A review of themes in disaster resilience literature and international practice since 2012

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ABSTRACT
This paper reviews the practice and research trends in disaster resilience and disaster risk reduction literature since 2012. It applies the rapid appraisal methodology to explore developments in the field and to identify key themes in research and practice. In particular, the paper examines how the emerging themes of disaster risk reduction from the Sendai Framework are being integrated into health risk management and disaster governance paradigms. The research findings identify three important emerging themes: socialization of responsibility for resilience; ongoing interest in risk management with an emphasis on public private partnerships as enabling mechanisms; and a nuanced exploration of the concept of adaptive resilience.

1. Introduction
Resilience can be understood as an umbrella term that encompasses a range of ways in which a system responds to external stresses, major disruptions and new circumstances (Holling 1973; Kapucu, Hawkins, and Rivera 2013; Manyena 2006; Milet 1999; Norris et al. 2008). While the concept has gained currency in many fields from ecology to psychology, in recent years it has become a prominent concept in the lexicons of climate change adaptation, disaster risk management, and sustainable development (Manyena 2006; Adger 2000; Nelson, Adger, and Brown 2007). The concept has proven to have particular utility due to its ability to encapsulate the behaviour of systems ranging from the cellular to complex socio-economic systems (Holling 2001). The promise of disaster resilience has been taken up globally in the pursuit of reducing the impacts of disasters and strengthening communities (United Nations 2015a;
National Research Council 2012; The Rockefeller Foundation 2017; Santos and Leitmann 2016). Given the broad range of contexts in which the concept has developed and is now being applied it is timely to consider how disaster management policy can be informed by recent developments in resilience theory and practice including how it is being reflected in international policy deliberations.

In this article, we review the literature from 2012 to 2017 on disaster resilience and related concepts. The significant growth in the disaster resilience literature in the preceding years, which is illustrated by Figure 1 has created a rapidly evolving research context. By surveying progress in the preceding half decade, we aim to synthesize and inform practitioners of new and emerging insights and their implications for policy. We identify major themes in the resilience literature and consider significant developments. In particular, we trace the evolution of international disaster management frameworks from the Yokohama Strategy (United Nations 1994) to the Sendai Framework as illustrated by Figure 2 (United Nations 2015c) and identify the emerging consensus on international best practice. We also consider the growth of resilience measurement frameworks and issues that need to be addressed to meaningfully operationalize these concepts.

The paper is organized as follows: We first provide a conceptual overview of resilience along with a synopsis of how the current milieu of disaster risk reduction policy evolved. The next section explains the methodology we used in reviewing the
literature and highlights the key themes which emerged from this review. We then provide an overview of the developments in efforts to operationalize and measure disaster resilience. Finally, we draw conclusions that have practical implications for policy-makers and practitioners.

2. Resilience: a conceptual overview

The term resilience was conceptually introduced by Holling (1973) to further an understanding of the capacity of ecosystems to persist in their original state despite external disruptions. Specifically, Holling defines resilience as “a measure of the ability of ecological systems to absorb changes of state variables, driving variables, and parameters, and still persist” (Holling 1973, p. 18). The term has since been applied to describe adaptive capacities of individuals, human communities and larger societies (Linnenluecke and Griffiths 2010; Nelson, Adger, and Brown 2007; Norris et al. 2008).

2.1. A short survey of resilience definitions

Norris et al. (2008) provide a comprehensive review of the evolution of resilience thinking and resilience definitions as applied not only to ecological systems, but also to individual, city, social, physical and community resilience and hazards research. There is no single broadly accepted definition as the concept has been applied in a diversity of settings. Table 1 shows the key themes of resilience definitions collated from across a range of research and policy domains.

Despite these differing perspectives, the key themes of ‘perturbation’ and ‘recovery’ remain constant. Although not always using those specific terms, the majority of interpretations emphasize the capacity for adaptation in face of external disturbance, stress or adversity. It is worth noting that the emphasis on “successful” adaptation in the climate change and disaster recovery literature represents an anthropocentric bias towards development and improved functioning in the face of stressful conditions. This positive adaptation bias is present in many policy documents and, without careful consideration, runs the risk of shifting the definition of resilience from what “is” to what “ought to be”. Resilience, from an objective systems perspective, is
not a normative term and does not necessarily imply growth or development (Middleton and Latty 2016). Rather the emphasis is on the ability of the system to persist within a given set of system parameters (Holling 2001; Middleton and Latty 2016).

