Advanced Sciences and Technologies for Security Applications

Anthony J. Masys
Leo S.F. Lin *Editors*

Asia-Pacific Security Challenges

Managing Black Swans and Persistent Threats

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ISSN 1613-5113 ISSN 2363-9466 (electronic)
Advanced Sciences and Technologies for Security Applications
ISBN 978-3-319-61728-2 ISBN 978-3-319-61729-9 (eBook)
https://doi.org/10.1007/978-3-319-61729-9

Library of Congress Control Number: 2017949869

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

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Introduction

Introduction

For many Asia-Pacific nations, domestic security challenges are becoming blurred with regional and global external security considerations. Recent events (both natural disasters and man-made disasters) have pointed to the inherent physical, economic, social and political vulnerabilities that exist in the region. Both black swan events and persistent threats to security characterize the challenges within the Asia-Pacific region.

Transnational security challenges such as global climate change, environmental degradation, pandemics, energy security, supply chain security, resource scarcity, terrorism and organized crime are shaping the security landscape regionally and globally. The significance of emerging transnational security challenges in the Asia-Pacific region has a global impact, and conversely, security developments in those other regions affect the Asia-Pacific region.

This edited book examines the contemporary regional security concerns in the Asia-Pacific region recognizing the transnational nature of black swan events. Key themes emerging in the book regarding security challenges include man-made disasters, international regulatory impacts on security, natural disasters, sustainability and security, and disaster response to human security issues.

Understanding Asia-Pacific Security Challenges

As part of the Springer book series *Advanced Sciences and Technologies for Security Applications*, this edited volume, *Asia-Pacific Security Challenges: Managing Black Swans and Persistent Threats,* introduces novel perspectives and innovative approaches that reveal the complexity associated with security and safety in the Asia-Pacific region.

The 13 chapters in this book reflect contributions from various experts and through case studies and research reveal the many perspectives, tools and approaches to better understand the security challenges in the Asia-Pacific region. The value added through understanding these security challenges can enable better management of black swan and persistent threats to the region.

Content

Anthony J. Masys in his chapter ‘Complexity and Security: New ways of thinking and seeing’ argues that the threats to human security that we face today are multiple, complex and interrelated and often mutually reinforcing. As such, ‘Global risks cannot be seen in isolation’ (WEF 2015). The hyperconnected world we live in is underpinned by hyper or hybrid risks, that is, ‘…the fragility and vulnerabilities that lie within the social/technological/economic/political/ecological interdependent systems’ (Masys et al. 2014). It is through these underlying networks that Helbing (2013:51) argues that we have ‘…created pathways along which dangerous and damaging events can spread rapidly and globally’ and thereby has increased systemic risks.

A Chatham House report, ‘Preparing for High Impact, Low Probability Events’, found that governments and businesses remain unprepared for such events (Lee, Preston and Green, 2012). This characterizes a security landscape that is truly complex and requires new ways in thinking and seeing. This chapter presents the Asia-Pacific Security landscape as a complex ‘ecosystem’ that requires concepts, tools and perspectives from complexity theory, systems thinking and network science to support regional and global security risk management.

Christian Fjäder in his chapter ‘Risk and Resilience in the Asia-Pacific region: managing the expected, preparing for the unexpected’ provides a backdrop to set the stage for the other chapters in this book. Fjadr argues that disaster risk reduction and resilience are gaining increasing attention globally as disasters affect more people and assets. The Asia-Pacific is one of the most important regions in the world, covering substantial amount of its landmass, number of people and share of economic activity. The region is, however, also the most disaster-prone region in the world. Consequently, disaster risk reduction and resilience building are of paramount importance to the region and indeed the world. The idea of risk reduction and resilience building complementing each other is a result of evolving practice in particular in context of hazards and disaster management. In principle, such approaches are pragmatic and in the simplest of terms rely on the notion that *risk reduction* is a practice aimed at responding to the expected (based on the information gained from the observation of risk events that have taken place in the past), whilst *resilience* is primarily focused on the ability to survive the unexpected. There are, however, some notable differences between practice and theory in how the relationship between risk and resilience is perceived. This chapter aims at examining the current efforts in the Asia-Pacific to integrate risk reduction and resilience-building measures into various policy frameworks and the disaster risk and black swan landscape in the region and to evaluate these in the context of theories of uncertainty, risk and resilience.

Ross Prizzia and Jason Levy in their chapter 'Climate Change and Security in the Asia-Pacific Region' put forth a number of conceptual, theoretical, political and normative arguments for developing the field of Climate and Sustainable Security and applying it to identify creative and tenable security solutions to problems that lie at the interface of resource scarcity, human insecurity, national vulnerability and ecological fragility in the Asia-Pacific region. Even conservative estimates predict that the rising temperatures and changing ocean levels in the Asia-Pacific region will lead to significant socio-economic, environmental and security concerns: higher temperatures, rising seas and a more energetic hydrologic cycle are expected to contribute to more intense storms, droughts, crop failures and food insecurity. Sea rise for coastal cities may be particularly damaging, especially as people and population densities continue to increase in flood plains and coastal areas of the Asia-Pacific. The herein proposed paradigm of Climate and Sustainable Security deals with protecting, restoring, designing and implementing a set of integrated natural, industrial, civilian and security processes that equitably and responsibly meet the biophysical needs of human communities in the Asia-Pacific region whilst maintaining long-term climate security, respecting financial constraints, meeting ecological limits and improving institutional arrangements for transparent, accountable and effective governance. It is concluded that emergency managers, security professionals and governments must promote climate adaptation and mitigation measures that protect communities in the Asia-Pacific region.

Leo S.F. Lin and John Nomikos in their chapter 'Cybercrime in East and Southeast Asia: The Case of Taiwan' aim to scrutinize cybercrime as one of the security threat types of transnational organized crime (TOC) in East and Southeast Asia region in the era of globalization. This chapter examines the nature of cybercrime and how it has evolved in the Asia-Pacific region and has been affected by globalization. Following the booming economy in East and Southeast Asia, internet has been used as a terrain to conduct transnational crimes, and the criminals try to utilize the loopholes between legal and judicial systems among the countries in the region. This chapter examines the threats that have been posted by cybercrime, which is different from the 'traditional' organized crime activities. This chapter uses Taiwan (Republic of China) as a case study. Following globalization and technological development, Taiwan's underworld went into a new stage of development, penetrating political, economic and other aspects in the society. Thus, many organized crime groups vigorously expand their organizations overseas into East and Southeast Asia. As a result, Taiwan syndicates "exported" modus operandi of telecommunication and internet fraud crimes, and those Taiwan criminals form organized crime groups in the neighboring countries to conduct their illicit business. The whole region has been affected by the telecommunication frauds operated by transnational criminal groups that are in many cases headed by Taiwanese. This phenomenon has become a security threat to the region that requires cross-border cooperation and joint effort.

Katie Subbotina and Nirupama Agrawal in their chapter 'Natural disasters and health risks of first responders' use the Asia-Pacific region as a backdrop to contextualize challenges associated with health risks for organizations responding to natural disasters to ensure better preparedness of their responders. Organizational preparedness has to include considerations for the type of event responders are deploying to, health risks they may be exposed to and how they could help the affected local vulnerable population. Organizations should consider preparedness of their responders with the same precision as businesses consider business continuity plans. Organizations should prioritize and specialize in the types of disasters they respond to and deliberately expand their scope as their preparedness level matures. Three case studies are presented to demonstrate the various situations and related health risks.

Simon Bennett in his chapter 'The March, 2011 Fukushima Daiichi nuclear power plant disaster – a foreseeable system accident?' opens the black box of the Fukushima nuclear disaster. The 11 March Tōhoku earthquake set in motion a series of events that disabled the six-reactor Tokyo Electric Power Company (TEPCO) Fukushima Daiichi nuclear power plant. The earthquake and tsunami caused power outages, chemical explosions, meltdowns, damage to buildings and radioactive emissions at TEPCO's oceanside site. Fukushima was the worst nuclear accident since Chernobyl. Impacts included the contamination of around 1,800 square kilometres of land and the evacuation of 150,000 people. Decontamination, decommissioning and disposal will take decades. He presents a systems-theory-informed analysis of the Fukushima disaster, with particular attention to the contribution of cultural factors, both organizational and national. The circumstances of the disaster are explored with the aid of Challenger, Clegg and Robinson's [1] model of system behaviour.

Regan Potangaroa and Maire Kipa in their chapter 'The Maori Response to Seismic 'Swans'' look at this 'Black Swan Event' (BSE) and examine its nature so that comparisons with other similar events can be made but more to record what happened. The apparent treatment of Maori following the 4 September 2010 Kaiapoi Earthquake presented something that New Zealanders didn't want to see or acknowledge. The notion of inequality or ethnic discrimination was un-New Zealand and therefore deeply unacceptable. It would subsequently result in the setting up of a Maori Response Network (MRN) in the Christchurch Earthquake in 2011 and also in the Kaikoura Earthquake in 2016. The success of both of these has yet to be recognized by the broader New Zealand community.

Neil Greet in his chapter 'Building Energy Resiliency in the Asia Pacific - Providing transition pathways for a more secure and sustainable future' argues that the global energy system is under stress with volatile oil prices, the challenge of climate change and economic uncertainty bearing down. Now is not the time to pretend that a 'business-as-usual approach' across the Asia-Pacific energy sector is a viable strategy which provides resilience. Currently, energy policy is stove piped and sector biased which does not reflect the multifaceted nature of energy. Addressing energy security in vulnerable cities requires a change in thinking. The traditional International Energy Agency (IEA) definition of 'energy security as the uninterrupted availability of energy sources at an affordable price' doesn't come close to addressing complex uncertainty. Energy planners in the Asia-Pacific must consider the interconnected vulnerabilities of technological innovation; resource climate management and security; geo-strategic competition; demographic shifts and efficient governance; social cohesion and trust; and hybrid and asymmetric threats. Failure to change the way nations think on energy is a failure to prepare for change.

Jason Levy and Ross Prizzia in their chapter 'From Data Modeling to Algorithmic Modeling in the Big Data Era: Water Resources Security in the Asia-Pacific Region under Conditions of Climate Change' argue that advances in computing technologies allow machine learning algorithms to automatically, repeatedly and quickly apply complex mathematical calculations to water resources and environmental security challenges. The concomitant increase in 'big data' research, development and applications is also driving the popularity of real-time automated model building and data mining for these security problems under conditions of climate change. The last decade has seen considerable growth in the theory and application in artificial intelligence (AI). It is shown that machine learning, a subset of AI, constitutes a data analysis method that focuses on the development of algorithms that can iteratively learn from data to uncover previously 'hidden insights' for environmental security managers in the Asia-Pacific. It is concluded that deep machine learning (i.e. deep learning) can help reduce losses to ecosystems, livelihoods and businesses. In particular, these losses can be more likely prevented and minimized through the use of data and algorithmic modelling that improves community resilience by institutionalizing sustainable hazard mitigation within accepted processes of water resources community planning and economic development *before* disasters happen. Key environmental threats including food, population extinction, water quality and climate change are considered. The difference between the algorithmic modelling and data modelling cultures is summarized with reference to the schools in which they originate, the assumptions they work on, the type of data they deal with and the techniques used.

Hsien-Ho (Ray) Chang in his chapter 'From Gas Explosions to Earthquakes: Case Studies of Disaster Response in Taiwan' utilized the multiple case study methods to review four major disasters that occurred in Taiwan in the past 4 years. Based on insights from disaster and risk research, the author proposes two suggestions at the end of his chapter for improving future response activities under the Taiwanese disaster management organization and response system.

Ram S. Jakhu and Kuan-Wei Chen in their chapter 'The missing link in the Global Aviation Safety and Security Network: the case of Taiwan' discuss the importance of Taiwan's participation in and contribution to the International Civil Aviation Organization (ICAO). The continuous absence of a notable aviation country situated at the crossroads of the Asia-Pacific poses a threat to global aviation safety and security, which requires the uniform adherence to accepted international standards and practices and the real-time exchange of information vital to air navigation. The lives and wellbeing of millions of passengers from around the world and the safe transit of high value air freight originating from, destined for or passing through Taiwan means the international community can no longer ignore the presence and importance of this strategic aviation hub in the Asia-Pacific.

Ping-Kuei Chen in his chapter 'Universal Participation without Taiwan? A Study of Taiwan's Participation in the Global Health Governance Sponsored by the World Health Organization' examines the health risk of Taiwan's absence in intergovernmental health governance networks. It provides a review of Taiwan's bidding strategies for the World Health Organization between 1997 and 2009. The country's participation in the World Health Assembly (WHA) and the International Health Regulations (IHR) network since 2009 was a significant improvement, but this experience failed to extend to other governing bodies. The chapter goes on to discuss the global public health risk of excluding Taiwan from cross-national health cooperation and why such a conundrum remains difficult to resolve. Taiwan's compliance regarding health governance relies heavily on self-regulation and the help of its allies. The United States has played a key role in enforcing global health regulations on Taiwan. Unlike other sources of threat in health governance, Taiwan currently does not represent a high health risk to other countries. As a result, Taiwan finds it difficult to persuade WHO members to manifest 'universal participation' by including Taiwan in various intergovernmental health networks. This pattern of governance, however, lacks transparency. Other countries will find it difficult to monitor or intervene in the event Taiwan's health authority is unable to deal with a transnational health emergency.

Jared Romeo Dmello in his chapter 'Dacoity in India: Investigating Thievery and Banditry in the British Raj's Jewel' examines a unique threat in the Asia-Pacific region: banditry. Despite continued anti-banditry efforts, the problem of dacoity persists in India today. Although it has a long history in the subcontinent, relatively little quantitative work has been done on the topic. Using official crime data published by the Government of India and information in the Census of India, this study seeks to evaluate the impact of state-level factors on the prevalence of dacoit crimes in India using multilevel modelling. Certain state-level characteristics do, with statistical significance, impact the prevalence of dacoit crimes in India. Using this analysis as a framework, this study evaluates the importance of characteristics within Indian society that allow the practice of dacoity to continue in quite large numbers. The study seeks to provide Indian decision-makers with new insight to evaluate potential mechanisms for finally bringing the century-old criminal activity to an end. By understanding what characteristics increase the likelihood of dacoity, decision-makers will be better positioned to shape effective tools for countering these actions. This research impacts the greater region, not just India. Banditry has a rich and lucrative history throughout South Asia. An empirical study in Indian banditry can provide insights for other states to counter their manifestations of the same problem.

Complexity and Security: New Ways of Thinking and Seeing

Anthony J. Masys

Abstract From the refugee crisis to economic slowdowns in emerging markets, from ever-rising numbers of terrorist and cyberattacks to water shortages and famines, global risks continue to dominate the headlines. The Asia-Pacific region in particular has the highest number of total occurrences, fatalities and effects of natural disaster events (flood and cyclone) and is no stranger to mega-disasters such as the likes of Super Typhoon Haiyan and Indian Ocean Tsunami of 2004. According to the World Economic Forum 'The world is insufficiently prepared for an increasingly complex risk environment' (WEF, Global Risks 2015 10th edn: insight report, 2015). The threats to human security that we face today are multiple, complex and interrelated and often mutually reinforcing. As such, 'Global risks cannot be seen in isolation' (WEF, Global Risks 2015 10th edn: insight report, 2015). The hyperconnected world we live in is underpinned by hyper or hybrid-risks, whereby '…the fragility and vulnerabilities lie within the social/technological/economic/political/ecological interdependent systems' (Masys AJ, Ray-Bennett N, Shiroshita H, Jackson P, Procedia Econ Financ 18:772–779, 2014). It is through these underlying networks that Helbing (Nature 497:51–59, 2013) argues that we have '… created pathways along which dangerous and damaging events can spread rapidly and globally' and thereby has increased systemic risks.

The Asia-Pacific region faces many human security challenges associated with meeting food, water, and energy requirements in scenarios that stress the human security 'ecosystem'. A Chatham House report 'Preparing for High Impact, Low Probability Events', found that governments and businesses remain unprepared for such events (Lee B, Preston F, Green G, Preparing for high-impact, low – probability events: lessons from Eyjafjallajokull. A Chatham House Report, London, 2012). This chapter presents the Asia-Pacific Security landscape as a complex 'ecosystem' that requires concepts, tools and perspectives from complexity theory, systems thinking and network science to support regional and global security risk management. The key is to embrace a strategic visioning and actioning that examines the interdependencies and interconnectivity across various 'actors' in the security ecosystem and how black swan events can stress the system. This is examined through

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_1

the lens of Human security that lies at the center of the water-food-energy nexus as well as the disaster risk reduction, sustainability and development nexus.

Keywords Human security • Asia-Pacific • Complexity • Systems thinking • Network mindset

1 Introduction

As described in Masys (2016a, b), the threats and risks to security (both man-made and natural) are varied and impactful. The distinction between natural and man-made threats is being blurred and the inherent vulnerabilities transcend this perceived dichotomy. Disaster events such as Hurricane Katrina (2005), Hurricane Sandy (2012), Fukushima Daiichi nuclear meltdown (2011), Typhoon Haiyan (2013) and global terrorist events illustrate the devastating effects of natural and man-made disasters on human systems and human security (Masys et al. 2014).

The Asia-Pacific region in particular has the highest number of total occurrences, fatalities and effects of natural disaster events (flood and cyclone) and is no stranger to mega-disasters such as the likes of Super Typhoon Haiyan and Indian Ocean Tsunami of 2004. Data from United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) 2015 shows that in the past four decades there has been a growing number of small and medium-scale disasters which have resulted in a total loss of over US$1.15 trillion. This threat and risk landscape challenges regional security along such lines as: national security; energy security; water security; food security; health security; human security; environmental security; economic security.

As described in Prizzia and Levy (2017) '…in the wake of the September 11, 2001 terrorist attacks, security has become an existential concern for countries across the Asia-Pacific Region. The increasing intensity, complexity and frequency of security threats has caused governments, industries, NGOs, policy makers and communities throughout the Asia-Pacific societies to urgently re-assess their exposure to security risks and vulnerabilities, contributing to a transformation in our understanding and perception of security in the Asia-Pacific Theatre'. It is the inherent complexity of the security landscape that is driving the requirement for a more holistic and 'nexus' approach to security planning. Our strongly connected global networks have produced highly interdependent systems that challenge our security posture through a lack of understanding regarding them. Helbing (2013: 51) argues that:

> Many disasters in anthropogenic systems should not be seen as 'bad luck', but as the results of inappropriate interactions and institutional settings. Even worse, they are often the consequences of a wrong understanding due to the counter-intuitive nature of the underlying system behaviour. Hence, conventional thinking can cause fateful decisions and the repetition of previous mistakes. This calls for a paradigm shift in thinking: systemic instabilities

> can be understood by a change in perspective from a component-oriented to an interaction- and network-oriented view.

These comments certainly resonate within the security domain. Shocks (whether man-made or natural disasters) stress our 'security' ecosystem often resulting in failures at various scales thereby posing serious threats nationally, regionally and globally. We can define an ecosystem as an evolving and dynamic collection of actors which respond to its environment. This biological analogy emphasizes the interdependence of all actors in the environment who 'co-evolve their capabilities and roles'. Like natural **ecosystems**, the **security ecosystem** comprises a variety of diverse actors (human, physical and informational) as described in Masys (2016a) that interact in complex and dynamic ways. To better manage black swan events that stress the security ecosystem, a fundamental redesign of our mental models and perspective is needed: essentially a paradigm shift in how we view and enable security. Woods (2006:316) asks the question:

> How do people detect that problems are emerging or changing when information is subtle, fragmented, incomplete or distributed across different groups involved in production processes and in safety management. Many studies have shown how decision makers in evolving situations can get stuck in a single problem frame and miss or misinterpret new information that should force re-evaluation and revision of the situation assessment….

Given the current security landscape and shocks to human systems characterized by complexity and wickedness (Masys 2016a, b), Goldin and Mariathasan (2014: 208) argue that 'physical, virtual and social networks need to be constructed in ways that allow them to withstand, and respond to the novel challenges of our time. They have to be flexible and organic rather than static and their capacities cannot be stretched to the limit'. The concept of resilience (supporting security) encompasses a capacity to anticipate and manage risks and the ability to survive threats and respond to challenges. The question becomes how do we conceptualize and manage security in the face of extreme events and black swans (Taleb 2007; Masys 2012a, b, c; Masys et al. 2015)? The paradigm shift of systems thinking and complexity provides some key insights.

2 Complexity

A Chatham House report 'Preparing for High Impact, Low Probability Events', found that governments and businesses remain unprepared for such events (Lee et al. 2012). The field of complexity science has provided alternative perspectives regarding non linear dynamics and greater understanding of underlying processes, interdependencies and interconnectivity of systems. This chapter introduces concepts, tools and perspectives from complexity theory, systems thinking and network science to support non-traditional security (crisis and disaster management).

As described in Masys (2007), complexity theory is an interdisciplinary field of research that provides a conceptual framework, a way of thinking and a way of seeing the world. Complexity is associated with the notion of intricate intertwining or inter-connectivity of elements within a system and between a system and its environment. As such the inherent complexity of a system cannot be fully understood by simply studying its constituent parts. Cilliers (1998:2) remarks that 'a complex system is not constituted merely by the sum of its components, but also by the intricate relationships between these components. In cutting up a system, the analytical method destroys what it seeks to understand'. It has been shown in the literature across various domains of inquiry how small changes to a system can produce large effects. As applied to security, thinking in terms of complexity provides a perspective that reveals emergent properties, nonlinearity and a 'dynamic system' of interactions and interrelations. Managing threats and risks associated with security is no longer a state-centric exercise. Understanding the interdependencies and interconnectedness of the security ecosystem through a forensic analysis (Masys 2016a) is a requirement. Important features that characterize complex systems and their behavior include the ability to produce properties at the collective level that are not present when the components are considered individually as well as their sensitivity to small perturbations. This dynamic behavior of complex systems involves interactions at all scales. The acknowledgement of nonlinearity enables new views on causality and its temporal and spatial implications on security. Complex systems analysis goes beyond the reductionist approach of breaking complicated phenomena into simple variables; new properties and behaviours evolve from the interactions between individual components.

3 Discussion: Asia-Pacific Security Landscape

3.1 Black Swan Events

The high impact and low frequency 'black swan' events are becoming the new normal in the Asia-Pacific region. The human security (freedom from want, freedom from fear) dimensions to black swan events are national and regional security challenges. As a 'security threat' such events '…disrupts the free flow of trade and investments across economies; and presents tremendous challenges and serious threats to the inclusiveness and sustainability of growth and development in the region. As per the World Bank estimate, the APEC economies have incurred disaster-related losses of over $100 Billion every year for the last ten years' (APEC 2015). Events like the Great East Japan Earthquake and Typhoon Haiyan characterize these events. Lixin et al. (2012:295) in their analysis of the disaster management system in China argue that 'China has been traditionally vulnerable to almost all natural disasters because of its vast territory, and complicated weather and geographical conditions. Almost all kinds of natural disasters, such as floods, droughts, earthquakes, typhoons, heavy snows, landslides and so on, have occurred every year (National Disaster Mitigation Center Disaster Information Department 2009).

These disasters induced serious losses. Generally, thousands of people die of these natural disasters, and about 200 million people are affected every year'. Such events have a significant impact on the security landscape (i.e. food security, energy security, health security) and signal opportunities for regional collaboration and cooperation with regards to disaster risk reduction and disaster management.

3.2 Understanding Disaster Forensics

As described in Masys (2016a), many large-scale disasters have a complex aetiology that transcends the reductionist, siloed perspective. They cannot be solved by technical approaches alone, but require an understanding of the collective 'social' dynamics. The 'social' here is used within the context of Actor Network Theory (ANT) as described in Masys (2010). This Latourian 'social' (Latour 2005:5) is defined as '… a 'trail of associations'. In this sense he describes the 'social' not as a designated thing among other things, but rather as a '…type of connection between things that are not themselves social'. It is these interdependent and interconnected 'actors' and the inherent relational dynamics that characterize the complexity. Such approaches as foresight, disaster forensics and network analysis support the opening of the black box of complexity (Masys 2010, 2012a, b, c, 2016a, b).

It is evident from the literature (Helbing 2013; Levine et al. 2011; Masys 2012a, b, c; Wattie and Masys 2014; Masys et al. 2014) that often policies and managerial decisions miss the mark with regards to crisis management and resilience and do not achieve desired outcomes, but actually lead to unexpected or unintended consequences (Masys 2012a, b, c). For example, Agyepong et al. (2012:iv22) argues that 'Policy resistance describes the situation in which the attainment of the goal of an intervention within a CAS is thwarted by the response of the system to the intervention itself. It arises from a 'narrow, reductionist world view' and a related 'mismatch between the complexity of the systems we have created and our ability to understand them' (Sterman 2006). A decision, action, inaction or some other intervention within a system, acts as a tipping point or trigger that leads to a response by another actor or group of actors. This response can be intended, unintended or a mixture'.

The same problems extend to the security domain. The issue stems from the complexity associated with the problem space of security whereby linear and 'siloed' thinking are too simplistic for 'security ecosystems' that are complex. Dekker et al. (2011):941) argue that '…analytic reduction cannot tell how a number of different things and processes act together when exposed to a number of different influences at the same time. This is complexity, a characteristic of a system. Complex behavior arises because of the interaction between the components of a system. It asks us to focus not on individual components but on their relationships'. This is the realm of 'disaster forensics': understanding the complex aetiology of intended and untended consequences.

Table 1 Top five global risks for 2016 and 2017 in terms of likelihood and impact (WEF 2017)

Top 5 Global Risks in terms of likelihood		Top 5 Global Risks in terms of impact	
2016	2017	2016	2017
Large-scale involuntary migration	Extreme weather events	Failure of climate change mitigation and adaptation	Weapons of mass destruction
Extreme weather events	Large-scale involuntary migration	Weapons of mass destruction	Extreme weather events
Failure of climate change mitigation and adaptation	Major natural disaster	Water crises	Water crises
Interstate conflict with regional consequences	Large scale terrorist attacks	Large-scale involuntary migration	Major natural disasters
Major natural catastrophes	Massive incident of data fraud/theft	Severe energy price shock	Failure of climate change mitigation and adaptation

3.3 Threat and Risk Landscape

The Asia-Pacific security landscape is not just a regional concern. It is affected and affects the global risk landscape. The top five global risks for 2016 and 2017 in terms of likelihood and impact respectively are outlined in Table 1.

These risks and threats certainly resonate with the Asia-Pacific Region and contribute to a complex security environment. As noted in Staniforth (2016:11) '…the range of threats to national security is becoming increasingly complex and diverse. Terrorism, cyber-attack, unconventional attacks using chemical, nuclear or biological weapons, as well as large scale accidents or natural hazards…could put citizen's safety in danger while inflicting grave damage to a nation's interest and economic well-being'. The Asia-Pacific region is under constant stresses from the impacts of natural hazards and man-made disasters thereby affecting vulnerable populations. The links between disasters, development, sustainability and poverty are not new. Extreme poverty characterizes much of the vulnerable populations within Asia and the Pacific region. Zoraster (2010) argues that '…many high-risk geographical areas have a disproportionately high percentage of marginalized populations; this same population is at a disadvantage for preparation, evacuation, response, and recovery'. Within the Philippines for example, over 25 per cent of the population are living below the poverty line. This characteristic marks a considerable vulnerable population in the face of such disaster events as Super Typhoon Haiyan. Across Asia and the Pacific 772 million people live on less than \$1.25 a day and are particularly vulnerable to disasters. They tend to live in low-value, hazardprone areas – not just city slums, but also steep slopes, seismic zones, floodplains and river banks or remote areas (UNESCAP 2016: XXIII). Human security framed along the lines of disaster risk reduction and resilience has acquired a renewed sense of urgency in the context of sustainability, development and poverty eradication.

Fig. 1 DRR, development and sustainability nexus

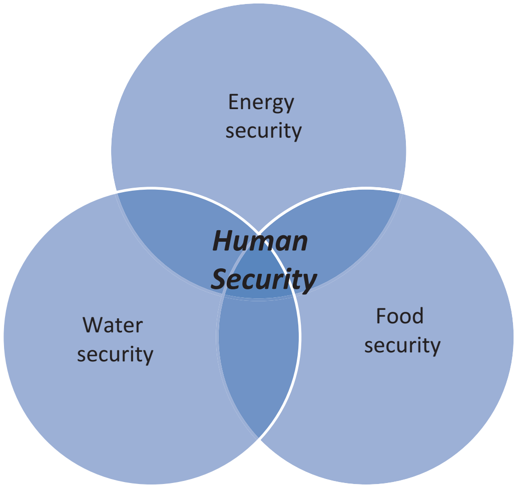
Development, sustainability, disaster risk reduction are inextricably linked and interdependent. At the center of this nexus (Fig. 1) lies human security (freedom from want, freedom from fear). Disaster risk reduction is a core development strategy amongst the 17 Sustainable Development Goals. For example as described in UNISDR (2015):

> Goal 1:
> Building disaster resilience is critical to achieving the goal of eradicating extreme poverty. As one of the key drivers of disaster risk, given the way it creates and aggravates economic and social vulnerability, poverty has significantly contributed to the growth in risk conditions which further limit the progress of sustainable development. Evidence suggests that the impacts of disasters undermine hard-earned development gains in both developing and developed countries, potentially dragging the poor and most vulnerable even deeper into poverty.
>
> Goal 8:
> Investing in disaster risk reduction and resilience is imperative to secure economic growth and development. Developed and developing countries alike have achieved significant economic progress over the years, yet the threat of increasing disaster risk raises uncertainties about their economic stability. This is due to the growing exposure of economic assets and people to hazards such as earthquakes, floods, hurricanes and drought, which magnifies disaster risk. Global average annual losses from disasters are forecast to increase from US$260 billion in 2015 to US$414 billion by 2030.

3.4 Water-Food-Energy Nexus

The Asia-Pacific Region is characterized as one of the world's most dynamic regions with regards to population growth, economic progress, urbanization, and industrialization. These factors have contributed to the demand for resources (food, water, energy) (Rasul and Sharma 2016: 689) and pose significant security concerns. The

Fig. 2 Water-energy-food nexus



food-water-energy nexus (Fig. 2) is relevant to human security and resonates with issues pertaining to poverty and vulnerable populations. Lack of understanding of this nexus can lead to unintended consequences. Water-Food-Energy nexus emerges as a critical security concern in the face of black swan events. Sourced from the World Water Development Report 2014 (UN Water 2017):

> The global community is well aware of food, energy and water challenges, but has so far addressed them in isolation, within sectoral boundaries. At the country level, fragmented sectoral responsibilities, lack of coordination, and inconsistencies between laws and regulatory frameworks may lead to misaligned incentives. If water, energy and food security are to be simultaneously achieved, decision-makers, including those responsible for only a single sector, need to consider broader influences and cross-sectoral impacts. A nexus approach to sectoral management, through enhanced dialogue, collaboration and coordination, is needed to ensure that co-benefits and trade-offs are considered and that appropriate safeguards are put in place.

For the energy sector in particular Sharifi and Yamagata (Sharifi and Yamagata 2016:1655) argue that '…climate change and global warming can have negative impacts on energy sector through increasing energy demand and intensifying extreme events that threaten the security of the generation, transmission, and distribution infrastructure'. Such security threats as climate change can result in '…multiple stresses, and adaptation requires comprehensive and integrated approaches, with coordination between different sectors and at different scales (local, national, and regional). Water, energy, and food are critical for human survival and sustainable well-being. All three are subject to rapidly growing global demand, and all face resource constraints, with billions of people lacking access to them (Bazilian et al. 2011). Clearly, meeting these critical needs represents the most important challenge facing society today' (Rasul and Sharma 2016: 683).

Within this mindset and in particular within the context of human security, water-food-energy nexus and the security ecosystem, it is recognized that there exists a disproportionality of ‘causes and effects’, in which as Urry (2002:59) remarks, past events are never ‘forgotten’. Ramo (2009:74) notes that ‘catastrophic changes in the overall state of a system can ultimately derive from how it is organized, from feedback mechanisms within it, and from linkages that are latent and often unrecognized’. Many interconnected and interdependent elements within human security systems and their contexts create extensive networks of feedback loops with variable time lags between the cause and effect of an action and non-linear relationships between system elements, collectively creating a ‘dynamic complexity’. As a complex adaptive system, the system dynamics evolve from the interactions among the system’s elements rather than the result of a change in one component. Understanding this interconnectedness and complexity is the essence of network thinking (Xu and Masys 2016) that views the system as a whole rather than its individual component parts, taking into account behaviour of systems over time rather than static ‘snapshots’ (Senge 1990).

With consideration of the DRR, sustainability and development nexus, Rasul and Sharma (2016:689) capture some of the key principles associated with systems thinking to support the water-food-energy security:

- ‘Understand the interdependence of subsystems within a system across space and time and focus on system efficiency rather than the productivity of individual sectors to provide integrated solutions that contribute to water, energy, and food policy objectives.
- Recognize the interdependence between water, energy, and food and promote economically rational decision making and efficient use of these resources in an environmentally responsible manner.
- Identify integrated policy solutions to minimize trade-offs and maximize synergies across sectors and encourage mutually beneficial responses that enhance the potential for cooperation between and among all sectors, and public–private partnership at multiple scales.
- Ensure policy coherence and coordination across sectors and stakeholders to build synergies and generate co-benefits to produce more with less and contribute to long-term sustainability with limited environmental impact.
- Value the natural capital of land, water, energy, and ecosystems and encourage business to support the transition to sustainability’.

To support security planning, the complex interplay of food, energy, and water demand and supply requires a holistic approach and institutional mechanisms to coordinate the actions and strengthen complementarities and synergies among the three sectors (Rasul and Sharma 2016: 696). Traditional linear thinking approaches are no longer valid. Agenda 2030 represents a transformational vision for dealing with human security. This can be addressed through a systems (nexus) approach associated with Disaster Risk Reduction, Development and Sustainability (Fig. 1).

Understanding the implications of these security challenges for the Asia-Pacific region has already reified with the ‘black swan’ shocks over the last number of years. ‘New ways of thinking’ are required (if not essential) to manage the complex problems associated with security management within this dynamic security ecosystem. As an integrating element, complexity theory provides not a methodology per se, but rather 'a conceptual framework, a way of thinking, and a way of seeing the world', and presents itself as a powerful way to view the security management domain. As presented with the nexus approach regarding water-food-energy security, complexity theory suggests that studying the interdependencies and interactions among the elements, as well as the unity of the system itself will provide critical insights to better manage shocks to the security ecosystem. Causal attribution moves beyond the traditional linear lens to reveal a more complex non-linear causality. Such an approach applying Actor Network Theory is detailed in Masys (2014, 2015, 2016a, b). Peters (2014) describes system thinking theories, methods and tools that can be applied to manage black swans within the security ecosystem.

3.5 New Ways of Seeing and Thinking

Disaster risk reduction (DRR) is an integral part of sustainability and development and is recognized as such in the Hyogo Framework for Action 2005–2015. The Sendai Framework for Disaster Risk Reduction 2015–2030 reaffirms and builds upon these key elements of sustainability and development.

DRR, sustainability and development figure prominently and are foundational elements for supporting human security. With regards to human security in the Asia-Pacific region, energy security is a key national security concern. Having reliable, safe and available energy is critical to support national economic and societal prosperity and innovation. Many countries throughout the Asia-Pacific region are natural resources deficient thereby challenging their energy security posture. For example in 2014 Japan imported more than 90 per cent of its primary energy supply, making energy security a major concern. The events following the Great East Japan Earthquake and tsunami of 2011 and subsequent nuclear disaster at Fukushima (Masys et al. 2014) capture the complexity and interdependencies of the security ecosystem. Within this complexity paradigm, risk is no longer localized but has become differentially distributed (borderless risk) thereby requiring society to deal with persistent insecurities and uncertainties nationally, regionally and globally. With the water-food-energy nexus, the challenges regarding energy security cascade across all three dimensions.

According to Helbing (2013:51) we are increasingly living in a 'hyper-connected world' which creates 'hyper-risks' because of numerous networks and interdependencies. When we consider this 'hyper-connected world', networked risks emerge thereby challenging our understanding regarding the defence, security and safety domain. As described in Masys (2014), in this 'hyper-connected world' with interconnected social/technical/political/economic systems, shocks to regional, national and global systems stemming from natural hazards, acts of armed violence, terrorism and transnational crime have significant defence and security implications. For

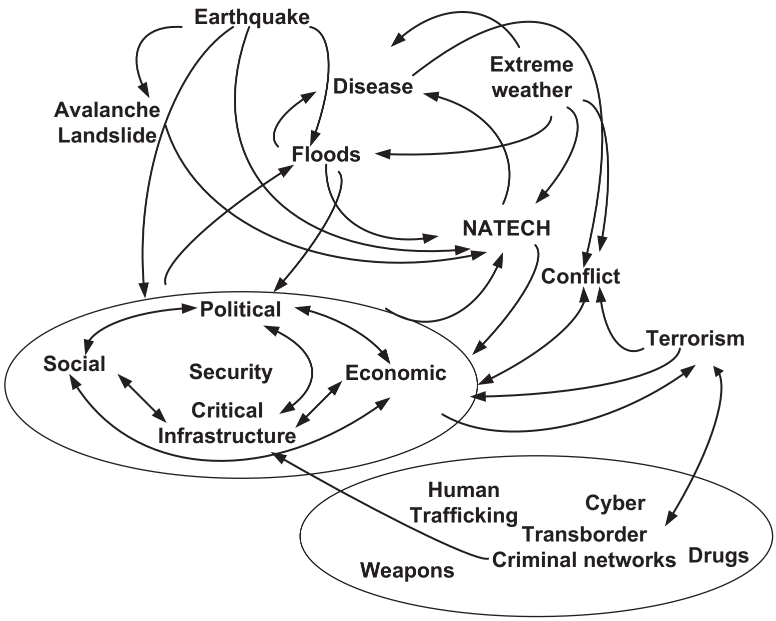


Fig. 3 Security ecosystem influence diagram

example, the local, regional and global supply chain security effects are reflected by Prizzia and Levy (2017):

> A rising sea level, for a country like Vietnam, with 2,000 miles of coastline presents a major environmental and food security challenge, especially in the Mekong River Delta region where 22 percent of the population lives and about half of the country's food is produced. With rising seas, millions of people in the Mekong Delta region will likely be forced to move. For the region's farmers, climate change has enormous implications, as Vietnam is an important player in the global food system. It is the second-largest producer of coffee, a crop grown in the highlands and that is affected by higher temperatures and rainfall pattern changes. Rice is their second-largest export commodity. They also export tea, pineapple, citrus fruit and sugar….

The complexity and dilemmas that characterize the security ecosystem (Fig. 3) requires a paradigm shift: a shift in the way we see; a shift in the way we conceptualize; a shift that recognizes the inherent interconnectivity and interdependencies. Such a shift challenges a reductionist approach and embraces a systems thinking paradigm. The paradigm of systems thinking permits a view of the world as a complex system in which as noted by Sterman (2000:10) we come to the understanding that 'you can't do just one thing' and that 'everything is connected to everything else'. This is supported by Senge (1990:73) who is of the opinion that the discipline of the systems approach lies in a shift of mind: in seeing interrelationships rather than linear cause-effect chains and seeing processes of change rather than snapshots.

The security ecosystem can leverage lessons learned from Typhoon Haiyan and other humanitarian and crisis management events (Masys 2012a, b, c). A systems lens reveals striking insights and solutions by helping to frame the problem across the DRR, Sustainability and Development nexus (Morgan 2005:15–16):

- ‘First, people see the part to which they are connected but are largely unaware of the bigger system(s) that surrounds it. They miss their impact on others and others on them.
- Second, people tend to lack a time dimension. They see the present but not the past. They are intent on figuring out where a particular system should be in the future. They have some interest in knowing where it is now. But they have little inclination to understand where it has been. They do not know the history of the present. ‘…everything that was left unprepared becomes a complex problem, and every weakness comes rushing to the forefront’ (Weick and Sutcliffe 2007)
- Third, participants miss - and in many cases mischaracterize - many of the key relationships that shape events.
- Fourth, people suffer from process blindness. They do not grasp the process dynamics, especially the deeper ones that are ongoing even within smaller systems. They suggest improvements which do not fit or even acknowledge the way the system actually works. They see individuals or events but not the processes of which they are a part’.

