



Moving forward to disaster resilience: Perspectives on increasing resilience for future disasters



1. Introduction

The severe consequences of the natural disasters that we have suffered in the last two decades (such as the Indian Ocean tsunami in 2004, the Katrina and Sandy hurricanes in 2005 and 2012, the Haiti Earthquake in 2010, the East Japan Great Earthquake and Tsunami in 2011 and the most recent earthquake in Nepal in 2015), have overwhelmed the response capacity of communities. Moreover, the perspective for the next decades is not satisfactory, since it is expected that the number of disasters will continue increasing due to climate change and dense settlements in coastal and other disaster-prone areas (Haigh and Amaratunga, 2010; Malalgoda et al., 2014). Additionally, the dependency of current society on critical infrastructures may contribute to rapidly escalate the effects, magnitude and impact of disasters. Thus, cities and communities face a big challenge to become disaster resilient (Turoff et al., 2016).

Disaster resilience can be defined as the ability of individuals, communities, organizations and states to adapt to and recover from hazards, shocks or stresses without compromising long-term prospects of development (DFID, 2011). According to the Hyogo Framework for Action (UNISDR, 2015), disaster resilience is determined by the degree to which individuals, communities and public and private organizations are capable of organizing themselves to learn from past disasters and reduce the risks of future ones, at international, national, regional and local levels.

This special issue sheds light on how cities and communities can become more resilient to deal with disasters. This requires more direct involvement of the communities in the area of a disaster, including the public and private enterprises. It also implies coordination and cooperation with all neighboring organizations so that problems shared with a neighboring community can utilize resources across the man-made borders, which do not stop the progress of a disaster. Communication among the stakeholders and sharing information with the citizens of the community are also essential to improve the resilience level of the communities.

This special issue includes thirteen papers that have been classified in three main groups: city and community resilience frameworks, natural hazards and critical infrastructure disruptions, and information management and sharing.

2. City and community resilience frameworks

Governments and organizations are making efforts to increase their resilience level, although the process presents several issues. Addressing the needs and priorities of the large number of stakeholders involved in the resilience building process (e.g., local governments, research institutions, academia, practitioners, international and non-governmental organizations, private sector and citizens) requires strong communication and collaboration among them that leads to achieving the expected results (Malalgoda et al., 2013; White et al., 2014). Participation of all the involved stakeholders including the public is vital to ensure that the interests of all stakeholders are taken into account (Doyle et al., 2014; Kapucu, 2012). Furthermore, proper coordination is essential to guarantee that resources are shared by all members, to prioritize the planning and response activities and to reduce conflicts among the agents (Doyle et al., 2014).

Fostering investment in building resilience should be seen as an opportunity to improve economic and social well-being of the whole society (Aldunce et al., 2014; Bhamra et al., 2011; IFPRI, 2013; Manyena, 2006). As will be explained below, although there are several attempts in the literature, there is still a lack of adequate organizational models, frameworks or technological tools that help to create a foresight capability that enhances the community preparation for emerging challenges (Collier et al., 2013; Whittaker et al., 2015). The resilience literature illustrates the need to involve different stakeholders in the city and community resilience building process and provides frameworks to build resilience. Currently, however, these frameworks present several challenges when they have to be applied in practice since they do not provide a detailed description about how they can be implemented (Jabareen, 2013; Weichselgartner and Kelman, 2014).

This first group of papers deals with the concepts of city resilience and community resilience. Three of them present a model to improve the city resilience and emergency preparedness of cities and organizations. The fourth one highlights the importance of collaboration among the different stakeholders and defines the factors that need to be fostered in these collaborations in order to create resilient communities.

2.1. A maturity model for the involvement of stakeholders in the city resilience building process (Raquel Gimenez, Leire Labaka, Josune Hernantes)

A majority of the world's population currently lives in cities and there is an urgent need to work towards building cities' resilience to the effects of acute shocks such as floods, droughts, and earthquakes and to chronic stresses such as climate change (100 Resilient cities, 2016).

This paper presents a maturity model with an ideal sequence of maturity stages for involving city stakeholders in the resilience building process. The maturity model consists of five maturity stages — unrecognized, initial, formalized, supportive, and proactive — that can guide local government in how to involve different stakeholders in the city resilience building process. In addition, the maturity model provides a number of policies that local governments need to implement at each maturity stage. These policies are classified into four principles (collaboration and networking, awareness and commitment, learning, and training and preparedness) that need to be fulfilled in order to engage stakeholders in building resilient cities.