Resilience can be usefully conceptualized as a characteristic of a system when considered as a whole. Traditionally a “stable” system was defined as strong, static and resistant to change (Manyena 2006; McEntire et al. 2002). Now, a stable system is understood as one that is flexible and able to adjust to stress, remaining more or less the same within a range of conditions (Holling 2001; Thompson et al. 2009). A resilient system has also been defined as a system that has sufficient adaptive capacity in the face of extreme stress to undergo transformational change and become a different kind of system change (Cartalis 2014).

Resilience then is best thought of as a “chapeau” term that encompasses a range of system responses, especially the ability of a system to:

a. Remain stable in the face of external perturbations and stresses;
b. Recover following a major disruption; and

c. Adapt to new circumstances.

2.1.1. Approaches to influencing resilience policy

A system, however defined, or one of its components, can be “more or less resilient” with respect to a given “shock”. Nalau and Handmer (2015) note three distinct types of systemic resilience approaches employed from a policy perspective. Organizations in systems of Type I focus on maintaining the current system, in Type II they take a broader approach in changing some parts of the current system, and in Type III organizations undertake transformational change to stay resilient and adapt to new circumstances. These approaches may be enacted by government agencies to deal with internal change, or be outwardly focused to support systemic community response and adaptation. All of these strategic approaches aim to maintain or increase

| Domain               | Key themes                                      | Key sources                                      |
|----------------------|-------------------------------------------------|-------------------------------------------------|
| Individual           | Challenging, learning, high risk, external events | Norris et al. (2008)                           |
| Physical             | Displacement, breaking, equilibrium, elasticity  | Vugrin, Warren, and Ehlen (2011)                |
| Community            | Stress, oppressive systems, hazards, adversity, violence, disasters, disturbance, recovery, ‘adjust easily’, moderate, bounce back, resources, buffer, collective action | Cutter et al. (2008); Kapucu, Hawkins, and Rivera (2013); Norris et al. (2008); Tierney (2012b) |
| Hazards research     | Survive and cope, minimum impact, reduce or avoid losses, contain effects, social disruption | Cartalis (2014); Henstra et al. (2004); Mileti (1999) |
| Ecological system    | Adversity, stress, surprise, disturbance, positive adaptation, recovery, original state, absorb, reorganise | Gunderson and Holling (2002); Holling (1973, 2001) |
| Social               | External shocks, hazards, social disruption, mitigate, recovery | Paton (2005); Paton and Johnston (2001) |
| City                 | Managing extreme events, bouncing back          | Cartalis (2014); Godschalk (2003)               |
the resilience of the system but with different outcomes. In this manner, the way a disaster and its impacts are understood and framed also impacts on the type of resilience approach advocated by a policy practitioner or policy community (Nalau and Handmer 2015).

The policy literature is also replete with different, if not contrary understandings of resilience. For example, Rosati, Touzinsky, and Lillycrop (2015) distinguish between “risk management” as a process of managing known risks and hazards (assuming that the system will return to its normal state afterwards) and “resilience” as approaches that require actors to prepare for unknown hazards and risks and think outside the most common scenarios in order to adapt in a constantly changing context. This definition is at odds with the dominant understanding of resilience, as in the overwhelming majority of uses the distinction is not made between known and unknown risks. (Norris et al 2008; Manyena 2006; Cartalis 2014 for an extended discussion of definitions and interpretations). However, policy practitioners have increasingly recognized the value of resilient and adaptive systems precisely in response to the increasingly interconnected world of complex risk interactions with hard-to-forecast second and third order hazard impacts (Beck 2009; Boin, Rhinard, and Ekengren 2014). While such theoretical reflections may seem somewhat abstract, they have tangible and practical implications for disaster risk reduction policy and implementation frameworks.

2.2. International disaster risk policy

In the 1990s the UN declared the International Decade for Natural Disaster Reduction, leading to the creation of the Yokohama Strategy; the first to provide international guidelines for the prevention and mitigation of disaster impacts. It focused on incorporating emergency management knowledge that existed in the local level and on improving coping capacities to manage known risks (Tozier de la Poterie and Baudoin, 2015). The Strategy was designed to focus international communities on cooperating to implement disaster risk reduction activities.

In the following decade, disaster risk reduction policy shifted to focusing on coping capacities and risk preparedness interventions (Tozier de la Poterie and Baudoin 2015). In 2005, the Hyogo Framework for Action (HFA) was developed. It outlined specific strategies for disaster risk reduction through actions that focused on understanding risk, reducing risk factors, building knowledge and strengthening preparedness (United Nations 2005). Although the HFA had a strong focus on prioritizing disaster risk reduction within communities, institutions lacked the means to measure how effective these policies were. Some authors also note that HFA failed to address and/or include the systemic changes needed to decrease vulnerability and risk (Scolobig et al. 2015). During the decade of the HFA (2005–15), disasters around the world continued to produce human, economic, infrastructure, and ecological losses, especially in the most vulnerable and poorest nations (Tozier de la Poterie and Baudoin 2015).

