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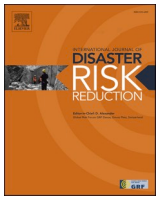

Disaster risk reduction and the limits of truisms: Improving the knowledge and practice interface

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ABSTRACT

Action toward strengthened disaster risk reduction (DRR) ideally builds from evidence-based policymaking to inform decisions and priorities. This is a guiding principle for the Sendai Framework for Disaster Risk Reduction (SFDRR), which outlines priorities for action to reduce disaster risk. However, some of these practical guidelines conceal oversimplified or unsubstantiated claims and assumptions, what we refer to as '*truisms*', which, if not properly addressed, may jeopardize the long-term goal to reduce disaster risks. Thus far, much DRR research has focused on ways to bridge the gap between science and practice while devoting less attention to the premises that shape the understanding of DRR issues. In this article, written in the spirit of a perspective piece on the state of the DRR field, we utilize the SFDRR as an illustrative case to identify and interrogate ten selected truisms, from across the social and natural sciences, that have been prevalent in shaping DRR research and practice. The ten truisms concern forecasting, loss, conflict, migration, the local level, collaboration, social capital, prevention, policy change, and risk awareness. We discuss central claims associated with each truism, relate those claims to insights in recent DRR scholarship, and end with suggestions for developing the field through advances in conceptualization, measurement, and causal inference.

1. Introduction

The Covid-19 pandemic, massive wildfires in Australia, California, and the Amazon, as well as other recent hazard events, dramatically illustrate the disruptive impact of disasters on countries around the world. These threats underscore the profound importance of sound evidence-based policies for disaster risk reduction (DRR) to mitigate hazard losses, build disaster resilience, and contribute to sustainable development. To this end, in 2015, the United Nations General Assembly endorsed the Sendai Framework for DRR [1] (SFDRR), a global successor agreement to the Hyogo Framework, which aims to reduce and avert disaster risks across the globe. The SFDRR stresses that DRR policies should be informed by science to guide priorities and decisions, as illustrated by its first priority of 'understanding disaster risk'. The scientific community has stepped up to the challenge, and DRR today constitutes a vibrant area of interdisciplinary scholarship [2–4].

Critics have argued that the SFDRR set ambitious goals that are unrealistic given that it is a non-binding framework. Other gaps concern the relationship between climate change adaptation and DRR, and insufficient attention to systemic risk [5]. Due to these and other gaps, it has been claimed that the SFDRR is unlikely to make use of cutting edge DRR science, which has led to suggestions for alternate measures to strengthen the science-policy interface in DRR [6]. But previous literature has also pointed to substantial hurdles that prevent further progress in knowledge production and the use of science to support the implementation of DRR measures around the world [5,7]. One issue is that the

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DRR research 'field' is fragmented and divided into distinct disciplines focusing on single hazards, reducing the ability to generate widely applicable knowledge to influence policy effectively [8]. In addition, variations in the use of key concepts and methodological approaches across disciplines pose another challenge to collective understandings and mutual learning [9]. Earlier works [10] have discussed strategies for overcoming these challenges, including, e.g., multi-disciplinarity, a holistic understanding of disaster risk management, science-sharing globally, and knowledge co-production.

The United Nations Office for Disaster Risk Reduction (UNDRR), to its credit, is interested in utilizing the knowledge and practice interface to inform DRR policy and practice. This interface, as conceived by the UNDRR, consists of a close and continuous exchange between DRR policymaking and research in different fields, which is urgently needed to develop effective and durable solutions [11].

In our view, these efforts, albeit important and laudable, suffer from two related problems. First, the lion's share of the attention about to how to better use science in DRR has concentrated on knowledge communication strategies while comparatively less attention has been devoted to claims undergirding actual DRR policy guidance. Second, the simplified way selected claims from research are often translated into policy documents and outputs, demonstrates shortcomings in how the DRR knowledge and practice interface has worked in reality.

