International Journal of Disaster Risk Reduction 49 (2020) 101668

Contents lists available at ScienceDirect

International Journal of Disaster Risk Reduction

journal homepage: http://www.elsevier.com/locate/ijdrr

Simulating synergies between Climate Change Adaptation and Disaster Risk Reduction stakeholders to improve management of transboundary disasters in Europe

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ARTICLE INFO

Keywords:
Climate Change Adaptation (CCA)
Disaster Risk Reduction (DRR)
Transboundary
ESPREssO project

ABSTRACT

Natural hazards and climate-related disasters disregard political borders, where additional barriers can complicate mitigation, response and recovery efforts within and between the sectors of Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR). The ESPREssO Project (Enhancing Synergies for Disaster Prevention in the European Union) aims to improve management of transboundary disasters by encouraging closer synergies between the CCA and DRR communities. Using targeted stakeholder interviews, questionnaires, Think Tank discussions and purpose-built serious games, ESPREssO draws on both CCA and DRR stakeholder experiences and informed perspectives in order to identify current gaps. Set within a fictitious border zone, ESPREssO's RAMSETE II serious game challenges CCA and DRR stakeholders in making coordinated decisions before, during and after a simulated disaster, in protection of population and critical infrastructure.

Results highlight the essential role of local governance mechanisms as the sharp end of the policy wedge, with current examples of proactivity that require to be championed and supported at national level in order to thrive. These good practice examples reflect the fact that transboundary settings, despite their challenges, act as fertile ground for mutual growth, offering opportunities for CCA and DRR communities to find innovative ways to cooperate and unite in developing synergies and strengthening their mutual efforts towards resilience. Stakeholders emphasise a need to invest more resources in informal cooperation and call on policy makers to recognise that each border zone raises its own unique set of complex challenges that requires flexibility and special consideration by transboundary authorities in management of disasters.

1. Introduction: gaps between CCA and DRR

Existing differences between CCA and DRR have been well-documented, not just in terms of their respective origins within the scientific and humanitarian communities, (Sperling and Szekely, 2005 [1]; Venton & La Trobe, 2008 [2]); but also their differing timescales, terminologies and implementation mechanisms (Schipper and Pelling, 2006 [3]; Mitchell and van Aalst, 2008 [4]), and their resourcing and fluctuating political attention (Helmer and Hilhorst, 2006 [5]; Mercer et al., 2010 [6]).

Conceptually, it seems appropriate that DRR is an appropriate delivery mechanism for CCA, however this does not always transfer to the operational level (EUR-OPA UNISDR, 2011 [7]). Environmental authorities usually have overall responsibility for climate change adaptation, whereas authorities for disaster management, civil defence and home affairs typically have responsibility for disaster risk reduction (UNISDR, 2009a [8]). This disparity impedes the synergising principles behind CCA and DRR (Thomalla et al., 2006 [9]), namely reducing vulnerability and increasing resilience and there needs to be greater collaboration between the respective parties (EUR-OPA UNISDR, 2011

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https://doi.org/10.1016/j.ijdrr.2020.101668
Received 18 June 2019; Received in revised form 15 April 2020; Accepted 12 May 2020
Available online 16 May 2020

[7]; UNISDR, 2012 [10]).

Over the past decade in particular, countries globally have sought to redress the disadvantages of earlier "silo" approaches seeking instead to systematically link CCA and DRR, often as an element of their development planning (UNISDR, 2009a [8]). Legislation such as the Hyogo Framework (2005–2015 [11]) and its successor the Sendai Framework (2015–2030 [12]) provided practitioners with synergising starting points, but increased emphasis and more work is still needed to be put into creating practical solutions to their integration (Gero et al., 2010 [13]) which must be adequately supported by local government (EUR-OPA UNISDR, 2011 [7]). The 2011 Global Assessment Report on Disaster Risk Reduction suggested incorporation of CCA and DRR in central planning locations or a relevant ministry with funds and the authority to support a risk reduction agenda (GAR, 2011 [14]). Governments are beginning to combine the two spheres into new national legislation or in a single ministerial responsibility but in Europe there are still problems with national-level planning and investment that need to be overome in order that their progression is synergetic (EUR-OPA UNISDR, 2011 [7]).

This paper concentrates on when these efforts stop or meet additional hurdles at borders, where complexities can be amplified by different (or even conflicting) policies, practices and cultures. Integrated delivery of CCA and DRR is driven by and critically dependent on detailed local socio-economic and environmental knowledge (EUR-OPA UNISDR, 2011 [7]). It is therefore logical that local governance often takes the first proactive steps in creating initiatives to deliver CCA and DRR in coherent ways. The outstanding challenge is preventing loss of support and both knowledge and financial investment as issues filter upwards through different levels of governance to regional to central government and competing priorities converge to potentially dilute or duplicate actions.

1.1. Transboundary CCA and DRR in Europe

Transboundary threats are characterised by consequences covering areas that cross national boundaries. Such crises can escalate along both geographical and functional dimensions, which, when combined, defines the catastrophic potential (e.g. Boin & Rhinard, 2008) [15]. The frequency, intensity, duration of transboundary disaster risk, and the ability to manage cross-border crises are increasing concerns in Europe, also considering the implication of growing climate change impacts (Boin et al., 2013 [16]; Abad et al., 2018 [17]).

Europe's variety of governance structures, cultural policies and geographical settings, provides a unique opportunities to align transboundary CCA and DRR. Vulnerability is magnified in Europe's transboundary coastal, riverine and alpine settings which bear the brunt of emerging challenges as impacts are felt most starkly and rapidly in these frontier locations to climate change. Around 20% (115 million) of European citizens are estimated to reside within 50 km of a national border (Abad et al., 2018 [17]), thus the potential benefits of synergising transboundary CCA and DRR activities, stakeholder networks, budgets and timeframes, cannot be overestimated in ensuring pragmatic, cooperative transboundary DRR in a changing climate.

Over the past few decades, Europe has prioritised this cooperative approach, reflected in its treaties and frameworks that aim to integrate CCA and DRR. This paper will use transboundary watercourses to highlight some of these advancements, complexities and remaining challenges in bringing together CCA and DRR before going on to suggest solutions gathered through a rigorous stakeholder engagement process.

1.1.1. Vertical integration of CCA and DRR

The European Commission supports overarching strategies which provide common goals that filter down and adapt to reflect the character of its member countries. This complements examples of European grass roots initiatives, which encourage vertical transfer of practical knowledge and best practice. Whilst top-down channels work in theory, both within nations and between the European Commission and its member states, in practice it is sometimes a different story in transboundary regions.