A review of the HFA resulted in the Sendai Framework for Disaster Risk Reduction 2015–2030 (United Nations 2015c). The scope of the Sendai Framework is
broad than the HFA, with an enhanced focus on “large and small, sudden and slow-onset disasters caused by natural and man-made hazards and related environmental, technological and biological hazards” (Oxley 2015, p. 11). The Sendai Framework includes a set of quantitative targets to measure resilience, gauging the extent to which actions are implemented and their effectiveness (Aitsi-Selmi and Murray 2015; United Nations 2015c).

The Framework also reflects complex contemporary global challenges. These include a rapidly changing climate, increased globalization, and the development of new technologies in the field of risk prediction and early warning systems (Tozier de la Poterie and Baudoin 2015). A notable inclusion in the Sendai Framework is the prioritization of health risks from hazards and the need to focus on health resilience. It promotes collaboration amongst the disaster risk reduction, climate change adaptation and science communities to develop strategies that protect and manage health risks arising from extreme weather and climate events (Sauerborn and Ebi 2012).

In addition to the Sendai Framework, 2015 saw the adoption of the Sustainable Development Goals (SDGs), followed by the ratification of the Paris Agreement (United Nations 2015a, 2015b). Although often implemented separately, these frameworks are interrelated and can be drawn upon in synergy to build resilience. For example, managing risks of disasters can contribute to progress towards the SDGs and integrating climate change adaptation into policy design and decision-making can promote resilient communities.

The Sendai Framework timelines are tied to the Paris Agreement and to the highly ambitious SDG global targets. However, the Sendai Framework provides little advice on translating these to the local level, and lacks attention to the role of ecosystems in disaster risk reduction (Oxley 2015). The Sendai Framework has also been criticized for not incorporating novel approaches to disaster reduction, but rather just continuing using the HFA approaches and concepts that have not been successful in reducing disasters worldwide (Glantz 2015). While drawing together capacity across these diverse fields poses significant coordination challenges for policy practitioners, it creates opportunities for more integrated policy development and more effective implementation.

In the next section we explore our findings on the major resilience-related research themes in the resilience literature that have evolved over the same time period as the Sendai Framework.

3. Literature review methodology

The rapid appraisal methodology “is an approach for quickly developing a preliminary understanding of a situation where specific research techniques are from a wide range of options” (Beebe 1995, p. 43). This approach gives researchers the opportunity to note trends in the literature, and allows consensus about good practice to be identified. A general schema for how rapid appraisal should be performed is given by Arksey and O’Malley (2005, p. 22): Stage 1: identify the research question; Stage 2: identify relevant studies; Stage 3: study selection; Stage 4: chart the data; then Stage 5: collate, summarize, and report the results.
The specific implementation of each of these stages depends on the study in question. The collection of potentially relevant literature is generally performed in large part by machine searches (Perales et al. 2014). Initial study selection is generally performed manually, most commonly by reading the abstracts, introductions, and conclusions of the papers that were found by automated methods to be potentially relevant, followed by careful review of the targeted publications.

For this literature review, \(~150\) academic papers from 2012 to 2017\(^1\) were identified from Google Scholar. This selection was based on the search term “disaster (prepar*/response/recover*/govern*) OR (recovery AND disaster) OR (measuring) resilience (implementation)?”.\(^2\) This filter was designed to capture papers in the following topic areas: risk reduction; disaster preparedness; disaster response; disaster recovery; economic recovery from disaster; measuring resilience; disaster governance; and resilience implementation. Papers were screened for relevance based on their titles, abstracts, and conclusions. If a paper was deemed relevant, it was imported into the text processing software suite NVivo. We undertook a text frequency analysis and found six groups of frequent lemmas\(^3\) in the literature (Table 2).

Lemmas were chosen as the basis of search frequency because searching for words themselves leads to less meaningful results, as function words like and and the tend to make up the largest proportion of words used in a document. These lemmas were then used as search terms for the body of documents. This allowed for the identification of the most relevant papers for each of the key terms.

### 4. Resilience themes in the literature

This section examines the three main themes that were identified by the literature review process with specific examples: (1) Policy and Governance; (2) Health and Disasters; and (3) Measuring and Assessment Frameworks. Under each theme, we introduce sub-groupings of findings, which give a more in depth and detailed view of the diversity of factors involved in each type of resilience.