The information presented in the maturity model was obtained through an iterative process that gathered the evolution of the resilience building process of six European cities at different maturity stages. In terms of the evolution of the four principles, it was possible to verify that in the cities that are at the more advanced maturity stages, the four resilience principles are fulfilled by an increasing number of city stakeholders. In addition, it was observed that the fulfillment of a principle contributes to the fulfillment of the other principles. Therefore, the maturity model developed in this paper contributes to the existing literature about city resilience by providing guidance for the local governments to assess the current stage of cities and to identify policies for engaging city stakeholders in the resilience-building process.

2.2. From planning to resilience: the role (and value) of the emergency plan (M^a Carmen Penadés; Ana G. Núñez and José H. Canós)

This paper explores the relationship between emergency planning and resilience building. It focusses attention on the emergency plan, showing how the management of the emergency plan can contribute to reinforcing an organization's resilience. They introduce a proposal to make emergency plans more resilient, identify resilience characteristics of emergency plan management and define a maturity-driven framework for resilience building called QuEP + R. QuEP is a quality-based framework for the assessment and improvement of emergency plan management within organizations that was used to find relationships between the QuEP components (mainly maturity levels and principles) and resilient characteristics. Thus, the authors were able to identify a significant number of practices and techniques that help organizations to identify, anticipate, and respond to catastrophic events, reduce the probability of their occurrence, or lessen their impact and duration.

2.3. Community views of the federal emergency management agency's "whole community" strategy in a complex US city: re-envisioning societal resilience (Heather Koch, Zeno Franco, Tracey O'Sullivan, Syed Ahmed and Mia DeFino)

The involvement of the community in disaster planning and response is vital in order to ensure a high disaster resilience level. Community Based Organizations (CBOs) are entities that represent the needs of the communities. Collaboration across CBOs, healthcare systems, and regional disaster response agencies is critical in order to create resilient communities. This research identifies the community factors that contribute to resilience in a mid-sized, socially complex city through collaboration among government, CBOs, and healthcare systems. First an environmental scan was conducted in the city of Milwaukee and then a table-top exercise based on the "world-café" model.

The results show that factors related to resource availability, inter-sector communication, and integration of community ideas into planning efforts are crucial for improving resilience through collaboration across CBOs, government and healthcare. The study also lists potential barriers to CBO involvement in disaster preparedness such as financial constraints, workforce limitations, prioritization of daily crises and lack of sustained relationships between CBOs and government agencies.

2.4. Striving to be resilient: what concepts, approaches and practices should be incorporated in resilience management guidelines? (Bruria Adini, Odeya Cohen, Aslak W Eide, Susanna Nilsson, Limor Aharonson-Daniel and Ivonne A Herrera)

This work proposes a holistic framework that includes concepts, approaches and practices that facilitate the development and implementation of guidelines for resilience management, and thus will help in the resilience operationalization process. The target beneficiaries of this framework are European and national agencies, policy makers, service providers, first responders and industry and enterprises. The framework includes 56 concepts, approaches and practices classified in eleven categories: 1) collaboration [11 items]; 2) planning [8 items]; 3) procedures [8 items]; 4) training [6 items]; 5) infrastructure [5 items]; 6) communication [3 items]; 7) governance [3 items]; 8) lessons learned [2 items]; 9) situation understanding (awareness) [1 item]; 10) resources [2 items]; and, 11) evaluation [2 items]. A systematic literature review and a Delphi process have been used to develop and validate the proposed framework. This work has been developed under the umbrella of the DARWIN project funded by the European Commission.

3. Natural hazards and critical infrastructure disruptions

Several case studies presented within this group of papers highlight the necessity to improve the planning for natural hazards and critical infrastructure disruptions, the preparedness level and coordination among the stakeholders, and the proper risk analysis to forecast the future response needs. Especially for communities living in areas under the threat of any kind of natural hazard, it is necessary to have frameworks that can help them to be well prepared for facing these disruptions. However, several authors argue that there is still a lack of proper estimation of the needed resources for response as well as a lack of integration and coordination during preparedness in order to properly respond during crisis.

When a locality is threatened by a natural hazard, the community plays an important role in reconstructing the affected area. Therefore, community based approaches are needed not only to respond and recover from crises but also for preparing and planning to face them. During the recovery, communities should have enough resources to reconstruct their urban area, and the public entities should provide them the required urban facilities for their well-being. Ensuring long-term and sustainable recovery solutions is necessary to resettle the affected areas.

