support objective assessment and cross-country comparison. Addressing this gap, we formulate an evaluation framework specifically tailored to the study of FEMS in Europe, which is then provisionally applied to the study of FEMS in England (UK), France, the Netherlands, Poland, and Sweden. Important differences are observed in how FEMS have evolved in relation to differing contextual backgrounds (political, cultural, administrative, and socio-economic) and exposures to flood hazard. From this provisional assessment, a number of opportunities for, and constraints to, enhancing the effectiveness of FEMS in Europe are discerned. The evaluation framework thus serves as an important stepping stone for further indepth inquiry, and as a valuable tool for future comparative study.

Key Words: *effectiveness; emergency management; England; evaluation framework; flood; France; Netherlands; Poland; Sweden*

INTRODUCTION

In an increasingly “risky” society (Beck 1992), emergency management is firmly situated in policy and public discourse as an essential system for protection, preparedness, and response to contemporary threats. Moreover, as new threats emerge or as existing threats evolve, so too must emergency management systems. The effectiveness of such systems is dependent upon a number of factors, which are well documented with the fields of crisis and disaster management, safety science, and public administration, such as the need for mechanisms that facilitate coordination, collaboration, and communication (e.g., Boin and ‘t Hart 2010). However, there have been only a few attempts to translate these findings into an operational framework for evaluating emergency management systems (McConnell 2011, Bossong and Hegemann 2013, Kuipers et al. 2015) or disaster management systems (Cardona et al. 2005, Carreño et al. 2007). Such a framework could play a valuable role in monitoring the progress of current systems and identifying their strengths and weaknesses, as well as function as a tool for facilitating cross-country comparisons. Although considerable lessons can be acquired through comparative research, arguably this has been constrained by the tendency for researchers to examine emergency management in country silos, and by the absence of common standards or methodology for facilitating comparability.

Addressing this neglected research gap, we present a comprehensive framework for evaluating the effectiveness of domestic Flood Emergency Management Systems (FEMS) in Europe. The decision to focus on FEMS is justified on the basis of mounting scientific evidence that projects the increased frequency and severity of floods in the future (Feyen et al. 2012).

Indeed, recent flood events in Europe, such as the flash flooding in the French Riviera in October 2015, the winter 2015/16 floods in England, and the spring 2016 floods throughout the European continent, serve as poignant reminders of the devastation that can be caused in terms of loss of life, disruption, and economic losses. In order to test this framework, it is applied to the FEMS of selected EU Member States, including England (UK), France, the Netherlands, Poland, and Sweden. These countries were selected because they present different flood risk profiles, as well as different cultural, socio-economic, administrative, and political backgrounds through which emergency management has evolved. While this maximizes comparative opportunity (Azarian 2011), these countries also reflect a shared set of normative standards and visions for effective emergency management (Alexander et al. 2016, Ek et al. 2016, Kaufmann et al. 2016, Larrue et al. 2016, Matczak et al. 2016), which makes it possible to formulate relevant benchmarks to assess current performance.

We firstly summarize the existing literature from which indicators and corresponding benchmarks were identified. Next, the methodology for both developing and then applying the evaluation framework is outlined. Drawing from cross-disciplinary research conducted within the EU project STAR-FLOOD, the evaluation framework is employed as a tool for identifying the strengths and constraints to the effectiveness of FEMS in the selected countries. We reflect critically on these observations and their implications for enhancing the effectiveness of FEMS in Europe. For insight into the broader project findings from STAR-FLOOD, the reader is referred to Hegger et al. (2016).

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LITERATURE REVIEW

Emergency management refers to a broad set of functions and is typically conceptualized in a cyclic form, organized according to distinct phases that capture the proactive and reactive responses to a hazard situation (Haddow and Bullock 2006, Waugh and Streib 2006). Although the origins of this cycle are somewhat contested, it has been employed as a heuristic device for analysis for circa 40 years (Neal 1997, Coetzee and van Niekerk 2012). Moreover, there is a strong consensus regarding the key phases of emergency management, although how these phases are delineated has influenced the number of phases conceptualized by authors (Baird et al. 1975). Simply put, emergency management can be divided into three broad phases, as follows:

1. Emergency preparedness groups the day-to-day activities performed by emergency professionals (i.e., pre-event, proactive phase); these may include assessments of risk, emergency planning, training and exercising, and community-engagement activities.
2. Emergency response refers to the activities initiated for a specific hazard event, such as risk mitigation (e.g., installing demountable defenses), rescue operations, continuity management, and coordination of multiagency response (i.e., reactive phase).
3. Recovery activities in emergency management are typically limited to the immediate aftermath of a hazard event, such as rehousing displaced people, addressing welfare needs, and restoring critical services.

Emergency management is distinguished from discussions of crisis/disaster management, where the latter is often associated with events or stressors that exceed capacities of “normal workaday systems to cope with them effectively” (Alexander 2003:118), and thus requires some form of external assistance (i.e., outside the domestic system, such as the EU Civil Protection Mechanism) (UNOOSA 2015). Disasters can be viewed as events that signify the collapse of the predictable and ordered world (Dynes 1998). In contrast, emergency management concerns the “ordinary,” rather than extraordinary, types of events that can be managed through the use of existing resources and established procedures (Alexander 2003, Henstra 2010). Nonetheless, there are clear synergies and even dependencies between the two; thus, both sources of literature were reviewed as part of this research.

While there is an extensive body of literature that examines the performance and effectiveness of emergency management arrangements, there have been few attempts to operationalize these findings into a comprehensive objective framework for evaluating emergency management systems, not least FEMS, which are the focus of this research. Operationalizing the criterion of effectiveness requires the identification of relevant indicators that are “transparent, robust and representative,” alongside corresponding benchmarks to measure “the distance between current conditions and an objective threshold” (Carreño et al. 2007:1). To begin, this section reviews existing studies on emergency management where similar attempts to formulate an evaluation framework have been attempted. Next, on the basis of a thematic analysis of the emergency management literature, we identify the emergent themes and preconditions, which underscore the evaluation framework developed as part of this study.

Lessons from existing evaluation frameworks of emergency management systems

There have been similar attempts at formulating evaluation frameworks of emergency management systems, albeit they are limited in number or are designed to satisfy specific objectives. Nonetheless, valuable lessons can be drawn and applied to the study of FEMS. For example, analysis of Civil Security Systems (CSS) within 22 EU Member States highlighted important differences in the distribution of responsibilities, legal frameworks, and operational practices (Bossong and Hegemann 2013, Kuipers et al. 2015). While these observations have implications for enhancing the capacity of transboundary crisis management, structural aspects of CSS were not shown to impact the effectiveness of domestic CSS per se (Bossong and Hegemann 2013). Evaluation was conducted on the basis of postevent inquiries, with some insights from stakeholder interviews. However, the authors acknowledge the limitations of this approach, given the diverse and intermittent nature of evaluation practices and absence of “common standards for effectiveness assessment in Europe” (Bossong and Hegemann 2013:39). Arguably, the ambition to provide an all-hazard holistic assessment of CSS exacerbates the evaluation challenge. Nonetheless, of interest to this paper are the recurring factors that seem to constrain CSS. These include problems in coordination, planning and preparation, control, and local expertise. However, while Bossong and Hegemann (2013) and Kuipers et al. (2015) take an important step forward in terms of developing an assessment framework for assessing the quality of CSS, according to the criteria of effectiveness, efficiency, and legitimacy, they neglect to develop the necessary benchmarks for ensuring consistency and comparability in cross-country assessments.

Similarly, McConnell (2011) presents a heuristic framework for evaluating the “success” of crisis management according to processes, decisions, and politics dimensions. A number of assessment criteria are proposed and related to both factual (e.g., adherence to procedures) and perceptive elements of success (e.g., societal support). McConnell asserts the importance of examining the contextual capacities and constraints, organizational hierarchies, and political systems within which decisions are made. In agreement with McConnell’s “shades of grey” interpretation, the evaluation framework we present equally recognizes that effective and ineffective aspects of FEMS may coexist, and can impact upon success of the overall system.

More broadly in the disaster field, Cardona et al. (2004, 2005) and Carreño et al. (2007) put forward a Risk Management performance Index (RMI) comprising a disaster management subindex to quantify the effectiveness of organizational abilities and capacity to plan and address the consequences of disasters. These include six indicators related to the (1) organization and coordination of emergency operations, (2) emergency response planning and implementation of warning systems, (3) endowment of equipment, tools, and infrastructure, (4) simulation, updating, and test of interinstitutional response, (5) community preparedness and training, and (6) rehabilitation and reconstruction planning. Each indicator is qualified by experts in emergency management and academia, using a 1 to 5 scale to determine the scale of achievement against the desired state (“objective threshold”), based on the model presented by Cardona et al. (2004, 2005). The composite RMI is applied to Latin America and the Caribbean as part of a cross-country comparison, and is therefore inherently coarse in its

resolution. Nonetheless, the method of “scoring” indicators according to an agreed optimum state provides a pragmatic and semi-objective means to assess each indicator in a consistent way to ensure comparability. We adopt a similar approach (see the methodology section).