#### 4.1. Policy and governance themes

The literature from 2012 displays a strong focus on themes of socialization of responsibility for risk and resilience, disaster governance and the emerging construct of

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**Table 2.** Lemma search results from the NVivo analysis of 150 selected papers.

| Lemma | Count | % of overall words | Includes |
|-------|-------|--------------------|----------|
| Social | 7432  | 0.67%              | Social, sociality, socialization, socialize, socializes, socializing, socially |
| Risk  | 6783  | 0.62%              | Risk, risking |
| Manage| 5595  | 0.51%              | Manage, manageability, manageable, managed, management, managements, manager, managers, manages, managing |
| Plan  | 5401  | 0.49%              | Plan, planned, planning, plans, plans |
| Develop | 4964 | 0.45%             | Develop, developed, developer, developers, developing, development, developments, develops |
| Health | 4883  | 0.44%              | Health |
adaptive resilience. These topics are not mutually exclusive: papers that deal with risk reduction and mitigation generally propose policy for developing resilience and address governance issues.

4.1.1. Socialisation of responsibility for risk & resilience
The most frequent lemma in the 150 articles was social. Articles that mention this lemma most often tend to discuss socialization of resilience strategies, emphasizing community engagement rather than top-down approaches from the state.

Harnessing social capital is a key concept in the literature that most frequently uses this lemma. Aida et al. (2013) identify two definitions of social capital: the network-based social capital of Bourdieu (1986), and the cohesion-based social capital of Putnam, Leonardi, and Nanetti (1993). Respectively, these are “the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationship[s] of mutual acquaintance or recognition” (Bourdieu 1986, p. 50) and “features of social organization, such as trust, norms and networks that can improve the efficiency of society by facilitating coordinated actions” (Putnam, Leonardi, and Nanetti 1993, p. 167).

Aida et al. (2013) propose that building social capital prior to the disaster event promotes “mutual cooperation and rescue efforts by neighbors, volunteers, and non-governmental institutions; financial and material donations” during a disaster event. Social capital networks also allow for the establishment and implementation of community-led recovery plans (Chamlee-Wright and Storr 2010). Results from surveys of communities in Hawai‘i Henly-Shepard et al. (2015, p. 360) suggest that respondents believe that “a sense of community is a key to enhancing coping capacity”.

The lemmas risk and manage suggest that risk mitigation is the preferred paradigm in the literature (Manyena et al. 2013). Risk management and risk socialization are interrelated in the literature, and so numerous papers relevant to risk management emphasize the advantages of socializing responsibility for risk and resilience (Aida et al. 2013; Aldrich and Meyer 2015; Crawford, Langston, and Bajracharya 2013; Dufty 2012; Henly-Shepard et al. 2015; Horita et al. 2013; Shaw 2013). Shared responsibility and cross-sectoral partnerships are also a recurring recommendation of papers that discuss risk mitigation. Kapucu and Khosa (2013) propose that the most disaster-ready university campuses are those that form stable partnerships between the public and private sectors. Busch and Givens (2013) also advocate for partnerships between the public, private and not-for-profit sectors, giving examples of disaster events where such partnerships played an important role in mitigating the potential risk of these events. The emphasis on socialization of responsibility and network coordination leads into a discussion of the disaster governance paradigm, which has seen a shift away from the traditional command and control model (Allen 2012; Kapucu and Hu 2016; Lassa 2015; Moynihan 2009).

4.1.2. Adaptive resilience
As by definition “resilience” incorporates an adaptive capacity, the term “adaptive resilience” is something of a tautology. Nonetheless, in the disaster literature it is commonly used and applied in the context of a “community’s behavior after the
disaster” (Kapucu, Hawkins, and Rivera 2013, p. 356). According to Tierney (2012b, p. xiv) “adaptive resilience enables social units to reassess their circumstances, learn from their disaster experiences, and adjust their strategies in light of the ‘new normal’ ushered in by disaster”.

In various parts of the literature the perturbations and disturbances to a system, such as disasters, are called stressors (Norris et al. 2008). A comprehensive model of the application of adaptive resilience in the face of these stressors is provided by Kapucu, Hawkins, and Rivera (2013) (Figure 3).

