Epilogue
The Credible Sentinel

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"It's not just a wake-up call, it's a wake-up scream."[1]

On October 12, 2013, Cyclone Phailin, a very serious cyclonic storm with a wind speed of 200 km/h, hit India's east coast. To protect vulnerable populations from the most powerful regional storm in 14 years, relevant authorities and cooperating agencies activated a disaster response plan that required the evacuation of almost one million Indians in the states of Odisha and Andhra Pradesh. More than a decade of preparations prior to Cyclone Phailin meant that many fewer lives were lost than in the aftermath of 1999's devastating Cyclone 05B (38 deaths versus more than 10,000, or 0.4 % of the loss of life).

In response to the 1999 disaster, the Odisha State Disaster Management Authority was founded. Governance mechanisms were developed and populations educated. Preparations involved "years of planning, construction of disaster risk mitigation infrastructure, setting up of evacuation protocols, identification of potential safe buildings to house communities and most importantly, working with communities and community-based local organizations in setting up volunteer teams and local champions who all knew exactly what needed to be done when the time came to

[1] Attributed in the *New Scientist* (November 6, 2012, issue) to Cynthia Rosenzweig of Columbia University (also senior research scientist at NASA Goddard Institute of Space Studies and cochair of the New York City Panel on Climate Change) in reference to Hurricane Sandy, which struck the US eastern seaboard on October 29, 2012, causing 50 fatalities in New York State alone and 275 fatalities overall. http://www.newscientist.com/article/dn22470-protecting-new-york-city-from-the-next-big-storm.html. Accessed 26 Oct 2013.

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Z. Zommers and A. Singh (eds.), *Reducing Disaster: Early Warning Systems for Climate Change*, DOI 10.1007/978-94-017-8598-3,

act" (World Bank 2013). In 2011, the International Development Association's investment of approximately $255 million focused on "enhancing the early warning system down to the 'last-mile' community level and building cyclone risk mitigation infrastructure, including multi-purpose cyclone shelters, evacuation roads and strengthening of existing coastal embankments."

As I write this epilogue, another disaster is unfolding—a series of major bushfires in New South Wales, Australia, in rural areas surrounding Sydney. For the relevant authorities, tensions are palpable between that which is predictable from historical bushfire data and the sorts of extreme fires that may result from the bushfire season's unseasonably early start. There were reported fears among New South Wales' authorities that a "mega fire" could occur if three major mountain fires combined into one and moved toward Sydney's outskirts. This threat did not come to pass. Even so, amid uncertainty, a news reporter documented that people in some communities became frustrated and confused by mobile phone alerts whose evacuation advice contradicted that of local fire fighters (Sydney Morning Herald 2013). By and large, however, the Australian public has so far trusted the authorities' directives, and public confidence in early warning systems (EWS) is essential to reduce disaster risk. Nonetheless, as long hot summers with extreme fire risk become ever more hazardous in the future, public confidence will be sorely tested.

These are compelling recent examples of how EWS are part of an interdependent approach to helping save lives and protect livelihoods as risks of extreme weather and climate change continue to grow. As the Cyclone Phailin and New South Wales bushfire examples attest, EWS may contribute to resilience—the ability of individuals, communities, societies, and systems to rebound from stressful or catastrophic events and reestablish a desired equilibrium—and thus may be essential for building resilient communities.

Disseminating timely information about hazards using promising sociotechnical solutions is one important aspect of a sound approach to EWS, so too are public education programs that enable citizens to discern whom to trust, that is, to ascertain the credibility of given warning messages and their reliability and accuracy (Hamza and Morinière 2011). Where sociopolitical contexts and sociocultural norms erode trust, and make it a challenge to identify the most accurate information on which to act, citizens may need to filter potentially contradictory information in optimal ways. Since the communications landscape that can facilitate EWS—from radio, print, and television to personal computers, mobile devices, and myriad social-media applications—is highly fragmented and unevenly accessible (Sorensen 2000), "credible sentinels" may be essential for existing and emerging hazards to be understood by citizens and for EWS to be effective.

A working definition of "credible sentinel" is in order. A credible sentinel is a person, a group of people, or an organization with essential knowledge of hazards, disaster preparedness and response, as well as a high degree of social and reputational capital. Well in advance of a potential disaster, credible sentinels employ hands-on education, risk communications, or a combination of both to help individuals and organizations become prepared. Prior to a disaster, credible sentinels may moreover use crisis communications and local outreach to warn individuals

and organizations to remove themselves from harm's way. And because they are seen by citizens to be authentic in their motivation—and/or skilled in their ability—to protect people from harm, credible sentinels' reserves of social and reputational capital can withstand false warnings. Ideally, their hard-earned social and reputational capital contributes to societal adaptation and resilience, acting as a bridge of trust between particular communities and the technologies of early warning, enabling both knowledge sharing and coordination of action. Of note, credibility and EWS effectiveness are discussed in Chap. 11 on emancipatory lessons for early warning practitioners (which emerged from the 1999 flash floods in France) and in Chap. 12 on how early warnings affected mitigation and recovery processes during the 2010 floods in Pakistan.