These key insights help to support the paradigm shift to systems thinking, complexity and nexus thinking. Levine et al. (2011: 7) argue that ‘…a system perspective can often reveal how behaviour that is competent from the standpoint of each individual actor does not contribute to achieving the overall goals which collectively all the actors in the ‘system’ say they are working towards, in different ways. System problems often result when different actors do not really share the objectives, or when they do not agree on which elements contribute to a single system’.

As shown in Fig. 3, the security ecosystem is integrated into the greater societal system showing how it influences and is influenced by disasters (both man-made and natural). Decisions displaced in time and space regarding security and disaster management can have significant implications as we have seen with the Fukushima nuclear accident and resulting stress on energy security for Japan and globally (Masys et al. 2014; Masys 2016b). A disaster forensics approach described in Masys (2016a) can help to unearth the complex interdependencies and identify key leverage points to support DRR, sustainability and development.

The mental models we have regarding security incorporate ones biases, values, learning, experiences and beliefs about how the world works. As described by Masys (2012b) with reference to the oil and gas industry safety culture, several processes through which mental models become flawed in industrial settings, resulted in the misreading of situations (Chapman and Ferfolja 2001) which resonates with security management and the lessons learned from various disasters. These processes include ‘… retaining outdated knowledge that no longer applies, accepting unreliable sources of information at face value, and missing out on critical data because of poor communication within the work organization' (Chapman 2005). As Weick and Sutcliffe (2007) argue within the context of organizations:

> … Expectations are built into organizational roles, routines, and strategies. These expectations create the orderliness and predictability… Expectations, however, are a mixed blessing because they create blind spots. Blind spots sometimes take the form of belated recognition of unexpected, threatening events. And frequently blind spots get larger simply because we do a biased search for evidence that confirms the accuracy of our original expectations.

What this shows through the complexity lens is that the security ecosystem is shaped by factors seeded in advance. Recognizing this presents an opportunity for new strategic possibilities regarding security management across the DRR, Sustainability and Development nexus that enables resilience (Masys 2014). Urry (2002:59), in his discussion of complexity and systems, remarks that there exists a '…profound disproportionality of 'causes and effects'. Such systems possess a history that irreversibly evolves and in which past events are never 'forgotten'. Failure to recognize or understand the complex interdependencies associated with the security ecosystem can result in making incorrect assumptions regarding attribution and contribution of events and decisions. Local actions and decisions can have regional and global impacts. When we consider economic security within our security ecosystem, the lessons learned from the 2007/2008 financial crisis resonate with the requirement for a systems view. Goldin and Mariathasan (2014:33) argue that '… one reason for the failure to identify and contain the financial crisis 2007/2008 in a timely manner was that the approach to governance was largely guided by thinking in linear and one-dimensional relationships. In a complex and highly nonlinear world, such thinking generates unintended consequences'. The global financial crisis which began in 2007 had '…triggered losses of $4.1 trillion with its effects felt in every global market' (Goldin and Mariathasan 2014:24). The importance of systemic thinking crosses the security landscape from cyber to mass migration, from epidemics to natural disaster triggered technological disasters. As noted in Goldin and Mariathasan (2014:66) 'systemic analysis must examine nodes, pathways, and the relationships between them, because catastrophic changes in the overall state of the system can ultimately derive from how it is organized- from feedback mechanisms within it and from linkages that are latent and often unrecognized'. This has been described in detail in Masys (2016a) leveraging Actor Network Theory to support disaster forensics.

When we consider lessons learned, Dekker (2011: 40) reminds us that 'everything that can go wrong usually goes right, and then we draw the wrong conclusions'. His statement resonates with the security management domain. Addressing the unique challenges associated with such inherent complexity requires collaborative efforts among key disaster management and security stakeholders that facilitate questioning judgments and underlying assumptions, and employing critical and creative thinking (Xu and Masys 2016; Strang and Masys 2015) in order to explore the new strategic possibilities.

In addition to systems thinking and network thinking described in Masys et al. (2014) and Masys (2015), foresight and scenario planning (Masys 2012c) emerge as key solution navigators with regards to shocks to the security ecosystem. Much of the challenges associated with managing shocks stems from the mind being '…blinded by optimism and confusion' or '…using out of date and unrealistic models of the world' (Ramo 2009:6). Leveraging alternative perspectives and system lenses provides insight to guide possible options based on defensible conclusions derived from evidence-centered research. Across management and applicable to DRR, Sustainability and Development, '…The most common source of mistakes is not the failure to find the right answers. It is the failure to ask the right questions. Nothing is more dangerous in business ***(or security)*** than the right answers to the wrong questions' (Ramirez and Wilkinson 2016:23).

The DRR, Sustainability and Development nexus and Water-Food-Energy nexus illustrates the human security implications of linear 'siloed' thinking. Systems thinking concepts are well known in the fields of biology, anthropology, physics, psychology, mathematics and computer science, and are beginning to gain impact in humanitarian, security and disaster management domains. In these domains, systems thinking constitutes a paradigm shift from the traditional linear way of thinking to a more dynamic and holistic perspective that embraces non linear behavior. Decision makers in these domains need to better understand the systems view to be able to tackle the wicked problems associated with the security ecosystem and black swan events.

4 Conclusion

Security management begins well before the disaster event (man-made or natural). Weick and Sutcliffe (2007:2) highlight how such an event can be '…considered as an abrupt and brutal audit: at a moment's notice, **everything that was left unprepared becomes a complex problem, and every weakness comes rushing to the forefront'**. Security can be challenged by the disruptive influences of climate change, public health outbreaks, food (distribution) shortages, financial crashes, cybercrime, natural and man-made disasters. As described in Masys (2015), in today's complex security environment we '…are not confronted with problems that are independent of each other, but with dynamic situations that consist of complex systems of changing problems that interact with each other (Rosenhead and Mingers 2001: 4–5).

The APEC leaders, in their past declarations and statements, have expressed their commitment to address natural disasters, which remains as one of the major challenges confronted in the region (APEC 2015). Such a collective and collaborative leadership posture positions the Asia-Pacific well in addressing black swan events affecting security (national, regional and global). To support this regional effort, this chapter argues for the paradigm shift in ways of thinking and seeing to support security planning and awareness exploring the DRR, Sustainability, Development human security issues. The complexity associated with the Asia-Pacific security ecosystem certainly supports this paradigm shift.

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Risk and Resilience in the Asia-Pacific Region: Managing the Expected, Preparing for the Unexpected

Christian Fjäder

Abstract Disaster risk reduction and resilience are gaining increasing attention globally as disasters affect more people and assets. The Asia-Pacific is one of the most important regions in the world, covering substantial amount of its landmass, number of people and share of economic activity. The region is, however, also the most disaster-prone region in the world. Consequently, disaster risk reduction and resilience building are of paramount importance to the region and, indeed the world. The idea of risk reduction and resilience building complementing each other is a result of evolving practice in particular in context of hazards and disaster management. In principle, such approaches are pragmatic and in the simplest of terms rely on the notion that *risk reduction* is a practice aimed at responding to the expected (based on the information gained from the observation of risk events that have taken place in the past), whilst *resilience* is primarily focused on the ability to survive the unexpected. There are, however, some notable differences between practice and theory in how the relationship between risk and resilience are perceived. This chapter aims at examining the current efforts in the Asia-Pacific to integrate risk reduction and resilience building measures into various policy frameworks, the disaster risk and black swans landscape in the region and to evaluate these in the context of theories of uncertainty, risk and resilience.

Keywords Black swans • Resilience • Disaster risk reduction

1 Introduction

Disaster risk reduction and resilience are gaining increasing attention globally as disasters affect more people and assets. For instance, between 2005 and 2014 disasters affected globally 1.7 billion people and caused USD$ 1.4 trillion in economic

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_2

damages (Melkunaite 2016). The Asia-Pacific is the world's most disaster-prone region according to the United Nations (UN). According to the UN, the region suffered 1625 disasters between 2005 and 2014, 40% of the world total. Even worse, an estimated 1.4 billion people were affected by these disasters, 80% of the global total. In terms of the economic impact, on the other hand, it has been estimated that disasters in the region have caused more than half a trillion US dollars of economic damage over the past decade, nearly half of the global total. Due to population growth, urbanisation and rapid economic growth, the human and economic impact of disasters is expected to grow further.

The 2015 Asia-Pacific Disaster Report – "Disasters without borders: regional resilience for sustainable development" – compiled by the UN Economic and Social Commission for Asia (ESCAP) – argues that achieving sustainable development in the region is difficult without effective risk reduction and disaster resilience strategy implementation. Moreover, as majority of disasters in the region are cross-border in nature, the report calls for a regional approach to disaster risk reduction and resilience in the Asia-Pacific. The report also points out to the necessity of, on the one hand, integrating risk reduction into other policy frameworks and on the other, the necessity to shift focus from response to adaptation, mitigation and preparedness by enabling disaster resilience.

The focus on risk reduction and resilience building has indeed been heard in the Asia-Pacific and in fact, there are a number of disaster risk reduction and resilience building initiatives in the region. The multiple regional initiatives, albeit partially overlapping, are important for developing solidarity and actionable commitments towards advancing DRR in the region.

The practice of risk reduction largely derives from a notion that it is both possible and advantageous to attempt to reduce the exposure of vulnerable populations to risks observed based on past events by a variety of planning efforts. The idea of risk reduction and resilience building complementing each other is a result of evolving practice, in particular in context of hazards and disaster management. In principle, such approaches are pragmatic and in the simplest of terms, rely on the notion that *risk reduction* is a practice aimed at responding to the expected (based on the information gained from the observation of risk events that have taken place in the past), whilst *resilience* is primarily focused on the ability to survive the unexpected. There are, however, some notable differences between practice and theory in how the relationship between risk and resilience are perceived.

Consequently, whilst the practices and theories are supposed to complement each other and contribute to each other's development, there is a danger of science and practice not being optimally aligned and enriching each other. The problem exists in particular in regards to the appropriate balance between *risk reduction* and *resilience* building in the preparedness for disasters and the ongoing practices of learning from them in order to enhance the capabilities required to guard in particular vulnerable populations against *all hazards*. Reaching such an optimal balance, hence, requires a firm understanding of central concepts of *risk*, *uncertainty* and *resilience*.

This chapter aims at examining the current efforts in the Asia-Pacific to integrate risk reduction and resilience building measures into various policy frameworks, the disaster risk and black swans landscape in the region and to evaluate these in the context of theories of uncertainty, risk and resilience.

2 Asia-Pacific: The World's Economic Powerhouse, But Also the Home of Frequent Disasters and Potential Black Swans

The Asia-Pacific, stretching from Asia in the east, Oceania in the south and the Americas in the west, is widely considered as the world's most dynamic region. The Asia-Pacific not only covers approximately 52% of earth's surface and 59 of its total population (Jha and Brecht 2011), but it is also the powerhouse of the global economy, accounting for approximately 59% of the global GDP, 49% of world trade (APEC website) and the East Asia and the Pacific region accounts for approximately two-fifths of the global economic growth (World Bank 2017). The region is also the hub of many of the Global Value Chains (GVCs), in for instance the apparel and footwear, agro-food, electronics and automotive industries. In 2013, the region accounted for approximately 45% of the global GVC-related exports of final products (UNESCAP 2012). Moreover, small and medium size enterprises (SMEs) from the region are important suppliers of many critical components and are increasingly important providers of IT and other services. The Mekong river subregion, for instance, is a critical production base for the global automotive industry and the provinces around Bangkok in Thailand are critical hubs for the global electronics industry, in particular in relation to semiconductors and hard disk drives.

2.1 The World's Most Disaster-Prone Region

However, as indicated in the introduction to this chapter, the Asia-Pacific is also the world's most disaster-prone region, in terms of disaster frequency, number of people affected and economic impact. Indeed, the region accounts for roughly 70% of natural disasters in the world and between 1970 and 2014 accounted for approximately 56% of the disaster related fatalities (Melkunaite 2016). The main reasons for this lie in the geographical destiny of the region, climate change and demographics. First of all, the region is engulfed by the Pacific Ring of Fire, which accounts for 75% of world's volcanoes and 90% of the world's earthquakes (Jha and Brecht 2011). Consequently, the region is not only the most active region in terms of earthquakes, but it also has experienced many of the largest earthquakes in the world. Some of the most famous examples of such "mega-earthquakes" are the magnitude 7.3 Kobe earthquake (the Great Hanshin earthquake) of 1995, the magnitude 8.0 Sichuan earthquake in 2008 and the magnitude 9.0 Great East Japan Earthquake in

2011 (the Tōhoku earthquake). The 1995 Kobe earthquake caused the loss of life of 6434 persons, devastated immediately 150,000 buildings and caused economic damage equalling to 2.5% of Japan's GDP at the time, whilst the 2008 Sichuan earthquake killed 70,000 people, injured 374,000 and caused approximately $US 85 billion in damages (Jha and Brecht 2011). The Great East Japan Earthquake of 2011, on the other hand, was the most powerful earthquake ever recorded in Japan and caused a cascading disaster of unprecedented proportion when it created a massive tsunami, which in turn damaged the reactors of Fukushima Daiichi Nuclear Power Plant. The cascading disaster cost 16,000 lives, 100,000 residents had to be evacuated from impacted areas and the country suffered a total economic damage of USD$ 212 billion, making it the costliest natural disaster in world history (World Bank 2014). Besides the devastating local impact, however, the cascading effects of the 2011 disaster echoed well beyond the immediate area of the disaster and Japan as a whole, disrupting global supply chains across industries. For instance, Shin-Etsu Handotai, one of the world's leading producers of silicon wafers and ingots, that are used in the manufacturing of semiconductors, had its factory in Fukushima and the disruption of production there caused a 22% drop in the global supply of silicon wafers and ingots (Jha and Brecht 2011). The disaster also caused extensive disruptions in other electrical components and the automotive industry, causing cascading effects in those supply chains across Asia and indeed, the world (Asian Development Bank 2009).

In addition to being prone to earthquakes, the region is also vulnerable to other natural hazards, such as tropical typhoons, floods and drought. One of the major factors influencing climate patterns in the region is the *El Niño South Oscillation* (ENSO) phenomena, which causes irregular and periodical variation of sea surface temperatures and wind patterns over the eastern Pacific Ocean, which in turn influence temperature and precipitation variations. ENSO in fact has two distinct phases, of which *El Niño* is the warming and *La Niña* the cooling phase. The warming phase essentially refers to the warming of the ocean surface, which influences wind and rainfall patterns, direction and strength. During the warming phase rainfall tends to become reduced over Indonesia and increase over the eastern tropical Pacific Ocean. It also weakens the low-level surface winds from east to west along the equator, whilst in some cases changes the direction to the opposite. The cooling of the ocean surface, on the other hand, tends to increase rainfall over Indonesia and reduce it over the central tropical Pacific Ocean. It also has the tendency to strengthen the easterly winds along the equator. The two phases could thus, be used to predict seasonal weather pattern changes in advance. However, the timing, intensity and duration of the two phases vary and the element of surprises in regardless of the potential significant (L'Heureux 2014). Asia is also subject to circular monsoon seasons, which affect the level of precipitation and winds, but these are by default regular and thus, predictable.

Whilst ENSO and monsoon seasons are a natural phenomenon and thus, somewhat predictable in their occurrence, the unpredictability of extreme weather events seems to be nonetheless increasing, in particular in terms of flooding and tropical cyclones. The primary recent examples include the massive and extended flooding in Thailand in 2011 and the massive tropical storms in the Philippines in 2013. The 2011 floods in Thailand are a particularly pertinent example of the challenges for risk reduction and resilience strategies. Whilst flooding in Thailand is not unheard of in the monsoon season, the tropical storms in July 2011 started a catastrophic cycle that continued almost to the end of the year and produced extraordinary heavy rainfall in parts of the country. In particular the northern and central regions of Thailand suffered enormously, experiencing 40% above normal precipitation that caused the Chao Phraya Rivers system to flood downstream. Consequently, the flooding inundated parts of Bangkok and surrounding industrial areas, bringing the water levels up to three to five meters above normal, rendering flood barriers at river banks and the flood preparedness measures useless. The several months long floods not only caused over 800 deaths, enormous impact on the environment and approximately USD$ 46.5 million in damages, but also disrupted important industries and global supply chains, when manufacturing plants seven industrial parks with hundreds of factories in the Ayutthaya, Nonthaburi and Pathum Thani provinces in Bangkok's neighbourhood were inundated under the masses of water and had to close down.

The factory closures hit two industries particularly bad; the automotive and electronics industries. The electronics industry manufacturers were particularly severely hit. Besides causing a major blow to the companies and the local workforce, the global supply chains of semiconductors and hard disk drives were severely impacted when major manufacturers, such as Western Digital, Seagate Technology, Sony and Samsung Electronics, had to close production. Seagate and Western Digital, for instance, are two of the largest hard disk drives manufacturers in the world and the shortage of supply shock caused by the disruption of their production causes prices to double world-wide. Moreover, the recovery of the global hard disk drives market took over 2 years. Also the automotive industry was hit bad when major manufacturers such as Honda Motor, Toyota Motor and Nissan Thailand had to close down. Much like in the case of the electronics industry, the local disruption causes a global impact for the automotive supply chain.

3 The Increasing Number of Vulnerable Populations as a Future Challenge

Whilst the fact that the Asia-Pacific is especially prone to a variety of natural disasters, another major reason for this continuous tragedy is that the region is also the home of the largest and fastest growing number of vulnerable populations. For instance, East Asia is currently the home to four of the top ten most vulnerable cities in terms of populations exposed to natural disasters; Guangzhou, Shanghai, Ho Chi Minh City and Osaka-Kobe. When you add South Asia's two top ten cities – Mumbai and Kolkata – on the list, Asia accounts for 6 out of 10 most vulnerable urban populations in the world (World Bank 2014). Moreover, in East Asia the number of urban population is expected to double from 1994 to 2025, putting enormous strain on the environment, infrastructures and resources, even under normal circumstances (Melkunaite 2016). Perhaps more concerning, however, is that the fastest rates of urbanisation in Asia are in the earthquake and tropical cyclone vulnerable areas of China and Southeast Asia, risking the doubling of the number of people in large cities potentially exposed to such natural hazards (World Bank 2014). Between 1970 and 2010 the number of people exposed to flooding more than doubled from 29.5 to 63.8 million and the number of people living in areas vulnerable to tropical cyclones grew from 71.8 million to 120.7 million (UNESCAP 2012). Whilst the population growth in the region has peaked, the concentration of populations in vulnerable areas is a considerable challenge for the future and, places a great strain on risk reduction and resilience building measures. The likely total impact of these factors is that the frequency and impact of disasters is more likely to grow than become reduced. Given that the resulting loss of lives, livelihoods and assets in the region is not only a human tragedy on its own, but also represents potentially a significant diversion of funds and resources from economic and socio-economic development towards disaster relief and recovery, the call for risk reduction and resilience building has a strong base. As the global value and supply chains are vulnerable to cascading effects from localised disasters and Asia has major concentrations of critical production and services for them, risk and resilience building in Asia should be a global priority.

4 The Terror of the Unexpected: Compound Disasters and Black Swans

Yet another factor driving the increasing focus on resilience is the inherent unpredictability of disasters. Even though natural sciences have made leaps in understanding the root causes and dynamics of natural disasters, they, in particular earthquakes and tsunamis, are nonetheless hard to predict in terms of occurrence and severity. Such levels of uncertainty make effective preparedness very difficult, regardless of the competences and resources available. The Great East Japan Earthquake is a demonstrative example of this. Japan, an advanced and prosperous nation, was in fact well prepared for earthquakes, as well as tsunamis, prior to the disaster. However, a magnitude 9.0 earthquake was deemed so improbable on basis of historical data that magnitude 8.0 was used as the worst-case scenario for planning. In a similar manner, cities along the coastlines had constructed breakwaters to fend off the impacts of possible tsunamis, but against waves up to 8 meters high. Both worst-case estimates proved to be underestimates. There was, however, nothing wrong with the estimates in the context of well accepted risk management principles. The estimates should have been adequate, taking into consideration data from past experiences. Moreover, there rarely are rewards available for planners that use once-in-a-thousand-years events as basis for their planning assumptions. Moreover, if the occurrence and impact of one individual event are hard to predict, predicting potential cascading effects from multiple events is practically impossible. This problem of "compound disasters" – multiple sequential disaster events that cause more catastrophic impact than any single individual disaster – was embodied in the 2011 Great East Japan Earthquake (Kawata 2011). One can prepare for an earthquake, a tsunami and a nuclear plant accident, but preparing for multiple events with no advanced knowledge of the potential causalities is not within the parameters of our capabilities. Furthermore, individual events may gain differing importance in different contexts, or cause cascading impacts that are more critical than the initial event. Hence, a potential event could be deemed as not catastrophic on its own merits, but may prove to cause a catastrophic event when combined with other coinciding events, whether these are related or not (Melkunaite 2016). The increased occurrence of such disasters and the concentration of vulnerable populations due to urbanisation would seriously challenge any measures taken for risk reduction, but also strengthens the call for resilience building as a complementary strategy.

Finally, a triggering event might not originate in the region, but nonetheless have catastrophic cascading impacts in the region. One example of such a possibility was the Eyjafjallajökull volcanic eruption in 2010, which despite its notable remoteness from the Asia-Pacific, nonetheless caused cascading effects there. For instance, 5 days after the eruption Nissan Motor had to shut down three auto assembly lines in Japan due to the inability to acquire the required tire-pressure sensors from Ireland, as flights in Europe were grounded on basis of safety concerns (Jha and Brecht 2011).

The idea of compound disasters and the problem dealing with them highlights the problem of high impact – low probability events, as proposed by Nassim Nicholas Taleb in the context of his black swan event theory (discussed in more depth in the theory section of this chapter). Albeit by default extremely rare, such events pose a significant challenge to disaster risk management. Not only are such event hard to value with any reasonable accuracy in terms of probability and impact, but there are few convincing policy arguments towards directing or reserving adequate resources to deal with them. Moreover, even if resources could be secured, it would be extremely difficult to distribute their use in an optimal manner due to the inherent complexity of such events. Whereas events fitting in the framework of the" normal accidents" theory, root-causes and dynamics of disaster events can be at least to a degree predicted through historical experiences, those of "black swan" events are simply not known. Consequently, such considerations would appear to support the use of strategies that focus on reducing risk exposure (as reducing the probability and impact are not an available option), whilst simultaneously building resilience capabilities to survive such extreme events and improve the society's resilience against any and all disaster events, regardless of their root-cause, origin or dynamics.

Some past examples from the region that could be categorised as black swans were for instance the 1997 financial crisis, SARS, bird flu and the 2004 Boxing Day tsunami that caused 350,000 deaths. Whilst predicting and naming potential "black swan" events goes against the very essence of the concept, one can speculate on the relevant categories, as well as the potential sources of such events. In terms of the relevant categories, a black swan that would have a serious impact on the region would most likely fall either into the category of a political, economic, social, environmental, technological or space originated event. One potential source for a black swan could be a compound result of the tensions created by the rising economic protectionism, leading potentially to trade wars, and when combined with a random triggering event (such as a North Korean missile test gone bad, or an accident between naval vessels in the South China Sea), could further escalate into a full blown geopolitical crisis (major war, or even nuclear war) between major powers (such as the United States and China). Another potential is a large-scale pandemic that could not only kill millions, but also, depending on its nature could alter social, economic and political structures in countries and areas affected. Technological risks are equally hard to predict, but given the development of deepening dependency on the Internet in constantly broadening fields of life, the collapse of the global Internet would have devastating impact. Whilst the global Internet could be considered quite resilient due to its distributed structure, such an eventuality is not impossible, but could be caused by for instance a massive cyberattack. As demonstrated by the October 2016 Dyn cyberattack, such an eventuality cannot be ruled out. Also, whilst Asia has already experienced more than its fair share of natural disasters that could be categorised as black swans (e.g. the Great Eastern Japan Earthquake and the 2004 Boxing Day tsunami), a massive volcanic eruption, for instance in Krakatoa Indonesia would certainly qualify as one. After all, last time Krakatoa erupted in 1815, it caused global average temperatures to drop 5 degrees and crops failing worldwide. Should Krakatoa erupt again, the ash clouds could result in worldwide food shortages, that would be particularly catastrophic to the vulnerable populations in Asia. Finally, the possibility of massive solar geomagnetic storms could disrupt satellites, electricity grids and a variety of critical electronic devices and systems, causing a potential compounding disaster beyond current imagination.

5 Risk Reduction and Resilience Building in the Asia-Pacific

Considering the disaster proneness of the region, the increasing number of vulnerable population concentrations and the fear of compound disasters, it is hardly a surprise that disaster risk reduction and resilience building have gained growing attention in the regional agenda. Consequently, the region has no shortage of such initiatives. In fact, most of the regional cooperation organisations have DRR on their agendas, if not on their own regard, then at least in the framework of the international DRR cooperation, such as the Hyogo Framework for Action (HFA 2005–2015) in past, or currently the Sendai Framework for Disaster Risk (2015–2030). The United Nations (UN) Office for Disaster Risk Reduction (UNISDR) coordinates the implementation of the Sendai Framework for Disaster Risk Reduction in the region through its regional structure and country presence. The Sendai Framework is a voluntary programme that recognises that the primary responsibility for disaster risk is with the state, but with a proposition that the responsibility should be shared with the local governments, businesses and other relevant stakeholders. The Sendai Framework's goal is: *The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries* (UNISDR website). The primary platform for the action plan and regional cooperation in implementing the framework is the Asian Ministerial Conferences on Risk Reduction (AMCDRR). The AMCDRR was established in 2005 and is organised biennially jointly by the United Nations Office for Disaster Risk Reduction (UNISDR) and a rotating Asian host country. The AMCDRR is intended as serving the regional states as a forum for agreeing on shared responsibilities and actionable commitments for DRR in the region. Altogether seven AMCDRR conferences have been arranged since 2005, the latest being the 2016 conference in India, which adopted the 'Asian Regional Plan for Implementation of the Sendai Framework' (UNISDR 2016a). Another important UNISDR platform supporting the implementation of the Sendai Framework is the ISDR Asia Partnership (IAP) forum. The IAP forum is intended as the operational arm of the UNISDR regional platform and focuses on providing a regional mechanism for consultation and technical support for the implementation of the regional plan (UNISDR 2015).

Other international organisations that have DRR related initiatives concerning the region include a variety of United Nations (UN) agencies, international financial institutions and bilateral assistance organisations. The World Bank's East Asia and the Pacific Disaster Risk programme, for instance, provides DRR related support in the form of "lending, technical assistance, institutional strengthening and capacity building, and provision of knowledge in the form of best practice, on-demand analytics and just-in-time assistance" (World Bank 2017). The Asian Development Bank (ADB), on the other hand, links DRR with climate change adaptation (CCA) in the context of its flagship DRR project the *Regional Partnerships for Climate Change Adaptation and Disaster Preparedness*. The focus of ADB is to provide tools and methodologies to integrate DRR and CCA approaches in the region (ADB 2013). The ADB also runs a fund supporting such initiatives. The Integrated Disaster Risk Management (IDRM) Fund was established by ADB in 2013 and is supported by the Government of Canada (ADB website).

The Asia-Pacific Economic Cooperation (APEC) Disaster Reduction Framework, on the other hand, is a call for action to the APEC member countries to strengthen DRR in all policy areas. It focuses on risk reduction and disaster resilience in a variety of areas in order to secure sustainable economic development regardless of the frequent disasters in the region (APEC 2016).

In Southeast Asia, the Association of Southeast Asian Nations (ASEAN) created the ASEAN Agreement on Disaster Management and Emergency Response (AADMER) in December 2009 in order to increase regional and national capabilities in disaster response through regional cooperation, coordination, technical assistance and resource mobilization. Moreover, the 2015 Declaration of Resilience envisions a disaster resilient ASEAN Community, whilst the ASEAN Vision 2025 on Disaster Management provides a strategic framework for the implementation of AADMER over the coming decade (ASEAN website).

Oceania is another important sub-region in the Asia-Pacific, both in terms of its disaster occurrence and vulnerability and the number of leading DRR initiatives. According to the World Bank's index the sub-region's exposure to natural disasters and its vulnerability to them tops the list; five out of ten of the registered natural disasters have indeed occurred in Oceania. Just during the past 20 years, Oceania has experienced a total of 156 disasters, which have claimed over 2300 lives, affected another 4.3 million people and caused economic damage worth of USD$ 58 billion (UNISDR 2016b).

Australia, for example, is one of the world's most vulnerable countries to climate change related disasters, such as drought, flooding and bushfires. The recent examples of climate related natural disasters include the 2009 Black Saturday bushfires in Victoria, which killed 173 and injured 414, and the 2010–11 Queensland floods, which killed 38 people, impacted three quarters of the state and ravaged the agricultural industry. The concern is, however, much broader and the exposure to natural disasters is expected to multiply in the future. For instance, the cost of natural disasters in Australia exceeded AUD$ 9 billion in 2015 alone. However, according to estimates, without any mitigating actions, the total cost of natural disasters could amount to AUD$ 33 billion by year by 2050 (Slezak 2016). On the other hand, following a sharp focus on the topic, Australia is currently considered one of the world leaders in DRR and an important regional partner. DRR has indeed been on the top of the Australian government's agenda in the recent years. The government, for instance, released a National Strategy for Disaster Resilience in 2011. The strategy called for a shared responsibility of DRR between governments (Commonwealth, States and Territories), business and communities, and instigated the importance of improved understanding of risks and communicating information about them. The strategy aimed at reducing risks in built environments in Australia and improving national capabilities in disaster resilience by bringing together the various levels of government; State and Territory governments, local governments and the Commonwealth government. The strategy also had a strong emphasis on partnering between different stakeholder groups and empowering individuals and communities. The Australian government has also established important funding mechanisms for DRR. For instance, the National Emergency Management Projects (NEMP) program allocated AUD$ 3.7 million funding to 22 nationally significant projects in the 2015–2016 period. The Natural Disaster Resilience Program, on the other hand, includes AUD$ 26.1 million each year by the Commonwealth Government and matched by state and territory governments, in order to support disaster resilience in local communities across the country. The National Bushfire Mitigation Program, in its turn, includes funding worth AUD$ 15 million over 3 years (2014–2017) to support initiatives with an aim to reduce long-term bushfire risks and disaster resilience against them. In addition to the Commonwealth Government, the state governments also have developed DRR strategies, plans and assessments. For instance, the Queensland state government released the *Queensland Strategy for Disaster*

Resilience in 2014. In addition to natural disaster focused DRR, Australia has addressed the risks to critical infrastructures. For instance, the Australian Government Critical Infrastructure Resilience Strategy was released in 2015 with a strategic goal of improving the resilience of critical infrastructures against all hazards. The partnership between business and government in critical infrastructure resilience, on the other hand, has been a central strategic already for quite long. The Trusted Information Sharing Network (TISN) for Critical Infrastructure Resilience was established by the Australian Government in 2003 as the primary engagement mechanism for such cooperation. The TISN provides a secure environment for critical infrastructure owners and operators across eight sector groups to regularly share information and cooperate within and across sectors to address security and business continuity challenges (TISN 2015). The focus on critical infrastructure resilience is well founded, taking into considerations that the biggest economic costs of natural disasters are associated with critical infrastructure damage (Slezak 2016). However, research commissioned by the Australian Business Roundtable for Disaster Resilience and Safer Communities found that economic costs and social impacts of natural disasters are even more costly than tangible impacts (Slezak 2016).

New Zealand, with a relatively isolated location in the South Pacific Ocean and in the middle of the Pacific Ring of Fire, sitting on top of two tectonic plates, is particularly prone to multiple natural hazards, including (but not excluding); flooding, high wind storms, drought, cyclones, snow storms, earthquakes, volcanic eruptions, geothermal events, tsunamis and landslides (IFRC 2014). The most pertinent examples of recent major disasters are the two massive earthquakes in the Canterbury region in 2010 and 2011. The 2010 earthquake reached magnitude 7.1 and caused significant physical damage, but no casualties. The February 2011 earthquake, on the other hand, whilst weaker at magnitude 6.2 earthquake, had its epicentre in the built areas and caused massive damage in the city of Christchurch, killing 185 people and injuring thousands. Whilst the earthquakes were tragic, they also triggered reviews of legislation concerning risk and disaster management and the state of preparedness in the country. Consequently, the dramatic experiences of the earthquakes motivated New Zealand to establish a particularly sharp focus on DRR. The sharpened focus on DRR proved its utility when the magnitude 6.5 earthquake hit the south of Wellington in August 2013 and later in November 2016 a magnitude 7.8 stroke North Canterbury, causing also a tsunami 2 h later.

In addition to being particularly vulnerable to major earthquakes, being part of the Pacific Ring of Fire, New Zealand is also vulnerable to volcanic eruptions. Albeit the majority of volcanoes are either inactive or dormant, there are also many active volcanoes and relatively frequent eruptions. For instance, the Taupo Volcanic Zone consists of three frequently active volcanoes, of which the Mount Ruapehu is the largest, and two of the world's most productive calderas. The Auckland Volcanic Field, on the other hand, is an area of roughly 360 km^2 situated around the city of Auckland, consisting of 50 separate volcanoes. Whilst the individual volcanoes are unlikely to become active again, the field itself is young and quite possibly active.

Moreover, the potential locations of eruptions are much harder to predict than with individual volcanoes, as the field can erupt anywhere (www.info.geonet.org.nz).

Perhaps also because of its exposure to a wide variety of natural disaster risks, New Zealand is another world leader in DRR and important regional thought leader in the topic, particularly known for its progressive approach to DRR law and regulations and engaging local communities in disaster resilience. In terms of regional cooperation and assistance, New Zealand is a major player. The New Zealand Disaster Response Partnership (NZDRP), for example, offers immediate assistance following a disaster, in forms of for instance, provision of initial emergency supplies, such as water, food and shelter, other humanitarian assistance and the provision of technical expertise. According to the scheme, accredited NGOs may apply funding granted by the Minister for Foreign Affairs on basis of their merit (www.mfat.govt.nz). New Zealand has also pledged strong support for the Sendai Framework for Disaster Risk Reduction and is one of the most active framework partners in the region. New Zealand is also well regarded for DRR and organisational resilience research, local universities offering both Masters and PhD degrees in the topics.

The Pacific Islands have also experienced more than their fair share of natural disasters. The best known recent examples were the category 5 cyclone Pam in March 2015 and the category 5 tropical cyclone Winston in February 2016. The tropical cyclone Pam hit Vanuatu with wind speeds up to 320 km/h, killing at least 15 and leaving 70,000 homeless. Tropical cyclone Winston, on the other hand, was the most powerful storm that has ever hit Fiji, claiming 44 lives and causing economic impact equalling to 20% of Fiji's GDP. The efforts to improve DRR in the sub-region mainly take place in the framework provided by the UNISDR Pacific Platform, which comprises; Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu and Vanuatu (UNISDR website). The focus of DRR in the Pacific Platform is distinctively strong in its coupling between climate change and disaster risk due to the Pacific islands' particularly high exposure to the negative impacts of climate change, e.g. rising of sea levels tropical storms, flooding and drought.

Also non-governmental organisations have turned their focus to risk reduction and community resilience in their work for strengthening civil societies against disasters. For instance, the International Federation of Red Cross and Red Crescent Societies (IFRC) established the *Asia-Pacific Reference Centre on Disaster Risk Reduction and Community Resilience* in order to support its national committees in the region in such capabilities. In fact, non-governmental organisations play an increasingly important role in regional DRR. Another important example of such efforts is the Global Resilience Partnership, a joint initiative by the Rockefeller Foundation, U.S. Agency for International Development and the Swedish International Development Cooperation Agency (Sida) seeks to "to identify and scale locally driven, high-impact, innovative solutions that will build the resilience of hundreds of millions of people in the Sahel, Horn of Africa, and South and Southeast Asia (Rockefeller Foundation 2017). Moreover, the Asian Cities Climate

Change Resilience Network (ACCCRN), a partnership led by the Rockefeller Foundation, focuses on coupling climate change and resilience and supporting South and Southeast Asian cities in identifying their vulnerabilities to climate change impacts and building resilience against them. The core countries in its focus are Bangladesh, India, Indonesia, Thailand and Vietnam (ACCCRN 2017).

The multiple regional initiatives, albeit partially overlapping, are important for developing solidarity and actionable commitments towards advancing DRR in the region. What is critical, however, is to ensure that appropriate linkages are built between the different vertical levels of commitments from local, national, regional and international initiatives.

6 The Expected Versus the Unexpected: Theories of Risk, Uncertainty and Resilience

The idea of risk reduction and resilience building complementing each other is a result of evolving practice in particular in the context of hazards and disaster management. In principle, such approaches are pragmatic and in the simplest of terms rely on the notion that *risk reduction* is a practice aimed at responding to the expected (based on the information gained from the observation of risk events that have taken place in the past), whilst *resilience* is primarily focused on the ability to survive the unexpected. There are, however, some notable differences between practice and theory in how the relationship between risk and resilience are perceived (Melkunaite 2016). Whilst the practices and theories are supposed to complement each other and contribute to each other's development, there is a danger of science and practice not being optimally aligned and enriching each other. The problem exists in particular with regard to the appropriate balance between *risk reduction* and *resilience* building in the preparedness for disasters and the ongoing practices of learning from them in order to enhance the capabilities required to guard in particular vulnerable populations against *all hazards*. Reaching such an optimal balance, hence, requires a firm understanding of central concepts of *risk*, *uncertainty* and *resilience*.

7 The Practices and Theories of *Risk, Uncertainty* and *Resilience*

The practices of Disaster Risk Resilience are largely based on a collection of experiences gained through the past disaster events and the lessons learned from them, as well as from the conceptual and technical development of methods and best practices established with international organisations working in the region. The practice of risk reduction largely derives from a notion that it is both possible and advantageous to attempt to reduce the expose of vulnerable populations to risks observed based on past events by a variety of planning efforts. The idea of risk reduction in the context of DRR has thus a strong coupling with sustainable development and involves a collection of practices of community planning and development that improve the structural condition of the community to withstand and reduce the impact of disaster events, in particular natural disasters, but in principle also human-made risks.

Resilience, on the other hand, has in recent years become a ubiquitous term that features in continuously expanding selection of contexts, ranging from engineering, ecology and psychology to economics and business. The definitions of the concept of *resilience* vary depending on the point of view and field of science in question. The most common and colloquial use of the term *resilience,* however, derives from material sciences, in which the term is used towards engineering design, and in particular towards understanding the behaviour and properties of specific materials in relation to their purpose; for example in the design of structures, such as support beams and bridges (Martin-Breen and Anderies, 2011). Resilience in complex adaptive systems, on the other hand, such as the ecosystem and social systems, is understood as a combination of an ability to **resist**, **recover** from and **reorganize** in response to a shock or a crisis. The key to resilience is thus **adaptability**, which is enabled by the non-linear nature of relationship between constituent parts of the system. Consequently, the definition of 'normal' in complex adaptive systems adapts to match the new circumstances and focuses on the ability to maintain the core function/s of the system, even if the system structure may change, or even collapse in the process (*Ibid.)*.