This group of papers covers the improvement of resilience in the context of natural hazards, climate change and Critical Infrastructure (CI) disruptions such as power outages. These papers provide some insights and challenges that communities living under these threats should consider to improve their resilience to recover from these events. One paper, in particular, argues the need for long-term disaster recovery and how the transition

from short-term to long-term is not linear. Another is focused on power outage disruptions and their impacts on Critical Infrastructures and society.

3.1. Governance and resilience: a case of re-development after a bushfire disaster (Thayaparan Gajendran and Richard Oloruntoba)

This is an excellent case study of the attempt to highlight the characteristics of an unusual and large peri-urban disaster. The Victoria Bush fires of February 2009 in Victoria, Australia were one of the largest of this type of disaster, occurring in a large forested mountainous area during a very long drought and heat wave. This large semi-rural area had many small towns scattered throughout the area and minimal preparation. One of the authors, Richard Oloruntoba, published an earlier paper on the disaster and what occurred (Oloruntoba, 2013). This paper looks at the attempt to create resilient communities through reconstruction and rebuilding activities in this environment for future such occurrences. A very recent situation in a mountainous forested area that occurred in the state of Tennessee in the fall of 2016 sounds very much like the Australian occurrence.

The paper also uses the framework developed by Turner (Turner, 1976) to characterize why such undertakings to develop resiliency can be very difficult. Fires seem to be a growing problem area due to climate change and increased numbers of dwellings in heavily forested areas. Getting rid of the forests is not a solution, as heavy rain storms would then lead to sizable mud and earth flows. Besides, the forests are often legally protected.

The real problem is that natural disasters do not recognize man made boundaries. In most countries, local governments do not organize themselves with their neighbors to set up efforts to coordinate and team up quickly in a new disaster. In a severe drought, small outbreaks become numerous and can grow into rapidly moving fire storms. How to get local government bodies in wide areas to completely integrate their preparedness for the disasters that can spread much further than their localities is still a human challenge, as spelled out in Turner's, 1976 paper.

3.2. Evaluating a “wicked problem”: a conceptual framework on seaport resiliency (Amir Hossein Gharehgozli; Joan Mileski, Alyssa Adams and Wyndylyn von Zharen)

A seaport is one of the most complex facilities that humans have designed and are an integral part of our current civilization. This state of the art paper clarifies that complexity and vulnerability due to both natural disasters and human induced situations such as terrorism and human imperfections in actions and design. Climate change and changing ocean heights are also potential serious future problems. The paper also presents numerous examples to make these complications clear. Many of our industrial creations have turned out to be significant problems and creations that often produce disasters; e.g. fertilizer plants, and refineries. The paper is a start of what might in the future lead to emergency management auditors, who are trained and licensed to determine if there are dangerous situations developing in various types of facilities. Developing that type of talent for the future would go along way towards improving our risk situation in all aspects of human endeavor.

3.3. Lack of spatial resilience in a recovery process: case of L'Aquila, Italy (Diana Maria Contreras, Thomas Blaschke and Michael Hodgson)

Using as a case study the L'Aquila earthquake that occurred in Italy in 2009, this paper analyzes the relationships among urban facilities, collaboration networks, and lack of spatial resilience in the recovery process. It is based on the hypothesis that the dissatisfaction of the displaced population in resettlements is related to the lack of enough supporting urban facilities in the resettlements and consequently, migration of the displaced population occurs. The lack of urban facilities hampers the creation of collaborative networks that contribute to the resilience building process and therefore, delays the recovery process.

Fieldwork, a survey of the displaced population, and statistical analysis with correlation and regression analysis methods were used in order to test this initial hypothesis. The results demonstrate that as the number of urban settlements increases, the preference to migrate decreases. Furthermore, the higher the distance and travel time to the city center, the higher the preference to migrate.

3.4. Disaster resilience as a complex problem: why linearity is not applicable for long-term recovery (Deborah Blackman, Hitomi Nakanishi, and Angela M. Benson)

The authors use case studies of earthquake recovery in Japan and Christchurch NZ to illustrate their argument that linearity is not applicable to long-term recovery. They argue that the disaster literature assumes an almost automatic linear progression from short-term to long-term recovery; but there is a need for a transition stage that involves challenges, changes of actors and management, and new approaches.