In recent years, a wide range of credible sentinels, including citizens, community groups, climatologists, journalists, nongovernmental organizations, multilateral institutions, and public bodies, have sounded the alarm about the emerging risk environment. As this book demonstrates, researchers and practitioners across disciplines are striving to inform an integrated approach to EWS, so that urban and rural populations worldwide can be adequately protected from hazards influenced by climate change. These include blizzards, cyclones, drought (Chap. 10), dust storms (Chap. 7), floods (Chaps. 8 and 9), forest fires (Chap. 6), heat waves, hurricanes, landslides, and tornadoes. Both locally and globally, the development of an integrated approach is increasingly difficult, as more intense and frequent extreme weather is occurring side by side with heightened systemic risks to global economic and financial stability, aggravating existing and emerging socioeconomic and sociocultural threats to the long-term well-being of many nations' citizens (World Economic Forum 2013) and raising parallel concerns about EWS financing and sustainability. The global nature of such converging stressors may mean that EWS should be rethought to address the emergence of interdependent, volatile, long-term background conditions that may dull the ability of key actors to filter signal from noise—and thus to respond effectively to disasters in the making.

In this charged context, both mundane and urgent priorities vie for the time- and resource-starved attention of policy makers, business leaders, and citizens. According to recent publicized research, limitations of human attentiveness, or "bandwidth," are particularly pronounced when time or resources are scarce (Mullainathan and Shafir 2013). It is well known, for example, that chronic stress affects brain function and inhibits coping ability (Lupien et al. 2009). The Eurozone's post-2008-financial-crisis experience indicates, for example, that fragile economies may correlate with chronic stress and thus with psychosocial vulnerability (WHO Regional Office for Europe 2011). This fact raises questions about the degree to which higher levels of psychosocial vulnerability may impact cognitive performance and whether a given society's cognitive performance may affect its capacity to make near-term decisions that support adaptation to a changing climate decades in the future.

Here, numerous vulnerabilities come into play: as the planet's great sea ice and ice sheets disintegrate and melt, coastal areas worldwide are threatened; a warming atmosphere has more energy for producing extreme weather; and globally,

infrastructure of housing, cities, and farms strains from operating in a climate increasingly unlike the one that had emerged under a different climate regime. Citizens and policy makers have understandable difficulty in considering such risks, their implications, and what might be done to reduce them. If the global economy remains as uncertain as it has been in the recent past—and there are informed and plausible grounds to believe it will—potential limitations in society's collective capacity to adequately prepare for extreme weather and climate change would represent a vulnerability that undermines resilience.

The Anthropocene, the geological epoch of human-induced change (Stromberg 2013), brings to a head questions about interactions between fact and fallacy; certainty and uncertainty; cause and effect; sociotechnical systems' effectiveness and scalability; hierarchies of power and influence, including gender and intercultural relations, as well as associations between traditional and scientific knowledge; and vulnerabilities associated with a complex civilization undergoing accelerating change. As atmospheric carbon dioxide concentrations rise beyond 400 ppm, it becomes more critical to determine at which vulnerable locations EWS might provide appropriate advanced notice of extreme weather or climate change–related events. These events and their magnitude are expected to become more unpredictable as the planetary system is increasingly influenced by anthropogenic change and associated societal and environmental repercussions.

For these reasons and others, climate change has been described as a "super wicked problem" (Levin et al. 2007), one that is virtually immune to satisfactory solutions because it is "characterized by four key features: time is running out; the central authority needed to address it is weak or non-existent; those who cause the problem also seek to create a solution; and hyperbolic discounting occurs that pushes responses irrationally into the future." There is also the requirement that "a great number of people […] change their mindsets and behavior" (Wikipedia 2013). Conceptually, EWS may represent a kind of "late entrant" into the super wicked challenge that climate change poses, even as the imperative to direct innovation toward climate adaptation (and, to a lesser extent, mitigation) grows. This is largely because substantial climate change is already locked in, reducing time available to conduct research and development of scalable technology-centered EWS and thus preparing for a more volatile, uncertain, complex, and ambiguous risk environment (Levey and Levey 2013).

To a greater or lesser extent, for example, credible sentinels have already communicated initial risk assessments, which to a concerning degree remain unheeded. A recent assessment of the past 20 years' financing of disaster risk reduction states clearly: "[…] financing for DRR has been both inadequate and markedly inequitable, with little prioritisation across full considerations of risk, need and capacity" (Kellet and Caravani 2013). The challenge is exacerbated because the United Kingdom, the United States, Japan, and the Eurozone are on an austerity pathway, a stance that inhibits the release of funding for national and international preparedness measures that are commensurate with plausible risks. And with the global focus on economic growth and financial stability, civil contingencies and public health experts may find it increasingly challenging to fund, coordinate, and scale adaptation and

mitigation responses in proportion to an enlarging risk landscape—particularly since decision makers today are demanding risk-related "information and certainty beyond what the climate science community can in many cases realistically achieve" (Conway 2011).