The concept of *resilience* has emerged particularly strongly in the recent years as a critical element of DRR in the region. Perhaps the most commonly referred to definition of resilience in the context of DRR is that of the United Nations Office for Disaster Risk Reduction (UNISDR). UNISDR defines resilience as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR 2017). According to UNISDR a resilient community is thus, one that has the ability to have the necessary resources and capabilities to organise itself both prior and during the disaster in a manner that minimised the impact to the community and recover from them (Melkunaite 2016). Other definitions by international organisations are somewhat more technical and emphasise a systems approach to resilience. The Asian Development Bank (ADB), for instance, defines *resilience* as follows: "the magnitude of a disturbance that a system can withstand without crossing a threshold into a new structure or dynamic" (ADB 2009). Such "human systems" approaches to resilience emphasise the systemic ability of communities to withstand or recover from stress, whether it is a result of natural disasters, environmental or climate change or economic, societal or political upheaval (Melkunaite 2016). The ADB, however, has also a more practical definition for resilience, stressing the adaptive capabilities of human systems and organisations for surviving crises; "the ability of countries, communities, businesses, and individual households to resist, absorb, recover from, and reorganize in response to natural hazard events, without jeopardizing their sustained socioeconomic advancement and development" (ADB). Such practice oriented definitions differ from more technical and theoretical definitions in a sense of stressing the adaptive capabilities of autonomous components of human systems, which then as a collective improve the system's ability to do the same. The coupling between the two approaches, however, may cause confusion in practitioners about the choices between top-down and bottom-up approaches and the merits of such alternative strategies. At least a partial reason for such divergence can be explained by the evolving understanding of resilience in DRR over the recent years. In particular over the recent years the thinking about resilience in DRR has been influenced by general trends in resilience in other fields, specifically in reference to the objectives of resilience and what they tell us about the fundamental nature of resilience a concept. In this context, the current literature has been dominated by a debate whether resilience should be thought of as primarily a process (or a strategy, approach) or rather as the desired outcome. Hence, resilience has been described both as the entity's ability to return to its predefined and pre-crisis state, which could be described as the "business as usual" or "*status quo*" state as quickly and efficiently as possible, as well as the entity's ability to absorb and adapt to shocks, so that the system continues to perform the same functions and provide the same services during the shock as under normal conditions, despite whether the system itself may have been altered as a result of the shock. The significance to vulnerable populations of the choice between the two can be significant, as the first could be seen as emphasising the ability to preserve the "normal" without any particular emphasis on the continuous development aspects at the cost of securing the continuity of the achieved minimum living conditions also after a disaster, whilst the second approach could be seen as emphasising the focus on the essential at the cost of the non-essential, but also the continuous development of the human system to improve (Melkunaite 2016). This suggests a value based choice, which has significant repercussions to the populations involved. Significantly, it also suggests that such a choice is essential in terms of coupling of risk reduction and resilience building in order to avoid situations where the two approaches that are meant as complimentary, do not proceed with expense of one another. After all, risk reduction primarily supports the first approach, whilst the sustainable development ideology would primarily support the latter understanding of resilience. As will be pointed out later on, this dilemma is directly connected to the understanding of resilience in DRR context is primarily deriving of its origins in ecology or the more recent emphasis on societal resilience.

Albeit the particular emphasis on resilience in the recent years and the increasing coupling between it and risk reduction as a holistic strategy of DRR are relatively recent, the concept of resilience in the context of DRR is not entirely new. The first was primarily influenced by the works of a Canadian ecologist Crawford Stanley Holling in the early 1970s, in particular by his article *Resilience and Stability of Ecological Systems* (1973), in which Holling emphasised the system's ability to adapt and improve cope with shocks in relation to a dynamic equilibrium, thus contrasting the systems stability and its ability to return to an equilibrium (*status quo*).

As opposed to the *status quo* approach, Holling argued that a resilient system may actually be inherently relatively unstable and fluctuate between different states of equilibrium. Such approach, whilst influential in the development of DRR from the 1970s onwards and more recently in the context of the Hyogo and Sendai Frameworks, it has also been strongly influenced by community and societal resilience approaches. The community resilience approach focuses on how communities as social systems react to crises, not so much in terms of how the physical infrastructures in the community can withstand and recover from them. Consequently, community resilience emphasises the adaptive and learning capabilities of communities to self-organise in the event of a crisis and maintain their critical functions and services despite a disaster (see for instance Boon et al. 2012; Cutter et al. 2008). Whilst the definitions for such resilience vary somewhat in the literature, researchers have put forward suggestions for what the elements of community resilience are. Cutter et al. (2008), for instance, refer to six elements of community resilience; ecological, social, economic, institutional, infrastructure, and community competence, whilst Bruneau et al.(2003) refer to four interrelated dimensions as elements of community resilience; technical, organisational, social and economic (leading to an acronym TOSE). Whilst community resilience approaches emphasise a "bounce back" aspect of resilience, it does not exclude transformative resilience entirely, as it acknowledges that returning to the pre-crisis equilibrium may not be possible, or even desirable, due to the changes in the community's environment. Due to the changes in the environment, it may be more prudent to adapt to the altered environment, rather than persistently aiming at "bouncing back" to the pre-crisis "normal" state (Melkunaite 2016).

Societal resilience approaches, on the other hand, focus on how human systems respond to and recover from external and internal shocks, regardless of whether they are natural or human-made in origin. Consequently, whilst it considers natural hazards, the scope can just as well be economic, societal and political upheaval, or in principle any endogenous or exogenous shock. Moreover, it does not limit itself to "bounce back" effects, but instead many accounts of societal resilience emphasise the transformative aspects of resilience, whether they are marginal or radical. Philippe Bourbeau (2013), for instance, refers to three types of (societal) resilience, each representing a different ontology: (1) **resilience as maintenance**, emphasizing utilizing the capability for adaptation towards the maintenance of the status quo, (2) **resilience as marginality**, aiming at keeping the changes produced by a crisis or shock as marginal in order to safeguard against changes to existing structures or policies and, (3) **resilience as renewal**, with an aim to transform, even potentially remodel, the existing structure and policies, relying on diversification between multiple structures and institutions acting as fullbacks (Bourbeau 2013). The maintenance, or *status quo*, type of resilience refers to the capability to return to the normal state as quickly and efficiently as possible, whilst preserving the system as closely as possible to its "normal state". This type of resilience would see the altering environment as a given state and focuses simply on guarding the society and its institutions and structures against it. The second type, on the other hand, would acknowledge the importance of adapting to the altering environment, but would seek to keep the changes in the societal structures and institutions as marginal as possible. The third, and most radical, type focuses on adaptive capabilities that allow for not only absorbing exogenous shocks, but the utilisation of multiple structures and institutions or policies in order to shape or alter them in a manner that minimises the negative impact to the society. Hence, whilst the two first types have preventive focus, the transformative approaches would involve a broader societal processes of change that stretch beyond the crises at hand. Such divergence in theoretical approaches to resilience, in particular between the robustness and continuity emphasising preventive strategies and those that emphasise more adaptive, or even transformative aspects, influence what objectives, resources and methods will be used for DRR. Whilst all these approaches have their merits, the choice between the different available emphasis has a particular importance for the coupling between risk reduction and resilience building; whilst preventive approaches to resilience are probably more compatible to risk reduction, they are also less complimentary. The closer resilience is to the preventive, *status quo* type of resilience, the more rewarded it becomes to question whether risk reduction and resilience building are in reality more synonyms to the one and same method or strategy, rather than two complimentary ones. The transformative approaches on the other hand, can work against the objectives of risk reduction and may in effect nullify some of the positive impacts of risk reduction. For example, if risk reduction includes urban planning measures that aim at reducing the risk in flooding exposed areas to critical infrastructure or function in order to maintain their functionality as close as possible to the normal state and, a transformative type of resilience building approach is chosen, a possibility exists that in more extreme disaster events these functions would be subject to moving, changing or even become abandoned altogether.

In order to avoid such potential contradictions, it is not only important to understand the theories of resilience, but also the theories of *risk* and *uncertainty*. For instance, the Bayes' theorem states that agents utilize probabilistic assessments about the likelihood of events based on observations on their past occurrence to understand their operational environment. Frank Knight (1921), on the other hand, distinguished the differences between "risk" and "uncertainty" in his seminal book *Risk, Uncertainty and Profit*, by arguing that whilst" risk" is observable and measurable, "uncertainty" operates in the limits of our knowledge, making assigning probabilities impossible. Risk is thus referring to situations where probability and impact of an undesirable event can be determined because the possible outcomes can be identified and the past frequency of their occurrence can be determined through observations of past events (Jarvis 2011). Uncertainty, on the other hand, suggests that possible outcomes are not known or decision-makers do not hold adequate knowledge or experience concerning the situation, or event at hand, to assign probabilities for the possible outcomes or to understand their possible impacts. This in turn leads to the inability to determine the appropriate response within the range of different courses of action. This problem was made famous by Nassim Nicholas Taleb, the author of the best-selling book -" The Black Swans", who used the metaphor of black swans to the propensity of trying to forecast hard to predict extreme events, i.e. low probability – extreme impact events, or assigning probabilities to rare events using scientific methods. Attempts to utilize scientific methods to measure such extreme outliers thus, creates false hope of prediction on events that are genuinely explainable only in the hindsight (Taleb 2007). Another, somewhat related, concept Is Charles Perrow's Normal Accidents Theory (NAT), which explores the social aspects of technological risk. NAT was largely motivated by the Three Mile Island nuclear power plant accident in 1979 and argues that in complex systems accidents are inevitable and "natural" consequence of complexity (Perrow 1984).

Consequently, ontological differences exist between the concepts of *risk* and *resilience* with significant consequences to the choice of available strategies, methods and practices in DRR. In general, risk management is exclusively a preventive approach and risk assessments are carried out in order to identify and quantify the negative impacts of potential events to the entity, measure its exposure to them and determine the appropriate mitigation measures to protect the entity against negative impact either by attempting to lower its exposure to the risk or lower the impacts of such events. The priorities of potential risks and hence, the scope and extent of mitigation measures are generally determined by the magnitude of individual risks, measured by their likelihood and impact. Whilst in principle exogenous risks cannot be terminated, the entity has the opportunity to determine whether to accept certain amount of risk left after mitigation efforts have been implemented (residual risk) or attempt to transfer it (principally to insurance). Resilience, on the other hand, can be generalised as an approach that emphasises the capability to absorb, adapt and/or recover from disaster events. Resilience can thus compliment risk reduction by providing the entity the capability to withstand, adapt to or recover from unforeseen risk events (uncertainty, black swans) that are not identified by risk assessments, or risk events of such magnitudes that required resources for their mitigation are simply not available, or events of such complexity that risk mitigation cannot capture adequately (compound disasters, NAT).

8 Conclusion

The Asia-Pacific is not only the world's most disaster prone region, but it is also of paramount importance to the world economy and the home of the largest number of vulnerable populations. Consequently, the development of Disaster Risk Resilience in the region should be a top global priority that will not only benefit the region, but potentially the entire world. The Asia-Pacific can also be a major testing ground for DRR practices and an important source of lessons learned for other regions.

Whilst risk reduction and resilience building are indeed generally complimentary, care should be exercised in terms of clarity of concept when devising holistic strategies for DRR. Such clarity in turn requires an advanced understanding of the theoretical concepts of risk, uncertainty and resilience, in particular in terms of the concept of *resilience.*

Resilience differentiates from the traditional risk-based approaches in a sense that it is based on the underlining notion that preventive strategies do not work under the conditions of extreme uncertainty due to the actors' inability to forecast and assess threats to a relevant extent. Consequently, the proponents of resilience would argue that preparedness towards unpredictable catastrophic events, the likes of the" Black Swans", requires an" all hazards" approach in preparedness and a strategy of survival, rather than mitigation. The underlining assumption behind this position is that since there can be no credible ability to prevent events from taking place, one should focus to manage their consequences towards survival and perhaps, renewal through learning. In an essence, one could argue that resilience is a" post risk" strategy (security after risk).

In sum, risk and resilience are a hot topic in the Asia-Pacific region with a number of institutions and policy frameworks increasingly focusing on the issue. The regional approaches, however, highlight the difference between risk management and resilience approaches; risk management (and reduction) is primarily focused on dealing with the expected, whilst resilience building is primarily focusing on capabilities required for dealing with the unexpected "Black Swans", (once in a thousand years events). Consequently, in theory, risk reduction would focus on frequent and seasonal events with fairly localised impact, whilst resilience building would address low probability – high impact risks, as well as to adapting to long-term risks, such as those brought about by global climate change and their wide-ranging cross-border implications. Likewise, the shift from reactive to proactive approach to disaster management would appear to make sense. There are, however, difficulties associated with determining the distinction between uncertainty and risk and consequently, the appropriate balance between risk reduction and resilience.

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Towards Climate Security and Sustainable Security in the Asia-Pacific Region

Ross Prizzia and Jason Levy

Abstract Global climate variability and change is increasing the frequency and severity of natural disaster events and security risks in the Asia-Pacific region. This paper puts forth a number of conceptual, theoretical, political and normative arguments for developing the field of Climate and Sustainable Security and applying it to identify creative and tenable security solutions to problems that lie at the interface of resource scarcity, human insecurity, national vulnerability, and ecological fragility in the Asia-Pacific region. Even conservative estimates predict that the rising temperatures and changing ocean levels in the Asia-Pacific Region will lead to significant socio-economic, environmental and security concerns: higher temperatures, rising seas and a more energetic hydrologic cycle are expected to contribute to more intense storms, droughts, crop failures and food insecurity. Sea rise for coastal cities may be particularly damaging, especially as people and population densities continue to increase in flood plains and coastal areas of the Asia-Pacific. The herein proposed paradigm of Climate and Sustainable Security deals with protecting, restoring, designing, and implementing a set of integrated natural, industrial, civilian, and security processes that equitably and responsibly meet the biophysical needs of human communities in the Asia-Pacific region, while maintaining long-term climate security, respecting financial constraints, meeting ecological limits, and improving institutional arrangements for transparent, accountable, and effective governance. It is concluded that emergency managers, security professionals and governments must promote climate adaptation and mitigation measures that protect communities in the Asia-Pacific region.

Keywords Climate change • Sustainable security • Asia-Pacific • Sea level rise

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_3

1 Introduction

Hundreds of millions of people living in the Asia-Pacific region are likely to lose their property, livelihoods – and even their lives – due to global climate variability and change. According to the UN's Intergovernmental Panel on Climate Change (IPCC 2014) Fifth Assessment Report–AR5 on global warming, flooding, famine and rising sea levels are expected to cause devastation to coastal communities in Asia.

As documented in the UN Intergovernmental Panel on Climate Change (IPCC 2014) over the next several decades, hundreds of millions of people living at low elevations along the coast of Asia are expected to suffer the worst impacts of climate change (coastal flooding, land loss, etc.) as temperatures rise, triggered by increasing greenhouse gas levels in the atmosphere. Sea level rise will primarily impact "east, south-east and south Asia. Some small island states are expected to face very high impacts" (IPCC 2014). Climate change poses severe and unique challenges to Asia's urban areas including precipitation extremes leading to increased risk of fire, droughts, and water scarcity and flooding, heat stress, food insecurity and unsustainable livelihoods. Accordingly, Asia's coastal cities face a higher risk of conflict, migration and deprivation, particularly in urban regions plagued by insufficient critical infrastructure, a lack of basic health and social services, chronic unemployment and poverty traps.

Other potential crises highlighted by the IPCC (2014) report include the high confidence that yields of major crops such as wheat, rice and maize will decline at rates of up to 2% a decade, at a time when demands for these crops – triggered by world population increases – are likely to rise by 14%. At the same time, coral reefs face devastating destruction triggered by increasing amounts of carbon dioxide dissolving in sea water and acidifying Earth's oceans.

In 2011, 80% of global disaster-related economic losses occurred in the Asia and Pacific region (UNESCAP 2011). These large disaster losses include not only destroyed property and critical infrastructure, but also damaged ecological systems in the Asia-Pacific. For example, there have been several major coastal storms to affect Pacific islands in recent decades: Hurricane Iniki (central North Pacific) hit the island of Kauai in Hawaii in 1992, leading to $2.5 billion in physical damages while Super Typhoon Pongsona (western North Pacific) struck Guam on December 8, 2002 and caused $700 million in damages. Other notable historical storm "event anatomies" in the Pacific Ocean region include Typhoon Chata'an (western North Pacific) and Cyclone Heta (central South Pacific). The strong winds, heavy rains, and high seas (storm surge, etc.) that accompany these disasters pose a direct threat to the well-being of Pacific communities, with island communities disproportionately affected by natural disaster.

2 Security in the Asia Pacific Region: Climate Change and Disasters in Asia Pacific Region

Security in the Asia-Pacific Region is of great importance to the United States as is reflected in the 2015 the US government report by the Center for Climate and Security, "The U.S. Asia-Pacific Rebalance, National Security and Climate Change". The report overview states that, the United States is in the early stages of what it characterizes as an "Asia-Pacific rebalance". On a very broad strategic scale, the United States intends to reorient its foreign policy and national security posture to the Asia-Pacific region, which is host to burgeoning populations, growing economies, and "strategic choke-points" like the South China Sea, and a number of rising powers (Werrell and Fermia 2015). The report describes the Asia-Pacific region as "one of the most vulnerable to the effects of climate change, with a growing coastal population, rising seas, numerous critical waterways fed by glaciers, threatened island states, increased drying, and projections of severe water insecurity" and in the near future "the effects of climate change are likely to both shape, and be shaped by, the U.S. role in the Asia-Pacific." (Werrell and Fermia 2015). The report concludes that "if the U.S. is to engage constructively in the region – building and broadening alliances, helping advance regional security and prosperity in the face of potentially catastrophic change, and advancing U.S. national security interests – it will have to seriously consider how climate change affects the region, how the U.S. can help advance the climate resilience of the region's diverse nations, and how the U.S. will adapt strategically to a changed security environment" (Werrell and Fermia 2015).

Efforts to slow and reverse climate change will take at least several generations. This chapter examines activities that can be taken now that will reduce the impacts of future disasters intensified by climate change on individuals, communities, economies and the environment. Programs designed to reduce the risks and impacts of climate-related disasters, when implemented, have succeeded in saving lives and property and demonstrated collateral benefits in reducing the impacts of climate change in communities throughout the Asia-Pacific. An examination of hazard mitigation, adaptation and preparedness activities in Asia-Pacific nations reveals those factors that communities should consider to successfully reduce the impacts of potential catastrophes influenced by climate change.

Climate change has impacted many parts of Asia. Some rural and agricultural regions (e.g., the Indo-Gangetic Plain, the breadbasket of South Asia) face severe water shortages brought about by a drier climate and a diminished flow from the shrinking Himalayan glaciers, while other regions face the prospect of increased floods. Intensified heat waves will increase mortality, especially among the elderly and in large cities that are already affected by a significant rise in temperatures caused by the effects of urban "heat islands." For example, in the case of Ho Chi Minh City, it is estimated that there is as much as 10 °C difference between the city and vegetated surroundings. Climate change will also likely increase the occurrence of vector-borne and diarrheal diseases (Kovats and Akhtar 2008).

Most vulnerable to the impacts of climate change are Asia's low-lying coastal regions and especially its large river deltas including the Ganges-Brahmaputra, Yangtze, and Mekong deltas. Identified by the Intergovernmental Panel on Climate Change (IPCC 2014) as "hot spots" of vulnerability, they are also the sites of some of the world's largest megacities (large urban regions variously defined as having more than 8 or 10 million people), significant not only from the standpoint of their large populations, but also their economic infrastructures and dominant roles in national and regional economies. The growing physical risks to Asian coastal regions result from a combination of factors related to climate change, including a rise in sea level and a likely increase in intensity of tropical cyclones, bringing higher winds and heavier precipitation, stronger storm surges, and increased coastal flooding. These "natural hazards" are largely attributed to human activities related to climate change caused by the unremitting increase of greenhouse gas emissions, resulting sea level rise, and land subsidence caused by the withdrawal of groundwater (Nicholls et al. 2007).

Because of the built-in momentum in the climate system resulting from past emissions and the limited capacity of the oceans to absorb and neutralize the harmful impacts, the physical risks posed by climate change will continue to grow into the next century, even if a dramatic reduction in greenhouse gas emissions is achieved. Rather than slowing, climate change will likely accelerate as emissions continue to grow. Recent modeling results suggest a possible warming of 5.2 °C by 2100 (*MIT News* 2009). A growth in mean temperature is only part of the problem. Climate change may also be causing a change in the paths of tropical cyclones, bringing destructive storms into places previously spared and perhaps even shifts in the Asian monsoon system, with potentially dire socio*e*conomic consequences (Fu et al. 2006). Risks posed by cyclonic storms and storm surges will be compounded by a rising sea level resulting from the thermal expansion of ocean water and the melting of glaciers and ice sheets. Sea level is projected to rise at an increasing rate during the twenty-first century and will continue to rise for centuries after global temperatures have stabilized. Earlier IPCC projections (IPCC 2007) of an 18–59 cm rise in global sea level by 2055 omitted possible effects of Greenland's ice sheet melting and are now considered far too low. One study suggests sea level could rise between 0.75 and 1.9 m by 2100, two or three times the IPCC estimate (Vermeer and Rahmstorf 2009).

Land subsidence further adds to the growing risk of coastal flooding. Many coastal megacities in Asia are built on deltas where significant sinking is occurring due to soil compacting or groundwater withdrawal for household or industrial purposes. Groundwater that flows out to the sea contributes to rising sea levels. A global study of sinking deltas using historical maps and satellite images identified the Pearl River Delta (China) and Mekong Delta (Vietnam) as particularly at risk, with much of their surface areas already below sea level and with only limited coastal barrier protection (Syvirski et al. 2009). In a number of Asian cities, the magnitude of land subsidence is greater than global or regional sea level rise. In Bangkok, the Gulf of Thailand is rising about 0.25 cm per year, but the city is sinking at a far faster rate, up to 4 cm per year (Associated Press 2007). In north Jakarta, land subsidence has been measured at 6 cm per year, and sinking bridges have now become obstructions to water discharge. Floodwalls along the Suzhou River in Shanghai have already been raised three times since the 1960s to accommodate land subsidence and a rise in relative local sea level. A floodwall that was built to withstand a 1 in 1000 year surge was already nearly overtopped in a 1997 typhoon.

Rising sea levels have many adverse impacts, including inundation of coastal plains, increased beach and coastal erosion, removal of protective sand dunes and vegetation, and intrusion of salt water into freshwater supplies, already a concern in many Asian coastal cities. However, the effects of sea level rise will be felt most severely in the form of amplified storm surges and flooding that can accompany tropical cyclones that threaten much of the region annually, which in the past have been 1 in 100-year flood events, may in the future become 1 in 10-year storms, with far-reaching implications for unprepared coastal populations. The enormous human and economic loss will weigh heavily on government officials caught unaware of the increasing frequency, magnitude, and extent of severe flooding related to climate change. Past surge and flood events have already caused havoc in many coastal regions. For example, around the Bay of Bengal there has been an estimated 1.3 million cyclone-related deaths over the past 200 years (Small and Nicholls 2003). More than 10 million people each year, most in Asia, experience some flooding due to storm surges (Mimura 2009). Major recent coastal floods include Bangladesh's in 1991, which killed 140,000 people and left 10 million homeless, and Myanmar's in 2007, when 146,000 people were killed due to storm surges up to 6 m in height that reached inland some 30 km, causing an estimated economic toll of U.S. $l7 billion. Storm-related floods in recent years have inundated 70–80% of both Jakarta and Manila. One estimate suggests that by the year 2100, even with a sea level rise of only 59 cm, a 100-year storm surge could inundate areas in Asia, affecting 362 million people, 10% of the projected Asian population (Mimura 2009). This estimate will need upward revision in view of recent projections of even more rapid sea level rise.

According to Indian Meteorological Department (IMD) Director General Laxman Singh Rathore, there has been an annual increase in hydro meteorological disasters by 7.4% due to climate change (Associated Press 2014). There are reduced number of rainy days during rainy season, unseasonal thunderstorms/lightning, and a rise in global temperatures. Winds, thunderstorms, floods, and other severe atmospheric phenomena are examples of hydro meteorological disasters. Rathore reported that the Asian countries were facing almost 85% of the world's disasters and 90% of floods occurred only in India. India faces a gross domestic product (GDP) loss of 2.25% in terms of economy and 12–15% in terms of revenue because of natural disasters. While 58.6% of land in India was prone to earthquakes, the scientists observed a steady rise in natural disasters such as thunderstorms, winds, hail storms, and air quantum disasters in urban areas in recent times due to rapid industrialization (Associated Press 2014).

Millions of people in Asia, the world's most disaster-prone region, face the threat of major climate-linked disasters and food crises. A year after Typhoon Haiyan wreaked havoc in the Philippines, Oxfam warned that governments needed to do more to prevent loss of lives and homes to extreme weather. With 4.3 billion people or 60% of the global population, Asia has borne almost half the estimated economic cost of all disasters over the past 20 years, amounting to around U.S. $53 billion annually. Without greater investment in climate and disaster-resilient development and more effective assistance for those at risk, super Typhoon Haiyan-scale disasters could fast become the norm, not the exception (Oxfam 2014), Asian states have started to adopt policies and programs to reduce the risks of disasters and adapt to climate change impacts such as extreme weather and rising sea levels. The report by Oxfam urged the Association of Southeast Asian Nations (ASEAN) to create a regional resource base to help member states carry out projects to adapt to climate change impacts and manage risk (Oxfam 2014).

Less fresh water, more coastal erosion, and degraded coral reefs are among the impacts climate change is already having on Hawaii and other Pacific islands associated with the United States, according to a major new climate report, the Third National Climate Assessment (Thompson 2014). More than 300 scientists contributed to the report which was released by the White House, confirming that extreme weather events linked to climate change—including heat waves, heavy downpours, floods, and droughts—have become more frequent and intense throughout the United States. These events are disrupting people's lives and hurting the economy. Highlights from the section on Hawaii and the Pacific include:

- Decreasing rainfall in low-lying areas, combined with a rise in sea levels that pushes seawater into aquifers, will put greater limits on the availability of fresh water.
- Rising sea levels combined with increased storm runoff will increase coastal flooding and erosion, damaging coastal ecosystems, infrastructure, and agriculture.
- A warming ocean will increase coral bleaching and disease outbreaks on coral reefs.
- Rising temperatures and reduced rainfall in some areas will put native plants and animals at greater risk for extinction.
- Pacific Islanders will find it increasingly difficult to sustain their traditional ways of life as climate change forces them to leave coastal areas.

Climate scientists continue to provide data that confirm that the Earth's climate system is unequivocally warming and that human activities such as deforestation and burning fossil fuels that increase concentrations of greenhouse gases in the atmosphere are causing most of it. Communities worldwide have suffered the destructive impacts of climate change that reportedly will continue with increasing severity.

3 Sea Level Rise, Water and Food Security in the Asia Pacific Region

Both developing and developed countries of Asia and the Pacific are particularly exposed to natural hazards. Of the 12 disasters with the highest death tolls across the world since 1980, 9 occurred in Asia. In 2011, 80% of global disaster-related economic losses occurred in the Asia Pacific region. The losses caused by these disasters were immense not only in terms of human lives but also in terms of property destroyed. A conservative estimate of the average annual direct economic damage due to disasters in countries of Asia and the Pacific in the period 2001–2011 was US$60 billion (UNESCAP 2011).

Economic losses from natural hazards differ widely among countries, even when accounting for the intensity of the disaster. The economic impact of climate change can be devastating for developing countries. A study funded by the World Bank Group and Global Facility for Disaster Reduction and Recovery (GFDRR) found that disasters' impact on gross domestic product (GDP) is 20 times higher in developing countries than in industrialized nations (World Bank 2014). Even more, for every person in wealthy countries who died in a disaster in the last 50 years, almost 30 individuals died in poor countries (UNESCAP 2011).

Nearly 40% of all the disasters triggered by natural hazards in the world occur in Asia, and 88% of the people affected reside in this region. Of the total number of people affected in Asia, the People's Republic of China (PRC) and India account for just over 40%, reflecting their population size and land mass. However, after accounting for population size and land area, Bangladesh, Philippines, India, the PRC, Maldives, and Japan (in this order) have been the top six countries affected since 2000. Floods are by far the most frequently occurring disasters in Asia and claim the highest numbers of victims.

Experiencing recurrent small scale events as well as devastating large scale catastrophes, no other region in the world is more affected by disasters than East Asia and the Pacific. In the last decade, Ho Chi Minh City, Jakarta, Manila, and many other cities have been repeatedly hit by floods. In the last 5 years, Asia has experienced a large share of wide scale natural catastrophes, including earthquakes in the Tohoku region in 2011, Padang in 2009, and Wenchuan in 2008; typhoons in 2009 in the Lao People's Democratic Republic, the Philippines, and Vietnam; a cyclone in Myanmar in 2008; and large scale floods in 2011 in Cambodia, Thailand, and the Philippines. The year 2011 was the costliest year on record for natural disasters with cascading effects (Japan) and trans-boundary consequences (Thailand), adding up to US$380 billion in economic losses, far greater than the 2005 record of US$262 billion. In the first 7 months in 2011, East Asia sustained about 80% of all disaster losses worldwide (World Bank 2013).

A rising sea level, for a country like Vietnam, with 2000 miles of coastline presents a major environmental and food security challenge, especially in the Mekong River Delta region where 22% of the population lives and about half of the country's food is produced. With rising seas, millions of people in the Mekong Delta region will likely be forced to move. For the region's farmers, climate change has enormous implications, as Vietnam is an important player in the global food system. It is the second-largest producer of coffee, a crop grown in the highlands and that is affected by higher temperatures and rainfall pattern changes. Rice is their second-largest export commodity. They also export tea, pineapple, citrus fruit and sugar (Hoffmann and Geisler 2016).

Changing rainfall is the key factor driving changes in groundwater storage in India, according to a new study led by the Indian Institute of Technology (IIT) Gandhinagar published in the journal *Nature Geoscience*. The study shows that changing monsoon patterns—which are tied to higher temperatures in the Indian Ocean—are an even greater driver of change in groundwater storage than the pumping of groundwater for agriculture (Asoka et al. 2017).

Agriculture in India relies heavily on groundwater for irrigation, particularly in the dry northern regions where precipitation is scarce. Groundwater withdrawals in the country have increased over tenfold since the 1950s, from 10–20 cubic kilometers per year in 1950, to 240–260 cubic kilometers per year in 2009. Satellite measurements have shown major declines in groundwater storage in some parts of the country, particularly in northern India. Also, groundwater plays a vital role in food and water security in India and sustainable use of groundwater resources for irrigation is the key for future food grain production, according to study leader Vimal Mishra, who notes that 'with a fast-growing population, managing groundwater sustainably is going to become even more important," and the "linkage between monsoon rainfall and groundwater can suggest ways to enhance groundwater recharge in India and especially in the regions where rainfall has been declining, such as the Indo-Gangetic Plain" (Asoka et al. 2017).

Groundwater acts like a bank for water storage, receiving deposits from surface water and precipitation, and withdrawals as people pump out water for drinking, industry, and irrigating fields. If withdrawals add up to more than the deposits, eventually the accounts could run dry, which could have disastrous consequences. "This study adds another dimension to the existing water management framework. We need to consider not just the withdrawals, but also the deposits in the system," says Yoshihide Wada, a study coauthor and the deputy director of the Water program at the International Institute for Applied Systems Analysis (IIASA) in Austria (Asoka et al. 2017). The issue of groundwater depletion has been a topic of much discussion in India, but most planning has focused on pumping, or the demand side, rather than the deposit side. By looking at water levels in wells around the country, the researchers could track groundwater replenishment following the monsoons. They found that in fact, variability in the monsoons is the key factor driving the changing groundwater storage levels across the country, even as withdrawals increase. In addition, the researchers found that the monsoon precipitation is correlated with Indian Ocean temperature, a finding which could potentially help to improve precipitation forecasts and aid in water resource planning. "Weather is uncertain by nature, and the impacts of climate change are extremely difficult to predict at a regional level," says Wada "But our research suggests that we must focus more attention on this side of the equation if we want to sustainably manage water resources for the future" (Asoka et al. 2017).

Asia's economic growth over the last decade has been relentless, bringing with it a rising population and an influx of people from the countryside to the cities in search of prosperity. These trends are not expected to abate. By 2025, the total population of Asia and the Pacific region should reach about 4.4 billion. And over the next 40 years, Asia's urban population is projected to increase from 1.9 billion to 3.2 billion. In another significant trend, the middle-income population will also grow to about 2 billion by 2050. Such demographic shifts bring benefits, but many problems also—whether providing jobs, services, or a clean environment. The accompanying rising incomes and rapid urbanization bring about other less obvious pressures, such changes in dietary preferences, which cause a shift toward more land and water intensive meats and foodstuffs. Without a significant increase in food production above current trends, declines in caloric availability and an increase in child malnutrition by up to 20% are anticipated. "Asia and Pacific is home to the largest numbers of the food and nutrition insecure people in the world, accounting for almost two thirds of the world's total of 800 million," says Mahfuzuddin Ahmed, Asia Development Bank's Technical Advisor on Rural Development and Food Security. "The region faces new challenges to produce and access more nutritious and safe food for its growing populations. Thus, achieving food security for all, now and into the future, is at the core of the post-2015 development agenda" (ADB 2016).

In this regard, climate change and disaster risks, financing gaps, poor logistics and infrastructure deficits are among the other major constraints to realize the Sustainable Development Goals to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture by 2030. For example, projections to 2050 for Asia and the Pacific show that with temperatures rising, yields of rice, wheat, and soybeans may decline by 14%–20%, 32%–44%, and 9%–18%, respectively. Meanwhile, post-harvest losses account for about 30% of the total harvest in the Asia and Pacific region. About 42% of fruits and vegetables and up to 30% of grains produced across the region are lost between the farm and the market caused by inadequate infrastructure such as roads, water, power, and market facilities, as well as a lack of post-harvest-facilities such as pack-houses and cool and dry storage facilities; lack of dedicated transport systems for food; and poor quality bulk packaging that result in spillage and damage (ADB 2016).

4 Improving Preparedness Though Innovation

Human ingenuity is challenged to invent new ways of dealing with the tremendous threats, risks, and impacts of global climate change in order to thrive into the far future. Innovation in all fields of science and technology, social sciences, business and finance, is needed to improve worldwide disaster preparedness. Creative financing and insurance practices comprise technical breakthroughs, such as insuring farmers or governments against droughts or storms based on physical parameters (index-based [parametric] insurance) covering events that cause loss, rather than the loss itself. This option substantially decreases transaction costs (Linnerooth-Bayer et al. 2011). Community-based organizations have innovatively experimented with microloans and savings with disaster micro-insurance in various set ups, which, with a number of caveats, provide a useful way forward.

Social innovation is equally important. Social grants awarded to communities encourage local ownership of preparedness projects, transparency, and accountability. The support enhances local decision-making processes. Local communities are empowered to decide where and how to increase community resilience with particular attention to smaller scale, less media-compatible hazards and events that often evade attention. The focus on local level leadership and responsibility for disaster preparedness reinforces meaningful and effective community involvement in disaster prevention, preparation, response, recovery, and reconstruction.

Kleinfelder, an Australia based consulting firm, created an innovative approach to developing practical preparedness plans which consists of three components (Beauvais et al. 2016):

1. Climate Change Projections derive the local effects of changes in temperature, precipitation patterns, sea level rise, and extreme events to be used in the vulnerability assessment.
2. The Vulnerability and Risk Assessment evaluates the susceptibility of individual assets based on climate change projections and then combines that data with the probability and consequence of the climate impact occurring to identify the highest risks as priorities for the adaptation/resiliency plan.
3. The Adaptation/Resiliency Plan identifies actions to address crucial climate change impacts, considering both short- and long-term responses, building and policy solutions, and all feasible options that are evaluated using multiple criteria including the client's interests.

Kleinfelder's multidisciplinary climate change team of academics and consultants includes internationally recognized leaders in climate science, infrastructure resiliency, vulnerability assessment, disaster planning and response, and preparedness planning. As the team conducts research and pioneering projects, first of their kind methods and techniques for responding to climate change impacts are developed. Innovations recommended by the team emerge from evidence-based research (Beauvais et al. 2016).

5 Towards Sustainable and Climate Security

In the wake of the September 11, 2001 terrorist attacks, there is a growing sense of insecurity felt by many citizens around the world. Sustainable security, with roots in the sustainable development and human security literature, seeks positive transformations for the co-evolving and mutually dependent human-environmental condition by integrating (and subsuming) national, human, environmental, and energy security concerns and capitalizing on opportunities provided by human creativity, diplomatic openings, modernization and environmental change. The field of Climate Change and Sustainable Security is proposed for protecting, restoring, designing, and implementing a set of integrated natural and man-made processes that equitably and responsibly meet the biophysical needs of human communities, while maintaining long-term security, respecting financial constraints, meeting ecological limits, and improving institutional arrangements for transparent and effective governance. Sustainable security and climate change planning in the Asia-Pacific identifies the preconditions of instability and helps to proactively address them in an increasingly complex and uncertain world. This following section includes sustainable security and climate change concepts that cross policy domains, geographic, political, and sectoral boundaries: collectively, they demonstrate the quality, breadth and depth of techniques, approaches and methodologies that are used to promote sustainable security and manage climate change. The focus of this section is on the Asia Pacific region. In the wake of the September 11, 2001 terrorist attacks, security has become an existential concern for countries across the Asia-Pacific Region. The increasing intensity, complexity and frequency of security threats has caused governments, industries, NGOs, policy makers and communities throughout the Asia-Pacific societies to urgently reassess their exposure to security risks and vulnerabilities, contributing to a transformation in our understanding and perception of security in the Asia-Pacific Theatre. In particular, the importance of global climate variability and change has necessitated a paradigm shift in our understanding of security in the Asia Pacific region This is particularly true when global climate change is coupled with socio-economic vulnerabilities, civil strife, environmental degradation and rising energy demand. As noted by Glenn et al. (2008) global instability may result due to rising food prices, failing states, a decline in water-food-energy supply per person and desertification.

Since the rise of the modern state system following the peace treaties of Osnabrück & Münster (1648) "state (national) security" has focused primarily, if not exclusively, on the use and threat of military force to defend the territorial and political integrity of sovereign states from external military threats (Sect. 5.1). However, global conflict and international treaties led to the creation of two security fields towards the end of the twentieth century: human security and environmental and energy security (Sect. 5.2). It is argued that the most recent paradigm, "sustainable security and climate security" (Sect. 5.3) integrates and subsumes these aforementioned approaches. Rather than simply protecting communities from threats, the Climate Security and Sustainable Security paradigm (Sect. 5.4), with roots in sustainable development (Brundtland 1987) and human development (UNDP 2004), focuses on understanding and addressing the antecedent conditions of insecurity. There are several definitions of sustainable security. The Center for American Progress (2009) defines "sustainable security" as the pursuit of collective (international) security over the long term and focuses on the three security legs of defense, diplomacy, and economic development (i.e. the creation of civilian institutions for ensuring law and order). The Oxford Research Group's project on Sustainable Security (2009) analyzes "underlying drivers of global instability" and focuses on resolving core problems, such as failed states or a perceived lack of civil rights ("curing the disease") rather than promoting the unilateral use of force to "control threats" ("attacking the symptoms"). We herein put forth a new field of Sustainable Security and Climate Security in order to respond to the climate change threat, to operationalize the sustainable security concept and to help transform institutions, policies, and regulations in the Asia Pacific region through an adaptive and participatory decision processes.