Strategic policies sometimes fail to fit the local level, or overlook complex issues that require a more detailed (often unique) perspective at the local and regional scale (e.g. UNISDR, 2009a [8]). Stakeholders express their local transboundary issues are often inadequately communicated or considered at national level (Booth et al., 2017 [18]. There are gaps at local transboundary level in terms of scientific investment, and in overcoming bureaucratic hurdles in order to share data and expertise. Yet these are the front lines most vulnerable in times of crisis, often requiring rapid access to state-controlled or even cross-border resources. Lack of scientifically relevant (or useable) data at these levels exacerbates their vulnerability, when compared to national level. It is the local level which also contains the flexibility to be proactive in securing themselves, particularly true of transboundary areas, so while there is vulnerability, there is a natural generation of proactive resilience-success stories which should be used as templates for other areas.

1.1.2. Horizontal integration of CCA and DRR

Interactions between European countries, regions and sectors are more complex, historically less well understood and less prioritised than top-down channels that exist between the European Commission and its member states. Barriers exist that hinder horizontal integration-particularly across borders-such as language, differing political priorities, divergent funding mechanisms, competition for resources and mismatched timescales for implementation. There is less experience for cooperatively developing lateral multisectoral strategies (Braunschweiger et al., 2018 [19]) amongst administrative members, and traditional conflicts may hinder fruitful cooperation. Coordinating agencies which take on organisational duties for other sectors without challenging their sovereignty are viewed as successful options for increasing horizontal cooperation (Braunschweiger et al., 2018 [19]) along with building on existing networks already in place. Task-oriented project collaboration works best for issue-based cooperation between sectors, which requires to produce visible results. This can lead to longer term partnerships which integrate adaptation measures into ongoing development processes (Braunschweiger et al., 2018 [19]).

1.2. Barriers to transboundary integration of CCA DRR in Europe

This section presents transboundary hurdles for CCA and DRR integration, using examples from Europe. These examples were gathered from ESPREssO stakeholders (policy-makers and practitioners from the European CCA and DRR communities) during 2016-18.

1.2.1. Political isolationism

Isolated national thinking or international competition, coupled with lack of political will and motivation, is a stumbling block for implementing better transboundary policies, tools and practices. There is a perception that unless directly situated on borders, climatic disasters can be handled by without assistance from neighbouring countries, or from EU support mechanisms. (Germany and the UK for example have aquired rather self-reliant reputations). While most disasters and emergencies within the EU are indeed on a scale manageable to modern industrialized nations, such isolated thinking is potentially problematic in light of a future where climate change may lead to unprecedented hazards and risks both sides of a border (Amaratunga et al., 2017 [20]). There is a need to challenge the perception that emergencies can be adequately dealt with without the need for international assistance, which is currently being starkly illuminated by the 2020 Coronavirus pandemic.

1.2.2. Legislative hurdles

Although there are a multitude of bilateral and multilateral

agreements between EU member states for dealing with risks, there is an absence of policies and tools for transboundary crisis management and a lack of legal instruments and concrete policies that can be used by national, regional and local governments in transboundary crisis response.

In France, the Oriental Pyrenees region is a recurrent case where a formal agreement for international cross-border assistance has so far been frustrated. On the French side, the region has sufficient authority, but on the Spanish side, regions such as Catalonia do not have foreign policy authority and involvement from central government is therefore required. This creates a type of conflicting legitimacy in cross-boundary management of crises, which is an aspect of preparedness that can be overlooked when the focus relies on coordinated response (Abad et al., 2018 [17]).

1.2.3. Sectoral gaps

Climate change increases stress on and competition for access to transboundary natural resources and their use, which national policies must be able to flex to. Transboundary alpine lakes (or watercourses) for example, play host to a variety of competing actors. In parts of South Tyrol (Italy) despite a long history of adaptation, water scarcity issues have risen over the last decade (particularly in early Spring and high Summer) due to a series of dry years combined with increasing demand for water for irrigated agriculture, tourism and households, creating uneven temporal and spatial distribution of demand and supply (EEA, 2009 [21]). In the Ticino region, Italian agricultural extraction requirements placing greater demand in times of summer drought, must be balanced with Swiss flood risk mitigation requirements (Booth et al., 2017 [18]). Long term arrangements which have worked in the past might in future require permanent or annual re-adjustment under climate changes.

Stakeholders who communicate regularly with their cross-border counterparts are however generally less dependent on seeking State assistance and more proactive in times of crisis and response times. In Switzerland, for example, the Kantonalen Krisen Organisation (KKO) (Cantonal Crisis Organisation) for the tri-national border Kanton of Basel-Stadt, runs regular disaster drills with its cross-border authorities in France and Germany, to ensure that communication channels remain open (Lauta et al., 2018 [22]). This is done proactively at local level and success is reliant on the counterpart authorities matching the initiative. Efforts like this will strengthen cooperation over time and help identify gaps before they emerge in reality. This premise for preparation and prevention is the same drive behind creation of serious games to use simulated disaster situations to prompt real-life actions.

Brethaut et al., 2015 [23]) emphasises a need for clear understanding of competences and trust between the different levels of governance in order to use resources efficiently and strengthen local governance structures to increase risk management capabilities and thus foster long-term resilience and disaster management capabilities.

Planning that once focussed on Disaster Risk Reduction and the *security* of citizens has increasingly expanding to incorporate adaptation measures to Climate Change risks over the past two decades, meaning that DRR policy makers and practitioners are needing to interact with a broader range of (CCA-related) stakeholders, including of course, their different perspectives, remits and expertises. This is naturally a two-way exchange and stakeholders note that a significant broadening of perspectives has accompanied the seating of security specialists (including defence sectors) around a table together with environmental groups, for discussions that once took place "behind closed doors." (Booth et al., 2017 [18]).

This, despite its challenges, is the front-line for generation of new ideas and synergetic policies and the arena this paper goes on to explore, using serious games as the method by which to engage those different perspectives that might not otherwise be used to engaging with each other. In that sense, it is novel in terms of trying to use conceptual and cascading hazard scenarios as an aligning tool for a broad set of actors.