It would seem the precautionary principle is on life support. Yet, if justice and fairness are paramount, the world's peoples have the right to be forewarned from the top down and from the bottom up. They should have the opportunity and responsibility to perceive the nature of extreme weather and climate change as well as to understand viable options for adaptation and civil preparedness locally, regionally, and nationally. Unfortunately, the challenge of warning populations from risks associated with extreme weather is becoming harder, especially when climate miscommunications from a variety of sources have very likely contributed to public confusion about observed and measured realities of changing planetary conditions and their impact on regional and local weather patterns. In fact, as risks mount—and, from the public's perspective, local seasonal weather patterns change substantively enough to cause widespread concern—the ability to identify an optimal response is likely to become more cognitively challenging, not less. Although EWS may become more accurate and predictive as analytical tools improve—with the promise of better decadal modeling for guiding the long-term decisions of policy makers and planners (Chap. 15) and relevant collaboration between governments, insurance industry players, and civic organizations aimed at prioritizing EWS (Chap. 16)—it is possible that such systems will be mistrusted if authorities presently minimize the implications of extreme weather and climate change and do not take responsibility for safeguarding citizens, if such systems cannot expand to meet needs because of cost or technical complexity, or if they do not lead people to experience a reassuring depth of security or preparedness. The societal use of EWS must be accompanied by a narrative of the twenty-first century that makes sense to citizens. Otherwise, accelerating economic, political, social, cultural, and technological shifts may undermine citizens' trust of EWS, impairing the ability of populations to respond appropriately.

For EWS to be as effective as possible, it may be valuable to explore and test four hypotheses. First, urban and rural communities may need to internalize plausible scenarios they discern could emerge from present circumstances. Communities' increased awareness of changes in the natural environment over time could play into this. Second, a consensus narrative of the twenty-first century may be needed to help local populations connect personal and community-based stories with rapidly changing terrestrial, atmospheric, oceanic, and societal phenomena to reduce the risk that a number of cognitive biases may prevent significant numbers of citizens from assigning appropriate risk to near and distant threats. Third, citizens may need to make a significant effort to critically examine media sources and sometimes even peer-reviewed research to become convinced that disaster-related risks correlated with extreme weather and climate change threaten the business-as-usual functioning of the private sector, governments, nongovernmental organizations, and therefore civilian life in the most fundamental, predictable, comforting sense. Arts, advertising, and other cultural media could provide a promising avenue for helping

citizens comprehend the risks they face (Khanna 2009). Fourth, implementing effective mitigation and adaptation responses may require that complex political, economic, and financial considerations be modeled.

Unfortunately, time is not on the side of public education and disaster preparedness, which makes such tasks increasingly crucial. Given the heightened risk for society to experience chronic stress as economic and climatic instability grow, it is possible that moderately funded, and even somewhat well-coordinated, risk communications outreach—backed up by promising EWS methods, tools, and technologies—would be heard by a relatively small proportion of decision makers and citizens. In addition, during this time of relative economic and climatic stability, effective risk communications outside of mass communications and social media may require institutions, organizations, and community groups to do essential and painstaking community-based work, which may necessitate the time-honored tactic of breaking through cognitive barriers by reaching individuals one by one, or in small groups, thereby influencing social norms and politics. In part, this would be accomplished by heeding the clarion call of EWS; in part, it would be accomplished by helping people learn, build trust, and foster social cohesion *both before AND after disasters strike and as part of the ongoing rhythm of their daily lives*. For its part, the public will need to learn to understand EWS in a context of society's need to adapt to a world in which socioeconomic and climatic conditions will be even more difficult than they are today. In parts of the world where extreme hardship and/or endemic conflict endures, the prospect of even further suffering may elicit despair among affected populations and the early warning community alike. Recent studies, for example, in Shyamnagar, Bangladesh; Punakha, Bhutan; North Bank Region, The Gambia; Budalangi Division, Kenya; and Kosrae, Micronesia, document limits to coping and adaptation (Warner et al. 2012). Even so, the task of maintaining hope, perhaps even hope against all hope, remains vital.

During this period of human-caused environmental change of an unprecedented scale—and in the face of increasing human and systemic vulnerability—how credibly the story of adaptation and preparedness is told will influence how well EWS contribute to protecting human populations and numerous societies' economic underpinnings (for example, through insurance programs better suited to extreme weather and climate change–related phenomena) as well as natural systems' bio-cultural diversity and resilience. We must move with urgency to identify appropriate ways to promote flexible and forward-looking decision making and thus empower individuals, communities, institutions, and organizations to enhance "their capabilities and level of agency to deal with climate change and uncertainty" (Jones et al. 2013). The credible sentinel, allied with EWS, will help limit the loss of life caused by extreme weather and climate change and, where possible, will support smarter and wiser adaptation to these now-inexorable planetary phenomena.

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Z. Zommers and A. Singh (eds.), *Reducing Disaster: Early Warning Systems for Climate Change*, DOI 10.1007/978-94-017-8598-3,