Lessons can also be drawn from assessment frameworks employed in practice. For example, the Federal Emergency Management Agency (FEMA) provides a Continuity Assistance Tool (CAT) to assist organizations in their ability to assess and strengthen continuity capabilities during an emergency situation (FEMA 2013). The CAT establishes industry-wide benchmarks to assess the performance of key continuity management functions. The key elements for effective continuity capability broadly relate to the organizational elements (e.g., orders of succession, delegation of authority), resource elements (e.g., human resources, continuity communications), training and exercising, and reconstitution elements. This self-assessment tool is based on a series of questions from which the tally of yes/no responses can be used to identify gaps in current capability. The subjective nature of this approach instills a degree of flexibility by acknowledging the varied occupations and needs of different organizations, and is an important strength of the tool.

Drawing from these influential frameworks, and the emergency management literature more widely, there are a number of recurring themes and preconditions for so-called effective emergency management.

Emergency preparedness

Strategic and operational planning for emergency response is seen as a standard precondition for effective emergency management and is formally established in the “grey literature” of the studied countries, as well as through academic studies dating back to the 1970s (e.g., Lewis et al. 1976, as cited in Coetzee and van Niekerk 2012). An emergency plan essentially constitutes a coordinated set of protocols for managing an adverse event (Alexander 2005:159). Proactive (pre-event) emergency planning is widely regarded as essential for establishing priorities, systematic response start-up, coordinated operational action, and tactical decision-making (Alexander 2002, Boin and t’ Hart 2010). Moreover, planning plays a vital role in defining the roles and responsibilities of emergency practitioners (Henstra 2010, FEMA 2013). A fundamental aspect of planning is to ensure business continuity; i.e., the ability to perform and maintain service provision during an emergency situation (Henstra 2010). Thus, planning requires consideration of the continuity of facilities (from which leadership and operations will function), communication channels, record management, and resourcing procedures (FEMA 2013). Although meticulous planning is required, the nature of certain types of hazard events (i.e., unpredictable, sudden onset, or unexpected) inherently requires capacity to be flexible and spontaneous (Perry and Lindell 2003, Waugh and Streib 2006).

Acknowledging the lack of a homogeneous standard for emergency planning, Alexander (2005) presents a series of standards for an all-hazard emergency plan at the local authority scale. Such generic plans should outline the legal framework and the jurisdiction and scope of the plan, include vulnerability/risk analyses according to scenario-based assessments, specify protocols and procedures (e.g., evacuation procedures and

arrangements for warning the public), and clearly define the roles and responsibilities of emergency actors. Alexander encourages the use of these standards as a means of evaluating the quality of planning documents via a judgement-based scoring system, although this is not fully developed. The framework we present incorporates many of these standards summarized by Alexander (2005). However, while Alexander, among others (e.g., Quarantelli 2000), asserts the importance of generic “all hazards” planning for its efficiency and ability to accommodate the potential for unexpected events, there is also an argument that hazard-specific planning could be helpful where a significant risk exists. Flooding is a pertinent example, given its rising frequency and severity in Europe (Feyen et al. 2012). Hence, the decision in this research is to focus on FEMS, only. Thus, it is argued that flood-specific planning should accompany generic emergency planning.

The distribution of responsibilities within and between emergency actors

A key precondition for effective emergency management is an organizational structure whereby roles and responsibilities are clearly apportioned (Zhou et al. 2011, FEMA 2013), albeit the literature does not prescribe a “perfect model” or assert how such an organizational structure should be substantively established. Indeed, Quarantelli (2000) observes the heterogeneity of civil protection arrangements worldwide and variation of highly centralized systems (e.g., Japan, America) to decentralized systems (e.g., Australia). These differences “simply reflect the prevailing political, economic and cultural patterns of different societies” (Quarantelli 2000:15). Nonetheless, a number of recurring and more generalized criteria can be identified as relevant for the effectiveness of emergency management from an organizational perspective. Given that emergency management is of a multiactor and multilevel nature in all studied countries, there should, firstly, be a clear division of responsibilities (i.e., administrative, coordinative, and operational) of all actors involved, regardless of whether they are public, quasi-public, or private (Zhou et al. 2011). It should, moreover, be clear to all actors what their responsibilities, and those of others, include, for instance regarding the upscaling or downscaling of responsibilities, chains of command and control, and transferring responsibilities through different phases of emergency management (e.g., response to recovery) (FEMA 2013). Lastly, responsibilities should be accompanied by proper powers and competencies in order to make them effective.

Closely related to the need for a clear organizational structure, emphasized in the repository of research and grey literature, is the importance of the “three Cs”: coordination, collaboration, and communication between emergency actors. The capacity of different types of actors to collaborate is generally seen as the foundation of effective emergency management (e.g., Britton 2001, Waugh and Streib 2006). This is necessary, given that different types of actors invariably operate within different organizational cultures and vary in their responsibilities, skills, expertise, and core functions (Alexander et al. 2013). In this respect, Waugh and Streib (2006) stress the importance of organizational cultures whereby collaboration and cooperation are embedded. This is increasingly seen in developed countries where a discursive shift toward the notion of Integrated Emergency Management is witnessed, whereby partnerships and

forms of horizontal and vertical governance are required (Drabek 1985, Kuipers et al. 2015, Gilissen et al. 2016).

Correspondingly, the nature of emergency management has changed from a directive task to one that is fundamentally a coordination task requiring the “skills and expertise, resources, and political authority to be brought together to ensure effective mitigation, response and recovery” (Britton 2001:52). Mechanisms for coordination and collaboration are required at the operational scale to ensure effective multiactor working (Boin and ‘t Hart 2010). Furthermore, communication pathways and exchange of information are considered essential (Drabek 1985, Boin and ‘t Hart 2010). Communication also plays a crucial role in facilitating institutional learning and promoting adaptation to improve the long-term effectiveness of emergency management (O’Brien et al. 2010).

This is echoed by Zhou et al. (2011), who employ factor analysis and fuzzy logic to identify five Critical Success Factors for effective and efficient emergency management: (1) organizational structure and clear division of responsibilities, (2) effective systems for transferring information, (3) government unity of leadership to plan and coordinate as a whole, (4) application of logistics technology, and (5) the need for continuous improvement of the operational system as a whole.

Institutional learning

Another factor that enhances the effectiveness of emergency management is the implementation of procedures and mechanisms for institutional learning (Real-Dato 2009). Institutional learning mechanisms aim to increase the skillfulness, responsiveness, and proficiency of emergency actors and organizations, and to continuously improve the emergency management system as a whole (Zhou et al. 2011). These include pre-event arrangements, such as exercising and training mechanisms, consultative structures, professional fora, and information systems, but also postevent arrangements, such as internal or external evaluation mechanisms (Real-Dato 2009). Testing, training, and exercising is identified by FEMA (2013) as a key means of preparing personnel and ensuring that they are capable of carrying out their responsibilities and procedures to guarantee continuity. In addition, with regard to training courses designed to prepare participants for a specific role and their operational responsibilities, Alexander (2003) also discusses the importance of educational courses geared toward enhancing general understanding and theoretical knowledge of emergency management. In order to optimize their effectiveness, institutional learning arrangements should be implemented both within organizations and at integrated subsystem levels.

Stakeholder and community preparedness

A low level of stakeholder preparedness to risks is generally seen as a major constraint to the effective implementation of risk-mitigating policies (Runhaar et al. 2012). Related to risk preparedness, for instance, Runhaar et al. (2015) and Gilissen et al. (*in press*) employ risk awareness and sense of urgency as indicators for their effectiveness. Active campaigning and the consultation of stakeholders about risks are presented as key activities in increasing preparedness. Such activities should preferably involve both public and private actors (e.g., emergency management authorities and relevant sectoral branch organizations) (Runhaar et al. 2015, Gilissen et al. *in press*). Apart

from informing relevant stakeholders and communities about risks, in order to optimize responsive potential, they should moreover be actively engaged in preparedness activities, including risk assessments, emergency planning, and training and exercising (Henstra 2010).

Availability and allocation of resources

The availability of sufficient resources and the proper allocation thereof is also necessary for effective emergency management (Cardona et al. 2004, 2005; Carreño et al. 2007). The term “resources” should be broadly conceptualized to include financial resources, as well as human resources (humanpower), technological resources (e.g., measuring equipment, communication devices), and specific technical tools, supplies, and equipment (e.g., sand bags, transport equipment, fire extinguishers, pumping equipment). Resources should be available and accessible where and when needed to those who need them in the execution of their responsibilities. Moreover, policies, plans, and procedures for sharing or exchanging resources, or securing additional resources, are seen as essential for ensuring continuity capabilities at times of crisis (FEMA 2013).

The recovery phase of emergency management

Incident recovery is widely conceived as the process of rebuilding, restoring, and rehabilitating the community following an emergency (Baird 2010, Cabinet Office 2012*b*). This may involve evacuation, temporary shelter, welfare needs, business continuity management, restoration of critical services, and management of environmental impacts. To support these activities, arrangements should be in place to ensure adequate planning for incident recovery and the production of recovery plans that consider methods for assessing the impact of an event and strategies for addressing those impacts. Moreover, resources should be in place to support and coordinate these activities. Crucially, mechanisms need to be in place to outline the distribution of responsibilities and transition from operational response to recovery. Often, this involves the inclusion of other types of actors, such as the voluntary sectors, to support additional tasks (e.g., welfare needs) (Baird 2010). Depending on the scale of event, recovery may be steered through national-level coordinating groups, government departments or agencies, or local-level actors.