Finding a common or shared resource, such as a transboundary waterbody, shared coastline or international river helps provide an aligning platform for "home-grown" cooperation generated locally, to develop around and warrants closer attention as examplary arenas for bringing CCA and DRR agendas together (e.g. Brethaut et al., 2015) [23]. This provides also the basis for creating a virtual environment, anchored to a major transboundary resource (in this case a river) which ESPREssO designed to necessitate cooperative interactions in the face of a "catalyst" disaster which the next sections illustrate.

2. European transboundary rivers: A pioneering arena for integrating CCA and DRR

The role of international rivers in Europe is powerful with regards to providing platforms to tackle the effects of climate change alongside Disaster Risk Reduction. Rivers like the Danube, Elbe, Rhone and Rhein, whose catchments act as threads through a patchwork quilt of cultures and governance regimes, offer a spearhead of cooperation in tackling a changing climate (Booth & Patt, 2018 [24]).

The Danube Basin, incorporating 19 countries, with some 81 million inhabitants was one of the first major transboundary river basins worldwide to adopt a CCA strategy when it did so in 2012, updated in 2018 (ICPDR, 2018 [25]). Along with other European rivers, the Danube faces changing flow patterns, brought about by intensifying storms, accelerated glacial melting upstream, and shifts in precipitation from snow to rain in upland catchments due to climate change (Booth & Patt, 2018 [24]).

Guidance on Water and Adaptation to Climate Change was published by the United Nations in 2009 [26] placing special emphasis on the specific problems and requirements of transboundary basins. The intention was to encourage concerted yet flexible action whilst acknowledging that at the time, experience with Climate Change Adaptation in the transboundary context was still limited, particularly in the practice sphere. A lot has since changed, with vulnerability assessments and shared initiatives increasingly incorporating both DRR and CCA objectives.

2.1. Multilateral action

Two examples of River Basin platforms which engage multi-level stakeholders through concerted multi-lateral action are the International Commission for the Protection of the Rhein (ICPR) and the International Commission for the Protection of the Danube River (ICPDR). The 2005 ICPR Action Plan against Floods [27] part of the "Rhine 2020" initiative [28] constituted a series of basin management actions with a budget of 12 billion Euros, aiming to reduce potential damages by 25% and reduce extreme flood levels under a changing climate. The program also sought to increase awareness using maps of flood-prone zones, such as the Rhine Atlas 2015 [29], and increase capacity to raise alert by establishing collaborations between upstream and downstream observatories (Abad et al. 2018 [17]).

2.2. Legislative advancements

Legislative advancements, e.g. the European Water Framework Directive (2000) [30] and the European Directive on the Assessment and Management of Flood Risks (2007) [31] provide frameworks to which regions can nest and prioritise work plans, reflective of their operational and natural environments. The EU Floods Directive has had a hugely positive impact on flood risk mitigation in particular: Large-scale, transboundary hydro-meteorological events like the Elbe/Labe floods in 2002 and 2013 demonstrate substantial progress has been made in the intervening period, with regards to transnational exchange of critical information and resources to deal with such disastrous situations available to both CCA and DRR sectors (Marx et al., 2017 [32]).

Brethaut et al., (2018 [33]) notes that in recent years the River Rhône has also undergone several changes that challenge its governance

structure, leading to new types of challenges and uncovering a number of uncertainties that need to be addressed. This situation is highlighted by growing tensions among river uses and growing uncertainties linked to climate change, environment and energy policies. In the case of the Rhône, this means incorporating overlapping Swiss, French and European Union governance into more streamlined and simplified strategies (Brethaut, 2018 [33]).

Focussing events (highlighted by Birkland 1997 [34]; 1998 [35]) act as catalysts or triggers to force a reconsideration of the transboundary governance of the river (Bréthaut et al., 2015 [23]). Such events occur suddenly and whilst they are relatively rare, they tend to be large scale and covered by media. They create new opportunities for forging innovative policies (Kingdon, 1995 [36]) to reflect public problems and seek to best address such issues. These events expose weaknesses of the current system(s) - especially the difficulties linked to coexistence of several (not necessarily coordinated) regulatory frameworks in the transboundary realm. While devastating, these events can often urgently streamline and simplify policy as will be illustrated in Section 2.4 and so they will form a key part in the design process of serious games to virtually test stakeholder interactions.

2.3. Opportunities for involving CCA in the DRR debate at transboundary level

Climate change is often regarded only as a stressor on existing environmental systems and resources, which while it can be the case, misses its ability to provide new opportunities for generating (and funding) transboundary cooperation, not only for dealing with technical and policy issues, but also for funding of large scale infrastructure (Earle et al., 2015 [37]). Large-scale multipurpose dam creation, for example, in some regions, increasingly plays a role in reducing vulnerability to climate change-contributing to flood prevention and mitigation of drought (ENTRO, 2011 [38]). Earle et al., (2015 [37]) reflects on hydropower being viewed as a clean energy as an "extra powerful argument" for its use within climate-change friendly strategies, despite potential political implications up or down-stream.

For transboundary water bodies, such projects have international consequences, both positive and negative and create enormously complex transboundary negotiations as sectors and governments compete. Brethaut et al., (2018 [33]) states that if water management is already characterised by complex multi-level interactions and trade-offs among various sectoral uses, the transboundary scale represents an additional level of intricacy with the involvement of different institutional and legal frameworks, multiple asymmetries among parties involved (Warner and Zawahri, 2012 [39]) and tensions between national interests. In other words, transboundary water management represents a "wicked problem" (Levin et al., 2012 [40]; Varone et al., 2013 [41]) which calls for new solutions and new institutional arrangements. (Brethaut et al., 2018 [33]).

There is therefore a two-sided aspect to CCA therefore that policy makers need to be objective of. CCA (rightly or wrongly) can be used to move the goalposts of long-held political processes, it can increase competition and it can elevate political ambitions. In other words, CCA, is a "game-changer" in many aspects of DRR. The implications of this for transboundary risk management are particularly notable, e.g. in the locating of vulnerable assets. This "game-changing" aspect will be incorporated into ESPREssO's serious game to explore both positive and negative outcomes, depending on the choices players make.