Ideally, national security, human security, environmental security, energy security and climate security should be mutually reinforcing, as a strong state apparatus is needed to address climate mitigation and adaptation, to ensure the physical protection of its citizens, to promote ecological integrity, and to provide public services. However, since 9/11, global military expenditures have increased by approximately 40% (SIPRI 2009) yet socio-economic inequality (both within and across societies) and environmental degradation in the Asia-Pacific region are increasing: the post-9/11 ecological "footprint" of humanity has become markedly unsustainable, (GFN 2009) and extreme poverty now affects the survival of more than 1.4 billion people around the world (STWR 2009), particularly citizens from less developed and marginalized regions of the Asia-Pacific. As shown in Fig. 1, the paradigm of sustainable and energy security operates at all scales (from the local to the global) and takes a more integrated approach than either of the other, older, security paradigms it integrates and subsumes. Note from Fig. 1 that the human security approach takes a decidedly anthropocentric focus. On the other hand, energy and ecological security focuses on environmental issues that are most acute

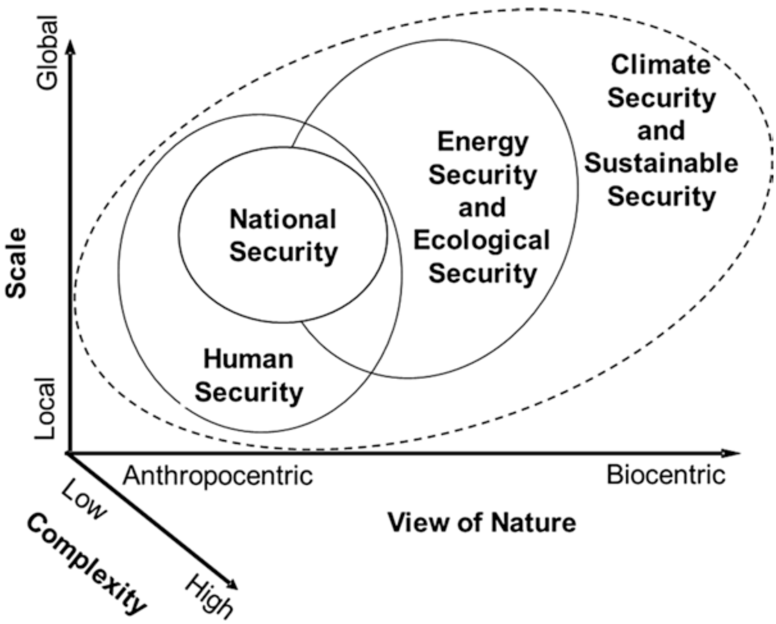

Fig. 1 The paradigm shift from human and national security to climate and sustainable security

at meso-scales and medium-term time horizons in critical environmental regions (Kasperson et al. 1999).

Ecological and energy security constitutes a more biocentric approach than human security which embraces ecologically relevant processes and structures. The sustainable and climate security approach contrasts with the aforementioned security paradigms (i.e. national security, human security, ecological and energy security) that focus primarily on protecting society from natural and human-induced hazards and threats rather than exploiting dynamic opportunities presented by the environmental and climatic variability and change.

5.1 State Security

The state (national) security approach has been dominant since the rise of the Westphalian system in 1648. For much of the mid-twentieth century, Cold War deterrence and détente were major foci of attention of "national security" studies. Towards the end of the twentieth century, an offshoot, "international security" highlighted the growing interdependence of nations ("international security"), with a focus on international arms control, disarmament, nuclear non-proliferation, and solving global environmental problems. However, single actors (or even states acting in regional alliances) are mostly incapable of dealing with threats arising from macro-regional and global scale problems such as global climate variability and change. The acceleration of global environmental and social pressures are blurring the classic distinction between external and internal threats, triggering a vigorous debate focusing on the weaknesses of traditional (national and international) security studies including a perceived overemphasis on state-centrism, instrumental calculations, and rationalist-empiricist assumptions about military threats and material power, to the exclusion of economic development, social justice, environmental security, democratization, ecological protection, disarmament and respect for human rights and the rule of law. For example, Williams (2007) discusses "the need to broaden the analytic and methodological agenda of security studies, while at the same time widening its scope to include issues of identity, human security, environmental security, and a host of other concerns". Accordingly, there is a need to critically re-evaluate and reform the Westphalian state and international security system in light of global climate change and other sustainability.

5.2 Human Security

With early roots found in the Brandt (1980, 1983) and Brundtland (1987) Commissions, the United Nations Human Development Report (UNDP 1994) and the Report of the Commission on Global Governance (CGG 1995) pioneered the human security discourse by heightening respect for the value of "human life and human dignity" and focusing on the protection of humans at all scales (from individual citizens to global humanity) rather than on states, borders and territory. Seven separate components of human security are defined in the 1994 UNDP report including food security (physical and economic access to food), health security (freedom from disease) and political security (protection of basic human rights and freedoms). These findings were expanded upon in the Organization for Economic Cooperation and Development (OECD) Development Assistance Committee's (DAC) Handbook on Security System Reform: "The traditional concept of security is being redefined to include not only state stability and the security of nations but also a clear focus on the safety and well being of their people" (OECD-DAC 2007).

However, implementation of the human security paradigm has been hampered by the difficulty of defining and measuring it: What, exactly, is the meaning of human security? While Western nations focus on "freedom from fear" (i.e. human rights), Asian countries have emphasized a "freedom from want". The human security paradigm has "fared poorly" in Asia for a number of reasons (Acharya 2007). First, democratization is perceived to be associated with social upheaval and violence (as accompanied by democratic transitions in Republic of Indonesia and Republic of the Philippines). Second, a tension exists between the human security concept and existing regional notions of non-interference, state (regime) security, and national sovereignty. A related challenge is that many dynamic Asian economies were not developed under liberal social and political institutions. For example, China, the world's second largest economy, remains distinctly authoritarian, and while nominally democratic, the Philippines is lurching towards more autocratic rule. As a result, in many regions of the world, there are still problems associated with defining, measuring and implementing human security.

5.3 Ecological and Energy Security

There are a number of reasons why national security is increasingly viewed in terms of energy and environmental security in the Asia-Pacific. First, energy and environmental conflicts are among the earliest and most pervasive security concerns in human history (Homer-Dixon 1999). Second, energy infrastructure remains vulnerable to intentional and inadvertent disruptions (particularly at world oil transit chokepoint and other key locations). Third, Asian nations are increasingly dependent on unreliable foreign sources of energy. Energy source diversity has become a fundamental principle of national security (Clarke 2008). That is, nations should aim for a diversity of abundant, clean (carbon-neutral) and reliable sources, including renewables. Nearly a century ago, First Lord of the Admiralty Winston Churchill changed the power source for the British navy's ships from coal to oil to improve fleet performance, thereby making the Royal Navy reliant on foreign oil, which was considerably less secure than domestic coal supplies. Churchill's oil "safety and security" strategy relied on diversification: "variety and variety alone" (Yergin 2007).

The Asia-Pacific now stands at, or near, "tipping points" in climate change and energy supply. Worldwide electricity demand is expected to grow by 76% by 2030, driven by population growth, rising living standards, growing consumerism, and the use of energy-intensive technologies while an estimated 1.5 billion people around the world still lack access to electricity (Glenn et al. 2008; IEA 2009). The ecological and energy security paradigm was developed in response to the fact that humans are consuming the Earth's biocapacity, which both provides resources and absorb waste, at an alarming rate. Specifically, the planet's life support systems require approximately 18 months to produce the ecological services that the world's population requires in 1 year, leading to ecological "overshoot" (GFN 2009). Put simply, humanity currently requires 1.5 Earths to meet our needs. Energy security requires identifying low-carbon and energy-efficient strategies.

Consequences of this growing human "footprint" include the degradation of our environmental assets (as evidenced by pressures on food and water supplies, declining biodiversity, diminishing forest cover, and collapsing fisheries), the accumulation of pollution (which exacerbates global problems such as climate change and ozone depletion), human conflict disease and the mass displacement of humans, all of which tend to disproportionately affect the poor. By placing environmental and energy issues squarely in the discourse of contemporary security policy, advocates of this security paradigm focus their efforts on the development, availability, practicability, and deployment of cost-effective conservation, recycling, and energy technologies which are less polluting, "smarter", and more efficient than current fossil sources of energy.

Continued reliance on a carbon economy will have serious impacts for climate change, human health and security across the Asia-Pacific region. For example, the burning of fossil fuels generates greenhouse gases and other harmful air pollutants, most commonly particulate matter and ozone precursors. This contributes to long-term human health problems, global climate change, urban smog, and acid rain. Without changes in the overall energy mix, major technologic innovations or viable substitutes for current energy sources, fossil fuels will continue to provide a lion's share of primary energy demand for the foreseeable future, forcing nations to import oil and gas from politically volatile regions of the world (DOE 2009). As noted by the Center for Energy and Environmental Security at the University of Colorado Law School (Doran and Guruswamy 2007): "the increasing reliance on hydrocarbons has created energy, environmental and economic insecurity."

5.4 Sustainable Security and Climate Security

Building upon the concepts of "sustainable development" (Brundtland 1987) and "human security" (UNDP 1994), attention is beginning to move from the "military/control paradigm" of national/international security towards a broader conception of "sustainable security" and "climate security" with an emphasis on resolving the underlying sources of insecurity (i.e., "curing the disease") by using untapped human potential, diplomatic openings, and environmental opportunities to enhance collective environmental and climate security. While sustainable development has faced many criticisms, a fundamental contribution of the concept remains unassailable – namely, that human development requires protecting, or improving, the environment – and that efforts to protect the biosphere are more likely to succeed when they simultaneously improve the human condition. By better understanding national, human, environmental, and energy security vulnerabilities in specific socio-economic, political and ecologic contexts – along with the multifarious and unique characteristics of co-evolving human and environmental systems – leaders and policy makers in the Asia-Pacific can use insights from energy and climate security to help prevent a cascade of global instability. For example, Brundtland (1987) provided an entire chapter on "Peace, Security, Development, and the Environment".

Sanjeev et al. (2003) defines sustainable security in terms of the "three linked pillars of society, economy and nature central to the field of sustainable development" where human security highlights the social dimension of sustainable development; environmental and energy security captures the ecologic pillar; and state security reflects the economic leg. There are several unique strengths of the "sustainable security" concept as derived from the sustainable development and human development literature (Brundtland 1987). Most importantly, the sustainable security concept aids in the synthesis and integration of the pre-existing fields of national (state) security, human security (from fear or want), and environmental (and energy) security. Since each of these three security approaches has been found incapable of ensuring genuine long-term collective security, by integrating and subsuming them into a common paradigm, sustainable security helps leaders and policy makers to highlight the complex system dynamics and nonlinear interdependencies of tightly coupled human-environmental systems. Other key benefits of a highly integrated and holistic "sustainable security and development agenda" include increased attention to the transdisciplinary fields of social justice, ecological health, and sustainable livelihoods; creating frameworks that link vulnerability (susceptibility) or resilience (assets and entitlements) with development; promoting transparent, flexible, and participatory processes for developing integrated education plans, environmental regulations, health priorities and economic reforms; ensuring that institutional reform and the devolution of responsibility for human and environmental security to lower levels of government occurs with the requisite financial and human resources; and promoting "contextually disaggregated" place-based goals and indicators (Sanjeev et al. 2003). Sustainable and climate security emphasizes that humans and the environment should be secured for their intrinsic self-worth and moral value. Moreover the sustainability paradigm emphasizes that humans and their governments have the potential to exploit opportunities arising from environmental risks and global climate variability and change; new attention is focused on the potential of states and their citizens to positively transform the evolving human-environment condition.

6 Climate and Sustainable Security: Towards Resilience in the Asia-Pacific

Resilience is widely accepted as a desirable property of human and environmental systems which must cope with the impacts of rising sea levels. Building disaster resilient Pacific island communities requires managing the unexpected and cascading impacts of inundation and other coastal hazards that cross policy domains, geographic, political, and sectoral boundaries. In the relatively near term, the impacts of global sea level rise are expected to contribute to the increased frequency of extreme water levels at the shoreline of Pacific Island nations. A resilient coastal community is able to withstand external shocks associated with rising sea levels, persist, and rebuild itself when necessary, preferably in a stronger (ISDR 2002). The resilience concept is embraced by decision makers searching for increased flexibility, robustness, and adaptability in the face of rising sea levels: applications range from hydrologic and hydraulic engineering ("safe-fail systems") to resilient financial instruments (i.e. portfolio hedging). The resilience paradigm is highlighted in Fig. 2.

7 The Gravity of Sea Level Rise Threats to Pacific Islands

Resilient communities possess the ability to anticipate, self-organize, adapt, and continuously learn from rising sea levels in order to provide better protection against future coastal hazards. Improved resilience to climate variability and change, in turn, is acknowledged to promote sustainable societies and to reduce socio-economic vulnerabilities.

The emerging and holistic concept of community disaster resilience requires us to recognize that lives and property can be secured through sustainable local pre- and post-disaster planning in advance of an extreme sea-level event. For example, homes raised above the expected flood elevation ("homes on stilts") are better designed than many non-elevated structures to cope with an inundation event.

Using mid-range scenarios, in which a rise in the sea level of 40 cm is envisaged by the 2080s, the number of people threatened worldwide from coastal flooding is projected to more than double to 200 million (Patz and Kovats 2002). The number of global "environmental refugees" is expected to reach 50 million by 2010, with small, low-lying island populations at the greatest risk (Potter 2008): rising sea levels currently pose a threat to more than half a billion people that live within 5 meters above sea level around the world (and the more than 100 million people worldwide live within one meter of mean sea level). Results show that sea-level rise is an ongoing and accelerating process with a high likelihood of becoming a grave danger to coastal communities on Pacific islands. There have been several major coastal storms to affect Pacific islands in recent decades: Hurricane Iniki (central North Pacific) hit the island of Kauai in Hawaii in 1992, leading to $2.5 billion in physical damages. Super Typhoon Pongsona (western North Pacific) struck on

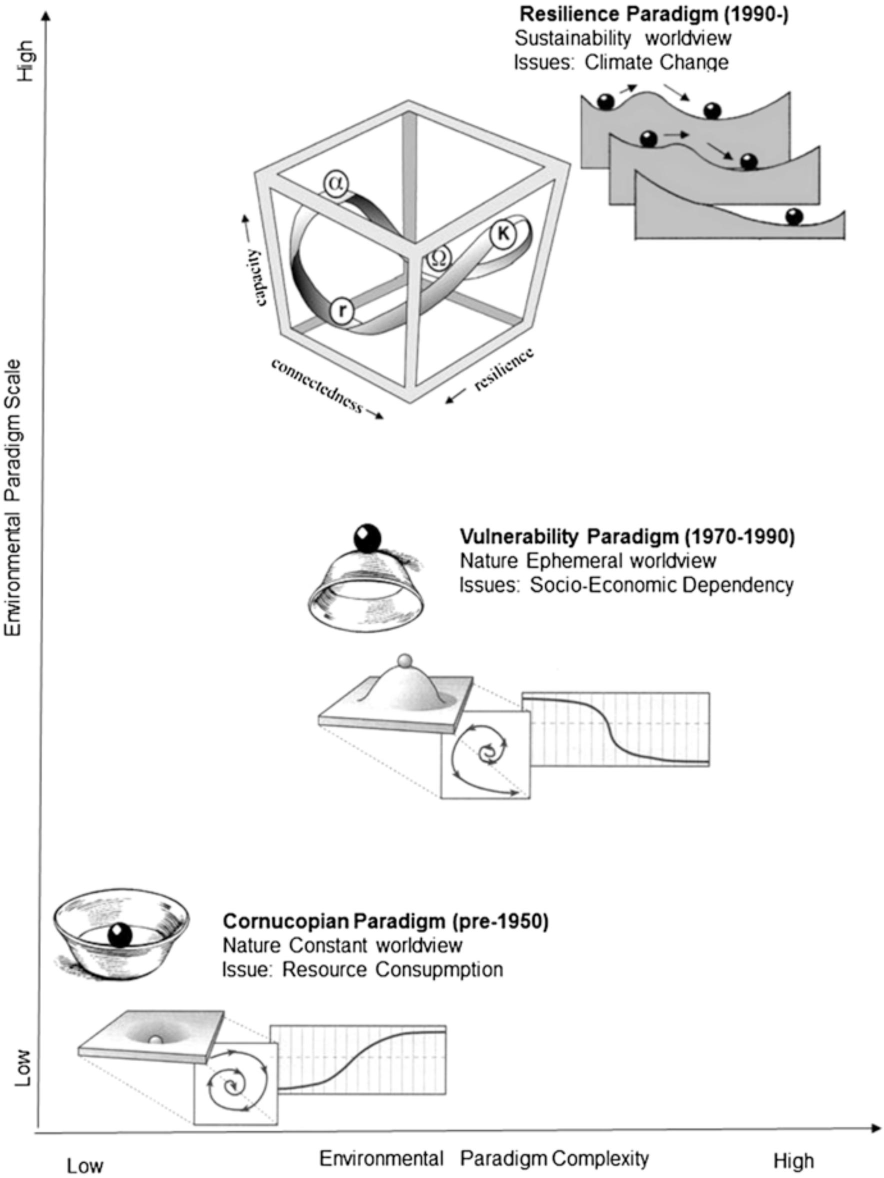

Fig. 2 The resilience paradigm

December 8, 2002 and caused $700 million in damages on the island of Guam. Other notable historical storm "event anatomies" in the Pacific Ocean region include Typhoon Chata'an (western North Pacific) and Cyclone Heta (central South Pacific). The strong winds, heavy rains, and high seas (storm surge, etc.) that accompany these disasters pose a direct threat to the well-being of Pacific communities.

The citizens of some Pacific island states and deltaic coasts do not have the luxury of retreating inland from the coast, and may face involuntary relocation. For example, in the Pacific nation of Tuvalu, a ring of nine Polynesian islands, several thousand people have already left for other nations because of rising seas and displaced people from low-lying areas could provide the human reservoir for the spread of disease, including malaria (Potter 2008). Accordingly businesses, non-governmental organizations and the public sector have an obligation to evaluate the impacts of sea level rise on Pacific islanders and to propose innovative solutions to mitigate these effects. In the Pacific Ocean, meltwater is expected to constitute a long term threat of sea-level rise (in the second half of the twenty-first century), with thermal expansion of the upper ocean posing the greatest immediate challenge. Table 3 shows the current trend of relative sea level rise at select Pacific Island locations. Observed rates of relative sea level rise for select US Flag and Affiliated Pacific Islands are shown (Fig. 3).

Climate-related factors can exacerbate existing fragile situations beyond the tipping point for many Pacific Island governments, even those that appear stable. Accordingly, developed nations have begun to consider the best ways to assist low lying island states as the impacts of sea-level rise and climate change begins to take its toll on families, communities and nations of Pacific islands. For example, in 2008, Australia focused on the humanitarian impacts of climate change in the Asia Pacific region, by hosting a conference entitled “The People’s Assembly: Sustainable Solutions for Victims of Sea Level Rise”, held at the Queensland State Library in late August. In this assembly event, a panel of scientific, business, academic, humanitarian and environmental leaders debated outlined practical adaptive strategies that Australia could implement to assist nations throughout the Asia Pacific region that were impacted by rising sea levels. Recommended solutions include improved training in meteorology (and related sciences) and the development of advanced early warning systems to predict extreme events in order to increase the adaptive potential of affected communities. The international aid agency Oxfam released a blueprint (Oxfam 2008) for Australia’s new engagement with Pacific nations, which recommended reducing greenhouse gas emissions by at least 95% by 2050; developing renewable energy alternatives; providing financial support funding to help Pacific nations adapt to rising sea levels; and assisting communities displaced by the results of climate change (including governance arrangements and preparations for forced immigration). In the context of sea level rise, the paradigm shift from crisis management to community based disaster resilience is shown in Table 1.

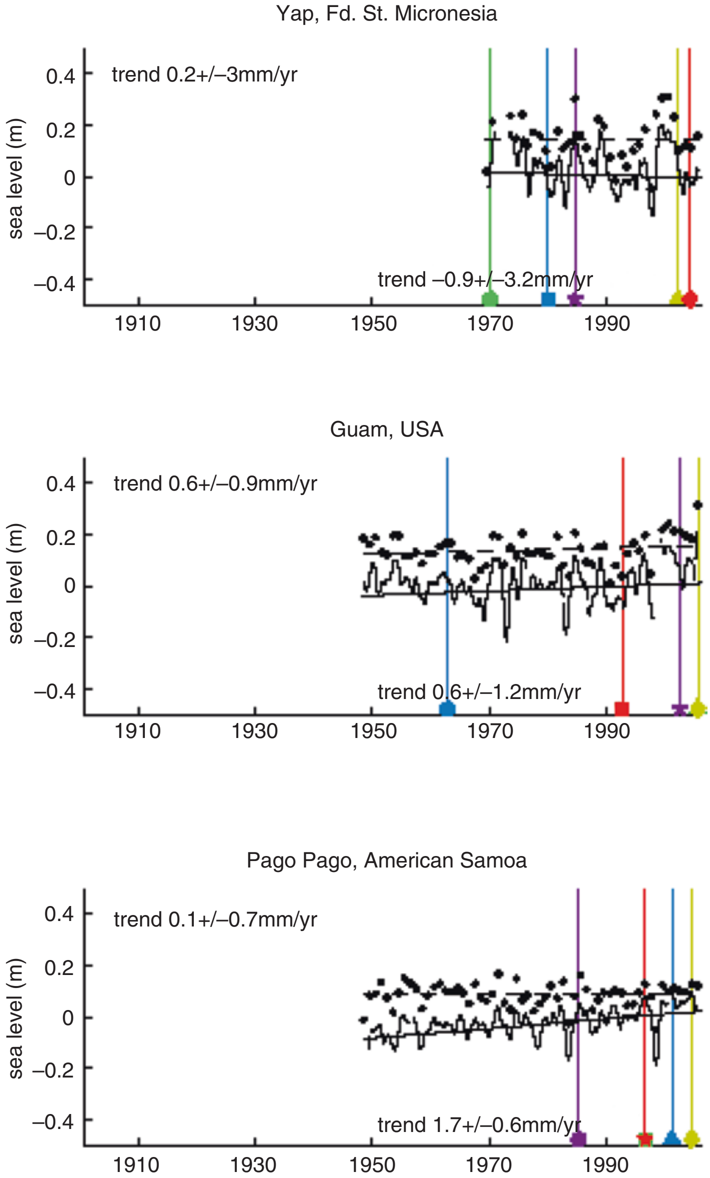

Fig. 3 Observed rates of relative sea level rise for select US Flag and Affiliated Pacific Islands. These are Pacific Region Integrated Climatology Information Products (PRICIP) derived data products that can be found at http://www.pricip.org/

Table 1 The evolution of risk assessment and emergency management

Crisis management		Disaster resilience
1. Hazards, emergency and disaster focused	**Emphasis** →	Vulnerability, risk and resilience focused
2. Single, event based scenarios		Dynamic, multiple risk issues and development scenarios
3. Reactive		Proactive
4. Respond to and recover from event		Assess, prepare, monitor and update/ adapt
5. Fixed, location specific conditions		Extended or changing conditions, with local variations
6. Single authority or agency has responsibility	**Operations** →	Involves multiple authorities and decision makers: Multi-disciplinary approach
7. Established hierarchical relationships: Command and control		Shifting and fluid relationships: Situation specific functions and free association
8. Response and recovery		Mitigation and preparedness
9. Urgent, immediate and short time frames in outlook and planning	**Time horizons** →	Comparative, moderate and long time frames in outlook and planning
10. Communicating to communities; directed, 'need to know' basis of information dissemination	**Information use and management**	Accumulated, historical, layered, updated, or comparative use of information; communicating with communities; open or public information, multiple, diverse or changing sources, differing perspectives, points of view.

Modified from ISDR (2002)

8 Conclusions: Improving Disaster and Climate Change Preparedness in the Asia Pacific Region

A case is made for advancing the field of Climate and Sustainable Security which deals with protecting, restoring, designing, and implementing a set of integrated natural, industrial, civilian, and security processes that equitably and responsibly meet the biophysical needs of human communities, while maintaining long-term climate security, respecting financial constraints, meeting ecological limits, and improving institutional arrangements for transparent, accountable, and effective governance. This paper puts forth a number of conceptual, theoretical, political and normative arguments for developing the field of Climate and Sustainable Security and applying it to identify creative and tenable security solutions to problems that lie at the interface of resource scarcity, human insecurity, national vulnerability, and ecological fragility. Using a plurality of epistemological and normative perspectives, technologies, practices and tools for Climate and Sustainable Security help policy makers and leaders in the Asia-Pacific to visualize and implement comprehensive, dynamic and interdependent sustainable security solutions using an adaptive and consultative process. This new paradigm is a novel attempt to focus attention on the complex trans-scale linkages and relationships among global challenges (i.e. climate change), national (i.e. state and economic) security, environmental and energy (biotic) security, and human (social) security.

However, in many countries of the Asia-Pacific region, governments continue to rely on strengthening state security systems using traditional intelligence services and national security tools, including increased surveillance capabilities for confronting international terrorism and stopping the illicit trade and trafficking of weapons of mass destruction. Global climate change and other high consequence, transboundary and highly uncertain threats facing humanity require existing" security apparatuses to adopt non-traditional approaches (Briggs 2009). While contemporary global crises share commonalities with previous security risks, for the most part, these new hazards are qualitatively different, as they are comprised of interdependent and uncertain forces, exhibit complex behavior (i.e. non-linear feedbacks and "strange" attractors), and pose existential threats to humanity. To help manage these threats, it is shown that the field of Climate and Sustainable Security can be used to develop early warning capabilities and forensic technologies in order to provide greater foresight about "black swan" (high-consequence, low probability) events which leaders and policy makers are likely to underestimate (often due to a lack of previous experience with such uncertain and complex systems). Simply put, by ensuring that security policies, plans, and activities are socially, ecologically and economically sustainable for both current and future generations the Climate and Sustainable Security paradigm constitutes a sine quo non for the collective security, and indeed the survival, of humanity.

Global climate variability and change is increasing the frequency and severity of natural disaster events and security risks in the Asia-Pacific region. Climate change threatens the fabric of life for people throughout the Asia Pacific – it affects key health, environmental and social dimensions including access to clean water, food production, and the sustainability of ecological systems and the urban built environment. Severe weather is predicted to become more frequent and destructive in the Asia-Pacific region warming trends are expected to bring new security challenges Asia-Pacific: warmer air holds more moisture, which portends record-breaking rainfall and more intense storms. Even conservative estimates predict that the rising temperatures and changing ocean levels in the Asia-Pacific Region will lead to significant socio-economic, environmental and security concerns. Sea rise for coastal cities may be particularly damaging, especially as people and population densities continue to increase in flood plains and coastal areas of the Asia-Pacific. It is shown that higher temperatures, rising seas and a more energetic hydrologic cycle are expected to contribute to more intense storms, droughts, crop failures and food insecurity. This has serious implications for national security in the Asia Pacific Region including the possible mass migration of "climate refugees" across international borders and increased conflict among nations competing for scarce resources (particularly among upstream and downstream nations in Asia). It is concluded that emergency managers, security professionals and governments must promote climate adaptation and mitigation measures that protect communities in the Asia-Pacific region.

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Cybercrime in East and Southeast Asia: The Case of Taiwan

Leo S.F. Lin and John Nomikos

Abstract This chapter aims to scrutinize cybercrime as one of the security threat types of transnational organized crime (TOC) in East and Southeast Asia region in the era of globalization. This chapter examines the nature of cybercrime and how it has evolved in the Asia-Pacific region in the era of globalization. Following the booming economy in East and Southeast Asia, the internet has been used as a terrain to conduct transnational crimes, and the criminals try to utilize the loopholes between legal and judicial systems among the countries in the region. This chapter examines the threats that have been posted by cybercrime, which is different from the "traditional" organized crime activities. This chapter uses Taiwan (the official name is the Republic of China, R.O.C.) as a case study. Following globalization and technological development, Taiwan's underworld went into a new stage of development, penetrating political, economic and other aspects in the society. Thus, many organized crime groups vigorously expand their organizations oversees into East and Southeast Asia. As a result, Taiwan exported many masterminds of telecommunication and internet fraud crime and those criminals form organized crime groups in the third countries. The whole region is affected by the telecommunication frauds conducted by transnational criminal groups that are in many cases headed by Taiwanese. This phenomenon has become a security threat to the region that requires cross-border cooperation and joint effort.

Keywords Transnational organized crime • Cybercrime • Asia Pacific security threat

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Disclaimer: The views expressed in this article are solely the author's own and do not reflect the official policy or position of any agency of the Taiwan government.

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https://doi.org/10.1007/978-3-319-61729-9_4

1 Introduction

Cybercrime has become a security threat, affecting nearly every country in the world. In this digitalized and globalized world, the criminals are utilizing the internet and technology to conduct illicit activities either in, or via, cyberspace. Without the physical boundaries, cybercriminals can commit the crimes through computer or mobile devices anytime, anywhere, making the world become more vulnerable. In East and Southeast Asia region, countries are also facing the security threat posed by cybercriminals. The booming economy and the advancement of technology have made Asia one of the most dynamic regions in the world. However, the region is facing challenges as cybercrime has also been growing at the same time. The examples of cybercrime in the region are internet sex crimes, selling narcotics using internet platforms, internet fraud, internet extortion, cyber hacking, etc. This chapter first touches upon the definition of cybercrime and the threats it has posted. Then this chapter moves to the discussion of the cybercrime threat and the challenges in East and Southeast Asia region. Finally, a case study of Taiwan will be presented. This chapter uses the example of telecommunication and internet fraud Crime, illustrating how the crime has been spreading throughout the region, both physically and virtually. It is imperative for all the countries in the region to work together and to fight against cybercrime.

2 Defining Cybercrime

The concept of cybercrime has been evolving and changing. The definition of cybercrime is also still in debate. Brenner pointed out that the term “cybercrime” and its various correlates have been in use for decades,[1] and we consequently have no way of identifying what is, and is not, a cybercrime (Brenner 2004a). McCusker argues that ‘the debate surrounding the actual and/or prospective involvement of traditional organized crime groups in cybercriminal activity is characterized by a tension between logic and pragmatism.’[2] He further argues that ‘there remains a confused and confusing plethora of terminology, purported parameters and alleged participants of cybercrime as well as concerns over the provenance and quality of evidence elicited in support of such activity (McCusker 2006)’. Wall also addressed that ‘the

[1] There are many different terms describing cybercrime. Many of them are not clear in definition and can be exchangeable, such as ‘computer crime,’ ‘technology crime,’ ‘high-tech crime ‘and ‘digital crime,’ etc.

[2] According to McCusker, Logic would dictate that traditional organized crime groups will engage with cybercriminal endeavors as fervently as they will with any low risk, high profit non-virtual criminal activity. Pragmatism would suggest that it remains questionable whether such groups either need that engagement or indeed have the capacity to exploit the cyber environment to the extent that their capital investment would produce the desired and appropriate financial gains (McCusker 2006).

confusion has led some authors to question "whether or not —there are indeed such things as cybercrimes (Brenner 2001)" (Wall 2015). Others have questioned whether cybercrime is actually a category of crime in need of new theory or whether it is better understood by existing theories (Jones 2003). Scholars such as Grabosky and Nisbett tend to consider that cybercrime is not abrand new type of crime, but traditional organized crime groups which use new methods of committing crimes (Grabosky 2001; Nisbet 2003). In other words, the cybercrime is 'old wine in new bottles.' There are also other scholars who argue that cybercrime is actually a new type of crime. Wall examines the impacts of the internet on criminal opportunities and behavior. He points out that "true cybercrime" are 'new opportunities for new types of crime.'[3] He further argues that cybercrimes then appear to have "opposite characteristics"[4] than traditional criminal activity (Wall 2003, 2005, 2015). McGuire and Dowling (2013) provide a powerful classification on cybercrime, based on the evidence found in the UK. They propose that 'cyber crime is an umbrella term used to describe two distinct, but closely related criminal activities: cyber-dependent and cyber-enabled crimes (McGuire and Dowling 2013)':

- C*yber-dependent crimes*: Offences that can only be committed by using a computer, computer networks, or other form of ICT. Cyber-dependent crimes include the spread of viruses and other malicious software, hacking, and distributed denial of service (DDoS) attacks, i.e. the flooding of internet servers to take down network infrastructure or websites.
- *Cyber-enabled crimes*: These are traditional crimes that are increased in their scale or reach by the use of computers, computer networks or other ICT. The cyber-enabled crimes are including fraud (including mass-marketing frauds, 'phishing' e-mails and other scams; online banking and e-commerce frauds); theft (including theft of personal information and identification-related data); and sexual offending against children (including grooming, and the possession, creation and/or distribution of sexual imagery)

Jonathan Clough (2015) posits that there is a third category, called 'computer-supported crimes (Kowalski 2002).'[5] Clough argues that these are crimes that ' the

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[3] Wall argues that there are three categories related to cybercrime and opportunities. First is the "Traditional crime using computers," there are "more" opportunities for traditional crime; second, "Hybrid cybercrime," there are "new" opportunities for traditional crime; third, "True Cybercrime," there are new opportunities for new types of crime(Wall 2003, 2005).

[4] The opposite characteristics include that cybercrimes are '… contentious in that there does not yet exist a core set of values about them. They appear to be largely free of a physical time frame. Cybercrimes can also be transnational, transjurisdictional, and global, and if there is a topography of the Internet, it is expressed more in terms of levels of access to the Internet and language rather than in terms of physical geography (Wall 2015).'

[5] For detailed discussion about computer-supported crimes, see Kowalski, Melanie. 2002. *Cyber-crime: Issues, data sources, and feasibility of collecting police-reported statistics*: Canadian Centre for Justice Statistics.

use of computer is an incidental aspect of the commission of the crime but many afford evidence of the crime (Clough 2015).' From the practical perspective, law enforcement tends to focus on cyber-dependent as well as cyber-enabled crimes. INTERPOL, the leading international criminal police organization, points out that 'although there is no single universal definition of cybercrime, law enforcement generally makes a distinction between two main types of Internet-related crime'[6]:

1. Advanced cybercrime (or high-tech crime) – sophisticated attacks against computer hardware and software;
2. Cyber-enabled crime – many 'traditional' crimes have taken a new turn with the advent of the Internet, such as crimes against children, financial crimes and even terrorism.

This chapter takes the definition provided by McGuire and Dowling, which provides a broader view on cybercrime encompassing cyber-dependent and cyber-enabled crimes, putting additional emphasis on the latter one.

3 The Threats of Cybercrime

3.1 Examining the Threats of Cybercrime

Even though scholars and practitioners have different ideas and opinions on definition of cybercrime, one thing is clear: organized crime groups are taking advantage of the advancement of technology. As Olson suggests, '[o]rganized crime is perfectly suited to profit from the information revolution. Its existence relies on innovating, adapting strategies and operations, and evading detection. These attributes complement the ever-changing nature and unpredictability of the information revolution. The Internet offers an array of lucrative opportunities with little or no risk (Olson 2004).' William also posited the same account, that "...there is growing evidence that organized crime groups are exploiting the new opportunities offered by the Internet (Williams 2001b)." As stated, the internet provides great opportunities to cyber criminals. McGuire and Dowling pointed that 'the nature of some "traditional" crime types has been transformed by the use of computers and other information communications technology (ICT) in terms of its scale and reach, with risks extending to many aspects of social life. New forms of criminal activity have also been developed, targeting the integrity of computers and computer networks such as the spread of malware and hacking. Threats exist not just to individuals and businesses, but to national security and infrastructure (McGuire and Dowling 2013).' From the practical point of view, the same account has been shared. For example, INTERPOL points out that 'cybercrime is a fast-growing area of crime. More and more criminals are exploiting the speed, convenience and anonymity of the Internet

[6] See https://www.interpol.int/Crime-areas/Cybercrime/Cybercrime

to commit a diverse range of criminal activities that know no borders, either physical or virtual, cause serious harm and pose very real threats to victims worldwide.'[7] The rapid expansion of e-commerce and the Internet has brought many benefits but also the emergence of various forms of crime that exploit the strengths and weaknesses of mass interconnectivity (Broadhurst and Chang 2013). The Internet provides more confidentiality, privacy, deniability, and 'untraceability' than any physical environment. TCOs leverage information and communication technologies in the same manner as legitimate business across the globe, and respond to the same driving forces (Etges and Sutcliffe 2010). In the example of fraud, 'modern technology changes that by automating fraud; perpetrators can use fraudulent e-mails and fake websites to scam thousands of victims located around the globe, and may expend less effort in doing so than their predecessors used to defraud a single victim (Brenner 2004b).' It seems that there is a broad consensus that the internet/ cyberspace has provided the criminal groups with agreat platform to conduct their illicit business, which has become increasingly athreat to modern society. There are undoubtedly criminal elements operating in the online environment as obtainers and disseminators of identity and identity-related information (McCusker 2006). There are a number of generic cyber crime threats that have been identified (Council of Europe 2005):

1. Offences against the confidentiality, integrity and availability of computer data and systems (via activities such as hacking, deception, interception and espionage);
2. Computer-related 'traditional' crimes (fraud and forgery), content-related computer offences (such as website defacement and dissemination of false information); and
3. Offences relating to the infringement of copyright and related rights (such as the unauthorised reproduction and use of programmes and databases).

3.2 Law Enforcement Viewpoint

For the law enforcement community, cybercrimes have posed great threats to the world. Apparently, people are more easily becoming the targets and/or the victims of cybercriminals especially there is an increasing use of technology and the Internet. Cybercrime has become a real threat to the world as the whole world has become more dependent on the internet and cyber services. These threats come in a variety of forms and target different features of the Internet, technological devices and their users. According to FBI's annual Internet Crime Report,[8] there are a total of 1 billion losses reported in 2015, and the most prominent crime types are Business

[7] See https://www.interpol.int/Crime-areas/Cybercrime/Cybercrime

[8] See https://pdf.ic3.gov/2015_IC3Report.pdf

Email Compromise (BEC),[9] Email Account Compromise (EAC),[10] and Ransomware.[11] According to the " 2016 Internet Organised Crime Threat Assessment (IOCTA)" produced by the European Cybercrime Centre (EC3) of the EUROPOL, many of the key threats remain largely unchanged from the previous report.[12] The key threats are Ransomware and banking Trojans,[13] Darknet,[14] EMV,[15] phishing campaigns,[16] DDoS attacks,[17] Cryptocurrencies,[18] etc. Europol indicates that '[organized crime] groups rely on fast and secure means of communication. E-mail, internet chat rooms and instant messaging all offer new opportunities, as do web-based and client server mail accounts, websites and message boards. It provides speed of communication and, combined with encryption tools, offer unprecedented security for the data they store and exchange (Europol 2006).' In 2017 EU Serious and Organized Crime Threat Assessment Report,[19] it highlights the types of crimes as below: cyber-dependent crimes (including Malware and network attacks), online child sexual exploitation material (CSEM),[20] and Payment card fraud.[21]

From above we can see that both cyber-dependent and cyber-enabled crimes are the focus of the U.S. and European Union, or so-called western, law enforcement community. It will be even more challenging for the law enforcement to face the threats relates to cybercrime in the future. First, as the number of internet and mobile

[9] According to FBI, BEC is defined as a sophisticated scam targeting businesses working with foreign suppliers and/or businesses that regularly perform wire transfer payments. The scam is carried out by compromising legitimate business email accounts through social engineering or computer intrusion techniques to conduct unauthorized transfers of funds.

[10] According to FBI, EAC is a sister scam to BEC. EAC differs from BEC in that it targets individuals or individual professionals instead of businesses. EAC is defined as a sophisticated scam that targets the general public and professionals associated with, but not limited to, financial and lending institutions, real estate companies, and law firms.

[11] According to FBI, Ransomware is a form of malware that targets both human and technical weaknesses in organizations and individual networks in an effort to deny the availability of critical data and/or systems. Ransomware is frequently delivered through spear phishing emails to end users, resulting in the rapid encryption of sensitive files on a corporate network.

[12] See https://www.europol.europa.eu/sites/.../europol_iocta_web_2016.pdf

[13] Ransomware and banking Trojans remain top malware threats in European Union.

[14] According to IOCTA report, peer-to-peer networks and the growing number of forums on the Darknet continue to facilitate the exchange of child sexual exploitation material (CSEM).

[15] According to IOCTA report, EMV (chip and PIN), geoblocking and other industry measures continue to erode card-present fraud within the EU, forcing criminals to migrate cash out operations to other regions.

[16] Targeted (spear) phishing aimed at high value targets has become a key threat.

[17] According to IOCTA report, there is a growing trend in the compromise of other data types, such as medical or other sensitive data or intellectual property for other purposes.

[18] Bitcoin, for example, remains the currency of choice for many cybercriminals.

[19] See SOCTA report: https://www.europol.europa.eu/sites/default/files/.../socta2017_0.pdf

[20] According to the SOCTA report, a growing number of Darknet forums facilitating the exchange of CSEM, coupled with the ease of access to these networks, is leading to an increase in the volume of material exchanged through the Darknet.