The empirical basis for their description of what is necessary for transition to long-term recovery and resilience is qualitative analysis of 53 interviews with authorities in recovery, urban planners, small business, volunteer organizations and residents in the two locations. Three core themes emerged as having the greatest potential impact: the inclusion of new actors; the development of new social capital, and the use of co-production with the local community. The authors conclude that short-term relief and rehabilitation are typified by a need for immediate reactions and are often done ‘to’ people. In order to transition to successful long-term disaster recovery and resilience to face possible future disasters, there is a need for all stakeholders to support the new ideas.

3.5. A spatial-temporal vulnerability assessment to support the building of community resilience against power outage impacts (Thomas Münzberg, Marcus Wiens and Frank Schultmann)

The United Nations emphasizes a strategic target to reduce disruptions of basic services and to strengthen the resilience of communities (UNISDR, 2015). In this vein, this work proposes an indicator-based assessment that enables crisis managers and critical infrastructure providers to enhance their understanding of the impacts of a power outage in the resilience of Critical Infrastructures (CIs) and districts. The spatial-temporal vulnerability assessment considers the location of affected CIs, their criticality for providing vital services to the population, and their Coping Capacity Resource Depletion components, calibrated using a Delphi process and validated through a case study in a German city. The results provided by the assessment allow a systematic evaluation of the exposure of people and CIs, having beneficial implications for the resilience building process.

4. Information management and sharing

Proper communication among the involved stakeholders and sharing information and lessons learned among them is vital to create resilient

communities. Ensuring the reliability and objectivity of the information is crucial to guarantee that the agents are properly informed. New technologies have introduced substantial changes in how communication takes place among stakeholders, individuals, and the community. Tools such as smartphones or social media channels keep citizens engaged, enabling them to report problems easily, potentially making cities safer, and increasing the speed of communication between decision makers and citizens during major events like disasters. However, governments and decision makers still need to improve these communication channels to train society and empower communities to play a greater role in the disaster resilience building process. In addition, the use of social networks by those responding to a disaster is not allowed in many areas because of the significant increase of “fake news” in social networks. In some countries, this opens the doors to possible legal liability if the information leads to significant bad decisions.

This third group of papers illustrates the importance of information management and sharing during the preparation, response and recovery of crises. Two papers highlight the importance of appropriately informing community during the response to improve community resilience and the need to establish the necessary mechanisms to allow this communication. The third one presents a knowledge management system and the fourth one presents a survey and a quantitative and qualitative analysis to examine the Citizens' Perception of Social Media in Emergencies in Europe.

4.1. Building resilience: the relationship between information provided by municipal authorities during emergency situations and community resilience (Odeya Cohen, Avishay Goldberg, Mooli Lahad and Limor Aharonson-Daniel)

This work emphasizes the importance of the information provided by municipalities during emergencies. The authors conducted a cross-sectional study that presents the relationship between satisfaction with information provided by the local municipality and community resilience. Based on the study, the authors recommend that decision makers in municipalities of small and mid-sized towns give priority to advancing a communication system that provides information during emergencies. The information has to target the needs of the citizens, including sub-populations such as low-income residents and minorities. In this sense, the better suited the information is to the population's needs, the higher the community resilience. Therefore, tailoring of information for vulnerable communities may increase their resiliency.

4.2. Multi-level port resilience planning in the UK: how can information sharing be made easier? (Duncan Shaw, Andrew Grainger and Kamal Achuthan)

Ports are vital for the operation of cities and whole countries. This paper uses a multi-level case study on the UK's system of ports to propose an approach to information sharing that uses the subjectivity of information from a supplier's perspective and from a user's perspective to reduce barriers of complexity, confidentiality and political sensitivity. It identifies information sharing in port resilience planning as an emerging area of the disaster resilience literature. The main contribution of this paper for practitioners is a method for promoting greater resilience and integration by sharing information across levels and along the supply chain.

4.3. iCEMAS: knowledge management system for disaster resilience (Magiswary Dorasamy, Murali Raman and Maniam Kaliannan)

In an earlier paper, the authors integrated the published work on the design of Emergency Management Information System (EMIS) with the academic concepts of Knowledge Management Systems (Dorasamy et al., 2013). In this follow on paper, there are significant additions to that earlier work. One of the main contributions of this paper is the details on how the resulting design of an effective system was presented to and ultimately accepted by government officials in the country of Malaysia. Also of interest is the involvement of many of the current Emergency Managers in all the development phases of the effort. The uses of surveys, interviews, and simulation tests in this process are also discussed. The current prototype is referred to as an Integrated Community Emergency Management and Awareness System (iCEMAS). This paper is a comprehensive explanation and case study of the development process for a new type of Emergency Management Information System.