2.4. Transboundary disasters as catalysts for cooperation

Riverine disasters such as the Sandoz chemical spill at Schweizerhalle, near Basel in November 1986 mark significant turning points for transboundary cooperation in Europe. As a result of fire at the Sandoz chemical plant, between 10,000 and 15,000 m^3 of chemically polluted water flowed into the Rhein through the Sandoz sewer system (Schwabach, 1989 [42]). A week after the fire, the event had huge implications for the drinking water supply and the ability to farm pastoral land in France, Switzerland, West-Germany and even the Netherlands (almost 1000 km from the accident site) (Schwabach, 1989 [42], Tuohy, 1986 [43]). It took the river decades to recover ecologically and the disaster remains one of Western Europe's worst environmental disasters, qualified by Boos-Herberger, (1997 [44]). The event shone a negative light on failings of the international community in particular to protect the Rhein from pollution events (Schwabach, 1989 [42]).

The 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal [45] followed three years later, designed to eliminate the risks arising from the transboundary movements of hazardous and other wastes. The Sandoz event, as a "focussing event" taught multiple lessons, not least in that of promoting accountability.

Whilst these major events can and do increase probability of more streamlined regime formation (Young, 1994 [46]) as actors have more impetus to come together to solve a shared (perhaps immediate) problem, (Schiff, (2017 [47]) points out that in the case of the Rhein, it exemplified collaboration over issues of common interest long before environmental consequences became a primary concern of riparian states. Historical relationships, particularly in border regions, greatly impact the speed and efficacy of future progress. Smoother transitions can take place in border regions that share cultural similarities or comparable levels of resources, but progress can be blocked altogether in areas of conflict or cultural and political divide.

Drawing on experiences from different transboundary settings, including transboundary disasters with associated multi-faceted sectoral interactions and cascading risk profiles, valuable information can be extracted for creating detailed simulated disaster scenarios, which allow stakeholders to explore and test a series of options, for developing potential collaboration mechanisms between CCA and DRR.

3. ESPREssO: method of data capture

The ESPREssO project (funded under Grant Agreement No. 700342 of the European Union's *Horizon 2020* research and innovation program) prioritises the need for overcoming barriers to DRR in Europe, with cross-border crisis management identified as one of its three central challenges. Perspectives gathered from its stakeholders support the debate that closer synergies between CCA and DRR sectors can be mutually supportive in strengthening resilience and reducing vulnerability in border zones.

In order to gather stakeholder perspectives, ESPREssO developed 3 serious games, RAMSETE I, II and III (Risk Assessment Model Simulation for Emergency Training Exercise) which intend to test stakeholder interactions and collective decision-making processes, around the project's three central Challenges:

- Challenge 1: To propose ways to create more coherent national and European approaches on Disaster Risk Reduction and Climate Change Adaptation;
- Challenge 2: To enhance risk management capabilities by bridging the gap between science and legal/policy issues at local and national levels;
- Challenge 3: To increase efficient management of transboundary crises.

ESPREssO's RAMSETE II was designed to explore gaps and barriers present in managing transboundary crises between the stakeholders currently active in this field. It focuses on policy-making and invites players to find avenues for achieving synergy for achieving better goals and solutions to their issues.

ESPREssO hosted an international Think Tank into management of transboundary crises in January 2018 in Zurich, Switzerland. It was attended by 23 ESPREssO partners and international stakeholders from

across Europe representing both CCA and DRR sectors at various levels of governance.

Players were encouraged to discuss arising events and situations, based on their professional experience. Real-life barriers were presented to the participants, or "players", albeit in a simulated environment, where players must cooperate with each other across the DRR-CCA spectrum in order to overcome these obstacles and to make progress in developing the most effective policies, while safeguarding fictitious assets, cities and populations from a simulated disaster.

Teams were mixed in advance so that there arose natural linguistic barriers that had to be overcome to allow negotiations to continue. This was a true-to-life aspect of the scenario in that it reflected the experiences of all who took part, as well as divergent perspectives, coming from different governance backgrounds (and cultures). This was highly productive in ensuring objective and practical means of cooperation. Furthermore, a great deal of effort was expended in recording the motivations behind any decisions made.

Results were collected with regards to presenting which priorities are favoured by the stakeholders, exploring how barriers between the various groups may be removed or eased, and assessing how better policy and decision making may proceed when DRR and CCA perspectives align rather than conflict. Results inform and support policy recommendations made to the European Commission as a set of ESPREssO Guidelines (Lauta et al., 2018 [22]) and a Vision Paper (Zuccaro et al., 2018 [48]) for synergising CCA and DRR activities in future, helping to streamline Europe's collective resilience against disasters.

3.1. Simulating disasters: RAMSETE II

The main issues affecting managing transboundary crises can be summed up into three points when building conceptual game-play. The scenario frameworks for the exercise had to reflect these problems in order to trigger the desired conversations among stakeholders:

1. *Separation*: the exercise should reflect persisting trends in terms of different terminologies, separate institutions and scientific communities affecting the ability to create discussion spaces in which to improve transboundary policies.
2. *Competition*: the exercise should instil a sense of competing for funding and political will, creating the impression that synergies are difficult to find, particularly over a border region.
3. *Difficulties* regarding centralised versus de-centralised policies, particularly in light of differing cross-border priorities.

The setting for the RAMSETE II exercise was a fictitious border region with various assets placed in different locations (Fig. 1). The two countries share a common border with a high level of cross-border economic activity. The whole region is exposed to a range of natural hazards: earthquakes, floods, storms, as well as the potential for Natech (a technological event, e.g., chemical spill, triggered by a natural hazard) events, both chemical and radiogenic. The exercise sees the participants confronted with a series of extreme events, requiring some form of collaboration between the participating countries, as well as