[21] There are two distinct types: card-present fraud (CP) and Card-not-present fraud (CNP).

devices users continue to grow, as well as the techniques/tactics of cybercriminals continue to advance, the budgets and resources of the law enforcement agencies seem not been able to catch up the pace. Secondly, the under-reported situation continues to exist. According to U.S. Department of Justice, there are millions of people in the United States who are victims of Internet crimes each year. Only about 15 percent of the nation's fraud victims report their crimes to law enforcement.[22] This under-reported situation, or so-called "dark figure," is not unique phenomenon in the U.S. but around the globe. The exact number of victims and their losses are the hard truth that we would never know, thereby resulting in the underestimation regarding the impact of cybercrime.

4 The Threat and Challenges of Cybercrime in East and Southeast Asia

4.1 Illicit Economy in the Globalized Era

Williams pointed out that criminal organizations are motivated to engage into transnational criminal activities at both macro (globalization and the new environment) and micro (specific incentives to go transnational) levels, where it is necessary to identify the specific calculations that an individual criminal enterprise might make – intuitively or explicitly – before embarking to international ventures (Williams 2001a). Based upon the same logic, this chapter further argues that there are two major forces at the international (macro) level that have assisted the illicit economy to rise in East and Southeast Asia region. First is the wave of globalization. According to Shelly et al., globalization is a key factor in the rise of transnational organized crime (Shelley et al. 2003). Globalization not only makes it possible to move goods, people and money through the global economy, but also facilitates the movement of "dirty money" as well as the transportation of drugs, counterfeit goods, arms, illegal aliens and nuclear material (Godson and Williams 1998). Broadhurst further argues that the transnational nature of cyber-crime reflects the process of globalization, which has intensified over the past two decades (Broadhurst 2006a). It is important to note that the areas of greatest growth in transnational criminality are regions in which there have been substantial increases in cross-border flows of people, money and commodities (Wesley 2007). In Asia region, with the advancement of the technology, transportation and popularity of internet, they have enabled the criminal groups to utilize the cyberspace to conduct crimes so as to earn profit.

The second force is the booming economy in the region. East and Southeast Asia is one of the most dynamic regions in the world that faces increasing threats and security challenges. Those threats, such as human trafficking and smuggling, drug trafficking, terrorism, territorial conflicts, the proliferation of weapons of mass

[22] See https://www.justice.gov/usao-wdwa/victim-witness/victim-info/financial-fraud

destruction and nuclear armament, and transnational organized crime, that have existed for decades. The World Bank's GPD data in 2015 shows that the top ranking Asian countries are China (number 1), Japan (number 4), Indonesia (number 8) and South Korea (number 13). The East Asia and Pacific region ranks the top in economic performance.[23] Also, United Nations statistics indicate that Asia accounts for more than half of the world population.[24] China (1.4 billion) and India (1.3 billion) remain the two largest countries of the world, both with more than 1 billion people, representing 19 and 18 per cent of the world's population, respectively.[25] This data continue to show that, in this region, the economies are among the world's greatest beneficiaries of globalization. Robust exports and large flows of foreign investment have driven economic growth and rapidly improved welfare, reflected in rising social indices (Greenwood 2004). The booming economy and the growing population are still influential to many aspects of the region's development, including political, economic and social aspects. Following this tremendous economic upgrades, the "illicit economy" has been also boosted dramatically. Moreover, the erosion of national borders fostered global movements of people driven by "a mix of push and pull factors that range from ethnic conflict and environmental degradation to the desire for economic betterment" (Williams 2001a). Undoubtedly, the criminal groups have already seized the global opportunities to expand their illicit business in the region.

4.2 *The Current Cybercrime Situation*

With the impact of globalization and the booming economy, like other types of crime, cybercrime has been also growing. According to Internet World Stats,[26] there are 1856.2 million internet users in Asia alone, which is tripled than the second largest number- Europe, with 630.7 million users. The chart shows that the internet users in Asia account for more than half of the internet user population of the world. Among East and Southeast Asian countries, China accounts for 39% of the internet users in Asia, followed by Indonesia (7.2%), Japan (6.2%), the Philippines (2.9%), Vietnam (2.7%), South Korea (2.5%), Thailand (2.2%), Taiwan (1.1%) and Malaysia (1.1%).[27] Along with the rapid rise of Internet use, cybercrime has also become prevalent in this region (Broadhurst and Chang 2013). This shows that Asia region has become a focal point of cybercrime. From the above statistics, we can find an interesting fact: Asia has ranked at the top not only in population and economic perfor-

[23] See http://databank.worldbank.org/data/download/GDP_PPP.pdf

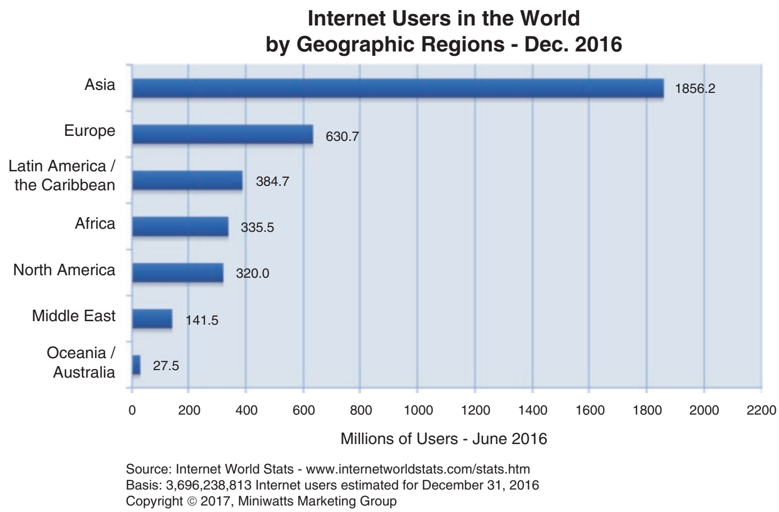
[24] Sixty per cent of the global population lives in Asia (4.4 billion), 16 per cent in Africa (1.2 billion), 10 per cent in Europe (738 million), 9 per cent in Latin America and the Caribbean (634 million), and the remaining 5 per cent in Northern America (358 million) and Oceania (39 million). See https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf

[25] See https://esa.un.org/unpd/wpp/publications/files/key_findings_wpp_2015.pdf

[26] See http://www.internetworldstats.com/stats.htm

[27] See http://www.internetworldstats.com/stats3.htm#asia

mance (GDP), but also internet users. Of course we can further examine the correlation between these factors, but this is not the main focus of this article. The data shows at least two implications. First, Asia could be the next focal point when it comes to cybercrime research. Given that more internet users and more money flows over the internet, there would be more opportunities for the criminals to conduct underground business and "earn money." According to the Australian Strategic Policy Institute, estimates of the cost of cybercrime to the Asia–Pacific vary, but suggested figures of about US$81 billion imply that it's a bigger problem than any country can address on its own.[28] Second, albeit there are no geographic boundaries in the cyberspace, criminals tend to aim at the increasing number of soft targets, and Asian countries are becoming more vulnerable. According to the 2013 Security Threat Report by Sophos, East and Southeast Asia accounted for 7 of the top-10 countries with most vulnerable to cybercrime, namely Indonesia, China, Thailand, the Philippines, Malaysia, Taiwan and Hong Kong.[29] For ASEAN countries,[30] as ASEAN has become richer, its population has become increasingly reliant upon the Internet for the provision of goods and services. When paired with the billions of dollars invested in the ASEAN economy, the bloc is a profitable target for cybercriminals.[31] This is not surprising taking consideration of the mass amount of internet users in the region. Traditionally speaking, scholars tend not to incorporate cybercrime into the category of transnational organized crime in East and Southeast Asia region. This chapter argues that we have to rethink about the transnational organized crime and re-categorize the cybercrime in the East and Southeast Asia region.



[28] See https://www.aspistrategist.org.au/us-australia-cyber-dialogue-fighting-cybercrime-asia-pacific/

[29] See https://www.sophos.com/en-us/.../sophossecuritythreatreport2013.pdf

[30] ASEAN means Association of Southeast asian nations. Currently there are 10 member countries joined the ASEAN, including Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

[31] Source: https://jsis.washington.edu/news/asean-cybersecurity-profile-finding-path-resilient-regime/

4.2.1 Cyber-Dependent Crimes

Since 2001, Guenther have pointed that malware like trojans and bot-net programs are spread through social engineering techniques (Guenther 2001). According to Broadhurst and Chang, criminal groups are engaged in computer or network intrusions to obtain sensitive information such as identity and password information. This in turn can be used to undertake large-scale financial crime and social engineering may be the preferred method of obtaining access to such data contained in digital devices/computers. The kinds of activities vary but encompass online scams and malware such as spyware, phishing, rootkits, and bot-nets (Broadhurst and Chang 2013). According to EUROPOL's 2016 Internet Organized Crime Threat Assessment (IOCTA), China, Taiwan, Japan, South Korea, India, Thailand and Vietnam are the countries with higher report of cyber-dependent crimes. The key lines are extracted as below[32]:

- China has an extensive and increasingly innovative digital underground. While it makes less use of traditional cybercrime forums, instead choosing to use instant messaging or spam on existing (unrelated) fora to drum up business, the range of products and services available mirrors that of Western underground markets. These markets are a key source for tools and equipment relating to card crime, such as ATM and POS skimmers.
- China and Taiwan have some of the most highest global malware infection rates and consequently highest volumes of global bots.
- China, Vietnam, India, Japan and Taiwan are reported as top sources of global spam.
- Asia is allegedly the source of over 50% of global DDoS attacks, with China alone responsible for over one quarter of these attacks. South Korea, India, Thailand and Japan make up the remainder.

There are a number of reports produced by private sector on cybercrime about Asia. One of the most recent one, ThreatMetrix APAC, a digital identity company, its 2016 Q3 Cybercrime Report pointed out the regional snapshots[33]:

- China: Automated bot attacks from China are extremely high with large attacks combining bots attacks with identity or device spoofing.
- Japan: Japan is a key growth region in the Network, with a 51 percent increase in transaction volumes compared to last year. Japan has the second highest percentage of rejected transactions at 14.4 percent; representing a steady year-on-year increase.
- Southeast Asia: SE Asia saw a 47 percent increase in attacks compared to last year, as total transaction volumes grew 45 percent. Mobile transaction volumes are grew 34 percent compared to 2015.

[32] See https://www.europol.europa.eu/sites/.../europol_iocta_web_2016.pdf

[33] See https://info.threatmetrix.com/wp-q3-2016-cybercrime-apac.html

4.2.2 Cyber-Enabled Crimes

The most common type, and perhaps the most serious one in the region, is the internet fraud. The advent of the Internet has presented a new frontier of opportunities to traditional fraudsters (Wesley 2007). Fraud takes many different forms in cyber space: 419 scams, auction fraud, credit card fraud, identity theft, phishing, and investment fraud are the most commonly-encountered varieties of online fraud. But while it takes on new forms online, fraud is fraud; online scams are versions of schemes that have been around for centuries (Brenner 2004a). As stated, China is one of the most affected countries by cybercrime. In recent years, the Chinese authorities have been working hard in fighting against internet fraud. The 'Internet-Hunting Platform (獵網平臺),' a fraud-reporting system developed by Beijing City Public Security Bureau and other private sectors, published a 'Internet Fraud Trend Research Report (網路詐騙趨勢研究報告)' in January, 2017. The report analyzed the data gathered from the internet users who reports internet fraud cases nationwide. There are a number of highlights in the report[34]:

- There are a total of 23,623 cases reported to the platform in 2016, with total losses of 195 million Renminbi (RMB), in which 14,202 cases are PC-related, and other 6421 cases are smart-phone related.
- Among the types of fraud, financial and investment fraud is the highest, which accounts for 37.9% of the total cases. Gambling fraud accounts for 15.7%, and part-time job fraud accounts for 11.1%.

Besides, according to the same report, the key features of the internet fraud in China are as follows: First, the cybercriminals distribute 'short links' to the victims which connects to phishing websites. The cybercriminals distribute the dangerous short links to PCs, smart-phones or emails, luring people to click the link connecting to phishing websites. Second, the cybercriminals post fake part-time job links in the famous websites, making people believe the job opportunities are real. The cybercriminals usually post job opportunities online which features high-paid, low-working hours, making people believe the job is real and are willing to pay 'deposit' to the cybercriminals. Third, the cybercrime groups are more organized, which operates in a way that is very similar to business enterprises. The cybercriminals are very familiar with the internet and telecommunication system, and they are able to utilize the loopholes to conduct illicit business. Lastly, the tactics that the criminals have used are more sophisticated and advanced, easily making people fall into the trap. Taking advantage of different kinds of internet services, the cybercriminals develop many schemes that are hard to tell for ordinary people.

Another case of cyber-enabled crimes are child sex tourism and the internet. The internet allows both travelling child-sex offenders and the child-sex traffickers to utilize. Travelling child-sex offenders would be able to access to networks and to gain information about child-sex at the country of destination, while the traffickers

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[34] Internet Fraud Trend Research Report (網路詐騙趨勢研究報告): See http://zt.360.cn/1101061855.php?dtid = 1101062366&did=210142130

can use the internet to distribute the advertisement. According to TOCTA report, many East and Southeast Asian destinations and source jurisdictions such as Cambodia, Japan, South Korea, Taiwan, Thailand and Vietnam do not yet have a protocol for Internet Service Providers to report unlawful cyber activities in relation to child pornography and child sexual abuse. These must be established as a vital means of undermining criminal activity (Lale-Demoz and Lewi 2013).

4.3 The Challenges Posted

With the growing economy and the increasing number of internet users in a country, people become more dependent on the internet. As the regional countries have modernized, they have increasingly relied on web based technologies to enable them to more efficiently use their resources. However, this virtual process has mirrored the uneven pattern of economic development found across East Asia (Thomas 2009). Given that the cybercrime activities operate in the cyberspace, there is no border limit for them. For the cybercriminals, the borderlines are advantageous for them. Do not forget that in East and Southeast Asia, countries in the region are in different economic sizes, languages, cultures and political systems. There are world economic powers like China and Japan, and there are least developed countries (LDC) like Laos, Cambodia and Myanmar. There are diverse languages and cultures in East and Southeast Asia, and there is hard to find a common language between them. Although most countries in the region promote English as the second language, it is still not as popular as that in Europe. This region also features different political system, from Constitutional monarch in Thailand to single-party rule in China. The above features in East and Southeast Asia increase the difficulties for the law enforcement agencies of each country to work together, and it gives the cybercriminals ample chances to escape from the apprehension in real world.

This chapter has identified some of the key challenges that are posted by cybercriminals in the region. First, legal-jurisdiction issue will be still a crucial concern. The transnational nature of cybercrime basically requires that states enact laws to harmonize definitions of criminality and enhance mutual cooperation across states (Broadhurst 2006b). East and Southeast Asia, because of different legal system, many countries may find it difficult to enforce their national laws as well as to work with other countries. Many cyber-crimes take place across jurisdictional boundaries with offenders routing attacks through various jurisdictions and can only be countered by a cross-border and international policing response (Broadhurst 2006a). Law enforcement agencies in many jurisdictions have been unable to respond effectively to cyber-crime and even in the most advanced nations, “play catch-up” with cyber savvy criminals (Sussmann 1998). As most cybercrimes are transnational in character, inconsistency of laws and regulations across country borders makes it especially difficult for countries to cooperate when investigating cross-border cyber crimes (Broadhurst and Chang 2013). As for the international legal cooperation, according to Broadhurst, in dealing with IT crime law enforcement is at a disadvantage because of the remarkable speed in which cyber-crimes unfold against the typically "low-speed cooperation" offered by traditional forms of MLA. The role of multinational agencies such as Interpol and the UN has never been more essential. Yet within Asia the results fall far short of creating a seamless web of bilateral or multilateral agreements and enforcement that would ensure a hostile environment for cyber criminals (Broadhurst 2006a). Although the head of states in the region have rhetoric statements on fighting cybercrime over the past years, but in reality there is still large room for improvement for yielding substantial results.

The second challenge is the political tensions in the region, which would impede cooperation between countries. Because of the political situations and the tensions between some countries in the Asia, cases of cybercrime with a political purpose are common. These can be seen between Taiwan and China, South Korea and North Korea, Japan and China, as well as Pakistan and India (Broadhurst 2006b). Perhaps the most prominent case is the cooperation between Taiwan and China on eliminating the cross-border telecommunication frauds. Since the pro-independent party-Democratic Progressive Party (DPP) won the presidency in Taiwan in 2016, the Chinese government has cut off all the communication and collaboration mechanism on fighting against trans-border telecommunication frauds that have been build since 2008. Moreover, Chinese government used its international political influence to ask the third countries to deport the Taiwan nationals who committed telecommunication fraud to China, instead of Taiwan. The most recent one is the Malaysia case, where Malaysian government, pressured by China, decided to deport 21 Taiwanese suspected of multi-million dollar telecoms fraud to China.[35]

A third challenge is the economic and social issue-digital divide. Broadhurst pointed out that 'the "digital divide" between nation-states is growing rapidly and the role of "advanced" IT-based economies in bridging this divide is essential (Broadhurst 2006a).' Most developing countries do not have a telecommunications sector capable of supporting information and communications technologies (ICT). He further argues that 'nowhere is this "digital divide" more extreme than in Asia, with countries such as South Korea, Japan, Hong Kong and Singapore leading the way with internet access reaching as many as 70 per cent of households (often with broadband), while Laos, Cambodia, Mongolia and Myanmar had less than 1 per cent of their populations connected (Broadhurst 2006a).' While this "digital divide" is often discussed in terms of infrastructure development and broadband penetration, the economic disparities and low socio-political capacity levels also present significant challenges to these states as well as all others linked to the World Wide Web (Thomas 2009). The emergence of e-commerce, as well as the social dimension of the internet and associated "cyber-crimes", is a striking example of the challenges to the independent capability of nation-states to regulate social and economic order within their territories (Broadhurst 2006a). The technological gap between developing and developed countries on the regional scale has become a threat for all

[35] See the related news coverage: http://www.reuters.com/article/us-china-taiwan-malaysia-idUSKBN13P09V

the countries in fighting against cybercrime. Usually, less developed countries would have insufficient national regulations and law enforcement power to deal with cybercrime, which gives the cybercriminals ample opportunities to take advantage out of it, especially when they operates the trans-border frauds while they are physically hiding in other countries. By this way, they would reduce the chances to be caught by the law enforcement agencies of the countries where the cybercrime victims are located in.

Finally, the language and cultural Norms would be challenges as well. Cultural norms can also override this liberal-economic understanding. Simply because a country has a high level of economic development and a liberal-democratic political system does not automatically guarantee a shared set of norms and values with other, similarly developed, countries (Thomas 2009).Each country has different language (and dialects) and local culture. The East Asian countries, including Japan, Korea and Taiwan, are largely influenced by Chinese culture, but their local culture still very different from China. In the case of Taiwan, although it shares the same language (Mandarin Chinese) with China, which makes the people across the strait communicate easily, the writing system, the usage of language, and the perception to democracy and way of life are still different from China. According to Chang, he finds that 'language and culture play important roles in facilitating cybercrime between Taiwan and China.' He posits that ' if a cyber criminal knows the culture of the target well, and employs the language that the user is familiar with, it is easier for the criminal to successfully persuade the target to open the email with a malicious code attached and become infected (Chang 2012).' In Southeast Asia, the culture and language is even more diverse, from tribal culture to deeply civilized culture, influenced by Chinese, Indian, Hindu, Buddhist and Islamic culture and language. Moreover, the legacy of colonialism still has influence on certain countries. For example, Taiwan has been influenced by Japan, and the Philippines have been heavily influenced by U.S. and Spain. Others like Hong Kong (influence by Great Britain), Macao and East Timor (both influenced by the Portuguese) are all having colonialism legacy existence.

5 Case Study: Taiwan's Telecommunication and Internet Fraud Crime in the Region

5.1 The Telecommunication and Internet Fraud Crime 'from' Taiwan

Given that there is no clear definition of cybercrime in academia and practical arena, and that this type of crime is still evolving, Taiwan authorities do not take clear stance from these contested definitions. According to Taiwan's National Police Agency (NPA), there are two categories of cybercrime. First is the use of computer/internet as the place of criminal act. Second, computer/internet is as the target of the criminality (Taiwan National Police Agency 2010). From 2010 to date, Internet hackers have been able to invade and steal private personal information using those methods, making cases more complicated and difficult to trace. Since communication systems have moving forward to the Internet and other communication systems, not only are the perpetrator's account number and identity concealed, but the IP address is also concealed by such technology and thus hidden abroad (Lin 2012). Since Cybercrime is the new type of crime following the information and technology development, Taiwan NPA further identified that the cybercrime is distinct from traditional crime types, with three aspects. First, cybercriminals take advantage of computer/internet and conduct crimes in cyberspace. Second, the act of criminality and the effect on victims are usually different in time and place via internet/computer. Third, there are high crime dark figures. Many cases are unreported due to personal privacy concerns or enterprises' reputation (Taiwan National Police Agency 2010). The examples of cybercrime are internet sex crimes, selling narcotics using internet platforms, internet fraud, internet extortion, cyber hacking, etc.

Fraud has been emerging in Taiwan since 2000 (Lin 2012). From the development of the internet fraud crime, we can easily find that, first, the telecommunication and internet fraud activities have been spreading in the East and Southeast Asia region, and second, most of the cross-border telecommunication and internet fraud crime groups are headed by Taiwanese nationals. There are a number of reasons: First, the 'know-how' of this certain type of crime originated from Taiwan. Taiwan is quite advanced in telecommunication and computer services than other countries in the region, thus it gives a great environment for Taiwanese criminals to learn and utilize the telecommunication and internet to conduct fraudulent activities. The second major reason is that the penalties of cyber fraud crime are still relatively low in Taiwan. Due to the fact that this type of crime is 'low-risk, high-reward,' many young people are lured to join the cybercrime groups. The third reason is that the Taiwan's economy and rule of law are better than those in Southeast Asia, thus the Taiwan criminals they could 'invest' less money to set up a 'call center' in a place and even hire local people to work for them. At the same time, Taiwan criminals realize that it may be more difficult for Taiwan law enforcement agencies to detect their locations. The above reasons are why these Taiwan criminals decide to conduct their illicit business in the cyberspace and outside the physical borders.

5.2 *Modus Operandi*

The cybercriminals take advantage of the computer and internet. Fraud syndicates operate via Internet e-mail, cellphone text messages, and the latest developments in technology combined with current technologies such as telecommunications, Internet, telephone, financial accounts, Internet telephony, and shopping sites and also by changing incoming call numbers from abroad, for example, changing the calling number into the number of an official authority or well-known online shopping auction by VOIP (voice over Internet protocol) Gateway as a transit route to forward incoming calls from other countries to Taiwan (Lin 2012). In particular, with the development of VOIP, the criminals are able to use internet telephony (IT) which is not easy to be traced by the police authorities. This is why the Taiwan cybercriminals tend to find a place in Southeast Asian countries where they are 'untouchable' by the Taiwan police authorities.

The fraud crime groups take advantage of the basic human nature- fear and greed, and the loopholes of the management in financial, telecommunication, and internet service. They use dummy bank account and fake phone numbers along with all kinds of schemes to scam the possible victims to wire transfer money or hand in cash face-to-face.[36] In most of the fraud cases, the criminal groups are organized and hierarchical. In the division of labor, it may include core members, management head office, financial section, telecommunication section, internet section, etc. In telecommunication section, three roles would be played by the criminals. The first role is bank clerk or police detective. The criminals taking this role have initial contact with the possible victims. The second role is the manager of a bank or head of the criminal investigation section of a police department. The third role would be the prosecutors or the judges. The criminals interact with the victims switching between the above roles, for example, making the victims believe that they are involved in a criminal case which is under investigation, making the victims in full control by the criminals and ultimately wire transfer money or hand in cash to the criminals.[37]

5.2.1 Recent Footprints and Implications

Here is the summary of selected major cases since 2016. The information provided is not a full list of all cases. The main purpose is to demonstrate how the Taiwanese involved Telecommunication and internet fraud crime is spreading in the region recently. From the recent examples, we can tell that Taiwanese headed/involved telecommunication and internet crime groups can be found all over the East and Southeast Asian countries, including China, Japan, South Korea, Malaysia, Vietnam, Indonesia, Laos, Cambodia, The Philippines, and Thailand.

[36] See http://www.police.taichung.gov.tw/TCPBWeb/wSite/ct?xItem=46883&ctNode=1481&mp=team01

[37] Also see http://www.police.taichung.gov.tw/TCPBWeb/wSite/ct?xItem=46883&ctNode=1481&mp=team01

Year	Country	Case summary
2016	Malaysia	In March, Chinese and Malaysian police authorities busted multiple locations and arrested 119 suspects committing telecommunication and internet fraud cases, including 52 Taiwanese, 65 Chinese, and 2 Malaysian citizens.
	Vietnam	In April, Vietnamese authorities arrested a telecommunication and internet fraud crime group of 11 suspects, including 5 Taiwanese nationals. This group is headed by a Taiwan national.
	Indonesia	In April, police authorizes in East Kalimantan Provence arrested 42 suspects involving telecommunication and internet fraud crime. 31 people are from Taiwan.
	Laos and Cambodia	Between April and June, Chinese police authorities, worked with Laos and Cambodian police, busted multiple locations in the two countries, arresting 81 suspects committing telecommunication and internet fraud crimes, including 56 Chinese and 25 Taiwanese.
	Cambodia	In August, Cambodian authorities arrested a telecommunication and internet fraud crime group, involving 12 Taiwanese and 52 Chinese.
	The Philippines	In December, the Philippines and Taiwan police authorities busted a telecommunication and internet fraud crime group in Cebu City, including 19 Taiwanese and 5 Chinese.
2017	Japan	In January, there are around 30 Taiwanese suspects arrested in Fukuoka-ken, Japan, for setting up a telecommunication and internet fraud targeting Chinese citizens.
	South Korea	In March, two female Taiwan nationals have been arrested for involvement in telecommunication and internet fraud activities.
	Thailand	In March, Thai and Taiwan police authorities busted a call center in Bangkok, where 10 telecommunication and internet fraud members, headed by a Taiwan national, are arrested.
	Indonesia	In March, Indonesian and Taiwan police authorities arrest 54 telecommunication and internet fraud members in Jakarta, including 18 Taiwanese and 36 Chinese.

The evidence shown above has several implications: First, internet and computers enable the criminals to conduct fraud crimes without the limit of borders. It is obvious that with the advancement of internet and technology, cybercriminals are utilizing it to conduct illicit business transnationally. For them, borderlines are the best protection line for them, as they could avoid effective investigation if they operate such a crime in other countries where the police are not effective and even corrupted. Second, cybercrime is borderless, which means most countries in the region would be affected. Evidence shows that cybercrime is spreading and that any countries in a region could be affected. Over the years of evolvement, the cybercrime as a modern type of crime has become a regional threat in East and Southeast Asia region.

Third, language and culture are the factors that make criminals work together. Evidence also shows that Chinese and Taiwanese criminals tend to work together due to the similar language and culture. One thing can be explained is that it is easier to build trust with same culture and language, as discretion and secrecy are the ultimate security guidelines for the cybercriminals. Fourth, rule of law and international cooperation would be the key to solve the problem. As stated, the countries in the region are very diverse. It is the same that the economic development and rule of law are also different among countries. In order to solve the transnational crimes, it relies heavily on the cooperation between two countries. Although the strategy and response of the official authorities toward the cybercrime are not the main focus of this chapter, this chapter would still need to point out that the cybercrime threats are complex per se, thus it needs more efforts for different jurisdictions to work together.

6 Conclusion

Albeit the definition of cybercrime is still contested, and this type of crime itself is still evolving, the threats of cybercrime are already affecting our world. In order to investigate cybercrime and its threats, this chapter discussed the patterns of cybercrime from two aspects: cyber-dependent crimes and cyber-enabled crimes. Both western academia and governments provide their views about the cybercrime threats in the digitalized and globalized world, considering the cybercrime threats as challenges for the law enforcement community. This chapter identifies that two challenges have been foreseeable. First, as the number of internet and mobile devices users continue to grow, as well as the techniques/tactics of cybercriminals continue to advance, the budgets and resources of the law enforcement agencies seem not to catch up the pace. Second, the under-reported situation continues to exist, which makes us underestimate the impact of cybercrime.

With the wave of globalization and booming economy in East and Southeast Asia region, the transnational organized crime groups are benefited from it, and cybercrime is also growing. Currently Asia holds more than half the population of internet users in the world, which means the concern of cybercrime is on the rise. Given the growth of the internet users, this chapter presents that Asia could be the next focal point when it comes to cybercrime research. Moreover, this chapter pointed out that Asian countries are becoming more vulnerable as cybercriminals are targeting the increasing number of soft targets among the internet users. Some examples have been provided in this chapter. In terms of cyber-dependent crimes, certain countries like China, Taiwan, Japan, South Korea, India, Thailand and Vietnam have higher report of cybercrime, such as DDoS attacks, automated bot attacks, malware infection, and spam, etc. With regards to cyber-enabled crimes, the most notorious one is the internet fraud. China, as one of the most affected country, with an increasing number of victims and financial losses. An internet child sex crime is another major concern for Asian countries. This chapter has identified some key challenges to the region. First, legal-jurisdiction issue are still a crucial concern. The second challenge is the political tensions in the region, which would impede cooperation between countries. A third challenge is digital divide, in which the technological gap between developing and developed countries on the regional scale has become a threat for all the countries in fighting against cybercrime. Finally, the language and cultural norms would be challenges, as it could be wisely used by the cybercriminals to create benefits for them.

In the case of Taiwan, since cybercrime is the new type of crime following the information and technology development, Taiwan authorities have been working on tackling the problems, including the telecommunication and internet fraud crime. As one of the most well-known crime type in the region, it has been evolving and developing in the region since 2000. During this period, the telecommunication and internet fraud activities have been spreading all over the East and Southeast Asia region and we found that most of the cross-border telecommunication and internet fraud crime groups are headed by Taiwanese nationals. There are a number of reasons: First, technical 'know-how' regarding this type of crime originated from Taiwan. The second major reason is that the penalties of cyber fraud crime are still relatively low in Taiwan. The third reason is that the Taiwan's economy and rule of law are better than those in Southeast Asia, thus the Taiwan criminals could 'invest' less money to conduct their illicit business and avoid from being detected by the law enforcement agencies. Taking the recent footprints of the Taiwan telecommunication and internet fraud crime groups since 2016 up to date, this chapter identifies that that Taiwanese headed/involved cybercrimes can be found all over the East and Southeast Asian countries. Several implications have been made by this chapter in the case of Taiwan. First, internet and computer enable the criminals to conduct fraud crimes without the limit of borders. Second, cybercrime is borderless, which means most countries in the region would be affected. Third, language and culture are the factors that make criminals work together. Fourth, rule of law and international cooperation would be the key to solve the problem.

To conclude, cybercrime is becoming more complex not only in its meaning but also its content. Undoubtedly, cybercrime has become a security threat in Asia-Pacific region and beyond. Given that cybercrime is impacting nearly every country and people in the region, it requires joint effort of the countries affected.

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Natural Disasters and Health Risks of First Responders

Katie Subbotina and Nirupama Agrawal

Abstract The main objective of this chapter is to provide information on health risks for organizations responding to natural disasters to ensure better preparedness of their responders. Organizational preparedness has to include considerations for the type of event responders are deploying to, health risks they may be exposed to, and how they could help affected local vulnerable population. Organizations should consider preparedness of their responders with the same precision as businesses consider business continuity plans. Organizations should prioritize and specialize in the types of disasters they respond to and deliberately expand their scope as their preparedness level matures. Three case studies are presented to demonstrate the various situations and related health risks.

Keywords Natural Hazards • Health risks • First responders

1 Introduction

> *Floods wash away the surface of society. They expose the underlying power structures, the injustices, the patterns of corruption, and the unacknowledged inequalities.* (Birn et al. 2009 p 370).

The United Nations International Strategy for Disaster Risk Reduction (UNISDR) has defined disasters as: "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses which exceeds the ability of the affected community or society to cope using its own resources" (UNISDR 2009). It is a comprehensive definition that touches upon societal dependencies and inability to restore them in a timely manner. This definition does not narrow the scope of a disaster by compiling a list of types of events that

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_5

could occur; rather, it allows for each community to define disaster based on their vulnerabilities and threats. For the purpose of this chapter, disaster definition is going to be narrowed to focus on health risks and is borrowed from a paper on "the role of the epidemiologist in natural disasters", by Sue Binder and Lee M. Sanderson. It states that a disaster is an "event that causes adverse health impacts on a population; usually, but not always, caused widespread destruction to the environment; and occurs suddenly or ever a relatively short period of time".

This chapter focuses on the studies of such health impacts to a population of first responders.

Natural systems, which are comprised of wind, water, and earth processes, function independently of social systems, and disasters occur only when the two intersect (Burton et al. 1993). Their interaction does not have to result in an adverse consequence and can be beneficial to the exposed population if they are properly protected. For example, a flood does not have to be destructive. It fertilizes the land, flushes out salts and toxins, recharges ground waters, and deposits sediment, among other benefits (Few 2003). However, in order to decrease human suffering from floods, which are considered one of the costliest disasters, mitigation and preparedness measures need to be adapted by vulnerable communities. These measures can include early warning system to allow people to prepare or evacuate and not be harmed, channel controls such as dykes and flood walls, as well as upstream water retention (dams and reservoirs), et cetera. It is at the intersection of natural events and vulnerable populations that negative consequences occur in the form of loss of life, property and livelihood. An affected population will need immediate response and eventual recovery resources, and that is when international assistance might be required.

Disaster data is retrieved from the International Disaster Database, where criteria for a disaster definition includes any one of the following conditions to be met, "10 or more people killed; 100 or more people affected; declaration of a state of emergency; and call for international assistance" (EMDAT 2017). When comparing data to other databases it is important to consider definitions and their effects on the search outcome. For example, Public Safety Canada identifies that in order to be defined as a disaster an event has to meet one or more of the following criteria: "10 or more people killed; 100 or more people affected/ injured/ infected/ evacuated or homeless; an appeal for national/international assistance; historical significance; and significant damage/interruption of normal processes such that the community affected cannot recover on its own" (PSC 2014, database). The two databases have similar parameters for declaring a disaster but differ in the implications following an event. These differences can have an impact on the number of disasters listed and have to be considered in order to decide if the results are comparable. However, for simplicity of data analysis statistics from only International Disaster Databased are considered in this chapter.

The chapter begins with classification of disasters and their impact on health; various backgrounds of first responders, such as local, national, and international; specific health risks related to various types of disasters; and finally, cases studies follow the suit highlighting the necessity to understand health risks not only based on the type of a disaster, but also geomorphology and geopolitics of the affected area.

2 Natural Disasters Classification

An overview of disaster classification serves as a reminder that disasters are generally divided into natural, human-caused or technological events. Human-caused events can be intentional such as terrorist attacks. Technological events can also be intentional when an act of malice is carried out using technology; or unintentional which can be due to human errors or a consequence of a natural event. For example, the March 11, 2011 a 9.0 magnitude earthquake on the east coast of Japan generated a tsunami that caused the meltdown of a nuclear power plant nearby. The event caused a long term and widespread emergency in the region due to high levels of radiation (World Nuclear Association 2017). Such unintentional events following a natural disaster are defined by experts as NATECH events, which can release small or large amounts of hazardous materials into the air. Such releases from plants or industrial sites lead to higher health risks for the exposed population (Young et al. 2004). NATECH events are mainly preventable if appropriate actions are taken prior to disasters. In this chapter, the focus will be on natural disasters as the primary event and secondary events can include either other natural disasters or NATECH events, as both play a significant role in the health risk of first responders.

Natural disasters are usually studied according to their phenomena of occurrence in their respective fields of studies. For instance, hydrologists study floods, while geologists and seismologists study earthquakes (Burton et al. 1993). Due to this historical division of studies, natural disasters are classified according to the natural process. As a result, breaking natural disasters into Hydrometeorological, Geological, and Biological events seems appropriate. Hydrometeorological events include water and weather related hazards such as drought, flood, and severe storms. Geological hazards consist of avalanches, earthquakes, and tsunami events. Biological events are divided into floral and faunal events. Floral events include fungal diseases, and faunal events include bacterial, viral and protozoal diseases as well as infestations.

The international disaster database, EM-DAT distinguishes between Geophysical, Meteorological, Hydrological, Climatological and Biological groups based on the triggering event. Each group is further divided into types and sub-types. For example, the Geophysical group is divided into earthquakes, volcanoes, and mass movement (dry) types. Sub-type for mass movement (dry) includes rock fall, avalanche, landslide, and subsidence sup-types. In turn, landslide is further sub-sub divided into mudslide, lahar, and debris flow (EM-DAT 2016).

Other classifications of natural disasters include according to their characteristics, such as speed of onset, magnitude, frequency, duration, areal extent, and spatial dispersion (Burton et al. 1993). Based on this system, all hazards can be divided into Permanent (e.g. tides, erosion) that continuously occur as a normal natural process, Evanescent (e.g. climate change, drought), with no clear beginning and no clear end, and Episodic (e.g. earthquake, floods, landslides, etc.).

Some of the simpler classifications include subterranean stress, surface instability, high winds, or abnormal precipitation or temperatures (Binder and Sanderson 1987). Depending on the research question, a researcher might choose to classify disasters according to any of the systems.

Natural disasters do not always happen independently and usually lead to secondary disasters, either natural or NATECH, which will affect types of health risks they are associated with. In this section, each type of natural disaster will be explored, along with their health risks, and an associated example. Table 1 summarizes global data collected from EM-DAT (2017) website between years 2000 and 2015 pertaining to the types of natural disasters that will be discussed in this section. Data is collected on the occurrence, deaths, number of affected, injured, and homeless people, as well as monetary damage caused by the event.

Occurrence of natural disasters is not evenly distributed. Hydrological disasters constitute 44% of all natural disasters (Fig. 1), while geophysical disasters happen approximately 8% of the time. This uneven distribution requires more intense preparation for commonly occurring disasters, indicating that hydrological events should receive special consideration during training and deployment preparations.

A distribution of natural disaster consequences is summarized in Fig. 2. This presentation depicts the relative distribution of damage associated with each type of a disaster. In this view, biological disaster causes many injuries and deaths; however it does not affect too many individuals, and doesn't render many people homeless. Hydrological disasters, on the other hand, affect a lot of people and leave many homeless, while not causing as many injuries or deaths. Each disaster, thus, presents unique distribution of consequences and adequate preparation depends on understanding health risks associated with each type of disaster. The rest of Section 2 delves deeper into each disaster class.

2.1 Hydrological

Hydrological events (Table 2) are defined as "events caused by the deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up" (UN 2014). Following the EM-DAT (2017) system, these events are further divided into flood and wet mass movement (rock fall), landslides and subsidence.

The same website calculates that there were 2936 hydrological events globally between the years of 2000 and 2015, causing 103,001 deaths, and affecting 1.4 million people (Table 3).