4.4. Towards social resilience: a quantitative and qualitative survey on citizens' perception of social media in emergencies in Europe (Christian Reuter and Thomas Spielhofer)

A European perspective is offered in this paper based on two large-scale surveys, one of over 1000 citizens across 30 European countries conducted in 2015, and the other conducted with 761 emergency service staff across 32 European countries in 2014. The aim of the overall study is to understand citizens' attitudes towards social media in emergencies in order to derive challenges and opportunities for social resilience through the use of social media. The authors adapt the definition of social resilience as the “capacity of social groups and communities to recover from, or respond positively to, crises” (Maguire and Hagan, 2007) and argue that social media can be understood as a key element in achieving social resilience.

This paper identifies a research gap in that even though it is known that many citizens use social media in emergencies, there is very little evidence exploring what proportion and types of European citizens currently do so. They found that about 50% of participants had never looked for information on social media as a result of an emergency, and the proportion of those who had never shared information during an emergency was considerably higher (67%). For those who did share, the most frequent type of information posted was about weather, road or traffic conditions, an eyewitness photo, and feelings about what was happening. Also noted is a growing expectation for emergency services to communicate with citizens via social media and to make use of information shared by citizens via social media. The majority (69%) of European citizens in the study agreed that emergency services should regularly monitor their social media sites, and 41% expected a response within an hour. Many recognized that such response is currently not likely to happen; thus there is a gap between citizens' expectations and emergency services behavior when it comes to social media use.

5. Conclusions and observations

Significant progress has been made in resilience over the past few years based on the selected papers of this special issue, although this sample of papers shows that there is still no single agreed upon framework to express the concept of resilience. It is still very clearly dependent upon the nature of the location, the type of disaster, the degree to which all the local communities, organizations and entities cooperate, and the ability to trigger significant external aid and necessary resources to reduce as much as possible the amount of death and injuries facing victims.

This special issue sheds light on the resilience building process by presenting different approaches to deal with natural disasters and critical infrastructure disruptions. These works use different perspectives and focus on different topics but they have a common denominator: the need for cooperation among the different stakeholders. Building resilience is not only incumbent upon governments and emergency services workers, but also requires the cooperation and commitment of society as a whole.

Relationships between the governmental entities in charge of disaster management and other public agencies, private agencies, non-profit agencies, and local media and citizens are vital for the effectiveness of disaster management (Kapucu, 2008). Through building and sustaining functional inter-organizational collaboration agreements, disaster management organizations can not only share information, financial resources, and human capital but also effectively coordinate their efforts in response to disasters and subsequent recovery (Kapucu and Hu, 2014). Therefore, joining experience, knowledge and expertise helps to identify how best to increase resilience and adapt (Oxley, 2013).

Citizens also need to take part in the collective responsibility of strengthening resilience in order to have resilient communities that learn how to thrive in the face of change and adversity and adapt to their full potential. Awareness, education and capacity building programs on disaster risk are key for mobilizing citizen participation in the resilience building process (United Nations International Strategy for Disaster Risk Reduction, UNISDR, 2012). A culture that fosters resilience can be encouraged by carrying out public awareness campaigns of disaster risk reduction and the potential effects of climate change, through programs in schools involving children and youth (UNICEF, 2014) and carrying out training activities in local communities.

Moving forward to resilience, therefore, requires the commitment of different agencies and a strong leadership from government organizations that provide strategies, support and resources to this end. In this vein, fostering investment in resilience should be seen as an opportunity to improve economic and social well-being (Aldunce et al., 2014; Bhamra et al., 2011; IFPRI, 2013; Manyena, 2006). Indeed, according to the US government's estimation, one dollar invested in preparedness for disasters saves four dollars if the disaster occurs (FEMA, 2017). With this in mind, governments should set up funding for localities to undertake such investments.

A very worrisome trend is that in this last decade the financial value of uninsured losses in natural disasters has increased a lot faster than insured losses. In part, this might be due to an increased emphasis on recording these losses, but these data suggest that resilience has been decreasing rather than increasing (see Fig. 1). We propose an effort to open a whole area of research to try to identify the uninsured costs of different likely types of disasters in specific areas by creating economic models incorporating both insured and uninsured losses in past and future disasters in any given area.