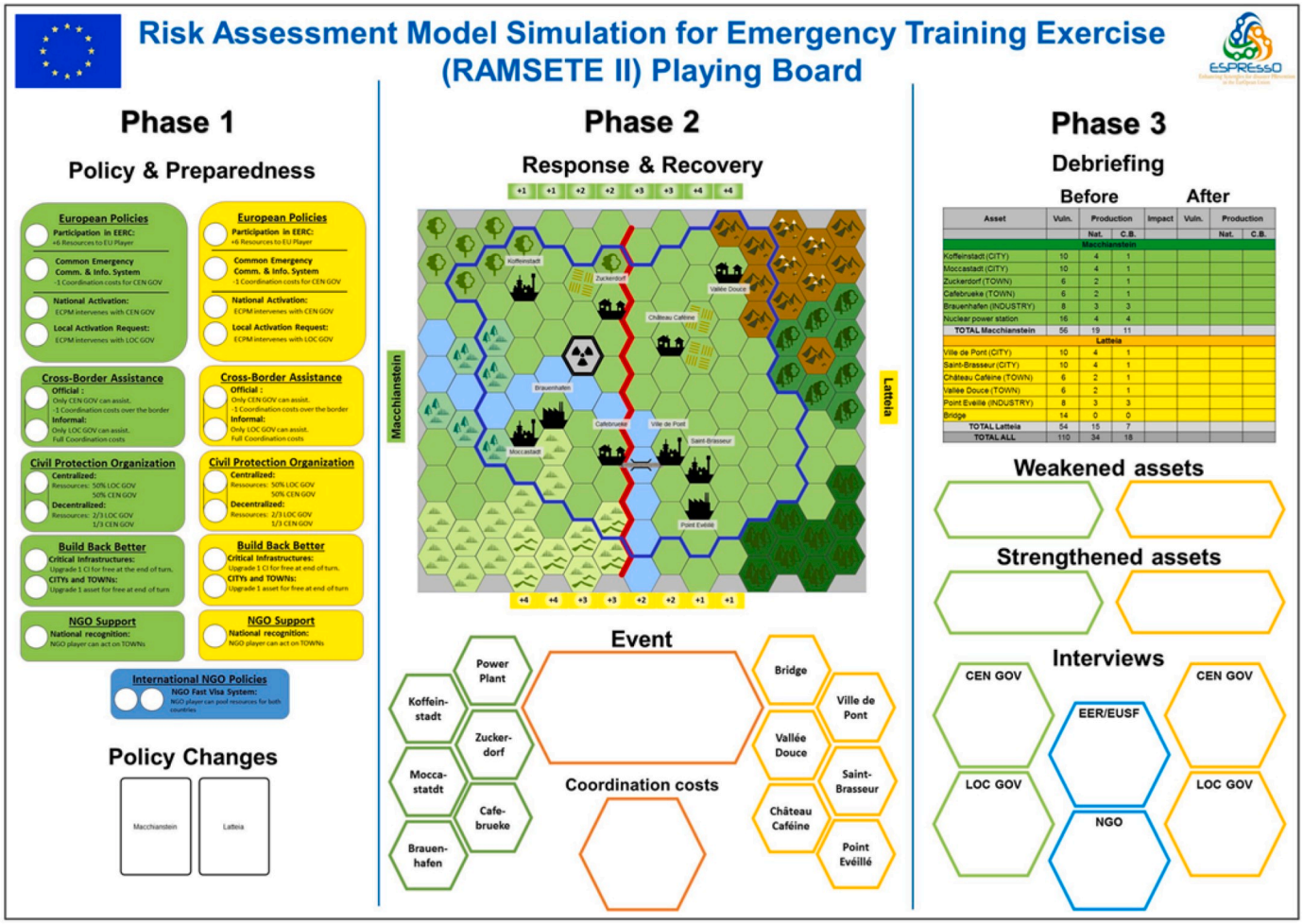

Fig. 1. The table sheet, or board used during the RAMSETE II exercise conducted in Zurich, Switzerland as part of the 2nd ESPREssO Think Tank. Note one sheet per round is used. The blank spaces are for either adding cards recording policy changes, spaces for explaining why certain decisions are made, and to denote the expenditure of resources, as well for describing the scenario event and marking the affected assets.

with NGOs and European mechanisms. Therefore, the importance of this exercise is the decisions made about what are the best policies to follow so as to deal with extreme events, while taking into consideration the other nation, including following a "build back better" policy.

The exercise involves three rounds, each dealing with a different disaster. Each round consisted of several phases: (1) Policy and preparedness, during which participants negotiated among themselves on how to best establish national and transboundary regulations for the most effective response to natural disasters. (2) Response and recovery, where an extreme event has occurred and the participants must deploy their resources to cope with the resulting damage to the affected assets. Again, this must be dealt with by employing not only the national resources, but also those of the NGO, the EU and, if possible or necessary, the neighbouring country. (3) Debriefing, where the participants are interviewed to determine their motivation for the decisions made, hence one of the more critical aspects of the exercise. It also allows the stakeholders to discuss the more 'realistic' situations given such circumstances in the real world (Fleming et al., 2019 [49]).

Each country was defined as initially having different civil protection organisation schemes, that is the choice between a centralised (e.g., France) or decentralized (e.g., Germany) system. There were also differing regulations for requesting or offering assistance during cross-border crises, and mechanisms by which NGOs and the EU could contribute. In addition, there was the need to consider the recovery phase, including the option of 'building-back-better'. The challenge to the participants was therefore how to best combine policies in order to make the best use of resources in order to safeguard their own territory, and to prevent the other country's crisis affecting theirs. The process of the game therefore saw the participants working within existing regulations, but then deciding on which ones to change where possible, which in turn involved the use of resources. However, negotiations between groups set out to ensure that this expenditure was worthwhile.

Reflective perhaps of real-world interactions, initial rounds took much longer to play than later rounds, as cooperation and practice built up through the game. Trust began to emerge which created a stronger platform for making best use of sectoral capacities in creating cross-border cooperation. Specific CCA-related and DRR-related activities, assets and actions were presented to the players during the policy-planning and response phases. Players were allowed to choose and debate strategies that they thought offered the best outcomes, either as individuals (representing a level of governance), or working together as a system.

4. Discussion: ESPREssO results and recommendations

Results reflect statements and recommendations made by the ESPREssO stakeholders during a one-day workshop split into two parts. This consisted of firstly, a team-based recording during playing of the game itself (3 teams of 6 players), capturing decisions and strategies on a pre-designed template. The game was designed so that each round, players would note their policies chosen, resources used and the relative "successes" and "failures" on the game board itself in a de-briefing session before moving on to the next round (Fig. 1).

In this manner, no interactions were missed and the evolution of the decision-making was recorded. This was followed by an secondary discussion session to further develop points in more detail with all attendees able to share ideas freely, no longer confined to their "game roles". This allowed a great deal of objectivity and some insightful reflections on how other sectors operate and prioritise (Fleming et al., 2019) [49]. We found that whilst diferent strategies were trialled by the players, the common themes to emerge from each team were consistent between the groups and are outlined as follows:

The first point raised by ESPREssO's CCA and DRR stakeholders is a call for proactive rather than reactive negotiation in the case of border zones. Transboundary crisis management is not something that can be readily improvised either within or between sectors. Structures and methods must be set in place well in advance, during times of normality. Proactivity also needs to take the form of strategic visions under which stakeholders are able to build on progress and retain flexibility to make long term decisions.