In this article, written in the spirit of a perspective piece, we argue that strategies for enhancing researcher-practitioner dialogues in DRR need to be accompanied by more targeted efforts by the research community to identify and critically review the foundational claims and assumptions that shape the understanding of DRR issues. Thus, using the SFDRR as an illustrative case, we ask: what core assumptions guide current DRR policy and practice and what is the scientific basis of those assumptions? By spotlighting these claims, which we identify throughout the SFDRR, the objective is to interrogate and scrutinize a number of selected truisms that have been prevalent in DRR research and practice. We conclude by briefly highlighting some promising avenues that we think are crucial for advancing new knowledge and, in turn, may be better able to strengthen the DRR knowledge and practice interface.

2. Ten truisms in the Sendai Framework for Disaster Risk Reduction

Despite advances in DRR scholarship, DRR discourse is still influenced by several core, and often oversimplified, claims, including prescribed solutions to reduce risks and enhance responses as well as common assumptions about impacts on nature and society. We describe these (over)simplified axioms, often uncritically imported from scholarship into DRR policy documents and received wisdom, as *truisms*. Some of these solutions derive from premises that are, while not necessarily wrong, surrounded by scientific uncertainty. If such truisms are simply accepted at face value, they may result in misleading policy guidance, ineffective and even counterproductive policy interventions. DRR research and practice, therefore, collectively needs to widen the perspective beyond policy panaceas [12] and unpack the complex, multivariate, and non-linear relationships characterizing vulnerability, risk, and disaster response. Here we departed from the central elements of the SFDRR (Box 1) in an effort to identify and exemplify truisms about DRR and discuss ways to advance new and necessary knowledge about their associated phenomena. We have utilized the expert knowledge of our multidisciplinary Centre of Natural Hazards and Disaster Science (CNDS) team to pinpoint core principles and relevant truisms from our respective fields that manifest themselves in the SFDRR. This enterprise is unavoidably subjective due to the different lenses, interests, and experiences of scholars. Moreover, what claims should be sorted under the DRR label is also open to interpretation, given its broad definition and overlap with climate adaptation and sustainable development agendas [13,14]. With these caveats in mind, we reviewed the guiding principles and the four priorities for action of the SFDRR in an effort to pinpoint recurrent assumptions and premises about the drivers and consequences

Box 1
Elements of the Sendai Framework for disaster risk.

Guiding Principles (Section III, p. 13–14)

Total of 13 principles guiding the implementation of the Sendai Framework. Including, e.g., responsibilities of governments, authorities, sectors, and stakeholders (principle b), and the importance of coordination mechanisms in achieving DRR (principle e).

Priorities for action 1–4 (Section IV, p. 14–24)

Priority for action 1 – Understanding disaster risk

Measures to enhance the understanding of, e.g., vulnerability, capacity, and exposure of persons and assets.

Priority for action 2 – Strengthening disaster risk governance to manage disaster risk

Importance of, e.g., collaboration and partnerships to strengthening governance for prevention, mitigation, preparedness, response, and recovery.

Priority for action 3 – Investing in disaster risk reduction for resilience

Public and private measures to enhance economic, social, health and cultural resilience of persons and assets through, e.g., innovation, growth, and job creation.

Priority for action 4 – Enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation and reconstruction

Efforts to prepare response and recovery ahead of disaster by, e.g., integrating DRR into development measures.

of disasters.

Specifically, we set out to link the guiding principles (section III), including responsibilities and suggested practices for reducing disaster risk, and each of the four priorities for action (section IV) to central themes in DRR research. This resulted in the identification of ten selected areas related to forecasting, loss, conflict, migration, the local level, collaboration, social capital, prevention, policy change, and risk awareness. For example, among the 13 Guiding principles in the SFDRR (principles 19a-m, p. 13–14), nine make references to five of the claims highlighted in this study, including: Collaboration reduces disaster risk (19b,d,e); The centrality of the local level (19i,f); DRR has become more proactive (19j); Disasters open opportunities for policy change (19k); and Social capital enhances resilience (19d). Table 1 details the linkages between each truism and the corresponding Sendai framework segment. The ten truisms are not exhaustive, although they represent a selection of core topics central to the SFDRR and the DRR literature. Some of these claims (e.g., calls for collaborative approaches for reducing disaster risk) are explicit and directly linked to established streams in the academic literature. In contrast, other claims (related to, e.g., forecasting and conflict) are more broadly defined and loosely coupled with specific research areas in the DRR field. Several claims (e.g., 'social capital enhances resilience') are limited to one area of the SFDRR, whereas, others receive broader recognition across several areas (e.g., 'collaboration reduces disaster risk'). Fig. 1 visualizes linkages between each truism and the SFDRR elements.