An important feature of this model is that it distinguishes between “bouncing back”, which embodies the engineering resilience approach that emphasizes the reconstruction of the built environment, and “adapting” which, in human systems “seeks to moderate or avoid harm or exploit beneficial opportunities” (Field et al. 2014, p. 118). As this conceptual framework illustrates, the community is the key to the idea of adaptive resilience. Community capital is a core element of this model, as it directly affects most of the constituents thereof. Coles and Buckle (2004, p. 6) suggest that resilience is best realized in situations in which the “community participates fully in the recovery process and has the capacity, skills and knowledge to make its participation meaningful.” Shaw (2013, p. 220) states that “it is increasingly observed and agreed that a sustainable [disaster risk reduction] activity is only possible when there is a strong involvement and commitment from the local institutions”. Community participation and the involvement of community organizations are key parts of ensuring the success of the implementation of adaptive resilience.

Given the central importance of resilience to effective recovery, researchers and policymakers alike have explored how resilience can be built in communities. Aldrich
and Meyer (2015) identify three strategies that have demonstrated beneficial results: (1) implementing “community currencies”, such as time banking programs; (2) holding focus groups and community events; and (3) careful planning of community layout and architectural structures. Each of these is supported by examples from a range of disaster situations (Aldrich and Meyer 2015). Further, Duffy (2012) notes that social media may be used to promote social capital, by facilitating coordination, or by spreading information that promotes mutual trust and recognition.

A small number of papers discuss the participation of indigenous populations in promoting resilience. The literature identifies two major advantages to incorporating indigenous populations in the disaster risk reduction process. First, the social structure of indigenous populations can be harnessed to improve community resilience and response. Kenney et al. (2015) contend that the Māori population of Christchurch were able to draw on their cultural norms and social structures as a coping capacity following the major earthquake of 2011. Second, and perhaps more prominent in the literature, is the use of local knowledge in implementing risk reduction strategies (Clarke and Mayer 2017; Gaillard and Mercer 2013; Mavhura et al. 2013). The recognition of the importance of indigenous knowledge and acknowledgement of local adaptive capacities reflects the ongoing movement towards incorporating local knowledge into formal resilience building activities.

4.2. Health risks from disasters

The health resilience literature responds in large part to the Sendai Framework, especially its recognition of local level health as a major factor in disaster resilience. Aitsi-Selmi et al. (2015) identifies this as a significant shift from response driven to a risk-management driven approach to disaster risk reduction, which sees five of the seven global targets in the Sendai Framework targeted towards building health resilience, focusing on reducing disaster mortality and disaster damage to health infrastructure (United Nations 2015c). According to the World Health Organization, health system resilience refers to “the capacity of the system to cope with and manage health risks in a way that the essential functions, identity and structure of the health systems are maintained” (World Health Organization 2015, p. 13). Translating these goals and systemic considerations to the community level, healthy people are less likely to experience disaster-related morbidity or mortality, healthy homes are disaster resilient and healthy communities minimize exposure to natural disasters.

Vulnerability is seen in terms of the biophysical impact to the population as well as how sensitive communities are to these impacts and their capacity to cope. For instance, the concept of social vulnerability appears in the literature (Cutter, Ash, and Emrich 2014; Shaw 2013). The concept of health vulnerability is more prevalent still, and refers to “the susceptibility of a population or a region to harm” (World Health Organization 2010, p. 2). A population’s health vulnerability is affected by differential physical, psychological and mental health effects of extreme events (Costello et al. 2009; Goldmann and Galea 2014; Reifels et al. 2013; Simonovic and Peck 2013). The literature also highlights potential health effects of impacts of disaster events on key infrastructure, such as failures in hospitals and transport systems, lack of access to
health services because of storms and floods, failures in risk communication and provision of medical care (Chang et al. 2014; Francis and Bekera 2014; International Panel on Climate Change 2012; Larkin et al. 2015; McDaniels et al. 2015; Rosati, Touzinsky, and Lillycrop 2015).

Disasters can have traumatic impacts on the health of populations and communities resulting from losses, displacement and deaths. Deaths from disasters are rarely due to infectious diseases, except in the case of epidemics. Communicable diseases can be worsened by disasters leading to more deaths. For example, following Typhoon Haiyan in the Philippines (2013), major health issues arose due to the failure to prevent infectious diseases and an increase in the severity of non-communicable diseases resulting from a lack of access to food, water, housing and medicine (Aitsi-Selmi and Murray 2016). Mental health issues are also prevalent when populations suffer extreme losses or abrupt displacement (Goldmann and Galea 2014). These stressors act to reduce coping capacity of communities and slow down the recovery process. Therefore, providing mental health support to improve community coping capacity becomes an important recovery strategy. The literature also emphasizes that the underlying physical health of the population is important when considering health resilience as this determines vulnerability and capacity to cope in the face of disasters, which includes understanding the prevalence and distribution of chronic disease and the ability of the population to access timely and appropriate preventive health services (Chandra et al. 2013; Dar et al. 2014; Gowan, Kirk, and Sloan 2014; Plough et al. 2013; Wulff, Donato, and Lurie 2015). For example, communities with more chronic diseases, elderly or those exposed to epidemics are more vulnerable (Tierney 2012a). According to the literature, then, such communities may need more services and support post disaster, therefore an understanding of baseline health conditions and risks for a community is essential in disaster risk reduction planning.