Results indicate an urgent need to bridge inter-sectoral and international terminologies in particular, to overcome language barriers and to align cultural priorities and policies in border zones; advancements which can be applied globally. Border zones ought to be regarded as unique policy arenas when streamlining preparation, response and recovery in times of disaster, to both circumvent the bureaucratic hurdles which currently hinder transboundary cooperation efforts and to avoid duplication of effort. Often what would seem an obvious and immediate benefit for combining strategies can be lost in translation or bureaucracy.

Where shared cultures exist across a border this seems to greatly strengthen transboundary resilience. Players that formed fair alliances early on, made better progress in later rounds, the ground work being essentially done. National and local governments and its population need firstly to be organised within each country in terms of strategy, tactics and operations, then EU (and NGO) support is easier to involve in more coordinated ways to best effect. Communication among each of those levels is therefore crucial. Some of the key points are explored below:

4.1. Role of non-governmental organisations (NGOs)

NGOs are often not included in formal crisis management (sometimes preferring not to be, desiring instead to maintain independence), in particular, their being excluded from the European coordination mechanism. Likewise, they are often not integrated into national response schemes, leading at times to inefficiencies and the duplication of efforts. Transnational NGOs (e.g. Red Cross and Red Crescent) have a useful role in particular for helping to fill the gap between national authorities.

However, the coordination of NGOs by national authorities may be important, given they may be quicker and more flexible than national governments and the EU. A strong presence at the local level may potentially strengthen the organisation itself, with the competences of national NGOs being expanded to support NGOs in local areas. NGOs do not take a holistic (multi-hazard) approach to strengthening resilience at the local level. Tensions and conflicts among different NGOs may exist, eg., competition for resources, differing interests and visions. However, competition between NGOs for recognition and visibility may also be positive in that it may motivate improved efficiency and best practices with regards to actions on the ground. It would therefore be important to experiment with new models of DRR governance that better include NGOs, particularly at local level.

4.2. Global-local objectivity (and vice-versa)

There ought to be greater synergies between local and global perspectives, (e.g. global perspectives amongst local level practitioners and a local level perspective at the global level). When objectivity is upheld towards the other end of the spectrum, policies have the greatest chance to succeed. Similarly, links between central and local governments first need to be robust-their relationship clearly defined, before effective engagement with satellite NGOs and with the European Commission can yield the most reward, creating a strong institutional framework. The Organisation for Economic Cooperation and Development (OECD) also recognises that intervention of a single agency cannot be evaluated in isolation from what others are doing, particularly as what might seem appropriate from the point of view of a single actor, may not be appropriate from the point of view of the system as a whole (OECD, 1999 [50]). Local government needs to take a shared global view and national governments need to retain an awareness of local issues. Encouraging state-level understanding of the issues faced by local and regional

practitioners in transboundary disasters is critical to moving forward, in ensuring they have the flexibility and reliability in seeking resources to deploy in times of crisis. This requires proactive, regular two-way exchange, perhaps via dedicated partnerships or platforms which can balance the interaction neutrally.

4.3. Local cross-border ownership of risk

There needs to be greater understanding and local ownership of a potential risk, from members of the public, at ground level. Building a common memory of disasters can be utilised in effective ways and the media have a strong role to play in this regard. CCA and DRR ESPREssO stakeholders note improving relations with media over time and these links often allow opportunities for inter-sectoral cohesion to develop. Showing damage and impact data of a disaster, in its immediate aftermath can influence public opinion and politicians most effectively at all governance levels. There is also a strong educational value in such efforts. There is a need to create shared disaster risk memory across borders, and not allowing this to become one-sided.

4.4. Standardisation of risk

Stakeholders in CCA and DRR require a common understanding of risk. While a view towards standardisation is inevitably beneficial, at the same time it is imperative that different standards are established per risk. Assessing all hazards and risks similarly is problematic. Blanket strategies by transboundary authorities are therefore to be treated with caution. This is proposed as a longer-term solution, as standards take a long time to become common practice, accepted by all sectors. Most of these issues can be circumnavigated by regular communication, which means when gaps do emerge, they are identified faster and steps can be taken to minimise them.

Standardisation of parameters in times of emergency are critical-warning thresholds for events such as a chemical spills, forest fires or flood levels should be consistent either side of a border. The fact that citizens on one side of a border might be warned in advance of the other side, due to varying critical warning thresholds, is inadequate and confuses joint preparation efforts. Equipment used and training qualifications recognised by transboundary authorities should be standardised and flexibly applicable to the neighbouring nation to ease transfer of resources if and when required.

4.5. Standardisation of data

Standardisation of data as an issue is not clear cut. Data has an economic value and strict laws exist on its exchange and management. Standardisation of data is undoubtedly crucial in managing any coordinated response, but different types and quality of data will emerge, depending on what kind of information is relevant to, or prioritised by, different authorities. If transboundary stakeholders are able to develop common policies attached perhaps to third party platforms for hosting and sharing data and resources, huge strides could be taken in terms of coordination at ground-level. With more research organisations beginning to opt for open datasets, this will go a long way to easing collaboration.

4.6. Communication

Communication, particularly in the presence of language barriers is a key issue. Visualisation and mapping were identified as useful tools to overcoming language barriers. However, even more important than how you say something, is the question of who is going to listen. Institutional channels of communication may not be symmetrical on both (or all) sides of a given border, creating mismatches in scope and response. The scope of the messages in particular was noted as a key aspect: it is very important that the right stakeholders receive the information they need in a way that they can understand and act upon it. Miscommunication problems often arise between two different political cultures. There may be strong public policies on both sides of a border, but the border area itself becomes a transitionary space, in which institutional frameworks might become blurred, or require strengthening in order to fully operate. This therefore requires extra communication (not less) and re-focussed efforts to alleviate issues in the most straightforward way [33].

4.7. Proactive governance and informal collaboration

Schiff (2017 [47]) credits the creation of spontaneous regimes in addressing *any* common purpose, as the best way to establish a shared history of governance among riparian actors themselves. Schiff (2017 [47]) urges that collaboration does not require a crisis, rather that actors identify their common issues and work to build organisations addressing those interests in a non-binding and informal way. The flexibility this approach entails is perhaps its greatest attribute in times of test. A transboundary network that can incorporate supportive informal or voluntary elements, is far more likely to succeed long-term, and be able to adapt as policy frameworks and political priorities change around them.

