

## Chapter 1

# DISASTER RESILIENCE: BUILDING CAPACITY TO CO-EXIST WITH NATURAL HAZARDS AND THEIR CONSEQUENCES

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*Keep my words positive, because my words become behaviors.  
Keep my behaviors positive, because my behaviors become habits.  
Keep my habits positive, because my habits become my values.  
Keep my values positive, because they become my destiny.*

Mahatma Gandhi

## INTRODUCTION

A long history of development in locations which has resulted in increased societal susceptibility to experiencing adverse impacts from interaction with natural processes, such as volcanic, wildfire, storm, flooding, tsunami and seismic events, has stimulated interest in understanding how to manage the associated risk. This is no easy task. Objectively, societal risk from natural hazards is constantly increasing. Even if the probability and intensity of hazard activity remain constant, continuing population growth and economic and infrastructure development results in a concomitant increase in the potential magnitude and significance of loss and disruption associated with hazard activity, and consequently, risk. In this book, the focus is on managing risk through influencing the consequences of hazard exposure. It does

so by identifying factors that influence a capacity for co-existence with periodically hazardous, but often beneficial, environmental elements. This involves developing a capability to sustain societal processes should disaster occur through the proactive development of a capacity to adapt or adjust to the consequences of hazard activity.

The most effective strategy for achieving this outcome is planning to avoid development in areas susceptible to hazard impacts (Burby, Deyle, Godschalk, & Olshansky, 2000). While this approach must retain a prominent position in the battery of hazard mitigation strategies, particularly with regard to decisions about future development in areas susceptible to hazard activity and post-disaster rebuilding, it does not cater for all circumstances.

Much economic, infrastructure and social development has already occurred in areas susceptible to disruption and loss from hazard activity. For example, in her review of research from United States Geological Survey and Smithsonian Institute sources, Mayell (2002) describes how there are some 457 volcanoes with cities that house one million or more people within 100km of them. Depending on prevailing meteorological conditions, whose distribution cannot be planned for, hazards such as volcanic ash may find them. The city of Auckland, New Zealand is built on a volcanic field, the location of whose future eruptions cannot be predicted. It is difficult to plan where future development should occur if the location and distribution of future hazard activity cannot be specified in advance. While many of these cities have, so far, been spared a need to confront significant hazard events, others have. Experience of hazard activity is not, however, necessarily a disincentive for societal development.

For example, some 3.75 million people live in Naples, which has a history of experiencing adverse consequences over several millennia as a result of its proximity (within 30km) to Vesuvius. Popocatepetal, which has erupted 15 times in the past 400 years, is located 60km from Mexico City and its 20 million inhabitants (Mayell, 2002). The cities of San Francisco (U.S.) and Wellington (New Zealand), to name but a few, are built on active fault lines that have been active in historical times. These cities thus remain susceptible to experiencing considerable devastation from future seismic activity. Even if a decision to halt future development was made, a need to develop a capability to confront the consequences of hazard activity is an important component in any plan designed to facilitate a societal capacity to co-exist with the

potentially hazardous elements of its environment.

### Co-existing With a Hazardous Environment

As the opening quote alludes, this starts from hazard issues being the subject of community discourse that supports choosing to develop adaptive capacity. It also involves ensuring that the choices that reflect the substance of this discourse are translated into beliefs and behaviors that, over time, become established within the fabric of society. When such values are established, societies and their members lay the foundation for a destiny that includes a capacity for their sustained co-existence with a hazardous environment.

That developing a capacity for co-existence with natural hazards is feasible, is evident from observation of communities that face regular exposure to hazard activity. For example, because it receives ashfall and ballistic debris on some 113 days/year from its proximity to Sakurajima volcano, the town of Kagoshima in Japan has developed building codes, ash removal practices and community attitudes and preparedness to facilitate continuity of societal functions during periodic volcanic episodes (Johnston, 2004). That is, when a need to confront hazard consequences prevails, adaptive mechanisms can be established within the fabric of a society.

In locations characterized by less frequent hazard activity, however, a more challenging risk management environment faces the emergency planner. If they are to rise to this challenge, emergency management planners need knowledge of the characteristics and processes that underpin a capacity to adapt to hazard consequences and they need to develop strategies to instill these into the fabric of communities at risk. Furthermore, they have to do so in the context of evolving hazard-scapes.

The hazards that communities will face will change over time. For example, growth of residential development in the peri-urban environment has increased risk from wildfire hazards. Changes in land use patterns (e.g., farming, land clearance, industrial development) have increased environmental degradation. Change is also emanating from factors such as global warming. This may result in areas which have previously enjoyed relatively benign relationships with their environment experiencing risk from new sources. Clearly, understanding the hazards that represent the source of adaptive pressures is an important



activity.