With projected climatic changes, many extreme events are expected to occur more often and at higher intensities, which will in turn increase the exposure of systems, communities and assets to disaster risks and further strain their capacity to recover and adapt (Grose et al. 2014; International Panel on Climate Change 2012; Nalau and Handmer 2015). Grose et al. (2014, p. 267), for example, report that regional climate models project increases in “the frequency and impact of the very worst fire-weather days” in Tasmania, Australia. Under such scenarios, therefore, the risk profile of a region may also change with the introduction of previously unexperienced hazards. The potential for multi-hazard issues with short-, medium-, and long-term impacts and unknown outcomes bring additional complexity into disaster management policy (O’Brien et al. 2006).

These climate-related impacts pose significant risks to health systems through service disruption, severe ill health, adverse social outcomes, and food shortages (Mavhura et al. 2013) leading to associated scarcity-related conflict (Mannakkara and Wilkinson 2014). As identified in numerous studies in recent literature, the impacts of disasters fall disproportionately on the poor, marginalised, sick and disadvantaged (Akter and Mallick 2013; Howard, Blakemore, and Bevis 2017; Linneroth-Bayer and Hochrainer-Stigler 2015; Nirupama and Maula 2013). Building resilience to climate risks should therefore be understood as part of disaster risk reduction programs (as
in, for instance, United Nations, 2010, 2011). Accordingly, the integration of disaster risk reduction and climate change policy is one of the main trends in the literature (Djalante et al. 2013; Jabareen 2013; Khailani and Perera 2013; Nalau and Handmer 2015; Serrao-Neumann et al. 2015; Wamsler, Brink, and Rivera 2013).

4.3. Measuring resilience and frameworks for action

A range of resilience measurement frameworks exist which span engineering to community resilience and accordingly, the attributes measured by each framework depend on its theoretical orientation and working definitions. This section discusses key steps taken in measuring community resilience, which include the consideration of the whole system and its subcomponents, identifying the level of analysis and identifying the framework for analysis. We identify two key frameworks and distil the key issues that are considered by each framework when seeking to measure resilience.

4.3.1. Defining the system’s components and subcomponents

In terms of defining the system’s components and subcomponents, the way a policy problem is framed impacts on the type of a management approach that is considered most effective in any given disaster context (Nalau and Handmer 2015). For example, in a future with climate change impacts, disaster risk reduction and disaster management will increasingly deal with “complex unbounded problems” which are outside prior experience and cannot be tackled with small adjustments in routine practices (Boin, Rhinard, and Ekengren 2014; Nalau and Handmer 2015). Hence, a dynamic understanding of the changing risk landscape is needed in order to adequately understand and assess the resilience of a system.

It also makes a difference whether resilience is considered from single-event or multi-event disaster perspective as this impacts on the projected recovery period within which the “bouncing back” and “building back better” is supposed to occur (Drennan, McGowan, and Tiernan 2016; Zobel and Khansa 2014).

4.3.2. Identify the level of analysis

Different levels of analysis have been used in measuring resilience. For example, Cutter, Ash, and Emrich (2014) use a geographically bounded frame of the county level in the US, as this level has the most reliable and long-standing data and county borders are usually less likely to change. Yoon, Kang, and Brody (2016) use community-level analysis in Korea in exploring community disaster resilience and Henly-Shepard et al. (2015) focus on social resilience also at the community level in Hawai‘i. These analyses do not include physical, environmental, and economic vulnerabilities but are more focused on factors such as demographics, education and socio-economic status. Taking a different approach, Zobel and Khansa (2014) explore temporal frames, from a single to multi-event levels where the focus is on the timing of the event and estimated recovery time thereafter or between events.

What is clear from these studies is that when the level of analysis coincides with jurisdictional boundaries the outcomes are relevant to and readily applied in a policy context (Henly-Shepard et al. 2015; Yoon, Kang, and Brody 2016).
4.3.3. Identify the framework for analysis

A common refrain in the literature and disaster resilience policy is that although there are numerous studies defining and discussing “community resilience”, few studies have actually provided practical models or assessments that enable its measurement (Ostadtaghizadeh et al. 2015). This section explores two dominant frameworks for measuring community resilience that highlight the different approaches to framing what will be measured and how these data may be collected.