In a crisis, "informal" mechanisms are able to mobilise faster, with full knowledge of the pre-exising institutional mechanisms by which to begin to advance more intense coordination between formal or more strategic actors. As relevant as this is amongst local and regional actors, states can begin to build stronger networks of transboundary collaboration, using informal actors as a "glue" to mesh the statutory bodies. From these informal collaborations, emerge formal arrangements, most importantly with stronger more sustainable foundations.

This opinion is echoed amongst ESPREssO stakeholders, who emphasise that there is less urgency to have new regulations or directives at the EU level in transboundary crisis management, but simply support for bilateral local agreements on the common problems and tasks to be dealt with. They agree that it already works this way in many, but not all, cross-border regions depending on discrepancies between population size, resources, state intervention, past conflicts and competition between agencies, NGOs and citizen groups.

In a vacuum of regulation, it is sometimes easier to find informal agreements and collaboration. A view towards the need to agree on *tasks*, not on producing strategies is gathering momentum-ideally informal cooperation, based on local knowledge. Agreement on strategies tends to be often more difficult, or slower to achieve.

5. Conclusions

Bringing together CCA and DRR in transboundary settings, supports the recommendation that transboundary risks should be proactively defined clearly and evaluated, where possible, in advance of when crises occur. Both CCA and DRR stakeholders need to have an understanding of their various requirements in coordinating actions, in order to harmonise actions, supported by a flexible governance structure that is unique to a cross border region.

A "special" kind of governance which means a cooperative space is needed prior to any legislation being drawn on in times of disaster. Partnerships are working proactively to achieve this across Europe and informal cooperation must be championed, supported and extended to other border regions where models are working. Lessons learned must be translated and the "value" of voluntary and informal contributions be properly counted, particularly in terms of communicating with local populations and promoting local ownership of risks.

Policies and practice set within a country ought to retain enough flexibility to adapt to situations where sovereignty or limits of jurisdiction cease-i.e. where "lines on maps" do not always align to, or fit to threat parameters in reality. Greater integration and a broader objectivity between CCA and DRR stakeholders can greatly assist this approach and will emphasise the need to invest more resources in

informal cooperation to promote renewed recognition for the benefits of collective, integrated decision-making and pooling of knowledge and resources in tackling common threats.

Standardisation of data, or terminologies, while key in developing cross-border response, must not dilute, merge or override specific knowledge in assessing impacts of hazards in different geographical and political settings. Whilst consistency is key, so too is reflecting the character of the particular border zone region so there is a fine balance to be struck by all involved actors in this regard.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The work presented in this paper was undertaken as part of the ESPREssO project (grant agreement 700342) supported by the European Union's Horizon 2020 research and innovation programme under the topic DRS-10-2015: Disaster Resilience and Climate Change topic 2: Natural Hazards: Towards risk reduction science and innovation plans at national and European level. ESPREssO partners would like to thank all stakeholders for their input to the project.