METHODS

Developing a framework to evaluate the effectiveness of Flood Emergency Management Systems

To develop the evaluation framework, we performed a systematic and comprehensive review of existing literature. Carefully constructed search strings were used to capture all relevant material related to the key words of “emergency management,” “crisis” and “disaster management,” alongside terms of “effectiveness” and “ineffectiveness,” using Boolean operators and truncation searches within the Web of Knowledge. The resulting literature was filtered to focus on publications post 1970. To avoid European and American centrism, no exclusions were placed on country of origin. Likewise, there were no exclusions for hazard type. However, relevant contextual differences were taken into account during the in-depth review of the sampled literature. In this process, literature related to emergency management systems, or subcomponents thereof, at multiple scales (international, national, and subnational scales), was examined to identify recurring performance indicators

and benchmarks. In addition to academic literature, policy documents (so-called grey literature) in the respective countries were also examined to determine how “effective” emergency management is framed.

A thematic analysis was then performed on both the academic and grey literature to identify the recurring themes and preconditions for effective emergency management systems (as outlined in the *Literature Review*). These were further refined and structured according to those indicators that are relevant for understanding flood emergency management specifically. This was achieved by drawing synergies with emergency management of hazards with similar etiologies (Alexander 2000), as well as performance criteria for generic emergency response. This resulted in the construction of a set of seven indicators for evaluating the effectiveness of FEMS. These indicators represent the processes and actions taken within flood emergency management, inclusive of preparation, response, and recovery phases, as outlined in Table 1.

To determine the effectiveness of current FEMS in the selected countries, a predefined set of benchmarks is put forward (Table 1). Adopting the 1 to 5 scale proposed by Cardona et al. (2004, 2005), each benchmark determines the extent to which the indicator in question is established, ranging from absent/minimal (1), emerging (2), and moderate (3) to significant (4) and outstanding (5). These categories are qualified according to three key factors, as follows:

1. the presence of the indicator and the extent to which elements thereof focus on flood incidents specifically—e.g., the presence of specified procedures and formal rules for coordinating actors;
2. the form in which the indicator is present—e.g., for effective FEMS, one would expect diversified approaches to enhancing community preparedness or locally tailored emergency planning situated within a hierarchy of planning documents; and
3. the scale at which 1 and 2 are established—e.g., ad hoc examples at the local scale are less desirable than a nationally consistent approach.

Applying the evaluation framework

In order to test the developed evaluation framework, it was applied to the FEMS in England, France, the Netherlands, Poland, and Sweden by drawing from multiple data sources to inform the assessment.

Firstly, semistructured interviews were conducted with relevant stakeholders, who were identified on the basis of actor mapping to ensure representation of the current agencies, organizations, and governmental departments involved in emergency management, as well as flood risk management more broadly, including policy-makers and practitioners operating at national to local scales. The interviews addressed governance and practice aspects of flood emergency management, such as the distribution of responsibilities, resourcing, the effectiveness of intra- and inter-agency working, and other aspects related to the identified benchmarks. Interviewees were asked to reflect on the strengths and weaknesses of the current system and the corresponding impact on its effectiveness. These interviews were then subjected

to thematic analysis (Fereday and Muir-Cochrane 2008). Accompanying these, workshops were conducted in each selected country to canvas further opinion. Both interviews and workshops were conducted between December 2013 and February 2015 as part of the STAR-FLOOD project (Hegger et al. 2016).

Acknowledging the potential sources of bias associated with interviewing professionals, a combined public administration and legal perspective was adopted to perform an analysis of national policy, legal documentation, public reviews into performance, postevent inquiries, and operational planning documents. The triangulation of data obtained via stakeholder interviews and document analysis provided the basis for interpreting the extent to which each benchmark is currently achieved in the respective countries.

The FEMS in each country were scored by the academic authors according to the indicators/benchmarks. Despite the seeming subjectivity of this approach, considerable efforts were made to ensure that interpretations are embedded in these various data sources from the respective countries. Moreover, this scoring method was employed as a means of ensuring a degree of objectivity, as well as consistency in national evaluations to provide comparable data. This information was then subject to qualitative analysis to help identify the factors supporting or constraining the effectiveness of FEMS in the selected countries.

The following section outlines the results for each indicator. It should be borne in mind that specific terminology exists in each country to refer to emergency actors. In all countries, the distinction is made between “first responders,” who provide the front line response to emergency events (e.g., emergency services), and another group of actors (e.g., utility providers, transport operators, telecommunications), who provide a supportive role in emergency management. For clarity, we adopt the terms of first and secondary responders; the relevant actors for each country are outlined in Table 2.

RESULTS

By reviewing each indicator in turn, this section provides a provisional overview of the effectiveness of current FEMS in the selected countries. Fig. 1 shows these results and illustrates the metaphorical “distance” between current conditions and the desired optimum state. This analysis demonstrates how the evaluation framework can be applied in practice and the type of findings that can be gleaned from this type of assessment. Due to practical constraints, only a broad-brush assessment is presented. Nonetheless, the evaluation framework can be conceived as an important stepping stone toward further indepth inquiry and comparative studies in the future.

Indicator 1: Emergency planning for flood response

Emergency planning for flood response in the selected countries is established through different arrangements (Table 3), albeit to varying degrees (Fig. 1).

Flood emergency planning is assessed as moderately established in Poland and Sweden. In both countries, emergency planning arrangements are in place, but there is only sporadic evidence of flood-specific emergency planning. The implementation of the EU Floods Directive (2007/60/EC) has been pivotal in raising the

Table 1. Indicators (I) and benchmarks of effective Flood Emergency Management Systems. (Benchmarks are scaled as absent/minimal [1], emerging [2], moderate [3], significant [4], and outstanding [5].)

Indicators and benchmarks

I.1: Emergency planning for flood response

1. Basic emergency plans are in place to inform emergency professionals about how to respond to a generic hazard event. No specific plan for flood emergency management is in place. Plans are not tailored to local conditions. Response to an incident tends to be reactive and not informed by existing planning.
2. As above, but there is evidence of locally tailored planning documents for generic emergencies in some places. This is not nationally consistent.
3. As above, but locally tailored planning documents are nationally consistent. There is sporadic evidence of local flood emergency plans; however, they are not based on the periodic assessment of flood risk.
4. Nationally consistent generic and flood-specific emergency planning is established at the local or regional scale and is informed by local hazard assessment.
5. Nationally consistent generic and flood-specific planning is established to build capacity to respond to known risks based on ongoing risk assessment and monitoring at the local scale. Flood emergency planning integrates hazard assessment with vulnerability information (e.g., location of critical infrastructure, population characteristics, concentrations of vulnerable groups). This accompanies and is aligned with subnational and national planning documents.

I.2: Arrangements for institutional learning

1. There is little or no attempt to identify lessons learned from incident management.
2. Debriefing protocols are evident following a significant incident to provide an opportunity to identify strengths and weaknesses in how the incident was managed.
3. Accompanying debriefing practices, emergency management is subject to public scrutiny and review following a significant incident. On the basis of scrutiny, attempts are made to implement lessons learned.
4. Beyond responding to a significant incident, there is evidence of a proactive culture of institutional learning, such as efforts to facilitate knowledge exchange within and between administrative/management districts and to periodically evaluate the performance of emergency management systems.
5. Procedures are established to promote institutional learning at frequent intervals and following emergency events. Mechanisms are in place to facilitate knowledge exchange, sharing experiences, and best practice (e.g., frequent meetings or computer-based tools that support dialogue between emergency professionals). Emergency management is periodically subject to public scrutiny and review.

I.3: Requirements of exercising emergency arrangements

1. Exercises are initiated on an ad hoc basis in some emergency management districts, only. There are no specific provisions for flood incident management.
2. As above, exercising is sporadic, with some examples of provisions for flood incident management.
3. Training and exercising emergency protocols is an established practice and involves relevant emergency professionals. There are more examples of specific training/exercising for flood incident management, but this is not a requirement nor common practice.
4. As above, but additional actors are occasionally engaged in emergency exercises (e.g., communities, private sector, and media). Training/exercising for flood incident management is an established practice and is nationally consistent.
5. Training and exercising is initiated periodically to test planning and operational procedures for specific hazard events, including flooding, at local to national scales. All emergency professionals are involved, and additional actors are engaged in exercises, where relevant. Exercises are seen as an additional means of raising citizen awareness of flood risks.

I.4: Distribution of responsibilities within and between emergency actors

1. Different organizations/agencies are involved in emergency response, but there is a lack of coordinated action.
2. There is clear legislation clarifying the roles and responsibilities of emergency actors to ensure a nationally consistent approach.
3. As above, but mechanisms are in place to facilitate integrated working between emergency actors; however, this is sporadic across the country. Mechanisms for upscaling and downscaling emergency response are in place, but reportedly lack effectiveness.
4. Mechanisms for facilitating integrated working between emergency actors are embedded in emergency management governance and practice. This includes a range of public agencies/organizations, critical infrastructure providers, civil society organizations, and voluntary sectors. There is a clear understanding of roles and responsibilities, and effective mechanisms for upscaling/downscaling response.
5. Opportunities are created and arrangements are in place to facilitate interorganizational working. There is a clear distinction of roles and responsibilities and established channels for communication and information sharing. Mechanisms for upscaling and downscaling emergency response through operational, tactical, and strategic tiers of decision-making are established.