The Norris et al. (2008) model incorporates four key components of resilience - economic development, social capital, information and communication and community competence. The authors identified key attributes of these components, “networked adaptive capacities”, which communities draw upon in times of disruption to assist their return to an equilibrium state Norris et al. (2008, p. 135). In the context of socio-ecological systems, adaptiveness is generally considered an institution’s ability to deal with complexities and uncertainties emerging from both current and future disasters (Djalante et al. 2013).

An alternative model of community resilience was developed by Cutter et al. (2008), which offers a place-based view of community resilience. The Disaster Resilience of Place (DROP) model incorporates social systems, the built environment and natural systems as system attributes that influence and interact with the inherent resilience and vulnerability of a community (Cutter et al. 2008). In contrast to the Norris et al. (2008) model, the DROP model reflects the connection between social systems and their built and natural environmental systems. The DROP model explicitly recognises that disasters happen to people in places (Boon et al. 2012; Cutter et al. 2008; Zhou et al. 2010). Consequently, place matters as much as the people involved when considering disaster resilience. The inclusion of social and natural systems and the built environment enables the consideration of institutional, infrastructure and ecological components as aspects of resilience (Adger 2000; Bruneau et al. 2003).

The DROP model (Cutter et al. 2008; Cutter, Burton, and Emrich 2010) does not incorporate the more subjective aspects of resilience including Information and Communication and Community Competence shown in the Norris et al. (2008) model. However, as Sherrieb, Norris, and Galea (2010) note, it is not possible to measure these attributes through publicly available data. Community surveys of attitudes and perceptions about community support and cohesiveness, both before and after an event, are required to measure resilience in these components (Sherrieb, Norris, and Galea 2010). Consequently, the DROP model which is built on the premise of accessing publicly available data provides a practical approach for policy makers seeking to establish benchmarks of community resilience. Cutter, Burton, and Emrich (2010) subsequently extend this model to develop a weighted series of indicators that captured these variables and condensed them to five key indices for assessing community resilience: scoring social resilience; economic resilience; institutional resilience; infrastructure resilience; and community capital.

Lee, Vargo, and Seville (2013) note that community resilience and organizational resilience are closely interlinked: communities cannot remain resilient without well-functioning and resilient organizations, including in the government and private...
sectors. This is supported by research in rural and regional Australia which highlights the centrality of business recovery to community resilience following a disaster (Drennan, McGowan, and Tiernan 2016). Integrating research into organizational resilience while also assessing community resilience through the DROP model could provide a blended approach where both levels are connected and assessed (Boin and van Eeten 2013).

5. Insights for practitioners

As the concept of resilience became prominent in the disaster research and policy domains, researchers devoted extensive efforts to attempting to accurately and clearly define it (Adger 2000; Manyena 2006; Norris et al. 2008). In recent literature, this debate has largely been accepted as well-explored if not settled. Due to the multifaceted nature of resilience, there is no single, consistently applicable definition. For the policy practitioner, this both simplifies policy design and contains hidden pitfalls. Whilst the practitioner can recognize and embrace resilience as a system characteristic with many attributes, the emphasis placed on desired or desirable characteristics for policy outcomes represents a definitional lens that has down-stream impacts on policy design and assessment frameworks. Selecting attributes of resilience as the focus of policy design is not a value neutral proposition. As it with many other policy problems, how the problem is defined will inevitably shape the nature of policy solutions (Kingdon 1993).

Nonetheless, the increased focus on more clearly defining resilience has enabled significant advances towards integrating resilience theory with the hazards cycle, which forms the foundational policy heuristic in the disaster management domain. Resilience theory has previously been overlaid awkwardly on the hazard cycle, as part of the process, an input to it and an outcome from it. Greater theoretical clarity about the types of resilience, such as Tierney’s (2012a) anticipatory, adaptive and responsive resilience lens, can now enable practitioners to more precisely delineate different types of resilience, their attributes and influencing factors at each stage of the hazards cycle.