Table 1 Global data on occurrence, deaths, number of affected, injured and homeless people, as well as amount of damage caused by the type of a disaster between years 2000 and 2015

Type	Occurrence	Deaths	Affected	Injured	Homeless	Damage($)
Biological	772	90,197	10,034,832	491,794	–	120,000
Climatological	467	22,123	986,259,050	5486	59,272	113,194,494
Geophysical	547	714,466	100,435,540	1,440,279	12,609,185	493,655,203
Hydrological	2936	103,001	1,436,360,013	287,097	16,604,621	427,104,065
Meteorological	1993	352,114	634,424,869	2,280,316	6,462,869	799,479,765
Total	6715	1,281,901	3,167,514,304	4,504,972	35,735,947	1,833,553,527

Data collected from EM-DAT database

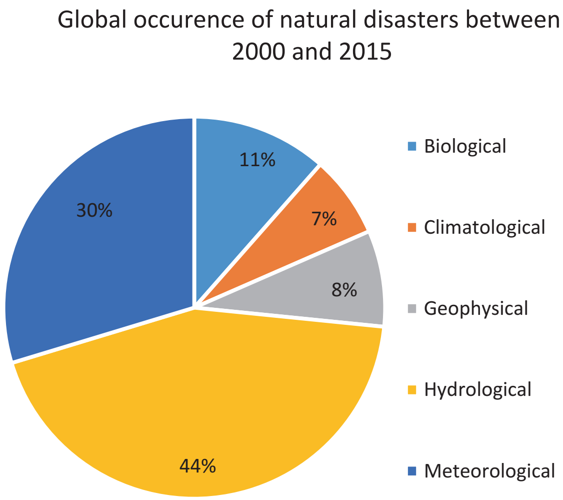

Fig. 1 Global distribution of types of natural disasters between the years of 2000 and 2015 (Data compiled from EM-DAT website)

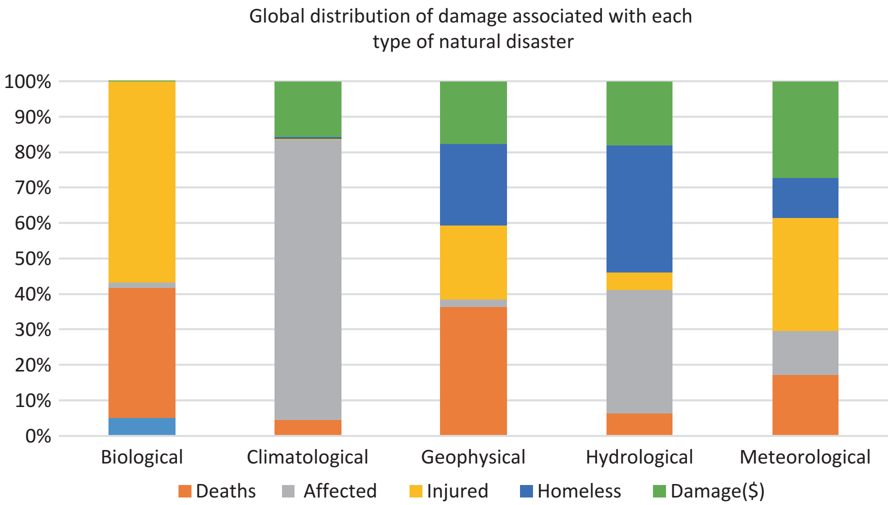

Fig. 2 Relative consequences of natural disasters divided into their types (Data gathered from EM-DAT website)

2.2 Meteorological

EM-DAT defines meteorological disasters as events that are caused by short-lived or small to meso-scale atmospheric processes that can last from minutes to days. Examples of meteorological disasters are storms, which can be tropical, extra-tropical or local as depicted in Table 4.

Table 2 Table adapted from EM-DAT

Class	Type	Sub-Type
Hydrological *(events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up)*	Flood	General River flood
		Flash flood
		Storm surge/coastal flood
	Wet mass movement	Rockall
	Landslide	Debris flow
		Debris avalanche
	Subsidence	Sudden subsidence
		Long-lasting subsidence

Retrieved from: http://www.emdat.be/frequently-asked-questions

Meteorological disasters are the second most common type of disaster to occur globally since 2000. Out of these disasters tropical storms are the most devastating since they cause the most damage, deaths and affect the highest number of people. Local storms have the second highest frequency and also hold second place in all other criteria (Table 5).

2.3 Climatological

Climatological disasters are events caused by long-lived, meso to macro scale processes, which can cause up to multi-decadal climate variability (EM-DAT 2017). Events in this class of natural disasters include heat and cold waves, extreme winter conditions, drought, as well as wild fire as summarized in Table 6.

Of all climatological disasters, drought occurs most often, followed by cold wave, and forest fires. In recent history, droughts also affect the most people and caused the highest amount of damage, while cold waves caused the most deaths (Table 7).

2.4 Biophysical

Biological disasters are defined by EM-DAT (2017) as “an exposure of living organisms to germs and toxic substances”, this definition includes insect infestation. Human activity, in particular international travel and trade, has introduced and transported alien species to new areas, which have altered normal functionality of the ecosystems and threaten native species (Ricciardi et al. 2011) (Table 8).

Biological disasters have caused $120,000 in damage according to EM-DAT; however, according to Natural Resources Canada, the cost of the emerald ash borer

Table 3 Data gathered from EM-DAT based on hydrological events from years 2000 to 2015

Type	Occurrence	Deaths	Affected	Injured	Homeless	Total damage	% of total
Hydrological	2936	103,001	1,436,360,013	287,097	16,604,621	427,104,065	
Flood	243	3606	29,716,530	2245	428,061	19,852,611	8.28
Coastal flood	41	606	10,382,313	386	22,335	8,369,462	1.4
Flash flood	419	16,168	146,425,783	53,307	1,168,372	45,799,339	14.3
Riverine flood	1934	68,489	1,246,160,626	228,471	14,560,022	350,349,868	65.87
Landslide	263	12,331	3,632,943	2374	418,826	2,679,785	8.96
Avalanche	33	1469	39,018	276	6950	53,000	1.12
Subsidence	1	287	2800	38	0	0	0.03
Rock fall	2	45	0	0	55	0	0.07

Retrieved from: http://www.emdat.be/advanced_search/index.html

Table 4 Table adapted from information available on EM-DAT website: http://www.emdat.be/

Class	Type	Sub-type	Sub-sub type
Meteorological *(events caused by short-lived/small to mesoscale atmospheric processes in the spectrum from minutes to days)*	Storm	Tropical storm	
		Extra-tropical cyclone (winter storm)	
		Local / connective storm	Thunderstorm/ lightening
			Snowstorm / blizzard
			Sandstorm / dust storm
			Generic (severe) storm
			Tornado
			Orographic storm (strong winds)

beetles invasion in Canada may reach $2 billion over a 30-year period (NRC 2014). Global infestation can have a much higher economic damage as shown in Table 9; according to one estimate the global damage inflicted by invasions can run up to $1.4 trillion per year, making it much costlier than the annual global cost of natural disasters (Ricciardi et al. 2011). Overall, viral and bacterial infectious diseases compromise the highest proportion of biological disasters. Viral infectious diseases affect most people, while bacterial infectious diseases cause highest mortality.

2.5 Geophysical

Geophysical disasters originate from solid earth and include earthquakes, volcanoes and dry mass movement, which lead to tsunami, rockfall, avalanche, landslide and subsidence (EM-DAT 2017, Table 10).

Geophysical disasters are the rarest of all classes of disasters; however, they affect and cause the most injuries and deaths (Fig. 2). Earthquakes occur 77.5% of all geophysical disasters making it the most common event, affecting and injuring most people. Earthquakes can also lead to tsunamis, and even though they represent only 4.5% of geophysical disasters, they cause almost as much damage as earthquakes themselves, making them disproportionally devastating events (Table 11).

Geophysical disasters pose similar health risks associated with other disasters, due to population displacement caused by property damage during earthquakes and tsunami, as well as damaged water-treatment and sewage facilities. Floret et al. (2006) inferred based on their research of over 600 disasters between the years of 1985 and 2004, there were only three recorded outbreak cases, which were: measles outbreak after the eruption of Pinatubo in Philippines, coccidioidomycosis after an earthquake in California and a malaria outbreak in Costa Rica after an earthquake and heavy rainfall. Even though epidemics are rare following geophysical disasters, there are other health risks that first responders are subjected to that must be looked into.

Table 5 Data gathered from EM-DAT based on hydrological events from years 2000 to 2015

Type	Occurrence	Deaths	Affected	Injured	Homeless	Total damage	% of total
Meteorological	1993	352,114	634,424,869	2,280,316	6,462,869	799,479,765	
Extreme temperature							
Cold wave	191	10,677	9,068,532	1,833,672	233,000	5,195,134	9.58
Heat wave	104	146,679	112,842	115,843		13,382,859	5.22
Severe winter conditions	63	3569	81,747,153	16,029	5247	23,960,200	3.16
Storm	214	2201	22,436,694	12,475	175,569	11,533,431	10.7
Convective storm	515	6098	148,126,467	124,173	817,470	185,974,804	25.8
Extra-tropical storm	82	268	526,440	294	1600	31,564,600	4.11
Tropical cyclone	824	182,622	372,406,741	177,830	5,229,983	587,868,737	41.3

Retrieved from: http://www.emdat.be/advanced_search/index.html

Table 6 Table adapted from information available on EM-DAT

Class	Type	Sub-type	Sub-sub type
Climatological *(events caused by long-lived, meso to macro scale processes in the spectrum from intra-seasonal to multi-decadal climate variability)*	Extreme temperature	Heat wave	
		Cold wave	Frost
		Extreme winter conditions	Snow pressure
			Icing
			Freecing rain debris avalanche
		Drought	
		Wild fire	Forest fire
			Land fires (grass, scrub, bush, etc)

Retrieved from: http://www.emdat.be/frequently-asked-questions

Table 7 Data gathered from EM-DAT website based on hydrological events from years 2000 to 2015

Type	Occurrence	Deaths	Affected	Injured	Homeless	Total damage	% of total
Climatological	467	22,123	986,259,050	5486	59,272	113,194,494	
Drought (other)	1	0	2,400,000	0	0	0	0.21
Drought	278	21,182	981,218,350			80,175,807	59.5
Wildfire	17	104	59,060	83	9570	3,351,000	3.64
Forest fire	133	430	1,847,123	1289	34,495	20,787,867	28.5
Land fire	38	407	734,517	4114	15,207	8,879,820	8.14

Retrieved from: http://www.emdat.be/advanced_search/index.html

Table 8 Table adapted from information available on EM-DAT website

Class	Type	Sub-type
Biological *(disasters caused by the exposure of living organisms to germs and toxic substances)*	Epidemic	Viral infectious diseases
		Bacterial infectious diseases
		Parasitic infections
		Fungal infections
		Prion infections
	Insect infestation	Grasshopper
		Locust
		Worms
	Animal stampede	

Retrieved from: http://www.emdat.be/frequently-asked-questions

Table 9 Data gathered from EM-DAT website based on hydrological events from years 2000 to 2015

Type	Occurrence	Deaths	Affected	Injured	Homeless	Total damage	% of total
Biological	772	90,197	10,034,832	491,794	–	120,000	
Animal accident	1	12	5				0.13
Epidemic	79	6216	184,135	100	0	0	10.2
Bacterial infectious diseases	366	51,441	2,171,522	339,675	0	0	47.4
Parasitic infectious diseases	15	643	1,138,076	0	0	0	1.94
Viral infectious diseases	292	31,885	3,741,094	152,019	0	0	37.8
Insect infestation	3	0	2800,000	0	0	0	0.39
Locust	16	0	0	0	0	120,000	2.07

Retrieved from: http://www.emdat.be/advanced_search/index.html

Table 10 Table adapted from information available on EM-DAT website

Class	Type	Sub-type	Sub-sub type
Geophysical *(events originating from solid earth)*	Earthquake	Ground shaking tsunami	
	Volcano	Volcanic eruption	
	Mass movement (dry)	Rockfall	
		Avalanche	Snow
			Debris
		Landslide	Mudslide
			Lahar – Debris flow
		Subsidence	Sudden subsidence
			Long-lasting subsidence

Retrieved from: http://www.emdat.be/frequently-asked-questions

3 First Responders – Who They Are and How Are They Different

Natural disasters attract a lot of attention and can urge people to help in whatever capacity they can contribute to powerful outcomes. Some people might donate money or belongings, while others would want to volunteer their time and expertise. These volunteers might hail from various backgrounds with varying driving factors.

Question around whether they have appropriate training and education and/or any association with established organizations are imperative in this field. Some of the people who feel motivated to help may be untrained or may not be associated with an organization established in the impact region.

Before the 2004 Indian Ocean Tsunami there were only a handful of Non-Governmental Organizations (NGOs) present in the Province of Aceh, Indonesia; however, following the disaster the number swelled to approximately 300 (Canny 2005). Such rapid influx of volunteers does not always lead to positive effects. It is absolutely vital that first responders arrive at the site of events not only prepared physically and mentally for the deployment, but also healthy enough not to endanger the vulnerable population. Occasionally, first responders can become victims themselves and use resources originally allocated to the affected population. When first responders become victims of a natural disaster, not only are they using up medicinal and care resources that were delivered for the affected population, but they also decrease the number of available staff. It is from this standpoint, that first responders always have to arrive prepared with full knowledge of their health risks.

3.1 Impacted First Responders

The first group of first responder arises at the site of the emergency. These are people who were not critically harmed themselves but are capable of providing assistance within their immediate surrounding. These responders will always be on site first and are unlikely to have any prior experience. They pose danger due to their inability to identify safety and health risks; however can save the most lives due to their immediate availability. Ninety four percent of survival following an earthquake are found in the first 2 weeks after the event and the number climbs steeply with each passing day making delays in search and rescue efforts a strong factor in the total mortality of the disaster (Zhang et al. 2012). It is important to relieve these individuals as fast as possible to allow them to attend to their personal needs, which can be health or livelihood related. Current strategies for emergency recovery see individuals gaining emergency employment if their primary source of income was jeopardized during the disaster. Resilient strategies during recovery will allow individuals to gain necessary experience to provide better response during future disasters improving outcomes of their community. Impacted first responders will never have the same level of expertise as trained first responders. Protocols and recommendations are in place regarding first responders who have completed adequate training in order to be deemed prepared for an international deployment within an organization that is already established at the site of event or was officially invited to participate in the response and recovery phases of the disaster management.

Table 11 Data gathered from EM-DAT website based on geophysical events from years 2000 to 2015

Type	Occurrence	Deaths	Affected	Injured	Homeless	Total damage	% of total
Geophysical	547	714,466	100,435,540	1,440,279	12,609,185	493,655,203	
Earthquake	2	78	0	171	14,555	0	0.37
Ground movement	423	465,506	95,153,763	1,389,517	11,443,115	271,199,794	77.3
Tsunami	23	247,860	2,486,140	49,358	1,033,559	221,379,540	4.2
Mass movement dry	1	10	0	0	0	0	0.18
Avalanche	1	16	0	0	0	0	0.18
Landslide	7	220	2037	20	1331	8000	1.28
Rockfall	2	111	0	72	625	0	0.37
Volcanic activity	3	63	190,587	69	0	0	0.55
Ash fall	83	602	1800,513	1072	116,000	1,067,869	15.2
Lava flow	2	0	802,500	0	0	0	0.37

Retrieved from: http://www.emdat.be/advanced_search/index.html

3.2 Local First Responders

First professional response to any emergency arrives from the local agencies prior to or concurrently with a call for international assistance going out. Local teams will have professional training and preparedness. However, one should be mindful of cases where local first responders' family members might be impacted causing their attention, distress, and distracting from providing relief efforts. A number of other barriers that could prevent responders from reaching the site include damaged road to allow access and dependent care when both spouses are first responders.

Local responders have local knowledge of customs and threats. They are usually able to get to the location fast and start life saving measures quickly. Their preparedness level depends on the resources available to their organization. If the organization lacked good decision making and adequate preparedness, they might not have access to the latest equipment that would assist in rescue operations. Health risk factors presented by natural disaster will affect local first responders but they should be well aware of hazards prevalent in their communities.

3.3 National First Responders

National responders generally have access to the best equipment and training programs that the country can offer. Unfortunately, those opportunities might be strained based on the economic capacity of the country as well as the frequency with which these resources are utilized. The political situation in the country might also influence success and acceptance of the national responders in affected communities. There might be a large number of hazards present for national responders to prepare for, and they should be encouraged from early stages of training to consider health risks associated with hazards of highest frequency for their country.

3.4 International First Responders

International responders work within a scope in which they are allowed to function. They cannot arrive in the country without an invitation, and their equipment has to pass customs prior to being released. These can be contributing factors to the delay of a rescue mission's onset and negatively impact survival rate during the unfolding of the disaster. International responders can vary in their preparedness level from being associated with an army to being a specialist who volunteers their time during disasters. For example, Global Medic, a registered Canadian charity organization, specializes in providing rapid and short term assistance comprised of clean water, medical assistance, shelter, and search & rescue. It is more likely that professionally trained responders will have adequate preparedness level prior to the deployment but even within those organizations it is crucial to establish health risk program that will enable better preparedness based on the geo-political location of the disasters. This requirement becomes crucial for volunteer organizations where responders might not have been deployed in years or generally do not go through adequate level of training.

First responders need to be reminded that part of their preparedness needs to include personal preparedness – for example, ensuring that their medical needs are met, they have appropriate amount of personally required medication as well as any other medication they foresee requiring during their deployment.

4 Health Risks Faced by First Responders

There are many types of natural disasters and there are many types of health effects that they can produce. In general, developing countries are more affected by health outbreaks due to pre-impact lack of resources and infrastructure (Watson et al. 2007; Waring and Brown 2005), while NATECH events affect industrialized countries to a greater extent because of high population density living in close proximity to industrial sites (Young et al. 2004). It is also noteworthy here that accidents such as the Union Carbide gas leak incident in Bhopal, India in 1985 occurred due to multinational companies operating in poor nations where low-cost labour is willing to work in high risk industries. Additionally, accidents such as the BP Deep Water Horizon in 2010 in the Gulf of Mexico affected the region damaging flora and fauna to an unprecedented magnitude.

Natural disasters can cause a high mortality rate, and there is a common myth that dead bodies pose a health risk. However, it is only the case when a pathogen spread, such as cholera or hemorrhagic fever occurs by direct contact with infected body fluids (Watson et al. 2007). The greatest threat of epidemics after a natural disaster is often due to overcrowding among the displaced individuals, poor ventilation, poor health status and lack of immunization prior to the disaster. Furthermore, lack of clean water and sanitation, which leads to either respiratory or gastrointestinal diseases can turn into a widespread health risk (Watson et al. 2007; Jobe 2011; Birn et al. 2009). In fact, outbreaks are more common in conflict-stricken areas rather than in disaster affected areas. However, depending on the geographical location of the disaster, the same event can lead to different health risks. For example, a flood occurring in the developed world can cause an industrial spill or an industrial waste tailing pond to fail, potentially leading to an exposure to hazardous materials for communities in the region. If the same magnitude flood occurs in the developing or poor nations, the risk of an increased rate of gastrointestinal epidemics due to suboptimal sanitation and hygiene, as well as fecal contamination of drinking water is more likely to occur (Watson et al. 2007). Health risk of first responders is thus dependent on the class of natural disaster as well as the geographical location of the event.

Health effects can be classified into waterborne, crowding, vector-borne, wound and other diseases as summarized in Appendix A. Waterborne diseases occur due to contamination of drinking water, poor sanitation and crowded shelters (Watson et al. 2007; Waring and Brown 2005). Cases are reported following flooding or other related displacements. Crowding conditions, which are common if population are displaced by natural disasters, occur due to a high number of people who are potentially malnourished living in close proximity to each other with poor ventilation. Wound related diseases occur when wounds become contaminated in people who have not been immunized in the last 10 years. People who are at risk of being affected are both victims and first responders if they are working with natural disaster debris. Other diseases in this case include coccidiomycosis, which is caused by a fungus found in soil when individuals are exposed to airborne dust. Finally, vector-borne diseases occur when new breeding sites for vectors (mosquitos) are created by standing water as well as due to disaster related displacement individuals changing their living habits, such as sleeping outside thus increasing their risk of being infected. Onset of vector-borne diseases usually occurs up to 8 weeks following a disaster (Waring and Brown 2005). An example of a NATECH event that can increase the risk of epidemics is power failure which can lead to failure of water treatment and supply facilities, thus increasing the risk of waterborne diseases and disrupt functioning of health facilities and vaccine preservation (WHO 2006). Health risk factors are incorporated into Table 12 based on a report compiled by the WHO following the 2004 Indian Ocean Tsunami, highlighting the need for proper hygiene and living conditions for the displaced population (WHO 2005). First responders working with the displaced population must have personal protection equipment as well as pharmaceuticals to protect themselves against diseases they will be exposed to during their deployment.

The Ebola outbreak in western Africa got worse due to prevalent flooding situation in Sierra Leone (Dumbuya and Nirupama 2017). Since July 2014, CDC (CDC 2015) had sent staff on almost 3000 deployments to support the Ebola response in West Africa, the United States, and elsewhere around the world. Responders filled a variety of roles, from disease detectives, to laboratorians, to logisticians, to health communication experts.

NATECH events rarely lead to epidemics, however, they can lead to direct releases such as chloride or ammonia following droughts, or indirect release such as agrochemicals washed into floodwaters. They can cause respiratory problems as well as expose population carcinogens and poisonous materials (Young et al. 2004).

Classification of health risks following natural disasters will aid in determining health risks of first responders during their deployment by allowing them to estimate type of pathogens they can be exposed to, based on the number of days lapsed following a natural disaster. Each class of a natural disaster is associated with different health risks, and each phase of a natural disaster has a different impact on human health and therefore requires different approaches for response. Natural disasters can be divided into pre-impact, impact, and post-impact phases (Binder and Sanderson 1987; Fig. 3).

During the pre-impact phase, public health interventions have the most impact on saving lives. For example, most deaths following earthquakes are due to structure collapses, as a result city officials can decrease morbidity (injuries and suffering) of

Table 12 Health hazards and their harm to human health

Health hazard	Health hazard example	Associated harm	Comments
Overcrowding	Inadequate shelter	Crowding diseases	Overcrowding is exacerbated by poor immunization
Food insecurity	Malnutrition	Acute respiratory infections	
		Vitamin deficiency and associated diseases	
Poor quality or quantity of water	Poor hygiene	Waterborne diseases	
	Poor washing facilities	Wound related diseases	
	Poor sanitation		
Standing water	Increased exposure to mosquitoes	Vector-borne diseases	Population movement and interruption of vector control measures increases risk of vector-borne diseases
	Increased number of breeding sites		
Inadequate health care services	Disruption of basic services		Waterborne diseases
			Crowding diseases
Debris	Open wound or lacerations	Wound related diseases	
	Trauma and injury	Infections	
NATECH	Toxin release	Exposure to harmful toxins	
Infrastructure damage	Electricity	Electric shock	
		Burns	
Power outage	Improper use of indoor generators, heaters or cooking devices	Carbon monoxide poisoning	

Information compiled from WHO (2005), Young et al. (2004) and Watson et al. (2007)

the population by enforcing building codes appropriate for the earthquake risk of the area. During this phase of a natural disaster, first responders are not directly impacted. Once an imminent hazard is recognized, such as an early warning for a major hurricane; first responders are provided with a guideline as to where they might potentially be deployed and what health risks they need to be prepared for. This phase is characterised by mitigation and preparedness actions of emergency management.

In the impact phase, health is affected by the release of energy of the event; be it either a volcanic eruption or a tornado. In this phase, vulnerable population will have the greatest suffering. During the 2011 Japanese tsunami, fishermen living in coastal communities were the first ones to suffer the impact of the hazard. The failure of the Fukushima nuclear power plant released harmful radiation into the atmosphere, water courses, and the soil causing severe health risk to the surviving

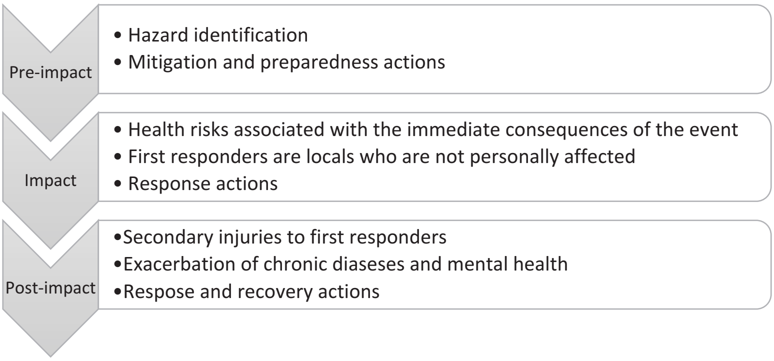

Fig. 3 Natural disaster phases and factors affecting population health (Adapted from Binder and Sanderson 1987)

population as well as the first responders. During the impact phase of the 2004 Indian Ocean tsunami, coastal communities not only sustain a high mortality, but also economic impact by losing their boats which served as sources of income (Keys et al. 2006). In this phase, first responders will generally be local survivors of the disaster.

Finally, the post-impact phase includes secondary injuries usually to local, national and international first responders as they perform relief operations post a natural disaster.

Floods, being the most frequent natural hazards, can serve as an example of how to analyze disasters and health risks that can impact first responders. Causes of morbidity and mortality following a flood can by due to direct or indirect impacts. Direct impact causes drowning (usually flash floods, coastal floods, or hurricane landfall), fatal injuries during evacuation and clean up, injuries (which are small, such as lacerations caused by the debris cleanup), and electrical shock (WHO 2014). Communicable disease outbreaks are rare after floods but can occur after drinking contaminated water or from an increase in the amount of standing water which leads to water-borne (typhoid fever, cholera, leptospirosis, and hepatitis A) and vector-borne (malaria, dengue and dengue haemorrhagic fever, yellow fever, and West Nile Fever) diseases. Indirect causes include impact on the health and critical infrastructure such as water and power supply (can lead to the consumption of spoiled food), as well as disruption in food supply which can cause food shortages increasing risk of malnutrition, weakening the immune system for immediate and future disasters. A summary of flood related health effects is presented in Table 13.

Hazardous materials can be released unintentionally if standing water is sprayed with pesticides to decrease a risk of vector-borne diseases or due to water becoming contaminated with chemicals that are stored in private homes or industrial sites, particularly if underground oil or gasoline pipelines are ruptured. Damaged sewage systems can cause water overflow or exposure of buried waste which might cause waste water contamination (Young et al. 2004). Hurricane Floyd in 1987 caused flooding of waste lagoon and municipal waste-treatment plants in North Carolina

Table 13 Table is adapted from a report on health impacts of flood in Europe and combined with information presented in Table 1 (Guha-Sapir et al. 2010)

Direct impact	Health Hazard	Example
Mortality	Drowning	
	Injury	Injuries during evacuation and clean up
	Exposure to the environment	Hypothermia
	Debris	Refer to Table 1
	Trauma	
	Vehicle-related deaths	
	Mud and water rushing in on campsites	
Morbidity	Injury	Contusions, lacerations, abrasions, cuts, bruises, sprains, strains and puncture wounds
Respiratory infections		Colds, coughs, flue, headaches, acute asthma, allergies to moulds
Other health hazards		
Health care services	Refer to Table 1	
Infrastructure damage		
Poor water quality		
Standing water infections		

releasing hundreds of thousands of gallons of biological waste into waterways. Carbon monoxide (CO) poisoning was added as a potential flood-related hazard due to an increasing number of reported cases in the last two decades (Daley et al. 2001). The danger is associated with using generator, power washers and others gasoline burning engines indoors where dangerous levels of CO can be reached within minutes. Providing education on safety and ensuring proper functionality of the equipment is imperative to mitigate this hazard.

There is a distinct possibility that first responders to floods might become primary victims since floods can develop rapidly; however, it is much more likely that responders will arrive in the post-impact phase. Their exposure to health risks will depend upon the time of their arrival. Their biggest risks would include lacerations and wound exposure to local bacteria and fungus during the search and rescue phase, diarrheal and respiratory diseases from the victims, and exposure to any potential hazardous materials released during or following the disaster. Pre-deployment awareness of potential endemic diseases and local hazards would help devise preventive strategies and reduce risks to responders.

This information is useful when put into the context of the type of natural disasters in which these hazards occur. In order to ensure first responders preparedness for the deployment, similar analysis should be performed for each class of disasters that the organization responds to and create preparedness checklists for their staff to complete prior to the deployment.

As discussed earlier, natural disasters differ in their triggering event, their characteristics, and effects they cause on the impacted communities. It is estimated that a nation in Asia is 28.5% more likely to experience a disaster in any given year than in Africa (Kahn 2005). Health hazards associated with natural disasters are just as diverse. Some of the primary health hazards were presented in Table 1 and are used throughout the text. Research presented in this paper identified additional health hazards that are presented in Table 14.

It is important to remember that hydrological disasters are the most frequently occurring disasters, and among them floods represent the biggest threat. It is of no surprise then that floods are a common secondary disaster to many others events as shown in Table 15.

Table 14 Updated table on health hazards associated with natural disasters based on information presented in the text

Health hazard	Health hazard example	Associated harm	Comments
Overcrowding	Inadequate shelter	Crowding diseases	Overcrowding is exacerbated by poor immunization
Food insecurity	Malnutrition	Acute respiratory infections	
		Vitamin deficiency and associated diseases	
Poor quality or quantity of water	Poor hygiene	Waterborne diseases	
	Poor washing facilities	Wound related diseases	
	Poor sanitation		
Standing water	Increased exposure to mosquitoes Increased number of breeding sites	Vector-borne diseases	Population movement and interruption of vector control measures increases risk of vector-borne diseases
Inadequate health care services	Disruption of basic services		Waterborne diseases Crowding diseases
Debris	Open wound or lacerations	Wound related diseases	
	Trauma and injury	Infections	
NATECH	Toxin release	Exposure to harmful toxins	
Infrastructure damage	Electricity	Electric shock	
		Burns	

(continued)

Table 14 (continued)

Health hazard	Health hazard example	Associated harm	Comments
Power outage	Improper use of indoor generators or heaters	Carbon monoxide poisoning	
Lightening	Delivery of electrical current	Fire	
		Burns	
		Death	
Hail	Fast falling large icicles	Properly damaged	
		Killed livestock	
Wind	Properly damage	Injury from the projectiles	
	Projectiles	Trauma during clean up	
	Knocked down trees	Electrical burns	
	Knocked down power lines	Power outage (see above)	
	Knocked down mobile homes	Debris (see above)	
	Unsafe traveling conditions		
Snow	Building collapse	Debris (see above)	
	Downed trees/ power lines (see above)	Motor-vehicle accidents	
	Isolation of homes in rural communities		
	Poor driving conditions		
Cold	Cold temperatures	Respiratory, cardiovascular, peripheral circulation, musculosketetal	Cerebrovascular accidents and coronary heart disease could be lethal
Dust	Elevated soil or sandstorm	Poor visibility	
		Respiratory diseases	
		Acute respiratory infections	
Heat stress	Inability to lower internal body temperature	Skin eruption	
		Heat fatigue	
		Heat cramps	
		Heat syncope	
		Heat exhaustion	
		Heat stroke	

Table 15 Natural disasters that occur alongside other disasters

Flood	Mass movement	Wildfire	Tornado	Strong winds	Tsunami
Blizzard followed by a tempearture increase	Volcanic eruption	Heatwave	Thunderstorm	Winter storm	Volcanic eruption
Tropical cyclone	Earthquake	Drought	Hurricane	Hurricane	Earthquake
Tsunami	Melting snow	Lightening		Blizzard	Meteor impact
Local storms	Rain downpoor				Underwater explosion
	Hurricane				
	Tsunami				

5 Case Studies

5.1 Japan – The 2011 Tohoku Earthquake and Tsunami

On March 11, 2011 at 2:46 pm a 9.0 magnitude earthquake took place 370 kilometers northeast of Tokyo at a depth of 24.5 kilometres (CNN 2013). The earthquake generated a tsunami that took an hour for up to 40 meter high waves to hit the coastline damaging nuclear reactors in the Fukushima nuclear plan, sweeping away vehicles, causing building (including hospitals) to collapse, and damaging several roads and highways (NOAA 2017; The Atlantic 2017). In the affected area, almost 80% of hospitals and a third of medical/dental clinics experienced various levels of damage, requiring patient evacuation and relocation (Saito and Kunimitsu 2011). While, more than 300 patients had to be evacuated from hospitals isolated by the tsunami, it is estimated that up to 1700 people who were ordered to "stay indoors" were evacuated from hospitals and nursing homes within a 20 km to 30 km radius from the damaged reactors (Saito and Kunimitsu 2011).

The earthquake and tsunami caused $220 billion damage in Japan and resulted in a nuclear disaster with an International Atomic Energy Agency (IAEA) rating of 7 at the Fukushima Daiichi Nuclear Power station. The tsunami also caused $30 million damage in Hawaii; $55 million damage to marine facilities in California; and $6 million in losses to the fishing industry in Tongoy, Chile over 16,000 km from the source. This was the first time observational evidence from satellites linked a tsunami to ice-shelf calving in Antarctica (NOAA 2017). The power cut off and the failure of the backup generators left at least six million homes without electricity and a million without water. Prolonged blackouts, water outages and fuel shortages also affected hospitals in the surrounding areas putting additional levels of stress on the facility. At the time of emergency declaration radiation levels were more than eight times the normal near the plant's main gate (Saito and Kunimitsu 2011; CNN 2013; The Atlantic 2017). Within 2 days of the disaster, a total evacuation numbers reached 185,000 and 50,000 Japan Self-Defense Forces personnel, 190 aircraft and 25 ships were deployed

Fig. 4 Overview of the Fukushima Daiichi Nuclear Power Plant impact area (NAIIC 2012)

to assist with rescue efforts. Due to escalating harmful radiation concern, an evacuation affecting almost 100 thousand people was declared. It is estimated that there were a total of 15,890 confirmed deaths and 2590 missing and presumed deaths; and 6152 injuries in 12 Japanese prefectures. (NOAA 2017) (Fig. 4).

While a lot of health and safety risks came from floodwaters, downed power lines, wet electrical outlets, interrupted gas lines and debris (CDC 2011), major concerns arose from the dangerous levels of radiation in the region. The government of Japan declared that the first priority after the incident was search and rescue working closely with local governments to evacuate residents and provide first aid and relief to victims, even though understanding of their medical needs was not easy (Saito and Kunimitsu 2011). Overall, hundreds of responders arrived in Japan to assist with the disasters as offers arrived from 116 countries and 28 international organizations. Japan specially requested assistance from teams from Australia, New Zealand, South Korea, and the United States, based on the need assessment (ABC 2011; WHO 2013a). The IAEA rating 7 incident amounted to a widespread release of radioactive material with severe health and environmental effects calling for a planned and extended counter measure (CNN 2011). Packs of potassium iodide tablets were made available by the 374th Medical Support Squadron at Yokota medical hub (Fig. 5).

During this time a shipment of rice from some farms northwest of the Fukushima Daiichii nuclear power plant was discontinued due to higher-than-allowed levels of radioactive cesium. At least 45 metric tons of radioactive waters were leaked from the nuclear facility contaminating the region and the Pacific Ocean. Studies by the World Health Organization estimated that the lifetime risk of developing leukaemia may have increased by about 7%; breast cancer by 6.5%; and 4% for all solid cancers. A 70% increase in thyroid cancer in females exposed as infants (WHO 2013a) is very concerning. National Institute of Health concurrently conducted their own studies and found an increased rate of asthma among girls (Talesnik 2015). To ensure the safety of responders and the residents, the 374th Aerospace Medicine Squadron bio-environmental flight scan was routinely conducted (Fig. 6).

Fig. 5 YOKOTA AIR BASE, Japan – Tech. Sgt. Greg Murray inspects packs of potassium iodide tablets at the medical logistics flight warehouse, Yokota Air Base, Japan, April 4, 2011 (By U.S. Air Force photo/Senior Airman Michael J. Veloz [Public domain], via Wikimedia Commons)

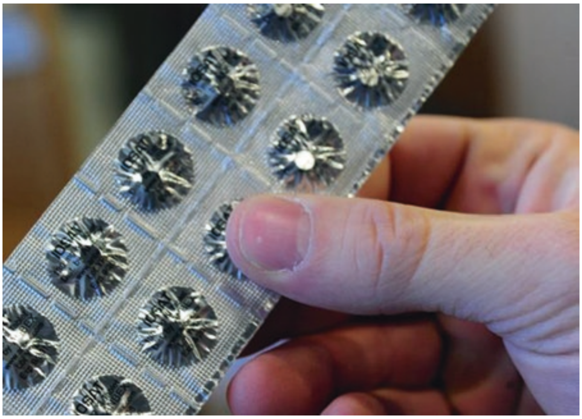

Fig. 6 Two members of the 374th Aerospace Medicine Squadron bio-environmental flight scan a returned C-130H Hercules for radiation at Yokota Air Base, Japan, March 25, 2011 (U.S. Air Force photo/Staff Sgt. Samuel Morse)

In 2012, the National Diet of Japan published the official report of the Fukushima nuclear accident independent investigation commission (NAIICS 2012) concluding that the nuclear crisis was a "manmade" disaster – the result of collusion between the government, the regulators and TEPCO, and the lack of governance by said parties. They effectively betrayed the nation's right to be safe from nuclear accidents. It was further complicated by the fact that the Basic Disaster Management Plan for Japan included plans for four natural disasters and eight accidental disasters but not combined ones. Responders possessed very limited knowledge of radiation protection and expected resources, such as electricity and lines of communication in the off-site centres, were not available (Saito and Kunimitsu 2011). Disasters, by definition overwhelm available resources and are often seen as unique events in their development; however, due to high level of potential health risk to responders it is crucial they possess necessary knowledge and resources to perform their duties safely and effectively.

5.2 The Philippines – The 2013 Typhoon Haiyan

On November 8th, 2013 Super Typhoon Haiyan, or Yolanda as it is locally known, went through the central Philippines. It was the strongest storm to ever make landfall with sustained wind speeds of 314 km/hour and wind gusts of up to 378 km/hour (Fig. 7). On the Saffir-Simpson scale, it was a Category 5 storm that generated sea surge of up to five meter and affected 4.2 million people, across 36 provinces in the Philippines (Mercy Corps 2013; US Marine Corps 2013). Total deaths are estimated to be 6340, and 2.5 million people in need of food (Mercy Corps, 2013, DEC, 2013). The World Health Organization classified this disaster as Category 3, the highest level, putting it on par with the 2004 Indian Ocean Tsunami and the 2010 Haiti Earthquake.

Fig. 7 Track map of Typhoon Haiyan. The points show the location of the storm at 6-h intervals. The colour represents the storm's maximum sustained wind speeds as classified in the Saffir–Simpson hurricane wind scale (By Meow [Public domain], via Wikimedia Commons)

Fig. 8 By Marines from Arlington, VA, United States (Haiyan Relief) [Public domain], via Wikimedia Commons

Humanitarian organizations in coordination with WHO worked tirelessly on providing water purification tablets, special diarrhoeal kits, and medicines and supplies to cover the basic health needs. The question was to manage the survivors due to the fear of an epidemic to erupt (Majumdar 2013). Four completely self-sufficient field hospitals from countries including Israel and Norway landed in the Philippines, but had to wait for hours for flights and boats to get them to the worst hit areas. Figure 8 shows US Marines helping survivors.

Infrastructure damage in the Haiyan path included downed power lines, lost communication, destroyed roads and many of the already vulnerable health facilities were left damaged or completely destroyed (WHO 2013d). This made it difficult to reach the affected people to provide relief. Part of the recovery processes included providing emergency employment to the victims who have lost income sources due to infrastructure damage (USAID 2014). As a result of the short-term employment program nearly 1500 km of roads and more than 1100 km of drainage canals were repaired and approximately 560 schools, 220 rural health care centres and more than 30 hospitals were restored (USAID 2014). These works were possible with the help of locals and long-term recovery personnel.

The WHO, in coordination with the Department of Health (DoH) of the Philippines, organized relief efforts for the survivors. They coordinated over 150 foreign medical teams and more than 500 tonnes of medical supplies and equipment that arrived in response (WHO 2013d). Of the local responders the DoH noted a total of 75 DoH team, 60 foreign teams, and 23 local health teams that were deployed to the affected areas. The government noted that the first responder, though, were victims themselves (DoH 2013).

Health needs arrived in waves, including the national and foreign teams treating injuries and attending to pregnant women and newborn children (WHO 2013b). During this time, the top five health events were acute respiratory infections, wounds, high blood pressure, fever, and animal bites (WHO 2013c). The second waves saw focus on disease outbreak prevention, including organization of mass immunisation of children against measles and polio, debris clean up and preventing the spread of diseases such as dengue and typhoid. Throughout these phases, the health of the responders was equally important, as well as the survivors. The DoH focused on watching tetanus, water-borne diseases, respiratory illness, childhood diseases and vector-borne diseases like leptospirosis, dengue and rabies to avert outbreaks and epidemics (DoH 2013). The third wave arrived within 3 months, focusing on non-communicable diseases such as heart attacks and diabetes as patients either lost their medication or were experiencing complications from the additional stress. Finally the fourth wave came within 6 months with an increase in mental health issues (WHO 2013b). It is noteworthy that within a year of the disaster, there were no major disease outbreaks in the affected areas while services such as reproductive health care, mental health provision and water quality testing became available (WHO 2013b).