I.5: Community preparedness

1. There is little or no attempt to consult the public about risks, not least flood risk, or make the public aware of emergency procedures.
2. Sporadic efforts are made to consult the public about risks (including flooding), but this is not nationally consistent.
3. Emergency professionals are required (whether by policy or law) to consult and inform the public about risks. This is nationally consistent. Beyond informing about risks, there are some examples where emergency professionals have actively engaged communities in preparedness activities.
4. As above, but active engagement of communities is widespread across the country.
5. Emergency professionals are actively involved in efforts to enhance citizens' preparedness for flooding at household and community scales, in all administrative/emergency management districts.

I.6: Provision of resources (financial, human resources, equipment, and decision support tools)

1. The resources needed to support the roles of emergency professionals are lacking.
2. There is a basic supply of necessary resources to support the roles of emergency professionals.
3. As above, but additional resources are available to support operational response to flooding (e.g., water rescue equipment); however, this is not nationally consistent.
4. Additional resources supporting operational response to flooding are established nationally, and mechanisms are in place for sharing/distributing resources according to need.
5. Emergency management, and flood incident management specifically, is adequately resourced in terms of funding, provision of equipment and tools to support preparation, response and recovery activities, as well as single agency and multiagency decision-making. Additional arrangements are in place to bring in further resources, if required.

I.7: Arrangements for supporting recovery-based activities

1. There is little or no planning for immediate recovery following an emergency incident (flood or otherwise).
 2. There is evidence of some planning for certain recovery measures (e.g., return of critical infrastructure) in some localities.
 3. Emergency professionals are required (whether by policy or law) to develop recovery plans that detail roles, responsibilities, and how to assess the impact of the event, and that outline provisions for addressing likely impacts. National guidance is provided.
 4. In addition to the above, arrangements are in place at all territorial levels to trigger the handover from response to recovery phases of emergency management and coordinate recovery activities.
 5. General and flood-specific planning for recovery management is established, which deals with physical damage, humanitarian issues (e.g., dealing with displaced communities and welfare needs of those affected), environmental issues (e.g., pollution control and decontamination), economic issues, and infrastructure issues (e.g., reinstating critical infrastructure). Arrangements are in place for additional agencies/organizations to become involved as required (e.g., voluntary sector to support human welfare issues). Governance structures are in place to coordinate recovery activities according to postevent periodic impact assessments and successfully manage potential cross-border issues.
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profile of flooding and prompting the development of flood hazard and risk maps. However, this is a new exercise in Poland, with methodologies for conducting flood risk assessments still being developed. As such, these are yet to be fully incorporated into emergency planning and are criticized by emergency professionals for being too coarse. In Sweden, the low risk of flooding simply means that specific flood risk assessments and planning occur in a relatively ad hoc way.

In the Netherlands and France, emergency planning is generally considered to be significant, as—alongside generic emergency planning—flood-specific emergency planning is pursued at national to local or regional scales to support strategic and operational decision-making. Emergency planning is commonly based on local/regional hazard assessments, and often involves vulnerability information. Nonetheless, an evaluation of emergency planning in the Netherlands showed that there are some regional differences in the quality of planning, with some plans still not meeting their legal requirements (Hoekstra Committee 2013, Inspectie Veiligheid en Justitie 2013). Similarly, in France, some municipalities still do not have their legally required flood emergency plans in place, due mainly to a lack of financial resources and expertise or a prioritization of other local issues over flood risks (Larrue et al. 2016).

Outstanding flood emergency planning is assessed in England, where flooding is framed as a distinct problem for civil protection, and civil contingencies legislation is reinforced in national policy (“National Flood Emergency Framework”) (Defra 2013). Beyond the statutory duties of emergency responders to assess and plan for local risks integrated with vulnerability information (recorded in Community Risk Registers), Multiagency Flood Plans have also been developed nationwide.

Indicator 2: Arrangements for institutional learning

Institutional learning is only at an early stage of development in Poland. Although most of the required arrangements (e.g., mechanisms for exchanging information on good practices, promoting educational programs, training, and periodic and postevent evaluations) have a statutory basis within the National Crisis Management Planning system, they are hardly put into practice across the country. Despite an emerging notion of proactivity, there thus is still much room for improvement.

In contrast, arrangements for institutional learning are better established and practiced in France, the Netherlands, and Sweden. Although there is evidence of an increasing proactive culture, institutional learning activities in France and Sweden still mainly take place following significant emergency events. Nonetheless, the ORSEC plan in France (Table 3) is periodically reviewed and is widely valued for its coordinative potential and its adaptability to local conditions and specific risks. In the Netherlands, alongside of established postevent learning arrangements, institutional learning is grounded in generic and flood-specific emergency legislation and policies (Haasjes et al. 2012, Hoekstra Committee 2013, Inspectie Veiligheid en Justitie 2013, Havekes and De Putter 2014). Nonetheless, there exist large regional differences regarding the quality of periodic evaluations. In addition, the quality and intensity of knowledge management and exchange are regionally differentiated; thus, national consistency is lacking (Hoekstra Committee 2013).

In England, cultures and arrangements for institutional learning are characteristic of the FEMS and are scored as outstanding. For instance, online tools are available to help emergency responders monitor and assess their performance (Cabinet Office 2012a). Furthermore, training is actively encouraged (Cabinet Office 2015). With regard to flooding specifically, commissioned postevent independent inquiries evaluate emergency responses

Table 2. Summary of emergency actors in selected countries.

Country	First responders	Secondary responders	Governmental departments
England	Local authorities	Utility providers (electricity, gas, water, and sewerage, public communication providers)	Department for Environment, Food and Rural Affairs (Defra): functions as the lead government department at times of significant flood emergencies (response phase)
	Environment Agency	Transport operators (network rail, train operating companies, London underground and Transport for London, airport operators, harbor authorities, Highways Agency)	Civil Contingencies Secretariat (department within the Cabinet Office): coordinates central government response
	Emergency services (police, British Transport Police, fire, Maritime and Coastguard agency, ambulance service)	Health authorities (Health and Safety Executive, National Health Service clinical commissioning groups)	Department of Communities and Local Government: functions as the lead government department at times of significant flood emergencies (recovery phase)
	Health authorities (National Health Service Commissioning Board, Public Health England, foundation trusts, acute trusts)	(These are referred to as Category 2 responders)	
	(These are referred to as Category 1 responders) Local resilience forums are established for every police district in England and are comprised of both Category 1 and 2 responders		
France	Municipal authorities (mayor, municipal ward)	Utility providers (electricity, gas, drinking water, public communication providers)	Department of Civil Protection (Home Office)
	Emergency services (e.g. fire brigade, police)		Departmental/regional prefect
Netherlands	Municipal/regional authorities (mayor/ chair security region) assisted by strategic emergency teams (including Chair of Water Management Authority)	Utility providers (electricity, gas, drinking water, public communication providers)	Ministry of Security and Justice
	Operational emergency teams (tactical and on location)	Voluntary sector (e.g., Red Cross)	Ministry of Infrastructure and Environment
	Emergency services (police, fire brigades, medical assistance organizations)	(These are occasionally referred to as "Crisis Partners")	
Poland	Municipal county/provincial authorities (depending on an emergency scale) and their risk management centers	Utility providers (electricity, gas, drinking water, telecommunications, transportation)	Ministry of the Interior and Administration, also Ministry of Health, Ministry of Transport, Construction and Marine Economy
	Emergency services (fire brigades, medical emergency services, police)	Voluntary fire brigades and other voluntary organizations	Chief Commandant of the State Fire Service
Sweden	Local authorities (municipal crisis management committees)	Utility providers (electricity, gas, drinking water, public communication providers)	Swedish Civil Contingencies Agency
	Rescue services		County administrative boards
	Police		

and highlight lessons to be implemented (e.g., Pitt 2008). Furthermore, Local Resilience Forums (Table 3) are seen as a key mechanism for sharing experiences and good practices (Cabinet Office 2013).

Indicator 3: Arrangements for training and exercising

Closely related to Indicator 2, arrangements for exercising and testing planning documents are essential for effective emergency management. England and the Netherlands both display significant examples (Fig. 1), with specific duties established in legislation and policies. In England, the Local Resilience Fora

typically provide a forum for frequent and hazard-specific exercises. National-scale exercises have been performed, which also served as a means of raising citizens' awareness of flood risks (Exercise Watermark Review Team 2011), but such exercises are not carried out systematically. Likewise, exercising flood emergency situations takes place at frequent intervals in the Netherlands. Participation of all relevant actors (including flood professionals) is strongly encouraged (Havekes and De Putter 2014), but in practice, the involvement of secondary responders and citizens in exercising procedures is considered less well established (Hoekstra Committee 2013, Inspectie Veiligheid en Justitie 2013). Concerns have also been

Fig. 1. Assessing the effectiveness of current Flood Emergency Management Systems in selected countries. (EN: England; FR: France; NL: the Netherlands; PL: Poland; SW: Sweden; I: Indicator)

	I.1	I.2	I.3	I.4	I.5	I.6	I.7
NL							
EN							
PL							
FR							
SW							

Legend	Optimal (5)	Outstanding (4)	Significant (3)	Emerging (2)	Low (1)

Table 3. Flood emergency planning arrangements in selected countries.