Table 1
Linkages between truisms and Sendai framework segments.

Truism	Sendai framework segment
Multiple hazards can be dependably forecasted	Priority 4: Enhance disaster forecasting and early warning
Knowledge of disaster losses is increasing uniform	Priority 4: Involve relevant institutions to review disaster preparedness plans (33a); promote cooperation of diverse institutions in reconstruction (33i)
Natural hazards lead to armed conflicts	Priority 2: Promote cooperation around shared natural resources (28d)
Natural hazards trigger migration flows	Priority 2: Local authorities work with migrants in disaster risk management (27h)
The centrality of the local level	Guiding principles: Risk drivers have local characteristics (19i), empower local actors (19f) Priority 1: Ensure use of local knowledge (24i); Priority 2: Local strategies (27c) and capacity (27c); empower local authorities (27h); Priority 3: Cooperation between scientific entities and private sector networks (31c); Priority 4: Strengthen evacuation capacity of local authorities (33 m)
Collaboration reduces disaster risk	Guiding principles: Shared responsibility (19b), society engagement (19d), coordination (19e); Priority 1: Share experience, lessons, practices (24g); enhance collaboration (24o); Priority 2: Strengthen coordination forums (27g); foster local coordination (27h); Priority 3: Coordination between financial institutions (31d); cooperation between health authorities and stakeholders (31e); collaboration and capacity-building to protect productive assets (31f); among public and private stakeholders to enhance the resilience of business (31i)
Social capital enhances resilience	Guiding principle: Inclusive participation, civic leadership, voluntary work of citizens (19d)
DRR has become more proactive	Guiding principle: Addressing risk factors is more cost-effective than response and recovery (19j); Priority 1: Promote a culture of prevention (24f); Priority 2: Formulate public policies to address prevention (27k)
Disasters facilitate opportunities for change	Guiding principle: Build Back Better after disaster recovery to reduce risk (19k); Priority 4: Use opportunities in the recovery phase to develop risk reduction capacity (33j)
Raising awareness increases preparedness	Priority 1: Strengthen public awareness (24 m); Priority 2: Foster public awareness-raising (27a); public awareness campaigns (27g); Priority 4: Establish community centers to promote public awareness (33d)

3. Multiple hazards can be dependably forecasted

The SFDRR promotes multi-hazard forecasting and early warning systems. Yet, while most natural processes underlying multiple hazards are relatively well understood, reliably forecasting them is far from possible. This is true even when using forecasting very broadly to span deterministic and probabilistic forecasts at multiple timescales, as well as plausibility predictions for long-term future scenarios. Indeed, while uncertainty estimates and other scenario-imaging techniques may aid in delineating an envelope of possible but unlikely future events, it is chimeric to believe that these may capture the full range of physically allowed occurrences (see Glantz, 1998 [15], and Street and Glantz, 2000 [16], for a discussion of unexpected environmental events). The list of natural processes that we can observe, but cannot reliably forecast, is very long [17,18]. It is also the case that most of the so-called 'natural hazards' cannot be considered exclusively natural. Human societies increasingly influence floods [19,20], landslides [21], droughts [22], wildfires [23], heatwaves [24], and earthquakes [25].

Moreover, compound and cascading events often generate the most severe impacts, due to a unique combination of drivers and/or hazards (e.g., strong winds and volcanic ash) [26]. Even by attempting to account for the complex interdependencies between climate drivers and/or multiple hazards, the occurrence of compound and cascading events is only partly foreseeable [27,28]. To better support and inform policy and decision-makers involved in DRR, there is a need for a continuously updated synthesis of the scientific knowledge of multiple hazards. Specifically, the boundary between what we (still) do not know and cannot forecast and what we can forecast with some (quantifiable) uncertainty shifts rapidly as the underlying science progresses, and only a concerted and continuative effort by the relevant research communities can produce a policy-oriented up-to-date evaluation of this boundary.