References

[1] F. Sperling, F. Szekely, Disaster risk management in a changing climate, in: World Conference on Disaster Reduction on Behalf of the Vulnerability and Adaptation Resource Group, Washington, DC, USA, 2005.
[2] P. Venton, S. La Trobe, Linking Climate Change Adaptation and Disaster Risk Reduction, Tearfund, London, 2008.
[3] L. Schipper, M. Pelling, Disaster risk, climate change and international development: scope for, and challenges to, integration, Disasters 30 (2006) 19–38.
[4] T. Mitchell, M.K. van Aalst, Convergence of Disaster Risk Reduction and Climate Change Adaptation, Rev. DFID (2008) 1–22.
[5] M. Helmer, D. Hilhorst, Natural disasters and climate change, Disasters 30 (2006) 1–4.
[6] J. Mercer, Disaster risk reduction or climate change adaptation: are we reinventing the wheel? J. Int. Dev. 22 (2010) 247–264.
[7] Council of Europe United Nations Office for Disaster Risk Reduction- Regional Office for Europe, Climate Change Adaptation and Disaster Risk Reduction in Europe, 2011, p. 73p.
[8] UNISDR, Adaptation to climate change by reducing disaster risks: country practices and lessons, Brief. Note (2009), 02.
[9] F. Thomalla, T. Downing, E. Spanger-Siegfried, G. Han, J. Rockstrom, Reducing hazard vulnerability: towards a common approach between disaster risk reduction and climate adaptation, Disasters 30 (2006) 39–48.
[10] UNISDR, UNDP, Disaster Risk Reduction and Climate Change Adaptation in the Pacific: an Institutional and Policy Analysis, UNISDR, UNDP, Suva, Fiji, 2012, p. 76pp.
[11] United Nations, Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, 22 January 2005, A/CONF.206/6, 2005. Available at: http://www.unhcr.org/refworld/docid/42b98a704.html. (Accessed 2 April 2020).
[12] UNISDR, Sendai Framework for Disaster Risk Reduction 2015 - 2030, 2015. Retrieved from Geneva Switzerland, http://www.preventionweb.net/files/43291_sendaiframework fordrren.pdf.
[13] A. Gero, K. Meheux, D. Dominey-Howes, Disaster risk reduction and climate change adaptation in the Pacific: the challenge of integration, Miscellaneous Report 4, in: Australian Tsunami Research Centre– Natural Hazards Research Laboratory, University of New South Wales, Sydney, 2010 [available at, www.nhrl.unsw.edu.au/research/projectddrcca.html.
[14] Global Assessment Report on Disaster Risk Reduction, United Nations, Geneva, Switzerland, 2011.
[15] A. Boin, M. Rhinard, Managing transboundary crises: what role for the European Union? Int. Stud. Rev. 10 (2008) 1–26.
[16] A. Boin, M. Busuioc, M. Groenleer, Building European Union capacity to manage transboundary crises: network or lead-agency model, Regul. Governance 8 (4) (2013) 418–436, https://doi.org/10.1111/rego.12035.
[17] J. Abad, L. Booth, S. Marx, S. Ettinger, F. Gérard, Comparison of national strategies in France, Germany and Switzerland for DRR and cross-border crisis management, Procedia Eng. 212 (2018) 879–886, https://doi.org/10.1016/j.proeng.2018.01.113.
[18] L. Booth, A. Scolobig, J. Jorin, Swiss National Report. Synthesis Report of Legal, Policy and Science Approaches within the Frame of Disaster Risk Reduction and Climate Change Adaptation, 2017. Submitted as part of ESPREssO Deliverable 2.1. Available online: www.espressoproject.eu/.
[19] Dominik Braunschweiger, Marco Pütz, Heidmann Frank, Mark-Jan Bludau, Mapping governance of adaptation to climate change in Switzerland, Regional Studies, Reg. Sci. 5 (1) (2018) 398–401, https://doi.org/10.1080/21681376.2018.1549507,D.
[20] D. Amaratunga, R. Haigh, N. Dias, C. Malalgoda, Synthesis Report of Existing Legal, Policy and Science Approaches in Relation to DRR and CCA, 2017. ESPREssO Deliverable 2.1. Available online: www.espressoproject.eu/.
[21] European Environment Agency Report, Regional Climate Change and Adaptation. The Alps Facing the Challenge of Changing Water Resources, 2009, 8/2009, EEA Report: 1-148. Copenhagen.
[22] K.C. Lauta, K. Albris, G. Zuccaro, G. Grandjean (Eds.), ESPREssO Enhancing Risk Management Capabilities Guidelines, 2018 (Project Deliverable 5.4). Available online: www.espressoproject.eu/.
[23] C. Brethaut, G. Pflieger, The shifting territorialities of the Rhone River's transboundary governance : a historical analysis of the evolution of the functions, uses and spatiality of river basin governance, Reg. Environ. Change 15 (3) (2015) 549–558.
[24] L. Booth, A. Patt, The Push for Proactive Climate Adaptation in Europe. Current History Magazine, Changing with the Climate: A Current History Anthology, Kindle e-book, 2018, pp. 35–40.
[25] ICPDR, International Commission for the Protection of the Danube River. Climate Change Adaptation Strategy, 2018. Available online, https://www.icpdr.org/flowpaper/app/#page=1.
[26] United Nations, Economic Commission for Europe. Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Guidance on Water and Adaptation to Cliimate Change, 2009, ISBN 978-92-1-117010-8. ECE/MP.WAT/30.
[27] ICPR, Action Plan on Floods. Kurzfassung Bericht Nr. 156, International Commission on the Protection of the Rhine, Koblenz, Germany, 2005, 2005a.
[28] 2020 Rhein, Programme on the Sustainable Development of the Rhein, International Commission for the Protection of the Rhein, 2001, ISBN 3-935324-38-3. Printed May, 2001.
[29] ICPR, Rhein Atlas (2001). Atlas of Flood Danger and Potential Damage Due to Extreme Floods of the Rhine, International Commission on the Protection of the Rhine, 2001. Koblenz, Germany, available at: http://www.iksr.org/.
[30] European Commission, Water Framework Directive 2000/60/EC, 2000.
[31] European Commission, The EU Floods Directive [Online], 2017. Online: European Comission Available: http://ec.europa.eu/environment/water/flood_risk/implem.htm.
[32] S. Marx, G. Barbeito, K. Fleming, B. Petrovic, A. Thieken, ESPREssO Deliverable: Synthesis Report on Disaster Risk Reduction and Climate Change Adaptation in Germany, 2017, 2017.
[33] A critical approach to international water management trends, in: C. Brethaut, R. Schweizer (Eds.), Palgrave Stud. Water Governance: Pol. Pract. (2018) 71–95, https://doi.org/10.1057/978-1-137-60086-8_4.
[34] T.A. Birkland, After Disaster: Agenda Setting, Public Policy, and Focussing Events, Georgetown University Press, Washington, D.C, 1997.
[35] T.A. Birkland, Focussing events, mobilization, and agenda setting, J. Publ. Pol. 18 (1) (1998) 53–74.
[36] J.W. Kingdon, The policy window, and joining the streams, Agendas, Altern. Public Pol. (1995) 172–189.
[37] A. Earle, E. Cascao, S. Hansson, A. Jagerskog, A. Swain, J. Ojendal, Transboundary water management and the climate change debate, Earthscan Stud. Water Resour. Manag. (2015) 182.
[38] ENTRO, Nile-Flow: A Quarterly Newsletter of the Eastern Nile Technical Regional Office, September 2011, Eastern Nile Technical Regional Office, Entebbe, 2011.
[39] J. Warner, N. Zawahri, Hegemony and assymetry: multiple chessboard games on transboundary rivers, Int. Environ. Agreements Polit. Law Econ. 1–15 (2012) 215–229.
[40] K. Levin, B. Cashore, S. Bernstein, G. Auld, Overcoming the tragedy of super wicked problems. Constraining our future selves to ameliorate global climate change, Pol. Sci. 45 (2) (2012) 123–152.
[41] F. Varone, S. Nahrath, D. Aubin, J.-D. Gerber, Functional regulatory spaces, Pol. Sci. 46 (4) (2013) 311–333.
[42] A. Schwabach, The Sandoz spill: the failure of international law to protect the Rhein from pollution, Ecol. Law Q. 16 (1989), 443 (1989).
[43] W. Tuohy, Four Nations Try to Cope as Rhein Spreads Spilled Chemicals, Los Angeles Times, 1986. November 13th, 1986. Part 1.
[44] A. Boos-Hersberger, Transboundary water pollution and state responsibility: the Sandoz Spill, Ann. Surv. Intl' and Comp. L 103 4 (1997).
[45] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1989. Adopted on 22 March 1989. Legal Citation: 1673 UNTS 126; 28 ILM 657 (1989).
[46] O. Young, International Governance: Protecting the Environment in a Stateless Society, Cornell University Press, New York, 1994.
[47] J.S. Schiff, The evolution of Rhine river governance: historical lessons for modern transboundary water management, Water Hist. 9 (2017) 279–294, https://doi.org/10.1007/s12685-017-0192-3, 2017.
[48] G. Zuccaro, M.F. Leone, C. Martucci, G. Grandjean, K.C. Lauta (Eds.), ESPREssO Vision Paper on Future Research Strategies Following the Sendai Framework for

DRR 2015-2030, 2018 (Project Deliverable 5.5). Available online: www.espressoproject.eu/.
[49] K. Fleming, J. Abad, L. Schueller, L. Booth, A. Baills, A. Scolobig, Bojana Petrovic, G. Zuccaro, M. Leone, The use of serious games for information elicitation from Disaster Risk Reduction and Climate Change Adaption stakeholders, in: General Assembly 2019 of European Geosciences Union, vol. 21, 2019. EGU2019- 13926.
[50] Organisation for Economic Development and Cooperation (OECD), Guidance for Evaluating Humanitarian Assistance in Complex Emergencies, OECD, Paris, 1999.