Country	Approach to emergency planning	Governing rules
England	Periodic assessments of local risks recorded in Community Risk Registers (Cabinet Office 2013), performed by first responders functioning within Local Resilience Forums (LRF). LRFs are established for every police district in England and are comprised of both first and secondary responders (according to primary and secondary legislation). This ensures that the wide range of emergency actors has a shared understanding of local risks, from which a range of generic and hazard-specific planning documents are produced. Multiagency Flood Plans are produced by the LRF to support strategic and tactical decision-making (Defra 2011).	Civil Contingencies Act 2004 Civil Contingencies (Contingency Planning) Regulations 2005 National Flood Emergency Framework (Defra 2013)
France	At the national scale, the Plan ORSEC is compiled by the departmental prefecture with the Inter-departmental Service of Defense and Civil Security. Mayors must develop specific emergency plans, namely Municipal Rescue Plans; this is compulsory for municipalities at risk of flooding, where Flood Prevention Plans have to be established.	Act on Modernization of Civil Security in 2004
Netherlands	Boards of Security Regions are required to produce generic strategic emergency plans based on regularly updated risk profiles of the region, as well as operational crisis plans. Aligned to the Security Regions' plans, Water Management Authorities produce flood-specific calamity plans, including provisions for flood incident management.	Security Regions Act 2010 Water Act 2009
Poland	The Report on Threats to the National Security sets the basis for the National Crisis Management Planning and for civil planning executed on provincial, county, and municipal levels. The implementation of Floods Directive (2007/60/EC) has prompted the development of flood hazard maps and flood risk management plans.	Crisis Management Act 2007
Sweden	All municipalities, county councils, county administrative boards, and central agencies are required to compile risk and vulnerability assessments. Where flooding has been identified as a risk at the local scale, it is to be incorporated into the local emergency management committees' generic emergency plan. For general emergency preparedness, relevant authorities are divided into six so-called "collaboration areas," which are responsible for establishing specific emergency plans.	Act on Extraordinary Incidents and the regulations on emergency preparedness Government Bill 2001/02:158

expressed about differences in the quality and frequency of regional emergency exercises, due mostly to the lack of experience and resources (Hoekstra Committee 2013).

Training and exercising are moderately established in France, Poland, and Sweden. In France, emergency exercises are a statutory requirement, but flood-specific exercises are not mandatory. As far as flood-specific exercises have taken place, there is no national consistency in doing so. Similarly, multihazard

training in Poland is typically organized at the provincial level, but there has been a limited number of flood-focused exercises, and nonemergency responders (i.e., private and other public sector companies) have limited involvement (Matczak and Abgarowicz 2013). In Sweden, the low risk of flooding (especially in comparison with other risks, such as forest fires, storms) means that flood exercises are not common practice unless prioritized as a relevant risk at the local level.

Table 4. Distribution of responsibilities within and between emergency actors in selected countries.

Country	Distribution of responsibilities within and between emergency actors
England	Emergency response is coordinated through a tiered command structure, convened at operational, tactical, and strategic levels. Tactical and Strategic Coordinating Groups (multiactor) will coordinate emergency actors as an event escalates (HM Government 2012). Crucially, no single responding agency has command control. In times of regional or national emergencies, coordination occurs through the lead government department or through the Civil Contingencies Secretariat for Level 2 to 3 emergencies. There is a duty for first and secondary responders to cooperate and share information. The voluntary sector may provide support (e.g., British Civil Defense Corps), but this is often ad hoc.
France	During local-scale emergency, responsibility resides with the mayor and can be transferred to the departmental prefect as events escalate to supralocal scales, or to the zonal prefect. With regard to large-scale emergency events (e.g., flood events), the French territory is divided into six “zones of defense.” Within this pyramidal organization, the Inter-Departmental Ministerial Centre for Crisis Management is a key actor and, for instance, plays a central role in national flood monitoring, forecasting, and broadcasting. For secondary water courses (which are not managed by the state but by local authorities), local forecasting systems are widely available.
Netherlands	For local emergency events, the responsibility for coordinating actors resides with the mayor, who is responsible for strategic decision-making and formally has supreme command over all actors involved in response. For supralocal emergency events, this responsibility is transferred to the chair of a security region, who will be supported by a regional emergency team consisting of representatives of all emergency services and other relevant parties, such as a representative of the relevant water management authority. For extreme supraregional events, ultimately the Minister of Security and Justice can take over command. Tactical coordination and operational lead at location takes place through operational teams, chaired by an operational leader and consisting of representatives of all emergency services and other relevant actors if needed. Although secondary responders (“crisis partners”) have no statutory duties, emergency authorities are encouraged to establish agreements with crisis partners about their specific role in emergency planning and response (typically through covenants).
Poland	Coordinating responsibilities are upscaled from the mayor to the provincial governor, and ultimately, the prime minister as events escalate. Crisis management centers and crisis management teams are established accordingly. These organizations constitute an information sharing and coordinative backbone, while operational capacities are organized through the National Firefighting and Rescue System. This system relies mostly on the state fire brigades, but also the voluntary fire brigades and specialized agencies (e.g., medical emergency services) are actively involved in response. About half of the 16,000 voluntary fire brigade’s units are integrated into the National Firefighting and Rescue System.
Sweden	Municipal crisis management committees have a statutory duty and specific competencies to coordinate response activities. In case of supralocal/national events, the county administrative board or ultimately the Swedish Civil Contingencies Agency will coordinate response. Secondary responders have a duty to cooperate and share information. This follows from the basic principle that everyone who is responsible for an activity under normal conditions also has responsibility in emergency situations (e.g., SOU 2007, MSB 2012). The role of secondary responders in Sweden is further formalized within the framework of so-called “collaboration areas.”

Indicator 4: Distribution of responsibilities within and between emergency actors

Effective emergency response is dependent on an appropriate organization and coordination between emergency actors. All countries have established specific and highly differing organizational structures and arrangements for coordination (Table 4, Fig. 1). Nonetheless, they are all based on the principle of subsidiarity, which advocates the devolution of decision-making to the lowest appropriate scale, with collaboration and coordination at the highest level necessary (Henstra 2010, Buijze 2014). The arrangements in place for facilitating integrated working between actors and transferring responsibilities in all countries are structured according to the type and scale of the incident (i.e., the geographical spread and societal impacts) (Table 3). A comparison, furthermore, reveals differences regarding the cooperation between first and secondary responders, which is ensured by statutory duties to cooperate and share information (England and Sweden), to more informal arrangements (e.g., through covenants) in the Netherlands, and ad hoc cooperation (France and Poland). Further differences are observed in relation to the involvement of the voluntary sector, as well as decision-making structures.

All countries’ systems, except the Netherlands’, are evaluated as significant for this indicator. The new organizational structure in the Netherlands (implemented in 2010) is generally considered to be a major improvement (Muller 2014), but still, upscaling emergencies to supraregional levels requires some crystallization (Hoekstra Committee 2013, Inspectie Veiligheid en Justitie 2013). Moreover, especially concerning flood incidents, there is a reported lack of clarity about the division of responsibilities and competences of emergency and water management authorities; the so-called generic and functional chains have not yet been properly aligned or integrated (Havekes and De Putter 2014, Muller 2014). Communication and information exchange systems have also proven to be ineffective in some specific emergency situations (Hoekstra Committee 2013).

Although the organizational and coordinative structures are considered highly effective, in England an identified weakness relates to the inclusion of the voluntary sector. While first responders must demonstrate due consideration of voluntary groups, there is no formal obligation to involve them; actual involvement thus is highly variable from one Local Resilience Forum to another, despite coordinated promotional activities (e.g., the Voluntary Sector Civil Protection Forum, Cabinet Office 2013).

In contrast, voluntary sector involvement is considered to be a key strength of the Polish system, but a general weakness thereof concerns the lack of effective mechanisms to promote coordinated working. Coordination and cooperation, thus, often take place in a somewhat ad hoc manner, as in France.

Indicator 5: Community preparedness

Community preparedness requires emergency professionals to be actively engaged in efforts to enhance citizens' awareness of flood risks and preparedness to flooding at household and community scales, in all administrative and emergency management districts. Efforts to enhance community preparedness to flood events are increasingly witnessed in the selected countries, in an effort to increase self-reliance and resilience at the local scale. Despite these efforts, there are considerable differences witnessed as to the degree of community preparedness in the selected countries (Fig. 1).

In the Netherlands and Poland, arrangements for enhancing community preparedness are still in an early stage of development and appear to be constrained by societal expectations that the state is responsible for preventing flooding and guaranteeing safety (Kaufmann et al. 2016, Matczak et al. 2016). This is understandable in the Netherlands, given that statutory rights to flood defense exist and high legal safety standards are established (Van Rijswick and Havekes 2012). In Poland, this attitude could be partially explained by the legacy of the omnipotent Communist state. Nonetheless, there are still examples where citizens are actively engaged in the FEMS. In Poland, this includes the voluntary fire service and examples of local "flood leaders" (e.g., City of Wrocław), although this constitutes a pilot initiative at this stage (Matczak et al. 2016). National and regional/local campaigns and informative websites are employed in the Netherlands to raise risk awareness, but despite these activities, community preparedness remains low (OECD 2014, Kaufmann et al. 2016).