4. Knowledge of disaster losses is increasing uniform

One aim of disaster risk reduction is to prevent future disaster losses, and one of the Sendai framework's overarching goals is to substantially reduce disaster risk and losses by 2030. The framework sets measurable targets related to this goal. During the last decades, official reports repeatedly announced that reported disaster losses, including fatalities, people affected, and economic damages, have increased [29]. While losses have indeed increased in absolute numbers, other studies suggest that global and regional average disaster losses have remained constant or decreased after normalization (accounting for increases in population, economic activity, and wealth), pointing to a potential reduction in overall vulnerability [30–32]. Yet, these global or regional averages may conceal local vulnerabilities. For example, in some areas, disaster losses are increasing faster than damage reduction can be achieved [30]. Comparing spatial and temporal trends of disaster losses is also impeded by the lack of standardized procedures for monitoring and collecting disaster loss data between or even within countries [8]. Thus, to meet future global targets in disaster risk reduction—including measurable indicators of disaster losses—the collection, analysis, and management of disaster loss data need to be better differentiated and carefully contextualized.

5. Natural hazards lead to armed conflicts

Natural hazards are often portrayed as a driver of war, violence, and destruction. For example, the conflict in Darfur in Sudan in the early 2000s was declared the first 'climate war', and reports attribute the ongoing Syrian conflict to a devastating drought [33,34]. However,

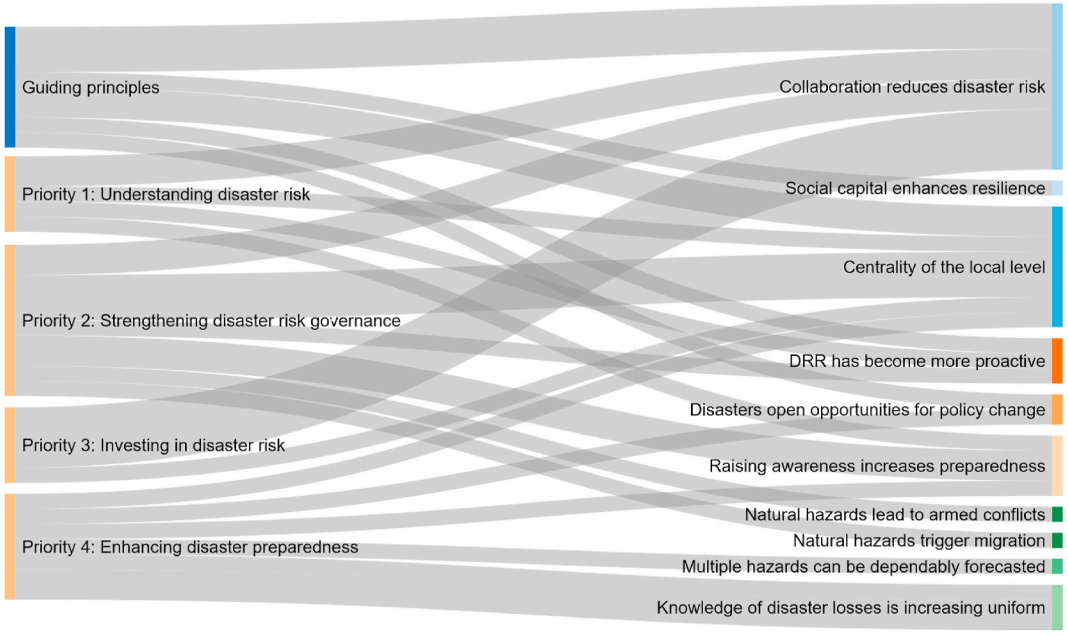

Fig. 1. | Illustration of research focus areas within the Sendai Framework for Disaster Risk Reduction (SFDRR) guiding principles and priority for action areas. Links show the connections between the SFDRR guiding principles and priority for action areas (left-hand side) and prescriptive DRR claims (right-hand side). Flow width indicates the absolute number of SFDRR principles and priorities linked to each claim, with greater width representing links to more principles and priorities (links detailed in Table 1). Diagram created using SankeyMATIC.

global headlines at times have moved beyond the academic evidence. There is indeed evidence that suggests natural hazards tend to increase rather than decrease the risk of armed conflict. However, where natural hazards play a role, they tend to be a contributing factor, rather than the main driver of internal armed conflict [35,36].