Response measures saw an influx of many international responders who came in a setting of extreme devastation. They worked with limited medical resources, depending on the supply from international sources, making it imperative to be aware of their personal medical needs and have sufficient supplies with them to sustain in a high stress environment.

5.3 Haiti – The 2010 Earthquake

The magnitude 7.0 earthquake that occurred on January 12, 2010 (Fig. 9) killed over 150,000 people, affected about three million people, and destroyed 280,000 residential and commercial buildings. This Caribbean country is prone to natural disasters; they are regularly hit by tropic storms, floods, mudslides and powerful earthquakes. During the 2008 hurricane season, they were hit by four storms which claimed the lives of 800 people. They also suffered from dire flooding in 2002, 2003, 2006, and 2007 (Jones 2016). Continuing deforestation practices make matters worse for communities.

Haiti presents as an extreme example of natural disaster vulnerabilities based on its geomorphology as well as social and economic factors. The threat faced by the nation is not only due to the frequency of hazards but from the lack of their coping capacity. This leaves the country highly exposed and vulnerable to environmental hazards. In order to fully understand the impact of the 2010 Earthquake that struck Haiti, it is important to first understand conditions of Haiti prior to the event. Haiti had been occupied by Spain and France until the early nineteenth century. It became the first independent Caribbean state in 1825, but freedom came at the price of a payment of 150 million Francs. It took until 1947 for the debt to the former slave owners to be repaid. Since gaining independence, Haiti has been engulfed in chronic instability, dictatorship and natural disasters which left it as one of the poorest nations in the Americas. In 1994,

Fig. 9 Map of epicenter of 2010 Haiti Earthquake. By Haiti_map.png: CIA derivative work: The Weatherman (Haiti_map.png) [Public domain], via Wikimedia Commons

a newly elected Haiti government dismantled the military, which caused a lot of unrest via coups in the past, leaving the police as the only institution in charge of security (Goyet et al. 2011; Jones 2016). As a result, a UN peacekeeping mission was established in 2004 and has been helping stabilize the country since (BBC 2017).

Part of Haiti's extreme vulnerability stemmed from poor construction of the buildings, high occupational density of those dwellings, and severe damage to facilities with high occupancy such as schools, universities, and administrative buildings during disasters (Goyet et al. 2011). Haiti was ranked 163 out of 188 countries in 2014 in the UN Human Development index, which is a composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living (UNDP 2014; Goyet et al. 2011; BBC 2017). On the World Risk Index, which is based on exposure to natural hazards, susceptibility, coping capacities, and adaptive capacities, Haiti ranks 21 (WRR 2016).

During the 2010 earthquake, the world responded with compassion and genuine concern for the people of Haiti. Humanitarian and disaster relief operations took over the landscape in an unprecedented way (Fig. 10). However, during the first 24 hours Haitians responded to the disaster by themselves, without a properly functioning healthcare system. About 60 International Urban Search and Rescue (USAR)

Fig. 10 Haitian citizens crowd a ship near a port in Haiti Jan. 16, after earthquake devastation left many homeless, injured and hungry. The aircraft carrier USS Carl Vinson (CVN 70) and Carrier Air Wing (CVW) 17 are conducting humanitarian and disaster relief. (By Mass Communication Specialist 2nd Class Candice Villarreal (http://www.navy.mil/view_image.asp?id=80042) [Public domain], via Wikimedia Commons)

teams responded from 30 nations with more than 1800 rescuers. Influx of such a large number of responders came at a price when the Nepalese UN troops introduced cholera and caused an outbreak that claimed about 10,000 lives in the country (BBC 2016). It was scientifically proven that the bacterial infection came from the UN base through leaking sewage pipes (BBC 2016). Unfortunately, once the bacteria entered the water source it was difficult to eliminate it, especially in a country with practically no effective sewage disposal system (BBC 2016; Chin et al. 2011); causing over 200,000 infections by October 2010. Based on data collected from Twitter, informally recorded cases on health cards, information on the extent of the outbreak was made available (WRR 2016).

Humanitarian response became easier to provide with targeted relief supplies needed in the right quantities at the right places and hence save numerous human lives (Fig. 11). Hundreds of displaced Haitians lived in make-shift homes outside Gheskio Field Hospital, located on Quisqueya University grounds, where International Medical Surgery Response Team technicians provided emergency medical attention to survivors. During this time, health workers had to also decide between caring for their own families and providing emergency care in their own neighborhoods. Disaster Medical Assistance Team members provided medical care to search and rescue personnel recovering victims from the ruble (Fig. 12). The recovery efforts were fraught with hazards including crushing injuries, infectious diseases, and inhalation hazards.

Since the devastating 2010 earthquake, Haiti has seen a number of other natural disasters, including an earthquake in 2016 and Hurricane Matthew in the same year.

Fig. 11 Hannah McDowell, an aid worker with God's Missionary Church in Penn's Creek, Pa., administers medicine to a Haitian child in Leogane, Haiti, Jan. 24, 2010. U.S. Marines flew into the area to establish a new humanitarian aid receiving area for Haitian earthquake victims at a missionary compound. By Cpl. Bobbie A. Curtis, USMC [Public domain], via Wikimedia Commons

Fig. 12 Tennessee-1 Disaster Medical Assistance Team member provides medical care to search and rescue personnel recovering victims from the ruble (By National Institute for Occupational Safety and Health (http://www.flickr.com/photos/niosh/8743414931/) [Public domain], via Wikimedia Commons)

While Haiti is struggling to rebuild the country from the last impact, they do not have the capacity to do so in a sustainable and safe manner, and that role could potentially fall on the international community. As seen in the previous example, first responders arriving to a site of the same disaster can find themselves facing very different challenges and threats to their own health. Haiti has struggled with stabilizing its own economy prior to the impact and will continue to do so for years to come.

6 Concluding Remarks

This chapter compiles a comprehensive list of health hazards associated with natural disasters to provide a practical reference to future responders. International organizations responding to disasters provide much needed assistance to local response teams; at the same time their presence can contribute to chaos and lack of coordination on the ground depending on the country and location of the event. A lot more should go into the risk assessment than merely knowing their direct threats such as type of disaster to which they are responding. They have to consider the historical context and the political state of the country, as well as their vulnerability, to ensure they would be an asset to the response and recovery measures and not a liability by taking up limited resources in case they need medication or treatment themselves.

It would be beneficial for first responders to familiarise themselves with health hazards associated with each disaster presented in the first row of Table 13, since it is likely their response will involve one of these events. Similarly, while there may be unique health effects for some events, there will be a lot of overlap; therefore, organizations should consider an "All-Hazards Planning" approach when preparing their teams for deployment.

There are few disasters in which first responders might arrive during the impact stage, such as a heat wave, drought or a winter storm. However, most of the time internationally deployed first responders arrive in the post-impact stage. The majority of natural disasters are associated with some level of property damage and population displacement, leading to unsafe water supply and potential bacterial outbreaks. It is therefore crucial to ensure that first responder's immunizations are up-to-date, that personal protective gear is available, and that the responders are adequately trained in its usage to ensure that donning and doffing does not result in contamination. First responders should also be familiar with the challenges and limitations of working in the gear for prolonged time period such as fatigue, dehydration, et cetera to decrease the risk of being unable to work during the deployment. Having the necessary dosage and amount of mediation available to meet personal needs will alleviate potential strain on the limited local resources.

NATECH events present a particular secondary complication. Developed countries are at a higher risk of NATECH events because of the close proximity of industrial sites to communities to areas with high population density. Identifying locations of these sites prior to deployment would decrease the risk of toxic exposure by allowing first responders to take appropriate preparedness and mitigation measures. Japan's 2011 tsunami and nuclear meltdown is an extremely tragic example that caused radiation to spread into the water, soil, and the environment. To this day, radiation related cancer cases are being reported and much of the population has not been able to return to their land. Some farmers brought in soil from other regions to start their greenhouses in order to claim their livelihood back.

Pre-deployment health of first responders is also of importance since disasters such as wildfires and volcanic eruption can exacerbate pre-existing conditions. Organizations might opt to not deploy vulnerable responders to ensure their continual health, or deploy along with sufficient mediations to decrease the strain on local medical service in case of adverse health impacts during the deployment. First responders should be in their most optimal health pre-deployment since it is difficult to exactly predict all of the health risks they will face, and the extent to which these risks will affect them.

Appendix A

Potential health affects following a natural disaster

Type	Sup-type	Symptoms	Transmission	Comments	Source
Waterborne	*Vibrio cholera* – Cholera	Diarrhea, vomiting	Contaminated drinking water or food, fecal/oral	Incubation period: 2 h to 5 days	Watson et al. (2007) and Waring and Brown 2005
Onset: 3–5 days					
Health promotion:					
Sanitation					
Water purification					
Personal hygiene					
Immunization					
Health surveillance	Escherichia coli				Watson et al. (2007)
	Hepatitis A	Jaundice, abdominal pain, nausea, diarrhea, fever, fatigue and loss of appetite	Fecal/oral, contaminated water and food	Most children develop immunity	Watson et al. (2007) and Waring and Brown (2005)
				Pregnant women fatality can reach 25%	
				Incubation period is 15–50 days	
	Hepatitis E			Incubation period is 15–50 days	Watson et al. (2007) and Waring and Brown (2005)
	Leptospira – Leptospirosis	Sudden onset fever, headaches, chills, vomiting, severe myalgia	Fecal/oral, contaminated drinking water by rodents urine that comes in contact with skin, mucous membranes with water, damp soil or vegetation or mud via flooding facilities	Incubation period: 2–28 days	Watson et al. (2007) and Waring and Brown (2005)
	Shigella dysenteriae – Bacillary dysentery	Malaise, fever, vomiting, blood and mucuos in stool	Fecal/oral, contaminated food or water	Incubation period of 12–96 hours	Waring and Brown (2005)
	Salmonella typhi – Typhoid fever	Sustained fever, headache, constipation	Fecal/oral, contained water or food	Incubation period 3–14 days	Watson et al. (2007) andWaring and Brown (2005)

(continued)

(continued)

Type	Sup-type	Symptoms	Transmission	Comments	Source
Crowding diseases Onset: between 5 and 10 days or >10 days Health promotion: Disease specific medication	Measles	Rash, high fever, cough, runny nose, red and watery eyes; serious post measles complications – diarrhea, pneumonia, croup	Person to person by airborne respiratory droplets	Dependent on baseline immunization coverage, especially in children under 15 years old Incubation period of 10–12 days	Watson et al. (2007) and Waring and Brown (2005)
	Neisseria meningitides – Meningitis	Sudden onset fever, rash, neck stiffness, altered consciousness, bulging fontanelle in under 1 year of age	Person to person airborne transmission via respiratory droplets	Responds quickly to antimicrobial prophylaxis Incubation period of 2–10 days	Watson et al. (2007) and Waring and Brown (2005)
	Streptococcus pneumoniae, Haemophilus influenza, or viral Acute respiratory infections (ARI) – Pneumonia	Cough, difficulty breathing, fast breathing, chest indrawing	Person to person by airborne respiratory droplets	Particularly affected children under 5 years old Risks include crowding, exposure to indoor cooking using open flame and poor nutrition Incubation period of 1–3 days	Watson et al. (2007) and Waring and Brown (2005)
Vectorborne diseases Onset: >10 days Health promotion: Vector control	*Plasmodium falciparum, P vivas* – Malaria	Fever, chills, sweats, heard and body aches, nausea and vomiting	Mosquito due to standing water after meteorological events creates breeding sites	Incubation period of 7–30 days	Watson et al. (2007) and Waring and Brown (2005)
Disease specific medication	Dengue	Sudden onset severe flu-like illness, high fever, severe headache, pain behind the eyes and rash	Mosquito due to rainfall and humidity creating breeding site	Risks include changes in human behaviour (i.e. sleeping outside). Incubation period of 4–7 days	Watson et al. (2007) and Waring and Brown (2005)
	Flavivirus – Japanese encephalitis	Quick onset, headache, high fever, neck stiffness, stupor, disorientation, tremors	Mosquito	Incubation period of 5–15 days	Waring and Brown (2005)
	Flavivirus – Yellow fever	Fever, backache, headache, nausea, vomiting, toxic phase-jaundice, abdominal pain, kidney failure	Mosquito	Incubation period of 3–6 days	

Wound related	*Clostridium tetani* – tetanus	Difficulty swallowing, lockjaw, muscle rigidity, spasms	Soil	Risks: Contamination of exposed wounds if vaccination is low	Watson et al. (2007)
Onset: 5–10 days					
Health promotion: Medication				Incubation period of 3–21 days	Waring and Brown (2005)
Other	Coccidioides immitis		Fungus found in soil in certain semi-arid areas of North and South America	Risk due to airborne dust after landslides following earthquakes	Watson et al. (2007)
	Mortality	Trauma		Health promotion includes safe body disposal	WHO (2005)
		Drowning			
	Morbidity	Injury		Onset in 1–3 days	WHO (2005)
		Near-drowning		Health promotion includes injury management and health needs assessment	
	Infections	Skin infections		Onset in 5–10 days	WHO (2005)
		Conjunctivitis			
		Ear infections			
		Dermatitis			

Compiled from scientific articles by Watson et al. (2007), Waring and Brown (2005) and WHO (2005)

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The March, 2011 Fukushima Daiichi Nuclear Power Plant Disaster – A Foreseeable System Accident?

Simon Bennett

Abstract The chapter presents a systems-theory-informed analysis of the 11 March 2011 Fukushima Daiichi nuclear power plant disaster. Following the Tōhoku earthquake, Fukushima-Daiichi suffered a series of failures that saw nuclear material released into the environment and the evacuation of 150,000 residents. Using a formula developed by Rose Challenger, Christopher Clegg and Mark Robinson (*Understanding crowd behaviours, vol. 1. Practical guidance and lessons identified*. The Stationery Office, London, 2010), the chapter argues that the disaster was a system accident originating in a spectrum of factors – social, economic, political and cultural. Secondly, the chapter argues that the disaster was foreseeable. Thirdly, the chapter argues that the mindlessness and groupthink that permeated Japan's industrial, bureaucratic and political elites increased the likelihood of disaster. As to how a repeat can be avoided, the chapter offers three options. First, the world community could try to persuade Japan to abandon its nuclear programme. Secondly, Japan could generate her electricity entirely from fossil fuels and renewables such as solar, wind, hydro, tide and biomass. Thirdly, Japan could seed her nuclear plants with managers and workers not culturally predisposed to conformity and obedience. The author concludes that each solution is problematic.

Keywords Fukushima-Daiichi • Disaster • Systems-thinking • Causes • Solutions

1 Introduction

The 11 March Tōhoku earthquake set in motion a series of events that disabled the six-reactor Tokyo Electric Power Company (TEPCO) Fukushima Daiichi nuclear power plant. The earthquake and tsunami caused power outages, chemical explosions, meltdowns, damage to buildings and radioactive emissions at TEPCO's

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_6

oceanside site. Fukushima was the worst nuclear accident since Chernobyl. Impacts included the contamination of around 1800 square kilometers of land and the evacuation of 150,000 people. Decontamination, decommissioning and disposal will take decades.

This chapter presents a systems-theory-informed analysis of the Fukushima disaster, with particular attention to the contribution of cultural factors, both organisational and national. The circumstances of the disaster are explored with the aid of the Challenger et al. (2010) model of system behaviour.

2 Systems Theory: Overview

Regarding failure in socio-technical systems (e.g. health-care provision, minerals extraction or electricity generation), systems theory (Perrow 1983; Dorner 1996; Maurino et al. 1998; Johnson 2005; Dekker 2006, 2014; Black and Koopman 2009; Holden 2009; Miller 2009; Reason 2013; Shorrock et al. 2014; Griffin et al. 2015) favours system-centric over person-centric explanations. Systems theory explains failure in terms of system characteristics like non-linear interactions and emergence. It acknowledges the mutability of systems. It looks behind the system-as-designed for the system-as-found. It documents *lived reality*. Intra-system phenomena like interactive complexity, tight coupling, safety migration and emergence render system behaviour unpredictable. According to systems-theory, disasters originate in a mélange of factors (Dekker 2006; Turner 1994; Hollnagel 2004). Disasters *emerge* from a system's network space – the topographical features of which are described by Challenger et al. (2010) (Fig. 1).

The systems theory known as actor-network theory (ANT) (Callon and Latour 1981; Callon and Law 1997) conceives of a socio-technical system as a purposive assembly of stories and things (actants). These stories and things, each of which exhibits agency (ANT's principle of generalised symmetry), together constitute the hybrid-collectif (Fig. 2).

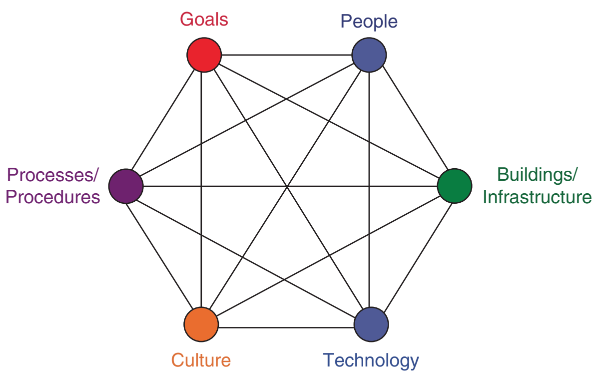
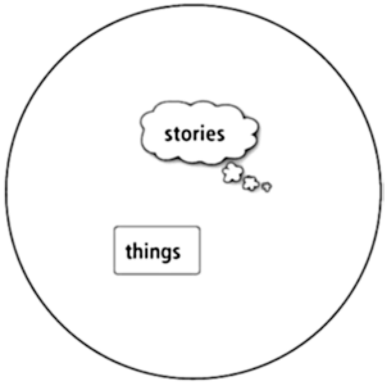


Fig. 1 How systems theory conceptualises socio-technical systems (After Challenger et al. 2010)

Fig. 2 ANT's conceptualisation of a socio-technical system (the hybrid-collectif). By creating an opportunity for engagement, Fig. 2 (a socio-technogram/text) is itself an actant. Texts act – at a distance and through time. Their agency *persists*



Actor-networks (socio-technical systems) exist within larger systems of belief, practice and artifaction. Each shapes the other. The man-made world is increasingly populated by systems-of-systems – meta systems like the global financial system that is made up of such actor-networks as stock and commodity exchanges, private banks, national banks, governments and supra-national actors and frameworks such as the European Union, Commonwealth of Independent States, World Bank, International Monetary Fund and North American Free Trade Agreement. The global economy is built on myriad, mutually affecting actor-networks. Meta systems display many of the characteristics of their component meso systems (for example, heterogeneity and emergent behaviours) (Maier 1998; De Laurentis 2005).

3 Was Fukushima a System Accident?

This section uses Challenger et al.'s (2010) system concept (see Fig. 1) to describe the circumstances of the disaster (although it is unlikely that all circumstances relevant to the disaster are listed).

3.1 Goals

Systems theory recognises that environmental factors impact individual, organisational, system and national behaviour: "You do not go about doing your business in a total vacuum, but rather under the influence of a wide range of … factors" (Monteiro 2012). Historically, Japan's reliance on imports has shaped its foreign and domestic policy. Japan's twentieth century imperialist adventures, such as the invasions of Manchuria, China and French Indochina, were motivated by a desire to secure reliable supplies of raw materials for the Japanese economy (Ambrose 1985).

In the 1930s, the political need to end an economic depression stirred the country's militarists and steeled the Japanese will (Columbia University 2009).

More recently, the Japanese government has used loans, grants and offers of technical cooperation to woo oil and gas-rich nations (Pollmann 2016). Japanese Prime Minister Shinzo Abe's 2016 state visit to gas-rich Russia was in part motivated by a desire to enlarge Japan's pool of energy suppliers. Japan's strategic energy mix includes oil, natural gas, clean coal, wind power, solar power and nuclear energy. Japan's lack of essential raw materials and dependence on energy imports shapes its world-view. Successive governments have framed nuclear power as essential to energy security (which is equated with national security). The government's nuclear policies reflect the country's historic and current depredations and vulnerabilities. Only by appreciating the latter can we explain the former. To a degree, at the time of the disaster, the topography, culture and politics of Japan's nuclear power actor-network were dictated by circumstance.

3.2 Technology

Although nuclear accidents are rare, as at Windscale in 1957 (see Fig. 3), Three Mile Island in 1979 and Chernobyl in 1986, when they do occur the consequences are serious and enduring. Impacts include worker fatalities, radioactive contamination of the food chain and reputational damage. In regard to production systems, some argue that simplicity delivers reliability (McIntyre 2000), others that sophistication (technical and organisational) delivers reliability (Roberts 1990; LaPorte and Consolini 1991). As devotees of the latter approach, nuclear designers look to system redundancy (defence in depth) to maintain safety margins. Application of this philosophy at Fukushima saw the provision of two types of on-site back-up for the reactors' cooling systems – diesel generators and DC batteries.

Fig. 3 Windscale, Cumbria. Site of Britain's worst nuclear accident

At the time of the disaster, Fukushima's back-up power systems consisted of:

– Reactors 1–5: Two diesel generators and banks of DC batteries for each reactor. The switching stations were located in the turbine buildings.
– Reactor 6: Three diesel generators and banks of DC batteries located in the turbine building. Unusually for Fukushima, the switching station for this reactor's back-up electrical energy system was located in the watertight reactor building.
– Reactors 1–6: From the late 1990s, three additional diesel generators located in a less vulnerable hillside building. The switching stations for reactors 1–5 remained in the turbine buildings.

At the time of the earthquake and tsunami, only reactors 1, 2 and 3 were operating. Reactors 4, 5 and 6 were undergoing inspection and maintenance. The 11 March earthquake and tsunami (that reached 14–15 metres) caused extensive damage:

– Fukushima's off-site power connectors went down.
– The inundation disabled 12 generators.
– The inundation disabled the switchgear.
– Lacking coolant (heat sink), three reactors suffered melt-downs (The National Diet of Japan 2012; World Nuclear Association 2016).

With reference to Reason's (Reason 2013) work on designed-in weaknesses, siting the majority of the plant's back-up electrical energy system (generators, batteries and switchgear) in buildings vulnerable to flooding created a latent error or resident pathogen. The tsunami rendered the latent error active, disabling the back-up supply. In regard to complex systems like aircraft or nuclear plant, the greater the number of designed-in weaknesses, the greater the likelihood of a system accident.

To augment resilience, back-up systems must be protected against foreseeable adverse events. The installation of three additional generators in the late 1990s (to meet a new safety standard) created a window of opportunity to harden the plant's back-up electrical energy system. This opportunity was not taken.

Finally, as mentioned above, while generally reliable, nuclear power generation creates unique risks, the manifestations of which (irradiation, environmental contamination, resource-intensive cleanups and disposals, reputation damage, etc.) *persist*. An accident in a conventional power station might kill dozens. An accident at a nuclear plant might, over time, kill thousands. Hazards associated with nuclear power generation are different in quality, scale and endurance to those associated with other forms of power generation.

3.3 Buildings and Infrastructure

Fukushima occupied a site raised about 10 metres above sea level. Unfortunately, the sea wall that bounded the site was not up to the task of protecting the plant from a major tsunami. The 14–15 metre-high March 2011 tsunami easily overtopped the site's 10 metre-high sea wall. The inadequacies of Fukushima's sea wall constituted a second latent error or resident pathogen. The World Nuclear Association notes: "The tsunami countermeasures taken when Fukushima Daiichi was designed and sited in the 1960s were considered acceptable in relation to the scientific knowledge then, with low recorded run-up heights for that particular coastline" (World Nuclear Association 2016). Given that an earthquake in 1896 generated a tsunami with a run-up height of 38 metres, it is difficult to understand how Fukushima's designers concluded that a 10 metre-high sea wall would offer adequate protection *in perpetuity*.

Japan's coastline has been threatened by tsunamis throughout history. An earthquake in 1993 triggered a tsunami that ranged in height from 10 to 20 metres. Over 200 people were killed – the largest tsunami-related death-toll in 50 years (Titov and Synolakis 1997). Other warnings included:

– eight tsunamis in the century prior to Fukushima with maximum amplitudes at origin above 10 metres.

– a tsunami in 1983 with a maximum amplitude at origin of 14.5 metres.

– International Atomic Energy Authority (IAEA) guidelines that suggested designers take account of worst-case tsunami hazards (World Nuclear Association 2016).

Warnings and exhortations had little effect on behaviour. Neither TEPCO nor Japan's nuclear regulator, the Nuclear and Industrial Safety Agency (NISA), acted on the IAEA guidelines: "Discussion was ongoing, but action minimal" (World Nuclear Association 2016). With reference to Toft and Reynolds' (Toft and Reynolds 1997) work on mitigation, learning was passive, not active. Although aware of the risk, TEPCO and NISA chose inaction over action. The height of the sea wall could have been increased. It was not. All the plant's emergency generators could have been moved to high ground (to be sited alongside the three new generators). They were not. Switching gear could have been proofed against inundation. It was not. "NISA continued to allow the Fukushima plant to operate without sufficient countermeasures" says the World Nuclear Association (World Nuclear Association 2016). With reference to Reason's (Reason 2013) Swiss Cheese model of failure, the latent errors introduced by TEPCO and NISA's inaction increased the likelihood of catastrophic failure (because latent errors compromise defences).

3.4 Processes and Procedures

At the time of Fukushima, Japan's nuclear power industry was regulated by NISA, a specialist unit within the Ministry of Economy, Trade and Industry (METI), that simultaneously regulated and promoted the nuclear industry. (Dualism is found in other industries. For example, the USA's Federal Aviation Administration simultaneously promotes safety and 'encourages and develops civil aeronautics'). NISA was overseen by the safety policy-focused Nuclear Safety Commission (NSC) and the research and strategy-focused Atomic Energy Commission (AEC). Both NISA and the NSC were compromised, NISA because of its location within the nuclear-industry-promoting Ministry of Economy, Trade and Industry, and the NSC because of its pro-industry agenda, risk-blindness, technophilia and jingoism. According to the NSC's Chair at the time of the disaster, the Commission had " … succumbed to a blind belief in the country's technical prowess and failed to thoroughly assess the risks of building nuclear reactors in an earthquake-prone country" (Madarame cited in (Kingston 2012)). Given Japanese governments' linking of nuclear power with national security, it is unsurprising that a commission located within the Cabinet of Japan should look at nuclear power through a prism that de-emphasised operational risk. As to NSC bias, the NSC Chair at the time of the disaster observed: "We ended up wasting our time looking for excuses that [stricter standards] are not needed in Japan" (Madarame cited in (Kingston 2012)). With reference to Weick, Sutcliffe and Obstfield's (Weick et al. 1999) work on informed, reflective decisionmaking, the NSC was *mindless* in its consideration of risks and hazards. Regarding the design of complex systems, there is a positive relationship between mindlessness and the prevalence of designed-in weaknesses (Reason's (2013) latent errors or resident pathogens). Regarding the operation of complex systems, their is a positive relationship between mindlessness and vulnerability. With reference to Rasmussen's (Rasmussen 1997, 1999) theory of safety migration, the more NISA and the NSC obfuscated, the more Japan's nuclear power stations operated at the edge of the safety envelope. Kingston (2012) alleges regulatory capture of NISA and the NSC by Japan's utilities and their backers: "In Japan, nuclear regulators have … long been regulating in the interests of the regulated". Further, in the matter of the planning and execution of Japan's large nuclear power programme, Kingston (2012) alleges groupthink (Janis 1972) on the part of the programme's political, bureaucratic and industrial leaders.

In September 2012, the government launched a new safety regime. Hoping to reduce the likelihood of conflicts of interest, the new Nuclear Regulation Authority (NRA) was located within the Ministry of the Environment. At the time of the NRA's birth, its Chair noted: "[P]ublic trust on nuclear regulation has been completely lost" (Tanaka cited in (World Nuclear News 2012)).

3.5 Culture

Helmreich and Merritt (2001) define culture as "the way we do things *here*". According to Kingston (2012), certain cultural traits specific to Japanese society helped that country realise its nuclear ambitions. These traits included murahachibu (social exclusion of those who questioned Japan's nuclear policies), amakudari (the rewarding with sinecures of bureaucrats whose decisions supported the nuclear programme) and corporatism (cooperative behaviour between parties who stood to gain from Japan's nuclear programme, for example trade unions, construction companies, financiers, investors and academics). In its report into the disaster, The National Diet of Japan (2012) identified another pervasive and powerful trait – civil servants' defensiveness: "[T]he first duty of any individual bureaucrat is to defend the interests of his organization". Defensiveness featured prominently in civil servants' "collective mindset", it was claimed (The National Diet of Japan 2012).

Since the 1950s, Japan's nuclear programme had been propelled by a powerful actor-network. Actants included the utilities, government agencies, sympathetic media outlets, technological exuberance, cultural conventions and energy poverty (Kingston 2012). The basic workings of Japan's nuclear power generation actor-network are shown in Fig. 4.

3.6 People

In their study of flight-deck culture, Helmreich and Merritt (2001) noticed differences in outlook and behaviour between western and eastern pilots. Japanese and Korean pilots desired acceptance and harmony: "In line with other cross-cultural communication research ... Japanese and Korean pilots were notable for showing greater concern for harmony in the cockpit .... [They were] less willing to disagree openly, less willing to speak up if a problem is detected" (Helmreich and Merritt 2001). American pilots were independent-minded and task-oriented (Helmreich and Merritt 2001). Yamamori and Mito (1993) describe the Japanese as 'conformist' and claim that Japanese workers focus their competitive instincts on outside groups for the sake of harmony.

In 1997 a Korean Airlines (KAL) passenger aircraft crashed on Guam killing over 200 (see Fig. 5). According to Wood (1999), "an internal report leaked onto the internet alleged that an authoritarian cockpit culture, inadequate English and pilot error were compromising safety [at KAL]". According to the National Transportation Safety Board (2000): "[T]he probable cause of the ... accident was the captain's failure to adequately brief and execute the non-precision approach, and *the first officer's and flight engineer's failure to effectively monitor and cross-check the captain's execution of the approach*. Contributing to these failures [was] inadequate flight crew training [my emphasis]". According to *Airline Business* (1998): "In many [accidents involving Asian carriers] there is evidence that effective questioning and crosschecking could have changed settings that led to disaster". At the time of the Guam loss, KAL's pilots were mostly of Korean descent. Many had transferred from the military. Following a spate of accidents the airline said it wished to create a 'Western-style' flight-deck culture (Wood 1999). To this end it commissioned the US Flight Safety Foundation "to examine all the safety divisions of the airline" and "an extensive crew resources management programme from alliance partners [US-based] Delta Air Lines" (Airline Business 1998). In February, 1998, Taiwan's China Airlines lost an Airbus A300 on approach to Taipei's Chiang Kai Shek airport. Over two hundred died. Like KAL, China Airlines has looked for solutions outside of Asia: "China Airlines has turned to Germany's Lufthansa for input on pilot training" (Airline Business 1998).

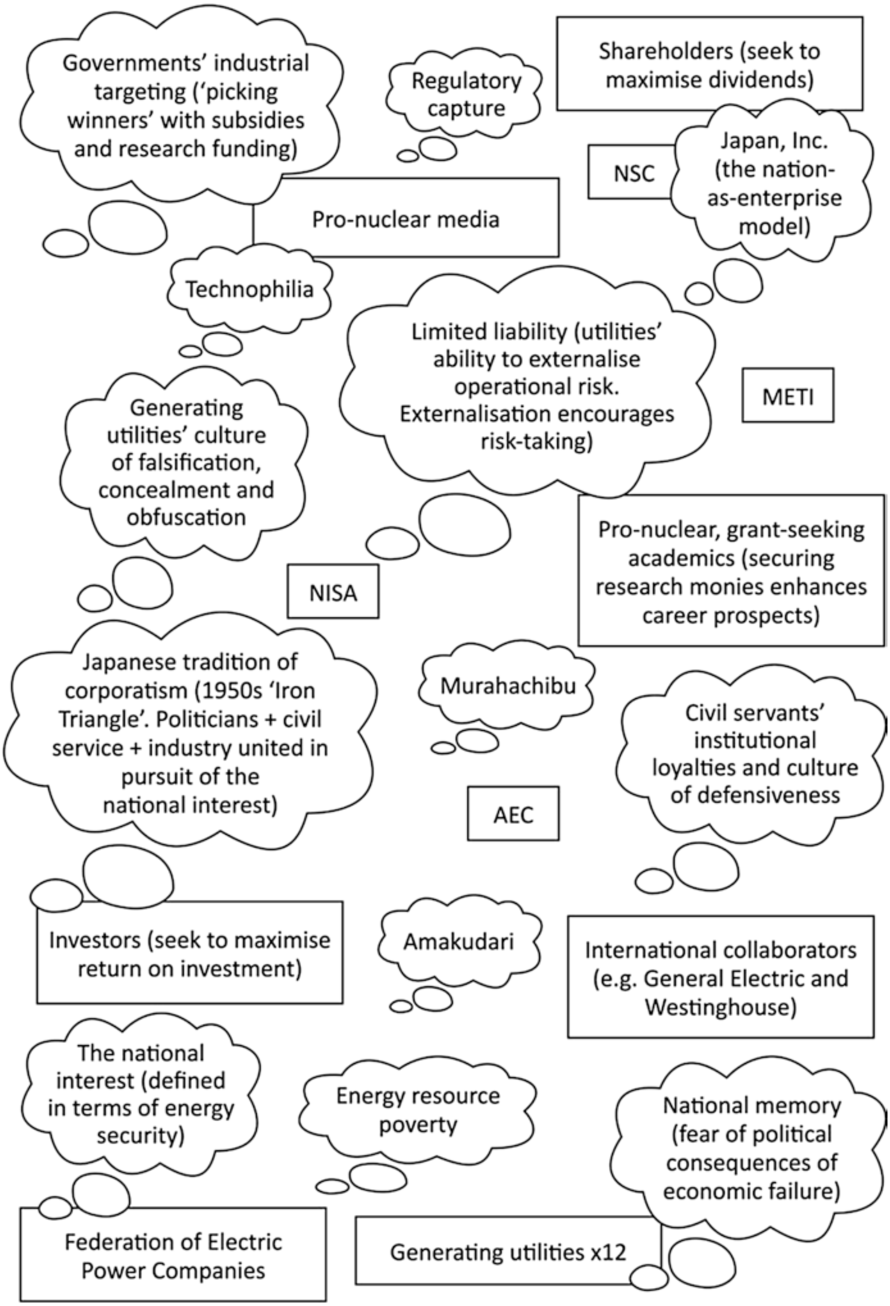


Fig. 4 Japan's nuclear power actor-network at the time of Fukushima. "Power is socially built" observe Fioravanti and Velho (2010)

Fig. 5 The KAL Flight 801 disaster. A dysfunctional culture reified?

3.6.1 Culture-Induced Dysfunction a Commonplace?

It is quite possible that the traits exhibited by Japanese pilots do not translate to other professions. It is possible that, unlike Japan's pilots, her nuclear workers are independent-minded, reflexive and healthily competitive. That they are unafraid to challenge experienced, senior colleagues whom they believe to be misinformed or misguided. That they are suspicious of norms, precedents, received wisdoms and folklores. That they are unafraid to improvise. Claims made by The National Diet of Japan (2012) in its report into the Fukushima disaster suggest otherwise: "[T]his report cannot fully convey – especially to a global audience – ... the mindset that supported the negligence behind this disaster. What must be admitted – very painfully – is that this was a disaster 'Made in Japan'. Its fundamental causes are to be found in the ingrained conventions of Japanese culture: our reflexive obedience; our reluctance to question authority; our devotion to 'sticking with the program'; our groupism; and our insularity".

Assuming first, that the Diet's analysis is correct, and secondly, that the industry's dysfunctional culture has not been remedied, it is reasonable to assume that Japan's nuclear plants are as vulnerable today as they were in 2011. With reference to Weick et al.'s (1999) work on the link between mindfulness (awareness) and performance, a *mindless* labour force creates a latent error or resident pathogen. Put colloquially, mindless workers are an accident waiting to happen. While it might be possible with great effort to modify corporate and professional cultures, it would not be possible to modify Japan's national culture. As Helmreich (1999) puts it: "[N]ational cultures are highly resistant to change because they surround an individual from birth ...". National culture is 'sticky'.

4 Conclusions

Was Fukushima a system accident? Yes it was. Better protections may have prevented the meltdowns. Fukushima's latent errors *amplified* the March 11 earthquake and tsunami's impacts. In the same way that avarice and poor planning revealed Burnden Park football stadium's latent errors in 1946, and crowd mismanagement revealed Hillsborough football stadium's latent errors in 1989 (Bennett 2016), the perturbations of March 11, 2011 revealed Fukushima's latent errors (resident pathogens). Perturbations give form to system weaknesses. They reveal vulnerabilities.

As well as shining a light on technological and design weaknesses, the disaster revealed socio-political weaknesses. As shown in Fig. 3, numerous actors shaped the *modus operandi* of Japan's nuclear sector. Acting in what they believed to be the national interest, politicians, civil servants and regulators gave the industry significant latitude. So much, in fact, that basic safety improvements were either delayed or rejected out of hand (The National Diet of Japan 2012; Kingston 2012). Perturbations foreground socio-political networks of influence and agency.

Was the Fukushima inundation foreseeable? Yes it was. The March 11 tsunami was no black swan (see Taleb's (2010) work for a definition of black swan events). Lagadec (1982) observed: "The disaster must not be seen like a meteorite that falls out of the sky on an innocent world; the disaster, most often, is anticipated, and on multiple occasions". The Fukushima tsunami was anticipated, and on multiple occasions: "Tsunami risk should have come as no surprise as the Tohoku coastline had had monster tsunami in 1611, 1677, 1793, 1896 and 1933, and in the decade prior to 3.11 numerous reports warned of tsunami risk in Fukushima .... Tsunami are a known risk in Tohoku and happen with alarming regularity. There are tsunami stones dotting the coastline warning future generations to heed the perils" (Kingston 2012).

If the National Diet of Japan (2012) is correct in its assertion that national cultural characteristics (that is, culturally embedded predispositions) helped create the conditions (affordances) for disaster, what can be done to rectify the problem? Three options spring to mind. Each is problematic.

First, Japan, recognising the risk to safety posed by politicians', civil servants', regulators' and employees' authoritarian predispositions, should abandon risk-laden technologies like nuclear reactors. If mindfulness is a precondition for the safe operation of nuclear reactors, politicians', civil servants', regulators' and employees' demonstrable lack of it suggests that, for safety's sake, Japan should wind down its nuclear programme. To a degree, the consequences of error are situationally-determined. Mindlessness on the flight-deck might cause the deaths of a hundred people. Mindlessness in the office of the nuclear regulator, in the boardroom of a nuclear utility or in the control room of a nuclear power station might cause the deaths – immediate and delayed – of tens of thousands of people. In Japan's case, alternative sources of energy include oil, gas, coal, solar, wind and tide. Japan's renewables sector is growing.

Secondly, mindful of the transboundary and intergenerational threat to public safety posed by nuclear power generation (Beck 1992; Matten 2004), the world community should persuade Japan to wind-down its nuclear programme. Such a tactic would be problematic, however. First, because it could be perceived as bullying. Secondly, because western companies like General Electric and Westinghouse profit from nuclear collaborations with Japanese utilities. Many skilled, well-paid jobs depend on selling nuclear technologies to countries like Japan. Further, western politicians, mindful of the 'nuclear vote', would be wary of adopting policies that might damage this money-spinning industry. Thirdly, because the international community has tolerated other countries' nuclear disasters, for example, Windscale, Three Mile Island and Chernobyl (see Figs. 6 and 7). Rounding on Japan would smack of hypocrisy.