Community preparedness is established to a higher degree in France and Sweden (Ek et al. 2016, Larrue et al. 2016). "Professionalization" of the public is one of the major aims of the French FEMS, where voluntary fire brigades play a key role. Municipalities can optionally call in voluntary civil protection reserves to assist in response activities. The intent is to train a specific group of volunteers who are capable of assisting the population, thereby providing "competent" support to emergency professionals. Although not yet highly established, these efforts to enhance community preparedness are becoming nationally more consistent. In Sweden, a network of so-called River Groups has been established since the mid 1990s to (1) disseminate knowledge about watercourses, (2) facilitate flood risk planning, and (3) improve flood emergency management through cooperation. In addition to these voluntary-based associations, information websites and campaigns by the Swedish Civil Contingencies Agency aim to raise flood risk awareness.

Only in England, community preparedness is outstanding, given the vast range of community initiatives that take place (Alexander et al. 2016). For example, community flood action groups are established by members of the public and typically work in partnership with certain first responders (namely local authorities and the Environment Agency), as well as the National Flood Forum (a registered charity). A key activity is the development of

community flood action plans (Cabinet Office 2011, Environment Agency 2012). Voluntary-based community flood wardens are also established in some areas to facilitate communication of official warning messages. This accompanies more passive forms of engaging local communities and making them aware of their local flood risk (e.g., interactive web-based flood mapping, mobile apps, publically available risk assessments).

Indicator 6: Provision of resources

There is no indication that the FEMS of the selected countries are severely lacking resources. Emergency management in all countries is mainly publicly funded through general means generated at the central and/or decentralized level. In some countries (England, the Netherlands, and Sweden), additional funding by central government is also available under specific conditions. In Poland and France, such arrangements for additional funding are not present. Nonetheless, financial resources for emergency management in all selected countries are generally estimated to be sufficient.

In terms of human resources, English local authorities can request support from neighboring local authorities in times of need on the basis of Mutual Aid Agreements. Historically, this has been somewhat "patchy" across the country, but the need for established such agreements was emphasized following the summer floods in 2007 (Pitt 2008). In the Netherlands, understaffing within the emergency management authorities is considered an issue, leading to a limited administrative (planning) capacity, especially during the preparation phase. Also in Sweden, staffing is reported as a key obstacle for effective emergency management, although the leading authorities have powers to raise support from other agencies and municipalities, or even instruct citizen participation. In all countries, additional humanpower can be summoned in emergency response activities through the voluntary sector, albeit this is less established in some countries (e.g., the Netherlands) in comparison to others (e.g., France and Poland).

All countries have a wide range of technical and technological resources available to support flood preparation, response, and recovery activities. In England, for instance, web-based interfaces act as portals for data sharing to facilitate joined-up working. Moreover, a national asset register of emergency resources is available, which may be called upon by all relevant agencies and organizations in the event of an emergency (Defra 2013). Whereas communication and information exchange facilities in the Netherlands have proven ineffective during a number of emergency situations, equipment for flood emergency management is widely available with emergency and water management authorities across the country. Although there has been considerable improvement in terms of financing and providing equipment, resources appear to be less committed toward the FEMS in Poland. Indeed, recent flood incidents exposed equipment and staff shortages (Matczak et al. 2016).

Indicator 7: Arrangements for supporting recovery-based activities

Arrangements for supporting recovery-based activities are established in the selected countries to varying degrees (Fig. 1). In England and Sweden, where this is scored as significant, such arrangements are firmly established within the respective FEMS, with national policies and legal guidance outlining clear

mechanisms for transitioning from response to recovery phases (Alexander et al. 2016, Ek et al. 2016). For example, Recovery Coordinating Groups are established in England (Defra 2013), and first responders have a statutory duty to provide advice and assist business and the voluntary sector with business continuity planning to ensure the continuance of activities during flood to postflood events (Cabinet Office 2013).

Also, the French FEMS contains policies regarding the transition from response to recovery, including specific arrangements for downscaling responsibilities, and initiating aftercare activities. For instance, the Institute of Major Risks provides some recovery guidance, but contrary to England, this is not substantively regulated, and regional differences in performance are observed. In the Netherlands, such arrangements are less well established compared to the French system, and there is hardly any national guidance in this respect. Nonetheless, recovery-based policies are increasingly established at the regional levels, and postevent activities, such as evaluations of performance and the reconstruction of damaged flood defense infrastructures, are more strictly regulated in the Netherlands (Havekes and De Putter 2014, Muller 2014). Additionally, critical infrastructure operators (e.g., electricity network operators and drinking water companies) are legally required to repair their networks and continue their services as soon as reasonably possible after an emergency event (Runhaar et al. 2015).

In Poland, arrangements for recovery-based activities remain in an early stage of development. For instance, recovery plans are occasionally established as a part of emergency planning, but this is not legally required and not necessarily common practice (Matczak et al 2016).

DISCUSSION

On the basis of our preliminary findings, the cross-country comparison we performed reveals important nuances in how flood emergency management is delivered in the selected countries. A general observation is the existence of similar practices in FEMS. For instance, they share the same underlying goals and principles, promote an integrated multiactor approach, proactive planning, and institutional learning through training exercises and systematic evaluations. However, there is also a number of differences in how emergency management systems have substantively evolved and the degree to which they have developed in relation to the benchmarks evaluated (Table 1, Fig. 1). These differences can be accounted for in light of differing contextual backgrounds, related to political, administrative, cultural, and socio-economic factors, as well as differing exposures to flood hazard.

For instance, the English system is scored as significant or outstanding for all indicators. In contrast to the other selected countries, diversified arrangements of flood risk management strategies have been employed for circa 65 years to address all aspects of risk in England (Alexander et al. 2016). This is encouraged largely by the absence of a statutory right to flood protection and statutory safety standards (as seen in the Netherlands). Thus, flood emergency management has served as a crucial strategy for minimizing the consequences of flood events and has evolved incrementally. Today, emergency management is embedded within the National Resilience Capabilities Programme, with a specific work stream dedicated to flood

emergency management (Cabinet Office 2013). Formal legal mechanisms underpin effective integrated working between emergency responders (e.g., duties to cooperate, and formation of Local Resilience Forums). Moreover, community engagement is highly established and steered through wider efforts to devolve responsibilities to the local scale. Although legal responsibility ultimately resides with citizens themselves, this shift is also attributed to financial drivers and concerns for the future sustainability of flood risk management (Alexander et al. 2016). Collectively, these factors account for the high effectiveness of the FEMS.

Similar to England, the cornerstone of the Swedish system is that individuals have the primary responsibility to protect themselves and their property (e.g., SOU 2007:31, MSB 2012). The model for Swedish emergency management is based on the fact that all crises occur at the local level; therefore, preparedness and the ability to manage emergencies must be built bottom up (Prop. 2001/02:158). In light of the low distribution of flood risk, this means that specific provisions for flood emergency management have not been established at the national scale, although the emergency management system more broadly is generally regarded as effective (Ek et al. 2016). Instead, flood emergency management is developed on an ad hoc basis by those municipalities affected by flooding. Arguably, this constitutes a more efficient strategy and provides the necessary flexibility for municipalities to adapt to local risks (Fiselier and Oosterberg 2004). However, this can also be considered as a weakness, as some geographical areas may be neglected. Moreover, municipalities or public agencies must mobilize the necessary resources, which can pose a challenge at a time of strained finances, albeit government compensation can be sought to support this (Ek et al. 2016).

Although most key aspects of the Dutch emergency management system are established in policies and legislation, certain aspects of flood emergency management specifically (i.e., institutional learning, community engagement, and recovery) are less well developed, or still show practical deficiencies, thereby impeding its effectiveness. This can, however, be understood within the context of a normative stance that floods should be prevented at all costs and the related legally established high safety standards for flood defense (Wiering et al. 2015). Although the traditional Dutch defense-based strategy has proven rather effective over time, recent policy developments aim at diversifying and developing other flood risk management strategies as part of a risk-based, multilayered safety approach (Kaufmann et al. 2016). However, the organizational structure (especially concerning the division of responsibilities and competences between emergency and water management authorities in emergency situations) requires some improvement.

In contrast to the other countries, the FEMS in Poland is still emerging in several aspects. This can be related to the significant ideological shift from the Communist regime and the impact of this legacy, which means that change can be slow to take effect. The occurrence of significant floods (e.g., the 1997 “Millennium Flood”) has played an important role in accelerating structural changes in the emergency management system (Matczak et al. 2013, 2016, Sadowski 2013). Likewise, several features of flood emergency management are lagging behind in France. In part,

this can be attributed to a broader transition toward decentralized governance. Indeed, amendments to civil security in 2004 assert the responsibility of private citizens for their own safety. However, this is slow to develop within an ideological background of solidarity, a principle established within the national constitution (Larrue et al. 2016).

This analysis highlights the importance of understanding FEMS within the legal, administrative, political, and cultural contexts in which they have emerged and currently operate. While it is generally agreed that a “one size fits all” approach is not applicable, the added value of comparison is that it can shed light on potentially shared constraints for increasing the effectiveness of FEMS. On this front, a number of constraints are identified, such as the underdevelopment of practices and cultures for institutional learning, resource constraints in terms of staffing and expertise, and lack of consistent protocols for recovery-based activities. Another important constraint appears to stem from the tension between each nation’s stance on emergency management governance (i.e., requests for citizens to be self-reliant) and citizens’ expectations that the state should intervene and offer protection from hazardous events. This attitude is particularly evident in the Netherlands and Poland (Kaufmann et al. 2016, Matczak et al. 2016). Even in England, where community engagement is standard practice, interviews with emergency professions revealed a degree of reluctance to let the public assist in the local response to a flood emergency (Alexander et al. 2016). This can be attributed to the perception that citizens are not formally trained and may risk putting themselves in danger, thereby becoming a liability rather than an asset to the response effort.