Similarly, while disasters may shape diplomatic efforts to end conflict, their impact tends to be short-lived and comparably minor [37,38]. Collectively, research points to low economic development, reliance on agricultural livelihoods, as well as the political and social marginalization of affected groups as conditions that moderate the natural hazard - armed conflict link [39–41]. Governance is crucial, too. Where political institutions are weak, disputed, or corrupt, their capacity to efficiently to handle grievances and disputes following droughts is hampered [39,42]. Many open questions remain, however, in particular concerning future changes. Two areas in urgent need of further study are compound effects from different hazards and assessing future climate change impacts [43].

6. Natural hazards trigger migration flows

Large numbers of people are predicted to be displaced by natural hazards in the coming decades. Recent assessments indicate that Sub-Saharan Africa, South Asia, and Latin America could see more than 140 million people move within their countries' borders by 2050 without climate action [44]. However, there is great uncertainty about these figures as migratory decisions are usually complex processes shaped by the evolution of other non-environmental factors such as economic, political, and social drivers [45]. Environmental factors contribute to migration, but their effect generally operates through other socioeconomic factors such as the search for improved living standards. In that sense, natural hazards can be cited as the main driver for migration, which is rooted in historical inequalities between groups on national and international levels [46]. Actual figures will also depend on climate change scenarios and adaptation strategies, significantly reducing the expected number of climate migrants [47]. Consequently, some scholars have called for a more careful framing of migration as a strategy that enhances communal resilience [48]. By moving outside of risk areas and accessing labor markets in new destinations, migrants can also remit money home, which has also been shown to contribute to household poverty reduction [49]. In addition to further studying these relationships, it will be equally important to further investigate instances when people are unable or unwilling to move away from exposure to natural hazards.

7. The centrality of the local level

It is an article of faith among many practitioners and scholars that the local level should be a central, or even the primary, focal point for DRR, community resilience, and crisis management. Guided by the conventional wisdom that 'disasters begin and end at the local level' [50], in most systems, disaster management is organized according to the 'principle of disaster subsidiarity' [51]. This practice is guided by the belief that local authorities are best situated to plan for and manage emergencies in their geographical area. Advocates of community resilience also emphasize the importance of local knowledge and expertise for risk assessment and argue that the capacity for disaster mitigation and resilience should be at the local level [52–55]. The Sendai framework acknowledges the centrality of the local level in its guiding principles and targets, stating that 'it is necessary to empower local authorities and local communities to reduce disaster risk, including through resources, incentives and decision-making responsibilities, as appropriate' (p.13). While it is clear that the local level is important to the all-of-society approach to DRR recommended by Sendai, there is a lack of well-founded research on what the appropriate default relationship between the local and other levels should be [56–58]. Forging agreement about when higher authorities should get involved, what form their involvement should take, and how they should relate to actors at lower levels of authority is challenging and requires more systematic research if meaningful guidance is to be provided for making this work in practice.

8. Collaboration reduces disaster risk

The SFDRR recognizes that effective DRR requires collaboration among diverse public and private stakeholders. It points to the state's

leading responsibility for DRR along with an 'all-of-society' approach, including coordination across sectors, jurisdictions, and levels of authority. Scientific literature similarly elevates the merits of collaborative governance, involving multiple stakeholders working together to define and address transboundary problems [59–61]. However, the literature also recognizes barriers to realizing this ideal, including difficulties to build institutions to sanction self-interested behavior [62]. DRR has several features that challenge collaboration. First, in the absence of clear performance benchmarks, collaborative effectiveness remains diffuse, subjective, and difficult to measure [63]. Second, it can be challenging for organizations to justify short-term economic, organizational, and human capital investments in joint efforts to address long-term, low-probability problems [64]. Indeed, there are examples of multi-stakeholder DRR projects that succeed in establishing broad participation and joint commitments, but challenges remain to, for instance, involve grass-root organizations and achieve integration with climate adaptation initiatives [65–69]. Third, DRR is a field dominated by experts, with limited public insight and interest, and low political conflict, which provides few incentives for collaboration to redress minor harms and mobilization for tackling low-probability, high--consequence events [70]. Fourth, effective DRR involves balancing preparedness for specific contingencies with an 'all hazards' approach covering any possible event [71]. These features complicate the identification of relevant stakeholders and create a complex 'ecology' of overlapping collaborative arrangements, creating coordination problems across networks [72]. The complexity of these arrangements and their relationships increases further if one takes into account that vulnerability is shaped by a variety of long-term processes associated with poverty, inequality and risk [73]. Enhancing understanding of these polycentric arrangements and their associated drivers and outcomes is thus an essential avenue for future research.