The proportion of the insured losses can be used as a measure of the amount of current resiliency, and the proportion of uninsured losses as a measure of the amount by which resiliency could be improved. Providing economic models for any local area that wants to measure its current resiliency can make the public and local governments aware of what they are facing for future disasters, giving them an ability to measure what investments in mitigation are going to be the most profitable contributions to increasing the resilience of a given location.

In any case, policy makers and other relevant stakeholders such as insurance companies, emergency managers and local communities need to be aware of the need for investing in resilience in order to mitigate potential negative consequences based on scientific methods. An example of this effort is the Zurich flood resilience alliance project that proposes a tool set for supporting the decision-making process, beginning from site/community selection to monitoring and evaluation of the implemented flood disaster risk reduction initiatives (Mechler et al., 2014).

Future research should address measures for the actual value of the resilience in any particular disaster. To reach this aim, a first step for an effective plan is quantifying appropriately the total loss potential in a given disaster threat and making investments for raising the level of resilience of the area. In complex systems, losses are a function of the interdependencies between infrastructure and economic systems (Kelly, 2015) and these interdependencies are not always easy to calculate. The World Bank in two recent studies (Hallegatte, 2015; Hallegatte et al., 2017) include in the estimation of the cost of a disaster the welfare effects and the capability of an economy to cope, recover and reconstruct. In this sense, they find that in a study of 117 countries examined, the effect on well-being, measured in terms of lost consumption, is larger than asset losses, being the equivalent to consumption losses of about \$520 billion a year (60% higher than other estimates of disaster losses).

Another important step forward should be finding suitable indicators and metrics that enable evaluation of the resilience level of a city, community or organization. Resilience is currently a complex and multidimensional concept difficult to measure precisely, but these metrics could be used by different stakeholders to make decisions about where to allocate resources and justify the investments on resilience. Therefore, defining replicable, analyzable, scalable, and most important, usable indicators to assess resilience should be another interesting field to explore.

In summary, this special issue aims to provide readers with reports on progress on research on resilience to date, and reflects on different aspects to consider for moving forward towards increased resilience. The content and viewpoints are not intended to provide conclusive answers, but rather

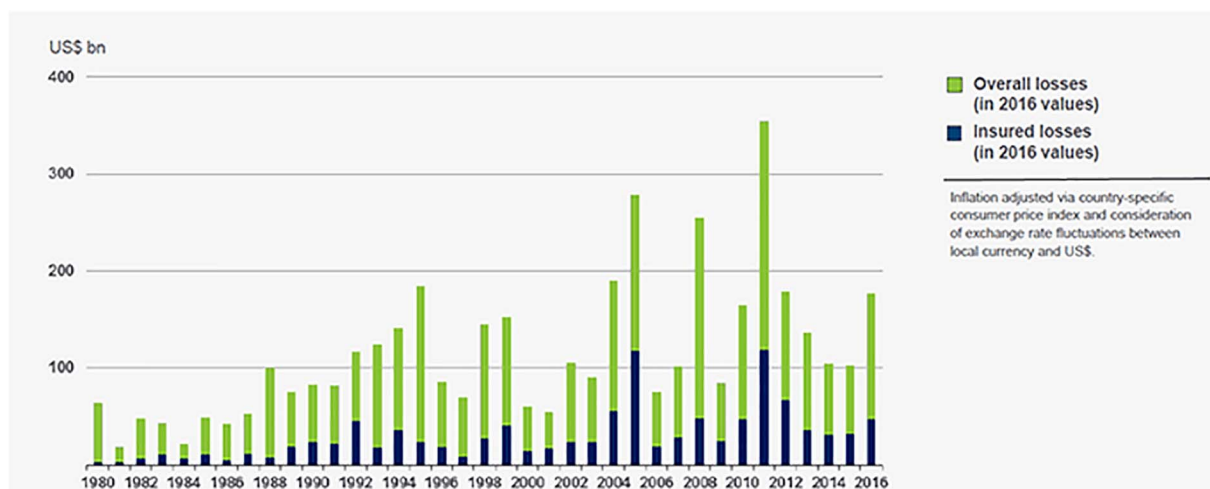


Fig. 1. World natural catastrophes overall and losses, 1980–2016.

Source: 2017 Munich Re, Geo Risks Research, NatCatSERVICE.

to provide new insights and encourage the research in this field so relevant to ensure the wellbeing of our society.

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