A final constraint that emerged from this analysis refers to how flood risk is nationally prioritized, which has a clear impact on how rules and practices are made nationally consistent. However, as the analysis of Swedish FEMS shows, national consistency (as outlined in Table 1) may not be so important in the context of low flood risk and high spatial variability across the country. While the evaluation framework we presented reviews predominantly the national FEMS, different results may be obtained at the local scale. Nonetheless, on the basis of this review, a number of general recommendations for improving the effectiveness of FEMS can be made and potentially extended to areas with similar contextual settings:

- Flood emergency management is embedded within broader emergency management frameworks, which ensure that resources are shared across different types of hazard events and that risks are proportionately managed. However, specific provisions for flood emergency management could prove beneficial in countries where flood risk is projected to increase. Lessons could be learned from the multiagency flood planning and subgroups within Local Resilience Fora seen in England, which provide further clarity on roles and responsibilities at times of flood emergencies.
- In countries exposed to low flood risk, or where flooding is highly spatially distributed, national-level guidance could support preparatory, response, and recovery activities specifically tailored to flooding at the local scale. This would ensure some consistency between those areas that are affected by flooding and would help establish good practices.

- Specific training exercises for flood emergencies should take place periodically to serve the dual purpose of (1) testing planning documents, responsive procedures, and communication structures, and (2) raising citizens’ awareness of local to national flood risks.
- Efforts to encourage community preparedness require better communication of flood risks and the distribution of formal responsibilities, and need to be situated alongside wider efforts to normalize adaptation within society.

CONCLUSION

Addressing a neglected research gap, we formulate and apply a framework for evaluating the effectiveness of FEMS in selected European countries. Cross-country analysis reveals important nuances in how flood emergency management is delivered, among a number of shared strengths and weaknesses in current approaches. Considerable strengths are observed in areas of both generic and flood-specific proactive emergency planning, and the organization and coordination between emergency responders. However, common weaknesses are discerned in the context of institutional learning, community preparedness, and recovery.

Observed differences are attributed to the evolution of emergency management through different institutional cultures, socio-economic conditions, and political processes. Different flood risk profiles and approaches to flood risk governance also account for variations in the delivery of flood incident management. While this raises implications for the transferability of examples of good practice, the comparative approach we presented serves as a useful tool for identifying such practices and debating their transferability potential. Overall, the evaluation framework we presented can be conceived as a valuable mechanism for steering intra- and inter-country assessment and monitoring of current FEMS over time. This can support the evaluation of flood emergency management policies, help identify constraints and opportunities for improving the effectiveness of flood emergency management, and provide evidence for targeting future investment.

Further research is warranted to examine the applicability of this framework to other EU Member States and other countries. Furthermore, the approach for performing the benchmark assessment we presented relies on the informed interpretation of the researchers, albeit grounded in extensive document analysis and stakeholder interviews. An extension of this would be to elicit stakeholder perspectives in scoring, and potentially weighting the benchmarks according to their perceived impact on the effectiveness of emergency management, thus merging qualitative and quantitative methodologies. Nonetheless, the research we presented is a necessary step forward in the study of flood emergency management systems, and provides a firm basis for more in-depth evaluations and cross-country comparison thereafter.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/8723>

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LITERATURE CITED

- Alexander, D. E. 2000. *Confronting catastrophe*. Oxford University Press, New York, USA.
- Alexander, D. E. 2002. *Principles of emergency planning and management*. Terra Publishing, Harpenden, UK.
- Alexander, D. E. 2003. Towards the development of standards in emergency management training and education. *Disaster Prevention and Management: An International Journal* 12(2):113–122. <http://dx.doi.org/10.1108/09653560310474223>
- Alexander, D. E. 2005. Towards the development of a standard in emergency planning. *Disaster Prevention and Management: An International Journal* 14(2):158–175. <http://dx.doi.org/10.1108/09653560510595164>
- Alexander, M., S. Priest, A. P. Micou, S. Tapsell, C. Green, D. Parker, 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, London, UK.
- Alexander, M., C. Viavattene, H. Faulkner, and S. Priest. 2013. Translating the complexities of flood risk science using KEEPER – a knowledge exchange exploratory tool for professionals in emergency management. *Journal of Flood Risk Management* 7(3):205–216. <http://dx.doi.org/10.1111/jfr3.12042>
- Azarian, R. 2011. Potentials and limitations of comparative method in social science. *International Journal of Humanities and Social Science* 1(4):113–125.
- Baird, E. B. 2010. *The recovery phase of emergency management*. Background paper prepared for the Intermodal Freight Transportation Institute, University of Memphis, Vanderbilt Center for Transportation Research (VECTOR), Memphis, Tennessee, USA.
- Baird, A., P. O'Keefe, K. N. Westgate, and B. Wisner. 1975. *Towards an explanation and reduction of disaster proneness*. Occasional Paper No.11, University of Bradford, Disaster Research Unit, Bradford, UK.
- Beck, U. 1992. *Risk society: towards a new modernity*. SAGE, London, UK.
- Boin, A., and P. 't Hart. 2010. Organising for effective emergency management: lessons from research. *Australian Journal of Public Administration* 69(4):357–371. <http://dx.doi.org/10.1111/j.1467-8500.2010.00694.x>
- Bosson, R., and H. Hegemann. 2013. *ANVIL deliverable 4.1: synthesis report on comparison of civil security systems*. ANVIL project. [online] URL: http://anvil-project.net/wp-content/uploads/2013/12/Deliverable_4.1.pdf
- Britton, N. R. 2001. *A new emergency management for the new millennium?* Keynote paper to the 2nd International Conference 'Cities on Volcanoes', Auckland, New Zealand, 11–16th February 2001.
- Buijze, A. W. G. J. 2014. Shared regulatory regimes through the lens of subsidiarity: towards a substantive approach. *Utrecht Law Review* 10(5):67–79.
- Cabinet Office. 2011. *Preparing for emergencies: guide for communities*. Cabinet Office, London, UK.
- Cabinet Office. 2012a. *Chapter 13: Support and challenge. Revision to emergency preparedness*. Civil Contingencies Act Enhancement Programme. Cabinet Office, London, UK.
- Cabinet Office. 2012b. *Emergency response and recovery: non-statutory guidance accompanying the Civil Contingencies Act 2004*. Cabinet Office, London, UK.
- Cabinet Office. 2013. *Emergency response and recovery: non-statutory guidance accompanying the Civil Contingencies Act 2004*. Cabinet Office, London, UK.
- Cabinet Office. 2015. *2010 to 2015 government policy: emergency response planning*. Cabinet Office, London, UK.
- Cardona, O. D., J. E. Hurtado, G. Duque, A. Moreno, A. C. Chardon, L. S. Velasquez, and S. D. Prieto. 2004. *Disaster risk and risk management benchmarking: a methodology based on indicators at national level*. IDB/IDEA Program on Indicators for Disaster Risk Management, Universidad Nacional de Colombia, Manizales, Colombia. [online] URL: <http://www.manizales.unal.edu.co/>
- Cardona, O. D., J. E. Hurtado, G. Duque, A. Moreno, A. C. Chardon, L. S. Velasquez, and S. D. Prieto. 2005. *System of indicators for disaster risk management: program for Latin America and the Caribbean: main technical report*. IDB/IDEA Program on Indicators for Disaster Risk Management, Universidad Nacional de Colombia, Manizales, Colombia. [online] URL: <http://idea.bid.manizales.unal.edu.co/documentos/Main%20technical%20report%20IDEA.pdf>
- Carreño, M. L., O. D. Cardona, and A. H. Barbat. 2007. A disaster risk management performance index. *Natural Hazards* 41(1):1–20. <http://dx.doi.org/10.1007/s11069-006-9008-y>
- Coetzee, C., and D. van Niekerk. 2012. Tracking the evolution of the disaster management cycle: a general system theory approach. *Jāmbā: Journal of Disaster Risk Studies* 4(1):1–9. <http://dx.doi.org/10.4102/jamba.v4i1.54>
- Department for Environment, Food and Rural Affairs (Defra). 2011. *Detailed guidance on developing a multi-agency flood plan*. Defra, London, UK. [online] URL: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254294/pb14046-develop-multi-agency-flood-plan.pdf
- Department for Environment, Food and Rural Affairs (Defra). 2013. *National flood emergency management framework*. Defra, London, UK.
- Drabek, T. E. 1985. Managing the emergency response. *Public Administration Review* 45:85–92. <http://dx.doi.org/10.2307/3135002>