9. Social capital enhances resilience

A number of the SFDRR's guiding principles and objectives, such as inclusive participation, community resilience and mobilization, and enhancing social safety nets at the community level, recognize the value of social capital. Social capital consists of social networks and relationships among individuals [74]. Empirical research identified that, in the face of disaster, social capital can increase individuals' access to physical and social resources and can speed up community recovery [75]. This association has sometimes been framed as social capital strengthening community resilience. Consequently, some NGOs have called for the systematic inclusion of social capital in resilience projects [76,77], and it has been embraced as a 'missing link to disaster recovery' [78]. However, while access to social capital can strengthen resilience for some, a lack of social capital can be a driver of vulnerability for others, as has been rightfully and repeatedly stressed by multiple scholars [79,80]. Existing networks are often not accessible to the most vulnerable, and social inequality puts some groups at a disadvantage, preventing them from building beneficial networks [74], which can lead to discrimination against marginalized groups in post-disaster aid distribution [75]. However, research pursuing more critical approaches to social capital has not yet received sufficient attention from DRR policymakers and NGOs. To enable DRR practitioners and scholars to take advantage of the critiques of social capital, a better empirical understanding is needed about building inclusive social networks that actively help vulnerable and marginalized groups access the benefits of social capital for disaster resilience while not harming them.

10. DRR has become more proactive

Several policy documents in DRR argue for a paradigm shift from response-driven approaches (*managing disasters*) to integrated approaches (*managing risk*) [81–83]. Concurrently, a large body of research has shown that response-driven measures do not only often lead to negative effects for the environment and high maintenance costs, but they can also backfire in the long term, for instance, by enabling population increases in hazardous locations [84]. Yet, evidence suggests that reactive measures still remain the favorite option for decision-makers as well as the local population affected by disastrous events [85]. For example, after a flood event, repairing, strengthening, and raising levees are more popular than, e.g., relocating people living in flood-prone areas. 'Once structural protection is built, development tends to increase behind it, amplifying motivation for its continuation' [86]. We argue that one obstacle to achieving the paradigm shift toward proactive measures is that the actual benefits of integrated approaches, which aim to reduce social vulnerability and risk, are still to be fully demonstrated. Hence, more research is needed to uncover the benefits of integrated approaches.

11. Disasters facilitate opportunities for change

The SFDRR portrays disasters as opportunities to draw lessons and build resilience by integrating DRR into development and 'build back better'. Moreover, popular wisdom holds that decision-makers will engage in learning, fix problems, and take action to avoid mistakes in the future. The transformative potential of disasters is also emphasized across several research fields. However, studies also suggest that disruptive crisis events may feed defensive behavior, reaffirm pre-existing orders, and implementation gaps [87]. Recent work involving 85 countries indicates that natural hazard events are unassociated with efforts to strengthen DRR [88]. Meanwhile, this research area requires more robust empirical research. Disasters have the potential to build pressure for change, raise public consciousness of risks and response gaps, and provide legitimacy for governmental decision-making. Yet, learning, policy change, and institutional renewal depend on several intermediate factors, including policy entrepreneurship, advocacy, power, agenda-setting, framing, blaming, and accountability [89,90,91]. Learning and change have also been attributed to repeated events that gradually build public pressure for policy-makers to 'do something', and single high-magnitude events whose impacts on society cannot be ignored [92]. But repeated events may also plunge societies into a vicious circle of recovery actions, which inhibit long-term proactive measures [88]. These insights mainly derive from single or comparative case studies using different conceptions of learning and change, which constrains cross-case comparison. Systematic empirical research is needed to get a better overview of patterns of stability and change across cases and scales.