The systematic scientific analysis of hazards and their distribution is still a relatively youthful endeavor. Until relatively recent times, knowledge of hazards in an area would have relied on firsthand experience or historical accounts. For hazards with long return periods, and thus extended periods of hazard quiescence, humankind has been denied the opportunity to gain comprehensive experience or knowledge of the hazard phenomena it may have to contend with. As a result, development has often taken place in ignorance of potentially hazardous circumstances. Articulating the nature of the hazard-scape (present and future) describes the context in which societal response and adaptation will occur.

Irrespective of whether they were made in light of knowledge of hazards or not, decisions regarding the location of societal development often reflect the association between geological and other natural processes and the resources and amenities (e.g., fertile soils, natural harbors, navigable rivers that serve as commercial highways, coastal scenery) they create for human populations. To fully realize the potential individual, community and societal benefits that can accrue from development in these locations, planning must address how to minimize the costs that arise when natural processes interact with human settlement in ways that create loss and disruption. That is, when they become hazards.

Hazards impact on people, they affect communities, and they disrupt the community and societal mechanism that serve to organize and sustain community capacities and functions. When hazard activity results in significant loss or disruption to established social processes, functions, activities and interactions, it can be defined as a disaster. Disasters expose populations and social systems to demands and consequences that fall outside the usual realm of human experience. This can occur suddenly, as is the case with earthquakes, or, as with environmental hazards such as salinity, more insidiously over periods of time that can be measured in decades. With rapid onset hazards in particular, the extent, distribution and complexity of their consequences generally exceed routine capacities and present significant nonroutine demands that call for novel, creative solutions to emergency problems. Extensive loss of or disruption to the physical, social and administrative infrastructure means that, in the absence of activities implemented specifically to develop a capability for continued

functioning, normal routines will no longer be supported or maintained within an affected area. It follows from this that adaptive pressures on communities will depend on the hazards they will have to contend with.

The information required to define this context extends beyond knowledge of hazards (e.g., volcanic, seismic) per se to include understanding of hazard characteristics and behavior. For example, for volcanic events, hazard characteristics include tephra, lava, ballistic material and gas. Seismic hazard characteristics include, for example, ground acceleration and liquefaction. Hazard behavior includes, for example, return and precursory periods, speed of onset, intensity, and duration. It is how hazard characteristics and behavior interact with the physical and social environment that defines the adaptive pressures on communities should hazard activity occur. The particular mix of hazard characteristics and behaviour will differ from place to place, as will the communities with which they will interact. Given the permutations that can arise from the interactions between community and hazard characteristics, planning for adaptive capacity is no easy task. If it is to occur, an important issue is identifying how adaptation can be facilitated.

## RESILIENCE AND ADAPTIVE CAPACITY

This book is concerned with identifying the values, beliefs, competencies, resources and procedures that societies and their members can call upon to facilitate their capacity to adapt to these circumstances and sustain societal functions in the face of significant perturbations to the fabric of everyday community life. That is, to identify the factors that makes societies and their members resilient. First, it is pertinent to consider what is meant by "resilient"?

The term resilience is often used in a manner synonymous with the notion of "bouncing back." This reflects its derivation from its Latin root, *resiliere*, meaning "to jump back." It implies a capability to return to a previous state. This usage, however, captures neither the reality of disaster experience nor its full implications. Even if people wanted to return to a previous state, changes to the physical, social and psychological reality of societal life emanating from the disaster can make this untenable. That is, the post-disaster reality, irrespective of whether it

reflects the direct consequences of disaster or the recovery and rebuilding activities undertaken, will present community members with a new reality that may differ in several fundamental ways from that prevailing pre-disaster. It is the changed reality (whether from the disaster itself or the societal response to it) that people must adapt to.

A definition based on the notion of "bouncing back" fails to capture this reality. Nor does it encapsulate the new possibilities opened up by the changes wrought by a disaster. In this context, disaster can be conceptualized as a catalyst for change; if mother nature does the demolition work, society can make choices about how to rebuild itself. Opportunities for development also extend to the social context. For example, disasters can generate a stronger sense of community amongst those affected than had prevailed prior to the disaster. Decisions can be made to reorganise social and institutional relationships in ways that sustain this new quality of life and so contribute to the social capital of the affected area in ways that will endure long after the disaster has passed into history. None of these outcomes will happen by chance. People, communities and societal institutions must choose to make it happen. If such choices are to be made, it is first necessary to define what it is that is intended to be achieved. Once this has been done, the next step is to consider how it can be achieved.