- Dynes, R. R. 1998. Noah and disaster planning: the cultural significance of the flood story. Preliminary Paper 265. Disaster Research Center, University of Delaware, Newark, Delaware, USA. [online] URL: <http://udspace.udel.edu/handle/19716/285>
- Ek, K., S. Goytia, M. Pettersson, and E. Spiegel. 2016. *Analysing and evaluating flood risk governance in Sweden – adaptation to climate change?* STAR-FLOOD Consortium, Luleå University of Technology, Luleå, Sweden.
- Environment Agency. 2012. *Flood plan guidance for communities and groups*. Environment Agency, Bristol, UK.
- Exercise Watermark Review Team. 2011. *Exercise watermark: final report September 2011*. [online] URL: <https://www.gov.uk/government/publications/exercise-watermark-final-report>
- Federal Emergency Management Agency (FEMA). 2013. *Continuity assessment tool (CAT). Continuity guidance for non-federal governments*. FEMA P-788, September 2013.
- Fereday, J., and E. Muir-Cochrane. 2008. Demonstrating rigor using thematic analysis: a hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods* 5(1):80–92.
- Feyen, L., R. Dankers, K. Bódis, P. Salamon, and J. I. Barredo. 2012. Fluvial flood risk in Europe in present and future climates. *Climatic Change* 112(1):47–62. <http://dx.doi.org/10.1007/s10584-011-0339-7>
- Fiselier, J., and W. Oosterberg. 2004. *A quick scan of spatial measures and instruments for flood risk reduction in selected EU countries*. Work document 2004.068x, RIZA Institute for Inland Water Management and Waste Water Treatment, the Netherlands. [online] URL: http://www.espace-project.org/part1/publications/reading/LfUquickscanofspatialmeasures_RIZA.pdf
- Gilissen, H. K., M. Alexander, J.-C. Beyers, P. Chmielewski, P. Matczak, T. Schellenberger, and C. Suykens. 2016. Bridges over troubled waters: an interdisciplinary framework for evaluating the interconnectedness within fragmented domestic flood risk management systems. *Journal of Water Law* 25:12–26.
- Haasjes, J. S. 2012. *De dijk staat op springen. Hoog water in de Veiligheidsregio Groningen. De evaluatie en bevindingen*. [online] URL: <http://www.veiligheidsregiogroningen.nl/zo-bereiden-wij-ons-voor/deel-2-de-evaluatie-en-de-bevindingen>
- Haddow, G. D., and J. A. Bullock. 2006. *Introduction to emergency management*. Second edition. Butterworth-Heinemann.
- Havekes, H. J. M., and P. J. De Putter. 2014. *Wegwijzer Waterwet – Een praktische handleiding*. Kluwer, Deventer, the Netherlands.
- Hegger, D., P. P. J. Driessen, and M. Bakker, editors. 2016. *A view on more resilient flood risk governance: key conclusions of the STAR-FLOOD project*. STAR-FLOOD Report No. D6.4. [online] URL: <http://www.starflood.eu/documents/2016/03/d6-4-final-report-webversion.pdf>
- Henstra, D. 2010. Evaluating local government emergency management programs: What framework should public managers adopt? *Public Administration Review* 70(2):236–246. <http://dx.doi.org/10.1111/j.1540-6210.2010.02130.x>
- HM Government. 2013. *Emergency response and recovery – non statutory guidance accompanying the Civil Contingencies Act 2004 (revised version October 2013)*. [online] URL: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253488/Emergency_Response_and_Recovery_5th_edition_October_2013.pdf
- Hoekstra, R. J., D. L. Berlijn, J. De Ridder, H. Smits, and J. De Vries (Hoekstra Committee). 2013. *Evaluatiecommissie Wet veiligheidsregio's en het stelsel van Rampenbestrijding en Crisisbeheersing: Eindrapportage*. Minsietrie van Veiligheid en Justitie, Den Haag, the Netherlands.
- Inspectie Veiligheid en Justitie. 2013. *Staat van de Rampenbestrijding 2013*. Ministerie van Veiligheid en Justitie, Den Haag, the Netherlands.
- Kaufmann, M., W. J. van Doorn-Hoekveld, H. K. Gilissen, and H. F. M. W. van Rijswijk. 2016. *Drowning in safety? Analysing and evaluating flood risk governance in the Netherlands*. Report No. D3.3, STAR-FLOOD Consortium, Utrecht, the Netherlands.
- Kuipers, S., A. Boin, R. Bossong, and H. Hegemann. 2015. Building joint crisis management capacity? Comparing civil security systems in 22 European countries. *Risk, Hazards & Crisis in Public Policy* 6(1):1–21. <http://dx.doi.org/10.1002/rhc3.12070>
- Larrue, C., S. Bruzzone, L. Lévy, M. Gralepois, T. Schellenberger, J.-B. Trémorin, M. Fournier, C. Manson, and T. Thuilier. 2016. *Analysing and evaluating flood risk governance in France: from state policy to local strategies*. STAR-FLOOD Consortium, University of Tours, Tours, France.
- Matczak, P., and G. Abgarowicz. 2013. *Country study: Poland*. Report of the Project “Analysis of Civil Security System in Europe”. [online] URL: http://anvil-project.net/wp-content/uploads/2014/01/Poland_v1.0.pdf
- Matczak, P., J. Lewandowski, A. Choryński, M. Szwed, and Z. W. Kundzewicz. 2016. *Flood risk governance in Poland: looking for strategic planning in a country in transition*. Report No. D3.6, STAR-FLOOD Consortium, Institute for Agricultural and Forest Environment, Polish Academy of Sciences, Poznan, Poland.
- McConnell, A. 2011. Success? Failure? Something in-between? A framework for evaluating crisis management. *Policy and Society* 30(2):63–76. <http://dx.doi.org/10.1016/j.polsoc.2011.03.002>
- Muller, E. R. 2014. Crisis en recht – Naar een integrale Crisisbeheersingswet? In E. R. Muller, T. Hartlief, B. F. Keulen, and H. R. B. M. Kummeling. 2014. *Crisis, rampen en recht: Preadviezen NJV*. Kluwer, Deventer, the Netherlands.
- Neal, D. M. 1997. Reconsidering the phases of disaster. *International Journal of Mass Emergencies and Disasters* 15 (2):239–264.
- O'Brien, G., P. O'Keefe, Z. Gadema, and J. Swords. 2010. Approaching disaster management through social learning. *Disaster Prevention and Management: An International Journal* 19(4):498–508. <http://dx.doi.org/10.1108/09653561011070402>
- Organisation for Economic Co-operation and Development (OECD). 2014. *Water governance in the Netherlands: fit for the future?* OECD Studies on Water, OECD Publishing.

Perry, R. W., and M. K. Lindell. 2003. Preparedness for emergency response: guidelines for the emergency planning process. *Disasters* 27(4):336–350. <http://dx.doi.org/10.1111/j.0361-3666.2003.00237.x>

Pitt, M. 2008. *Learning lessons from the 2007 floods. The Pitt Review*. Cabinet Office, London, UK.

Quarantelli, E. L. 2000. *Disaster planning, emergency management and civil protection: the historical development of organized efforts to plan for and to respond to disasters*. Preliminary Papers 301, Disaster Research Center, University of Delaware, Newark, Delaware, USA.

Real-Dato, J. 2009. Mechanisms of policy change: a proposal for a synthetic explanatory framework. *Journal of Comparative Policy Analysis* 11(1):117–143. <http://dx.doi.org/10.1080/13876980802648268>

Runhaar, H. A. C., H. L. P. Mees, A. Wardekker, J. van der Sluijs, and P. P. J. Driessen. 2012. Adaptation to climate change-related risks in Dutch urban areas: stimuli and barriers. *Regional Environmental Change* 12(4):777–790. <http://dx.doi.org/10.1007/s10113-012-0292-7>

Runhaar, H. A. C., C. J. Uittenbroek, H. F. M. W. van Rijswijk, H. L. P. Mees, P. P. J. Driessen, and H. K. Gilissen. 2015. Prepared for climate change? A method for the ex-ante assessment of formal responsibilities for climate adaptation in specific sectors. *Regional Environmental Change* 16(5):1389–1400. <http://dx.doi.org/10.1007/s10113-015-0866-2>

Sadowski, M., editor. 2013. *Adaptacja wrażliwych sektorów i obszarów Polski do zmian klimatu do roku 2070*, IOS/PIB, Warszawa, Poland.

Swedish Civil Contingencies Agency (MSB). 2012. *Vårt gemensamma ansvar*.

Swedish Government (SOU). 2007. *Sweden facing climate change – threats and opportunities*. Final report from the Swedish Commission on Climate and Vulnerability, Stockholm, Sweden.

United Nations Office for Outer Space Affairs (UNOOSA). 2015. *Emergency and disaster management*. [online] URL: <http://www.un-spider.org/risks-and-disasters/emergency-and-disaster-management>

Van Rijswijk, H. F. M. W., and H. J. M. Havekes. 2012. *European and Dutch Water Law*. Europa Law Publishing, Groningen, the Netherlands.

Waugh, W. L., Jr., and G. Streib. 2006. Collaboration and leadership for effective emergency management. *Public Administration Review* 66:131–140. <http://dx.doi.org/10.1111/j.1540-6210.2006.00673.x>

Wiering, M., C. Green, H. F. M. W. van Rijswijk, S. J. Priest, and A. Keessen. 2015. The rationales of resilience in English and Dutch flood risk policies. *Journal of Water and Climate Change* 6(1):38–54. <http://dx.doi.org/10.2166/wcc.2014.017>

Zhou, Q., W. Huang, and Y. Zhang. 2011. Identifying critical success factors in emergency management using fuzzy DEMATEL method. *Safety Science* 49:243–252. <http://dx.doi.org/10.1016/j.ssci.2010.08.005>