12. Raising awareness increases preparedness

Public campaigns to raise risk awareness are a central focus of the SFDRR. It is often assumed, also in policy documents [93,94], that awareness-raising campaigns translate into adopting precautionary measures. In contrast, a large body of research in risk perception has shown that the interplay between risk awareness and preparedness is rather complex [93–101]. Wachinger et al. [94] reviewed several studies and found that higher levels of risk awareness were not necessarily associated with higher levels of preparedness. Numerous factors come into play, including actual losses related to the direct experience of extreme events [95,96], trust in authorities and experts [97], and levels of social capital [98,99]. While these studies have advanced our understanding of the complex interplay between risk awareness and preparedness, they were based on single surveys in the wake of major disasters. Only a few studies have analyzed changes in both awareness and preparedness over time [102–104]. As a result, it remains largely unknown how and to what extent risk communication and other awareness-raising actions can help reduce disaster risk. More longitudinal studies are needed to unravel this complex interplay and better inform the public awareness campaigns such as those advocated by the SFDRR.

13. Conclusion

Scientists and practitioners are in agreement concerning the importance of evidence-based policymaking for effectively reducing disaster risks around the world. However, most previous discussions around effectively using science in DRR have mainly focused on improving knowledge communication. In contrast, less attention has been devoted to the substantive claims that guide action. Here we highlighted ten examples of *truisms* representing established claims within DRR policy discourse and briefly reviewed the available scientific evidence behind each claim. This is unavoidably a highly subjective endeavor. Yet, the objective was not to provide an exhaustive list of topics and questions backed by a systematic literature review. Instead, we aimed to pinpoint vivid examples of assumptions that have established themselves as departure points in DRR policy. For this work, we utilized the Sendai framework as a prominent DRR policy product to examine ten detected truisms from across the social and natural sciences that informed the document, but there are certainly other sources that could be consulted for the same purpose.

We argue that the DRR research field should identify prioritized research directions, linkages between knowledge areas, and ways to cope with the difficulty of transcending topics and disciplines to address this bias. The challenges of conceptualization, measurement, and causality also must be addressed. Several research areas exemplified here – the interplay of hazards and non-environmental drivers of migration and conflict, pathways from risk awareness to preparedness, the interplay of hard and soft measures, and drivers of collaboration – recognize the complexity of the processes leading to specific outcomes. Identifying and studying these complex relationships, including interaction effects and multiple causal pathways to the same outcome [105–107], are important avenues for gaining new insights about drivers and consequences of disaster risks. These steps convey a general ambition to abandon overly simplistic and predictive models in favor of approaches that acknowledge more dynamic complex systems and unanticipated effects [12].

Several critical DRR phenomena need greater conceptual clarity, including, e.g., prediction, collaboration, social capital, and disaster loss. Other concepts, such as prevention and response performance, have clear normative implications, which often manifest in debates around alleged successes and failures [108]. These dimensions deserve conceptual development and empirical assessment. Future work should also explore relationships between DRR and associated policy areas, including climate change adaptation and urban planning. Advances in measurement should accompany these efforts. This is partially linked to developing better data, e.g., to monitor trends in disaster losses across scales [109]. Efforts to address these data issues also require greater transparency concerning methods for normalizing impacts in relation to, e.g., economic development, wealth, and historical patterns of hazard exposure [32,110,111].

Strengthening the science-policy interface in DRR is a bidirectional process involving individuals in both the scientific and practitioner communities that actively engage in forward-looking dialogues to identify what knowledge is needed to inform responses to urgent policy challenges [112, 113]. This is illustrated, for instance, by growing practical recognition of connected events in risk assessment methods and planning, which has been accompanied by increased scientific attention to compound effects of multiple drivers [27,28]. In addition, we hope that more research to identify and address truisms about DRR will advance and add nuance to the understanding of phenomena determining disaster risk. However, it is essential to recognize that the knowledge base will still be preliminary, fragmented, and, at times, even contradictory. This demands researchers and practitioners strive for a common understanding of scientific uncertainty [7,114,115]. Another crucial insight concerns the practical reality of DRR governance, where policy-makers prioritize certain kinds and sources of information and draw on emotions, beliefs, and habits to make decisions quickly [116].

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Declaration of competing interest

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