Integrating health resilience into disaster management policy provides policy-makers with opportunities to leverage multiple points of influence on a community’s socio-economic system. Such actions are appealing to practitioners as they deliver immediate population health benefits, whilst investing in long term benefits arising from reduced vulnerability to future risks from disasters. While reducing vulnerability contributes to increasing resilience, building health system resilience is more than just the absence of vulnerability. As vulnerable communities are part of the wider systems, health resilience thinking must stretch beyond preparedness to disaster events to define the roles that health institutions, health leaders, governments and other community organizations can play. Building health system resilience is therefore a cumulative process which entails “building capacity to recognize, monitor, anticipate, communicate and prepare for climate-related health risks; prevent, respond to, manage, and cope with uncertainty, adversity and stress; adapt operations to changing risk conditions; recover from crisis and setbacks with minimal outside support; and...
learn from experience and improve system capacity for the future” (World Health Organization 2015, p. 14). Specific areas of action include: developing the technical and clinical capacity of health professionals; provision of adequate information services and early warning systems through better monitoring and surveillance of patients; innovative and new technologies for health data storage and health monitoring, especially those tailored to particular patients; improvements in healthcare service delivery, especially with respect to the service’s adequacy to deal with climate change; and responsible financial management in already burdened health systems (World Health Organization 2014, 2015). In this manner, health governance and policy can act as an overarching response for risk management both within and beyond the health sector, contributing to efforts to build disaster resilience and support climate change adaptation (World Health Organization, 2014). All aspects of public health promotion can be exploited to reduce health risk from disasters (Keim 2011).

Moving beyond building resilience, to applying it in recovery, the health resilience literature provides a range of insights to disaster management practitioners. Strategically, an enhanced appreciation of community health resilience indicators will provide practitioners with a greater understanding of a community’s baseline vulnerabilities and recovery needs. Further, the literature highlights the importance of mental health to building resilience and sustaining a community’s coping capacities during the recovery phase. This research points to the importance of recovery policy that prioritizes mental health, and in so doing, supports communities to lead their own recovery.

Drawing from resilience theory, the stability of system elements equally influences community wellbeing as it does governance capability. The stability of relationships in the disaster management governance network is essential for effective coordination of policy and operations across the response and recovery phases. These findings are challenging in the context of calls for greater integration of climate change adaptation and health resilience policy networks into the disaster management domain. Practitioners face the challenge of embracing and navigating change, whilst retaining the connections and system stability that underpin effective policy coordination. With the increase in climate change impacts, there is also a need to be vigilant what works in what context, and when particular practice needs changing. For example, if fire seasons change and number of hot days increase, practitioners will also need to consider finding new ways in increasing institutional and community capacity to deal with unprecedented events (Nalau et al. 2016).

Our research demonstrates that there are clearly significant opportunities for disaster management, climate change adaptation, and the health sectors to work towards the common goal of building adaptive capacities for resilience. The disaster risk reduction community has extensive experience with design, implementation and evaluation of strategies and policies to improve disaster risk reduction and to promote preparedness, response and recovery. The climate change adaptation community has experience with increasing community resilience through incorporating adaptation responses to the incorporation added impacts of climate change into policies and programs, and engaging with communities about what they value and what successful adaptation looks like for them.
However, despite similar goals, these different network actors have often worked in parallel with different frameworks, definitions, institutional arrangements, funding, assessments and information bases. Drawing on our research into the frameworks for assessing resilience, we find that frameworks aligned to jurisdictional boundaries produce the most useable data for policy practitioners. Similarly, by aligning the level of policy design and analysis, disaster management, health and climate change adaptation policy networks can more effectively integrate efforts to build resilience.

6. Conclusion

This paper has examined the main trends and themes in the disaster literature in the context of resilience. Our review of the recent literature highlights three key research themes: (1) socialization of responsibility for resilience; (2) ongoing interest in risk management with an emphasis on public private partnerships as enabling mechanisms; and (3) a nuanced exploration of the concept of adaptive resilience. We also explored the emergence of health policy as a key element of building resilience. There are many ways to define and understand resilience, many different ways to assess and measure it, and a diversity of factors which all influence for example what resilience can look like or should be in any given community. This diversity of definitions and factors underlines the inherent complexity in resilience theory and operational models that pose ongoing challenges to practitioners.

Notes

1. Where necessary, we draw on literature that pre-dates the 2012 search timeframe to provide relevant context and grounding to the analysis. Seminal grey literature sources are also referenced where they act as foundational influences in the resilience field, including reports by the World Health Organization, the United Nations and the International Panel on Climate Change. This grey literature is referenced specifically because of its critical role in shaping the research and policy context; this paper does not otherwise include grey literature over the period 2012–2017.

2. The wildcards in this search term have the following meanings. ‘*’ stands for any string of characters: for instance, ‘prepar*’ will capture ‘prepare’, ‘preparation’, ‘preparedness’, and so on. ‘?’ makes the previous term optional. Parentheses control the scope of these operators, and multiple terms in parentheses separated by a bar ‘|’ means that the search term will select one of those terms.

3. A lemma is the basic version of a term, usually the form that is entered into a dictionary.

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