In this book, resilience is a measure of how well people and societies can adapt to a changed reality and capitalize on the new possibilities offered. To accommodate the former, the definition of resilience used here embodies the notion of adaptive capacity (Klein, Nicholls & Thomalla, 2003). To encapsulate the potential for new possibilities, an element of learning and growth should also be implicit in its conceptualization, as should the notion of disaster as a catalyst for development. Neither a capacity to adapt nor a capacity for post-disaster growth and development will happen by chance. Achieving these outcomes requires a conscious effort on the part of people, communities and societal institutions to develop and maintain the resources and processes required to ensure this can happen and that it can be maintained over time. In particular, it is important to ensure that civic agencies and institutions with a role in emergency planning and community development nourish this capacity in community members. This can facilitate the development and maintenance of a societal capability to draw upon its own individual, collective and institutional resources and competencies to cope with, adapt to, and develop from

the demands, challenges and changes encountered during and after disaster.

### THE NATURE OF ADAPTIVE CAPACITY

In this context, resilience can be defined as comprising four general components (Paton, 2000; Paton & Bishop, 1996). Firstly, communities, their members, businesses and societal institutions must possess the resources (e.g., household emergency plans, business continuity plans) required to ensure, as far as possible, their safety and the continuity of core functions in a context defined by hazard consequences (e.g., ground shaking, volcanic ash fall, flood inundation) that can disrupt societal functions. Secondly, they must possess the competencies (e.g., self-efficacy, community competence, trained staff, disaster management procedures) required to mobilize, organize and use these resources to confront the problems encountered and adapt to the reality created by hazard activity. Thirdly, the planning and development strategies used to facilitate resilience must include mechanisms designed to integrate the resources available at each level to ensure the existence of a coherent societal capacity, and one capable of realizing the potential to capitalize on opportunities for change, growth and the enhancement of quality of life. Finally, strategies adopted must be designed to ensure the sustained availability of these resources and the competencies required to use them over time and against a background of hazard quiescence and changing community membership, needs, goals and functions.

Understanding how interdependencies between people, their communities, and societal institutions and organizations influence adaptive capacity thus becomes important. That is, it is necessary to describe resilience, or adaptive capacity, at several interdependent levels (Buckle, Marsh, & Smale, 2000; Paton 2000; Paton & Bishop, 1996; Tobin, 1999). For example, the ability of a community to adapt to adverse or challenging circumstances and recover using its own resources requires that attention be directed to safeguarding the physical integrity of the built environment (e.g., land use planning, design standards, building codes, lifeline engineering, retrofitting buildings).

At another level, resilience can be conceptualized as a social resource (e.g., facilitating community members' commitment to reduc-



tion and readiness activities) whose existence is sustained by ensuring an equitable distribution of the costs and benefits associated with hazard reduction and readiness activities. Resilience also comprises a behavioral level concerned with encouraging the sustained adoption of preparatory adjustments and the ability to respond to and adapt to adverse hazard effects. It must also encompass the social, cultural and environmental contexts within which societal activities occur. The latter includes ensuring economic, business and administrative continuity (including emergency management and social institutions), and promoting heritage and environmental sustainability (Buckle et al., 2000; Mileti, 1999; Paton, 2000; Spenneman & Look, 1998).

If emergency planners are to act on this, they need knowledge of the hazard-scape prevailing within their jurisdiction and the elements that can be mobilized to develop a capacity to adapt to hazard activity. These issues are addressed in the next chapter.

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## Chapter 2

### IDENTIFYING THE CHARACTERISTICS OF A DISASTER RESILIENT SOCIETY

DOUGLAS PATON AND DAVID JOHNSTON

#### INTRODUCTION

To develop resilience, it is necessary to identify its constituent components. This chapter introduces the resources and processes that people, communities, and social systems can utilize to facilitate their capacity to adapt to the challenges posed by disaster, recover as quickly as possible, and use the disaster experience as a catalyst for future growth and development. It commences with an introduction to the circumstances that will challenge adaptive competencies.

Gregg and Houghton (Chapter 3) introduce hazards in terms of characteristics such as their frequency, magnitude, precursory and reaction times, and their spatial and temporal distribution. In conjunction with the assessment of how these characteristics interact with the built and social environment over time, hazard analysis thus plays an important role in risk assessment and in the development of effective mitigation plans and strategies by identifying the causes and consequences of hazard activity that societies will have to adapt to. An important target of this planning derives from understanding how hazard activity impacts on those elements of the built environment that facilitate the performance of societal functions.

Johnston, Becker and Cousins (Chapter 4) discuss how hazards can impact on the infrastructure, services, utilities and linkages that sustain societal functions (see also Chapter 14). They present several case