Fig. 6 Nuclear hazards are democratic and merciless: A derelict funfair in Pripyat, Ukraine, a town affected by fallout from Chernobyl

Fig. 7 Nuclear hazards are transformative: contaminated land declared out-of-bounds

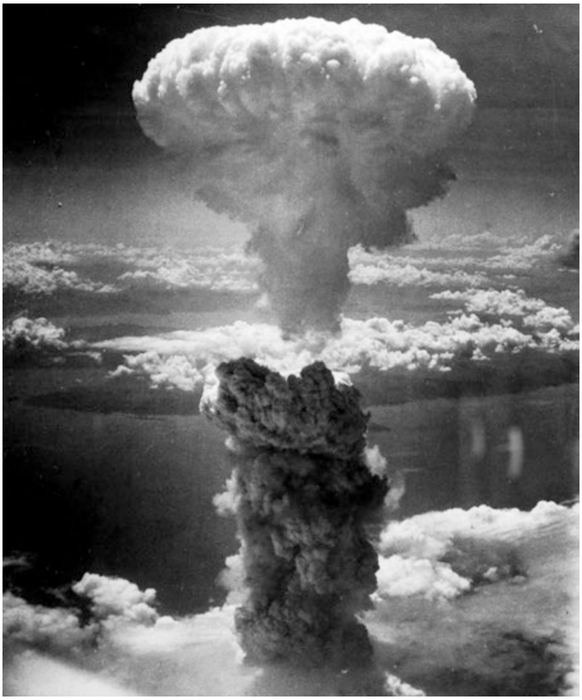


Fig. 8 Expression of the USA's technological superiority – Fat Man explodes over Nagasaki

Thirdly, Japan could try to heal herself. For example, by 'seeding' the utilities and regulatory agencies with nuclear inspectors, engineers and plant managers from other countries. However, culture engineering, while superficially plausible, is difficult to do. First, because national culture reproduces itself through stories and artifacts. Culture is omnipresent, forceful and sticky. As Helmreich (1999) puts it: "[N]ational cultures are highly resistant to change ...". Under such circumstances, insurgent professionals, however determined, would struggle to make a difference. Secondly, it is possible that the insurgents would be overwhelmed by the host nation's pervasive cultural norms. Socialisation influences outlook and behaviour. Thirdly, it is possible that the insurgents, feeling distant from their new colleagues and desiring comfortable relations, would adopt the cultural norms they were tasked to change. Human beings dislike feeling awkward or uncomfortable. Following the collapse of the Third Reich, Allied troops stationed in Germany were frequently seen at dances and other social events despite being ordered not to fraternise with civilians. Why did they defy orders and mix? Because, in their eyes, maintaining good social relations produced better results than not. Further, it was a release – an important consideration for a generation that had endured years of dislocation and battlefield slaughter.

The March, 2011 Fukushima Daiichi nuclear power plant disaster was a foreseeable system accident. Contributing factors included a lack of active learning, denialism on the part of politicians, civil servants and plant managers, and a definition of the national interest that prioritised energy security over public safety. It could be argued that Japan's historic vulnerabilities made such behaviours inevitable. In the middle of the Twentieth Century the same vulnerabilities provoked an aggressive expansionism that, in December 1941, saw Japan attack the most technologically advanced nation on earth. Four years later Japan was cowed by Little Boy and Fat Man (Fig. 8). It could also be argued that with the right culture and different priorities, the Fukushima disaster could have been avoided, or at the very least, its impacts mitigated.

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The Maori Response to a Seismic 'Swan'

Regan Potangaroa and Maire Kipa

Abstract This chapter looks at this Maori Black Swan Event (BSE) and examines its nature against current definitions and specifically against the New Orleans's Lower 9th Ward response. It then considers how Maori managed with a study of the Maori community at Rapaki just outside Christchurch following the 2011 earthquake. The existence and the current management of this BSE in New Zealand and how Maori manage should be recognised in disaster plans. That is not happening. Moreover, the sense by both authors is that this work will resonant with other ethnic responses in New Zealand such as Pacific Islanders, SE Asians and Chinese.

Keywords Black swan • Maori • Christchurch

1 Introduction

The apparent treatment of Maori following the 4 September 2010 Darfield Earthquake presented something that New Zealanders didn't want to see or acknowledge. The notion of inequality or ethnic discrimination was un-New Zealand and therefore deeply unacceptable. It would subsequently result in the setting up of a Maori Response Network (MRN) in the Christchurch Earthquake in 2011 and also in the Kaikoura Earthquake in 2016. The success of both of these MRN's and also the occurrence of the Black Swan Event (BSE) that generated it has yet to be recognised by the broader New Zealand community. This was however witnessed by both authors as they were on the 'front line' in all of the contexts covered and those experiences they bring to this writing.

This chapter looks at this Maori BSE and examines its nature against current definitions and specifically against the New Orleans's Lower 9th Ward response. It

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_7

then considers how Maori managed with a study of the Maori community at Rapaki just outside Christchurch following the 2011 earthquake. The existence and the current management of this BSE in New Zealand and how Maori manage should be recognised in disaster plans. That is not happening. Moreover, the sense by both authors is that this work will resonant with other ethnic responses in New Zealand such as Pacific Islanders, SE Asians and Chinese.

The phrase "Black Swan" is an expression of something that does not or is presumed not to exist. It underlines how something completely unexpected can unravel systems of thought, value propositions and processes. In this case, "the observation of a single black swan would be the undoing of the logic of any system of thought, as well as any reasoning that followed from that underlying logic" (Wikipedia 2017).

A BSE has three principal characteristics (Taleb 2007):

1. It is unpredictable in that it is beyond the modelling, the experience of the planners and the history of the discipline involved. The event is a 'surprise' to the observer.
2. It carries a massive and/or significant impact.
3. After the first event, the psychological biases which blind people, both individually and collectively attempts to rationalise the experience in hind sight to make it appear less random and more predictable, than it actually was.

According to Taleb we concentrate on the things we already know and fail to allow for what we don't. While concentrating on what we do know is reasonable within itself; the requirement to know what we don't seems quizzical. For example, could we know about the role of the internet and companies such as GOOGLE or the possibilities of people contributing freely to an encyclopaedia such as Wikipedia…….or on the other hand the Syrian Crisis, climate change and the 2008 economic crisis. The suggestion that any of these were 'knowable' and thereby 'manageable' seems unreason. Taleb disagrees.

He further questions why is it that we seem to over-estimate our ability to predict the future and thereby determine our destiny? (Taleb 2007). And while the emphasis for BSEs have been identified in Insurance (Munich Re 2015), Finance (Stuart 2011) (Foresight NZ 2016), Security (Broad 2016) and possibly the Military; there is the sense that other areas could also benefit from its application. The main barrier appears to be one of perspective. For instance, the relationship between cause and effect in these events is built upon knowing both the causes and the effects. Not knowing one or other results in an inability to act; but act one must do nevertheless (Cholewa, Mamula-Seadon 2012). We then become immediately tangled in what is our role/job/task and what is the responsibility of others. We start questioning ourselves about 'what if I get it wrong', 'am I responsible' and how would that 'look' and affect me, my position or my status. Consequently, we appear to be ill equipped to know or manage a BSE. New Zealand research has instead concentrated on resilience after-the-disaster and in particular organisational/community resilience rather than any preparedness before it (Kachali et al. 2012; Kenney et al. 2015).

In this chapter the terms ‘Black Swan’ and ‘Blind Spot’ are used interchangeably because the sense in the field was more of a ‘blind spot’ that came upon you rather than the ‘surreal’ appearance of a black swan on a quiet pond.

2 New Orleans Lower 9th Ward August 2005

‘What ís happening here isn’t a Black thing, it’s not a White thing, and it’s not a political thing. This is something that affects everyone, no matter who you are. It’s just that the poor are the ones hit hardest, and a lot of the poor are Black.’ (Perrin et al. 2008). What happened in the Lower 9th Ward was a BSE that occurred seemingly ‘under-the-nose’ of city authorities.

Cutter gives more details about what happened in New Orleans with her comments (Cutter 2006) ‘...race and class are certainly factors that help explain the social vulnerability in the South, while ethnicity plays an additional role in many cities. When the middle classes (both White and Black) abandon a city, the disparities between the very rich and the very poor expand. Add to this an increasing elderly population, the homeless, transients (including tourists), and other special needs populations, and the prospects for evacuating a city during times of emergencies becomes a daunting challenge for most American cities. What is a major challenge for other cities became a virtual impossibility for New Orleans. Those that could muster the personal resources evacuated the city. With no welfare check (the hurricane struck near the end of the month), little food, and no help from the city, state, or federal officials, the poor were forced to ride out the storm in their homes or move to the shelters of last resort. This is the enduring face of Hurricane Katrina—poor, black, single mothers, young, and old—struggling just to survive; options limited by the ineffectiveness of preparedness and the inadequacy of response’. It was missed despite the warnings (Homeland Security 2006) and the city’s hurricane history going back to 1722. It even had its own name, ‘The New Orleans Scenario’ and was treated by FEMA as one of the three most critical disasters facing the US (Moynihan 2009)....Yet it was missed nonetheless.......and Cutter seems somewhat generous with her comment that ...what is a major challenge for other cities became a virtual impossibility for New Orleans...’ given that the year before the city had an evacuation due to Hurricane Ivan.

However, she goes on to comment that ‘...socially created vulnerabilities are largely ignored in the hazards and disaster literature because they are so hard to measure and quantify. Social vulnerability is partially a product of social inequalities—those social factors and forces that create the susceptibility of various groups to harm, and in turn affect their ability to respond, and bounce back (resilience) after the disaster. But it is much more than that. Social vulnerability involves the basic provision of health care, the liveability of places, overall indicators of quality of life, and accessibility to lifelines (goods, services, and emergency response personnel), capital, and political representation.’ Perhaps this was why it was missed........

Thus, it seems that BSE's can and do exist in the post disaster context. This one was unpredicted (despite the apparent warning signs), certainly had a large impact on a nation that seemingly could not help its own that was played out on national and international media and as ostensibly suggested by Cutter was explainable.

3 The New Zealand Blind Spot

Nonetheless, it was unthinkable that something similar could happen in comparative 'small town' New Zealand; but it did.

Maori are the indigenous people of New Zealand. They migrated via canoes from Polynesia sometime between 1250 and 1300 CE (Te Ara 2017a). A unique culture and language developed that is evident today with whakapapa or ancestry being connected back to these canoes. Maori appear to be more urban based with 84% living in metropolitan areas and especially for Auckland where 25% of that number reside (Te Ara 2017b). New Zealanders pride themselves on the racial harmony they enjoy and so what happened ran deep. What occurred in New Orleans Lower 9th Ward could not occur there……. but that was not the case.

4 Darfield Earthquake, 4 September 2010

A magnitude 7.1 earthquake occurred in Darfield which is approximately 40 kilometres west of the city of Christchurch in the South Island of New Zealand. The seismic event damaged buildings and caused soil liquefaction in the rural town of Kaiapoi and the Christchurch suburbs of Bexley, Aranui and generally throughout Christchurch's Eastern suburbs. The liquefaction caused problems with buried water and sewer pipes, flooding and building foundations. Liquefaction occurs when seismic shaking forces water in the soil to move upwards that consequently turns what was stable ground temporary into quicksand. The Eastern Suburbs which includes Bexley and Aranui is also where the city's sewerage treatment ponds are located and hence where lower Christchurch land values could be found; and in many socio-economic ways mirrored the Lower 9th Ward of New Orleans.

An apparent lack of communication (The Press 2010) had Maori Party MP Rahui Katene calling for a public apology over the treatment of one 30-strong Christchurch Martin whanau (an extended Maori family unit) who were evicted from an Earthquake Welfare Centre. The family were publically labelled as "repulsive" by Christchurch City Mayor Bob Parker based on Police reports that family members were intimidating others and that they had falsely claimed their houses as being uninhabitable. However, Lala Martin showed The Press [the main daily newspaper in Christchurch] through her quake-hit Gayhurst Rd [located in Aranui in Christchurch] home yesterday and pointed out what appeared to be sewage coming out of a drain and into her mud-pit, flooded front yard. She was trying to keep her six children, two of whom were bottle-fed, out of the muck, but one of her babies appeared to have developed a gastric illness. She showed The Press the Green inspection notices [posted by Civil Defence Authorities] that bore Thursday's date [they only found about the Green notices basically saying the houses were "habitable" on the day they were evicted from the centre] but said it was the sanitation aspect that made her flee her home. "We've gone from being victims of the earthquake to victims of the people who were helping us out. I wouldn't use the facilities again, I would just stay home." Grandmother Manawai Martin wept as she said she was more traumatised by being labelled "bludgers" (and publicly castigated by the Mayor) than by any earthquake. "Maori will be too scared, too embarrassed, to come use [relief services]," she said. Grandfather Noel Martin said he left his Mongrel Mob [Maori based gang] patch in the car when they arrived at the centre. "Yes I'm in the gang. What's that got to do with the state of emergency?" (TV3 2010).

Martin said Parker had "done the damage" to their family and he would be voting for Jim Anderton. Parker said he would meet the family if they wanted but it was "not a high priority". Manawai said the first the family knew of being evicted was when police approached them. At 1.20 pm [on Friday] they were issued a trespass order saying they had until 2 pm to move all 30 out, she said. Manawai started crying immediately. Her family had helped out at the centre and one of her 14-year-old granddaughters had been given a Civil Defence vest in recognition of all the work she did. The family only discovered their houses had green placards on Friday and she wanted one more night in the shelter as getting 30 people mobilised was difficult. There was no definition of who were allowed in the shelter, she said. Most of those they met had no damage to their homes and were there because they needed support or they were scared. Noel Martin said he was one of the workers cleaning up Christchurch and straight after the quake he went to his daughter's house and then checked on her neighbours. "[Parker] has turned this from a positive into a negative," he said. Parker "absolutely refuted" that race played any part in the disaster relief effort. He said his comments about the family were in response to reports from police that the family was making things "significantly harder" in the centre. Though he did not believe he was wrong, he would happily admit it if he was, he said.

Therefore, what happened with the Martin whanau was unexpected, had deep implications and moreover at least for the Mayor could be readily explained. It was a BSE. And it would have probably ended there had it not been for a subsequent and more damaging earthquake 5 months later.

5 Christchurch Earthquake, 22 February 2011

An even more devastating earthquake happened on the 22 February 2011 at a location 10 kilometres south-east of the centre of Christchurch near the port town of Lyttleton. Though smaller in magnitude at 6.1 than the earlier 7.1 Darfield

Earthquake it caused extensive building damage and the loss of 185 lives. With earlier experiences of the Martin family still fresh, it seemed that a separate Maori Response Network (MRN) should be established to avoid a repeat of that earlier incident and the potential for conflict at Earthquake Welfare Centres.

The MRN was set up at Rehua Marae in central Christchurch and was established ostensibly to facilitate communication and to identify the appropriate service providers over the short to medium term. This is discussed in more detail in the next section, but there was deep resentment amongst Maori leaders and elders which was revealed on New Zealand National Television.

'Well...I can say that...because we are on the ...I suppose the poor side of town.... in terms of how bureaucratic people look at it ...we're last in line.... we see the Mayor alot on TV...but it's always about the inner city or the other suburbs you know... we've never see him..... in fact he came around once... on this street only because the Minister of Maori Affairs turned up.....why do we always have to miss out.... why are we always last...' Peter Mason a resident of the Eastern Suburbs of Christchurch and then Chair of Nga Hau e Wha National Marae (located in the Eastern Suburbs) being interviewed about the seemingly 'forgotten' earthquake affected Eastern Suburbs of Christchurch April 2011 (Maori Television 2011) (Fig. 1).

On that same program, Bob Parker the then Mayor of Christchurch in response stated that ...'no body's going around here [the Christchurch Earthquake Response Centre]saying we won't go to that area, that's a lower socio-economic area...let's go and look after the people who have got more money...is that even reasonable. I mean if someone's suggesting that of me I would resign from my job right now...I just feel so strongly about that ...that is a pathetic criticism ...sorry if I am being offensive but I find that deeply, deeply offensive ..you know of anything...what we have done in this organisation is to say look at the areas that have been hit for a second time [the first being an earlier earthquake in September 2010] and devastated by the impact of this [February 2011 Earthquake] and let's do everything we can to get into those areas and to ensure that we can support them as best as we can'. The program was aired on prime time National Television on 10 April 2011, 47 days after the 22 February 2011 earthquake.

It is interesting to note the similarities to New Orleans in terms of Civic management and its apparent rejection. Furthermore, it is also interesting in that this Black Swan was well known to Maori but a shock to non-Maori; and hence the significance of these two interviews.

6 The Christchurch MRN Timeline

A timeline based on the MRN operations from when the Earthquake happened on the 22/2/2011 till when it was scaled down a month later on 21/3/2011 has been compiled and is in Appendix A. The approach of constructing the MRN timeline allows the nature of the BSE both in Christchurch and later in Kaikoura to emerge.

Fig. 1 The Eastern Suburbs of Christchurch, before and after the 2011 Earthquake. The *circled area* is the same house for reference (Source Google Earth and Authors)

This is regardless of the ethnic trigger occurring earlier in the 2010 seismic event. The timeline was formed from key discussions and information summarized from minutes of meetings, emails, reports and journals kept by volunteers working with the Kaitahu (Strategic) Steering Group (KSG).

The timeline (perhaps surprisingly) shows that the MRN worked well and had potentially better communication and information flow with the Government Departments through Te Puni Kokiri (TPK, the Government Department dealing with all Maori Affairs) than those outside the network. It also had good communications with Te Runanga o Ngai Tahu (the local Maori Iwi or recognised tribal authority) and acted as an effective information exchange centre, a contact point for other Maori Iwi coming in from outside Christchurch, the Maori Wardens Association (both local and national) and coordinated donations coming in and distribution going out. In addition, it was able to pick up and direct reports of particular cases like the Martin's that would have otherwise "fallen off the radar. Almost by default it became a focal point for visiting dignitaries such as Kevin Rudd who at that time was the Australian Minister for Foreign Affairs." And finally it became something of a touch point for the emotion of the disaster for which there was no other facility given that the CBD was cordoned off and many churches and other suitable buildings were damaged and hence closed.

However, the timeline also highlights a lack of access in specific areas such as health, provision of port-a-loos and entry into Welfare Centres. The health issue was particularly unfortunate as a team of trained nurses arrived from the Arawa (Iwi) from New Zealand's North Island. They brought their own medical supplies and were deployed on the 28 February to the Aranui and Wainoni area of the Eastern Suburbs of Christchurch and were so successful that they used all their medical supplies by the 1 March. They requested supplies from Christchurch Hospital but were rejected and the team told that people in the Eastern Suburbs should come into the hospital. Travelling to the main hospital was problematic given the state of the roads, the lack of transport and the pressing issues of family and home. Moreover, the move to a community based approach (Ratima 2010) for areas such as the Eastern Suburbs was a recognised method of health care delivery and the reasons for its earlier adoption made even more sense in the post disaster context (Boulton et al. 2009). This gap is summed up by one interview that "[It's] about advocating for the weakest, for the poorest, for the ugliest, for the least likely to earn some bread. And sometimes when you're working with that…you're working from the bottom of the barrel". People don't want to work with these people because they've tried to and [it's] too hard. For us, that's our bread and butter…it's about "we know you, we probably know your uncles and aunties, and we're interested in how they are and you and we're interested in how the rest of your whanau is working and how we can get in there and help support that". Other supplies were found and the nurses were still active through till the 7 March 2011. But the experience of the (community based) health workers/nurses perhaps underlines that there will be sections of the community that disaster professionals seek to assist but may not be able to because of "a gap" or maybe "the gap".

7 The Nature of BSE's

It is evident from this timeline analysis that a BSE depends on the observer and that it emerges when the gap between what we know and what we think we know becomes untenable (Taleb 2007). Maori seem to have known about the black swan in the Eastern Suburbs and moreover had over time seemingly become accustomed to it. While for others, its existence would mean resignation from their public role as was stated by the Mayor. This strong contradiction seems to be the signature for this BSE.

In a similar way, it would appear that the mind can be prone to such blind spots or bias; and that can be quite public especially as connectivity increases through mobile phones and the internet. Moreover, it would have been a simple act to go out to the Eastern Suburbs and visit the area and 'see' what was actually happening rather than relying on reports and feedback. This would have been a simple 10–15 min car drive.

In addition, driving out may have also underlined that some of the data being used by the Planners and the CDEM may not have been accurate; as was shown with the port-a-loos (Potangaroa et al. 2011). But what eventuated in this instance was the demolition of houses and eviction the families that occupied them. The associated pay out for land did seem equitable if you had assets; but not for those renting. The overall effect was the clearing of much of the Eastern Suburbs after a protracted insurance process that did not provide the intended alternatives for those that were displaced.

On the other hand the gap between a resilient and a Black Swan response one may not be as different as proposed.

But overall the sense within the MRN, like the Martin family earlier, was that Maori were on their own; a theme that was certainly coming through the Press, Maori/National television (National Television 2011) and the radio media (TV NZ 2011) and parallel what happened in the Lower 9th Ward of New Orleans (Rotary NZ 2011). In particular the comments from Perrin et al. seem to make sense in the eastern Suburbs…. "Many of us alternated between emotional numbness, intense anger, sadness, and guilt. Trying to make sense of the destruction and our reactions to it often brought surreal confusion. At times, we felt detached from reality, and memories of our own homes seemed distant. Following the advice of a faculty member, we had brought pictures of our families to provide a sense of normalcy. The pictures seemed out of place among our surroundings; even phone calls home felt odd because loved ones could not fully understand what we were experiencing. On a small scale, we began to appreciate how residents may have felt amid their devastated lives" (Perrin et al. 2008). This was poignant for the Eastern Suburbs given that the Western Suburbs of the city was in comparison unaffected and life went on as usual.

8 Kaikoura Earthquake, 14 November 2016

At 12.02 am on the 14 November 2016, a 7.8 earthquake struck near the coastal town of Kaikoura; which is 150 kilometres north east of Christchurch. Road access is cut off by numerous and significant landslides and the collapse of several bridges. In a similar manner the railway is also cut off and hence the only access is via helicopter. There is confusion within Civil Defence Emergency management CDEM (Stuff 2016). The harbour had been rendered almost useless due to the seismic upheaval of the harbour sea bed. The 111 phone line fails and by 12.57 am there is confusion amongst CDEM as to whether a tsunami warning should be given as a 2 metre tsunami had already hit the town. This particularly impacts on the many tourists that are now stranded in Kaikoura and they head up to the local Takahanga Marae which is adjacent to where an informal camping ground is set up. There are approximately 700 people that spend the remainder of the night at the Marae as aftershocks continue and there is no power available (Fig. 2).

9 THE Kaikoura MRN

A timeline was again constructed for the Kaikoura MRN based on situational reports, field/diary notes, meetings/hui, reports and data and observations from being at Takahanga Marae from 19th to 23rd November 2016. It is from the perspective of Maori and particularly for the Takahanga Marae in Kaikoura and is in Appendix B.

This timeline shows that the MRN worked well. Moreover, it is not clear how the CDEM would have managed the tourists that were stranded in Kaikoura if it had not been for the Marae serving 10,000 meals in 6 days. Local Maori stayed away because they appreciated the pressure and the associated work that those on the Marae would be under. The Ngai Tahu Iwi were able to set up supply lines and support for the Marae. But again its contribution, as it was earlier in Christchurch with

Fig. 2 The Kaikoura Context (Source authors)

Rehua Marae, was essentially ignored by this Earthquake Response run out of the Emergency Operations Centre EOC located in the Kaikoura Council Building.

The Marae lacked access to water, toilets, power and food; with the water being the most important one. However they were able to work around it using firstly 'borrowed' water tanks and then a New Zealand Red Cross water bladder elevated on the back of a truck tray so that water could flow down when the taps were turned on. Initially, it was manually carried into the kitchens and then a pump was used once power was restored. There was frustration on the Marae that it was presented with the issue of stranded tourists: that CDEM did not have any plan and then when it did step up, it felt ignored. There were disputes over food that was being helicoptered in and the Police had to be called; there were assaults over access to petrol chits and there was an ongoing struggle to maintain water access. Moreover, the Marae had to put aside helping local Maori and hence the last community meal was served on Sunday 20 November 2016. It seemed to be the right time. The focus then switched over to assessments and needs of local Maori both in Kaikoura and in the district. Some families were sorting out their needs but a percentage between 20% and 30% needed assistance. One example was a whanau group (an extended family) of 32 living in one 3 bedroom house because their respective houses were earthquake affected and moreover they felt safer together. The sense that others were 'worse off' then what they were seemed to sum up the local Maori perspective; but it was obvious that a solution needed to be actioned so that the family could plan their return to 'normal' living conditions.

The Marae was crucially involved in the paua relocation when there was disputes between the volunteer's relocating paua and the Ministry of Prime Industries (MPI) that were seeking to 'protect' the paua.

The Runanga (local Maori tribal authority) based at Takahanga Marae have the legal right and the cultural imperative to issue permits for customary gathering of kaimoana (sea food) in the Kaikoura district. They were approached by a volunteer group that were trying to relocate the paua (a large sea snail) that were marooned when the sea bed at the inter-tidal zone was lifted by the earthquake. The MPI stepped in and stopped the operation saying that their scientific evidence was that paua would find their way back to the sea. This did not make sense to those on the ground as even cray fish and fish could not find their way back to the sea and were dying. It was shown that the scientific evidence that MPI were referencing did not account for large ground uplifts and grudgingly allowed the volunteers to proceed. The logic of leaving paua to ultimately die on the rocks rather than risk their relocation was seemingly resolved. However, MPI may have had other concerns such as poaching and the relocation areas for paua. But what is clear is that the Runanga based at Takahanga Marae were able to assist in unblocking what would have been a disaster for Maori and also for the paua industry.

There were several other roles that the MRN based at Takahanga Marae took on but these two were crucial.

10 What Were the Lessons Learnt?

The following lessons were taken from the experiences in Christchurch and Kaikoura:

- BSE in the field seem difficult to nail down to one issue. They appear to come in ‘flocks’. While the central BSE was the ethnic discrimination and its resulting division within what was considered a harmonious New Zealand society; there were others.
- The core of the BSE triggers were well known to Maori but were seemingly unknown to non-Maori. Lambert is blunt and refers to it as “something that indigenous peoples have already mapped into their lifeworld’s through colonisation” (Lambert 2014). Nonetheless, this has emerged as a central issue especially when moving forward and determining the next planning/operational steps.
- The core of the BSE appear to be ‘historic’ and existed prior to the disaster (as was probably the case in New Orleans)
- They are hard to accept or even acknowledge; and hence the ‘history repeating itself’ in this sequence of events from 2010 to 2016. It would seem to have been doing that for some generations.
- In both situations there was the sense of a ‘Blind Spot’ and that Maori were unfortunately on their own.
- Maori connection and their much longer historic perspective of the land was not understood nor included in the plans and post disaster response. Maori are tied to the land by this history and effectively cannot move; and much like Cutter observed in New Orleans, the ‘enduring face of the Maori response to seismic swans’ is the desire to remain.
- It is perhaps academically interesting that these BSE were triggered by earthquakes and whether flooding or storms would have generated similar occurrences? The sudden-ness of earthquakes and the inability to prepare do make them prone to creating BSE’s. The post disaster scenario of ongoing earthquakes

and access to buildings and services at least for the New Zealand context suggests that BSE could be linked to earthquake disasters more than other disaster types.

- The ability of larger Maori organisations to response should be recognised and CDEM probably needs to include them around the planning table as members of the planning group rather than solely for consultation. They represent significant assets and networks in areas where CDEM have been shown to be lacking. Examples of such organisations include the Ngai Tahu Iwi, Government Departments such as Te Puni Kokiri and Whanau Ora, te Putahitanga, the Maori Wardens and Marae such as Nga Hau e Wha National Marae, Takahanga and Rehua. Such engagement is currently not happening.
- Finally, the role of Marae in the confusion of a BSE cannot be underlined enough.

11 BSE's and Resilience

Intuitively, there would seem to be a connection between BSE and resilience (Hughes and Healy 2014). The identification of risks and vulnerabilities that has been the usual disaster management approach works but only where all the risks and their associated vulnerabilities are identified. This is proving problematic to the point of not being operational; and what responders are increasingly seeing are post disaster contexts that could not have been anticipated (NZ Govt 2016). The Asian Tsunami in 2004 was seen as the ultimate disaster, which was exceeded by the Pakistan earthquake in 2005. That was again exceeded by the earthquake in Sichuan in 2008 and then by the earthquake in Haiti in 2010. That was exceeded again when there were two major disasters in 1 year with the Pakistan Floods. Thus the idea of resilience would appear to be at least one operational response to these increasingly complex and unpredictable situations. Would resilience be something that could or should be applied in a BSE and moreover are they connected? Initial research suggests "No" and what is being heard spans between 'we have done all that could reasonably be expected of us' to 'an attack is inevitable and will be overwhelming, so there's not much point worrying about resilience' (Sullivan-Taylor and Wilson 2007).

Hence a small study was completed following the Christchurch Earthquake to address this issue which has perhaps gained importance given the Kaikoura event. The study focussed on the Maori community of Rapaki which is by the sea and just two bays from the Christchurch port of Lyttleton.

12 The Rapaki Historical Background

The Lyttelton Harbour area has been occupied by Maori for over 700 years with the first Europeans arriving in 1770. It was known as Port Cooper and around 1850 renamed to Lyttelton. The Rapaki Native Reserve of 850 acres, was part of the Port Cooper Block which had a Deed of Sale dated August 10th 1849; though Rapaki

Fig. 3 The Rapaki Boulders with Tamatea in the background (Source authors)

had been occupied well before then. It is a Maori Reserve that stretches from the sea to the hill tops to the South with the prominent peak being Te Poho Tamatea ("the Breast of Tamatea"). It is apparently named after Tamatea Pōkai Whenua who climbed the peak to recited a karakia (or ritual chant) asking a tohunga (a priest or expert practitioner) to send fire to warm his people. It is one of many such landscape sites in the area named after the historical events, stories and battles of the Maori Ngāi Tahu tribe and their Ngāti Māmoe ancestors. On the other end of the site, the sea has provided a source of food and in 1998 Rāpaki became one of the first sites for a Mātaitai reserve. This is where the Rapaki community control and enforce customary fishing resources and access. Thus the historical ties at Rapaki run deep.

13 Field Work

The study was completed as part of a larger city wide one conducted by the Institute of Environmental Research (ESR) and was in partnership with Canterbury University and the Seaview Resilience Centre. The Rapaki study consisted of 13 semi structured, in-depth interviews with key people that lived in Rapaki about how the community responded to the Christchurch Earthquake. Rapaki was hit by bouncing boulders from Tamatea and were featured in worldwide media coverage (Fig. 3).

The CDEM red tagged several of the houses because of the possibility of boulders risk but people ignored these risks and quietly moved back into their homes. Carbon dating of boulders suggested that there was a 7000 year cycle of boulders coming down from Tamatea with their being an active period of around 100 years. The decision was to move people out of the tagged houses but because of the ancestral connection that residents felt with the land they decided to nonetheless stay.

The interviews suggest that Maori have a substantial social resilience which is based around the Marae but more so in the 'Place' as a historical or cultural 'anchor'. For Rapaki that stretched out over 700 years as outlined earlier which at times seem to give it almost 'mythological' connections. However, from a BSE perspective, the interviews suggested the following methodology:

1. Accept the new situation that is presented to.
2. Find meaning in it.
3. Try to improvise to find final resolution of this new context.

For example, the community kept the boulder in the above photographs and actual made it into a kind of memorial. One commented that the earthquake disaster was ‘an opportunity to change things’. Thus, they accepted the new context. They then found comfort in remembering comments from their parents that had now found a scientific basis or meaning. And finally they also found ways to work around being barred from returning to their homes such as temporary accommodation and exit routes. The approach does have similarities to an Adaptive Leadership Style suggested by Heifetz and Linsky (Heifetz 2011).

Could this be a Maori approach to BSE’s?

The interviews also suggested that:

- Rapaki is a place that can heal socially with one particular poignant story of how one child affected by the earthquake was able to find resolution on returning to Rapaki. Thus the land had the capacity to ‘spiritually’ heal because it was the ‘residence’ for those that had gone before.
- And moreover, Rapaki seemed to be “a person” to those interviewed, regardless of their age or the time they had lived there. It was like there was another person somewhere in the background.

Could this personalisation also be part of that Maori response to BSE’s?

14 Conclusion

Black Swans are messy; and the move to their rationalisation may not be as automatic as Taleb suggests; New Zealand is still trying to understand what happened…. much like New Orleans. On the other hand, the MRN seems to be accepted as the standard response mode by Maori and may have to be folded into the CDEM procedures. The key should be that ‘No one is left behind’.

Appendices

Appendix A: Christchurch Earthquake 2011 Maori Recovery Network MRN Timeline

The MRN was based at Rehua Marae in Springfield Road just outside the Red Zoned CBD area of Christchurch.

Terms

Iwi = Regional tribal representation	TRONT = Governing body for Ngai Tahu.
TPK = Te Puni Kokiri Govt Dept. for Maori Affairs	Ngai Tahu = The Maori Iwi or confederation of local tribes
KSG = Kaitahu (Strategic) Steering Group	MP = Member of the NZ Parliament.
Kaumatua = Maori elder	Hui = meeting
Whanau = (extended) Maori family	Marae = Maori meeting house or community centre
CDHB = Canterbury District Health Board	MSD = Govt Ministry of Social Development
Te Arawa & Tainui are two other Maori tribes/Iwi from outside Christchurch	Rapaki and Tuahiwi are important Maori settlements just outside Christchurch.
Kohanga Reo = Maori preschool or “Language Nest”	Rehua Marae = Marae located in Christchurch central
WINZ = Govt Dept for Work and Income/ Benefits.	Hapu =tribal sub group
MCDEM = Govt Ministry of Civil Defence and Emergency Management	Nga Hau e Wha Marae National Marae in the Eastern suburbs unfortunately damaged by the earthquake
WHAKAMOEMITI = pray meeting	MOE = Govt Ministry of Education
WAG = Welfare Advisory Group	CCC = Christchurch City Council
Kai = food	Mihi whakatau = formal greeting and introduction

Day 1: Tues 22nd Feb 2011: 12.51pm 6.3 magnitude earthquake. Christchurch. TPK Regional Manager David Ormsby visits Rehua Marae and Kaumatua to assess whanau safety, buildings, property and utilities.
Day 2: Thurs 24th Feb 2011: AFTERNOON, Ngai Tahu whanau & staff of TRONT call Emergency Hui at Rehua Maraefor Fri 25th Feb. TPK staff arrive from around the country & stationed at Rehua, Rapaki & Tuahiwi Maraes undertaking rapid assessments across Christchurch suburbs
Day 3: Fri 25th Feb 2011: 10AM – 20+ Iwi, Taurahere and TPK officials present: Aim-to provide a short to medium term plan to identify the appropriate service providers and facilitate communication lines.
HEREWINI TE KOHA (TPK Wellington) update from Civil Defence and asked everyone to ask the question “What can we start doing now to mobilise a response for Otautahi?” TPK and other services to get the general understanding of all areas ranging from where to send kai to assisting whanau leave the region.
The KSG is set up as a wider government response group to run parallel to the WAG. TPK to be the link to feed back to the hub. Pipeline of requests and referrals with TPK prioritising Marae needs. The importance of mobilising and getting out to streets to make contact with households via the wardens noted, provide support & information for whanau to register needs
MARK SOLOMON – TE RUNANGA O NGAI TAHU (Ngai Tahu Chairperson/Leader) Discussed how the MRN would work regarding delivery/distribution and storage of food.Tainui and Te Arawa offering doctors and support.Many non-Maori groups offering help and needs to be well coordinated.
ROGER PIKIA - TE ARAWA CEO/spokesperson for Te Arawa & Tainui:confirmed Te Arawa & Tainui Iwi medical teams, kapahaka groups for manpower and admin staff flying out of Rotorua. KSG to resolve food and accommodation.

(continued)

RAHUI KATENE (MP FOR SOUTHERN MAORI ELECTORATE). Acting for the Minister of Maori Affairs and advised she would set up access to Govt ministers based on needs assessment from the MRN.
Red Cross emergency grants processed by TPK staff. Maori Coordinator for 0800 777 846 Emergency Helpline. Ngai Tahu begins establishing office admin needs.
Day 4: Sat 26th Feb 2011: MRN/HQ to be led by Ngai Tahu & Ngai Tuahuriri with the aim of gets assistance to those in need in the community. Communication channels between TPK, MCDEM, WAG & local Iwi/Hapu. Govt response and Maori action framework tabled. TPK channelling CDEM information into the MRN and deployment of assistance. Informal monitoring of what, where and who? Whanau engagement seen as critical. Te Runanga o Nga Maatawaka for 0800 emergency helpline
TPK & Civil Defence coordinate emergency relief to worst affected Marae, suburbs and whanau. TPK process Red Cross emergency grants, missing persons register & liaison with welfare centres. He Oranga Pounamu coordinate information and support from the Maori NGO's and officials from MSD, CDHB. Kohanga Reo Whanau Networks & Maori Health workers on standby. Maori Wardens on standby (national and local) they are also working with Police but will attend KSG briefings. Te Arawa Rotorua: on standby with mobile team of nurses, drivers and support crew.
Te Wananga o Aotearoa / Open Wananga, Ora Hauora staff/whanau on standby. Red Badge Security 24 hr support stationed to coordinate entrance and exit from Rehua marae.All visitors checked in and checked out. Over 250 visitors, volunteers and officials visiting each day.
Day 5: Sun 27th Feb 2011: 11.00HRS WHAKAMOEMITI or CHURCH SERVICE
53 Maori wardens on standby and deployed from New Brighton Police Station. Wardens comment on how a lot of people are not at home, appear to have left/abandoned properties. Concern about hygiene, health hazards due to sewerage, liquefaction, dust. Delivered non-perishable foods, fruit, vegetables, nappies, 400 1 litre cartons of milk, 400 small cartons of flavoured milk,110 packets of assorted meat parcels.
Day 6" Mon 28th Feb 2011: HQ fully operational with daily briefings of the KSG 08.30hrs - 09.30hrs. Civil Defence & Police Update (from New Brighton), Maori Wardens Update. Lack of toilets is a problem. Port-a-loos urgently need to be cleaned. Need for medical/nurses staff. Need for water containers. Concerned that no one is visiting and checking on people's well-being in their homes. Reports that security staff at some Welfare centres are "unfriendly" to Maori Wardens. Meetings organized with Welfare centre managers. Marae Updates – all activated; Call Centre Update – pamphlets being organized; Emergency Relief – water, food, toilets needed; Logistics and Supply – not enough assistance; Te Arawa Nurses / team deployed to Aranui, Wainoni & New Brighton: Public Briefings at 10.00am & 7pm: Welfare centres report Pioneer 700pax, .Burnside 800 pax, Rangiora 360 pax, Windsor?, Rolleston on Standby, Cowles Stadium operating as a info centre/referral centre only. KAITAHU as a helpline & call centre facility 6000 leaflet drop of Earthquake Emergency Helplines, Marae phone numbers and addresses to be delivered by wardens and volunteers. MOE – no schools open till 7th March, 27 seriously damaged, 50 moderate damage, remainder minor damage. WINZ mobile services deployed to East side, 14,500 emergency payments made, 20,000 super annuitants called – 19495 checked, 8 referred to emergency and 90 site visits conducted. Operation Suburb 14 day target to visit 50,000 homes "red" (people must leave), "yellow" (restricted access, can take personal belongings), "green" (safe).600-1000 Wed, 7000 – 40,000 over the next 2 weeks. Pacific Recovery Network visiting HQ daily and stationed out in the suburbs and Hampshire St Hub. Liaison with Public Health officials re hygiene, water quality checks and establishing hygiene protocols, boiling water and food preparation. Meals at HQ for 120 – 200 volunteers. Hygiene Stations: with water, face masks, hand sanitizing solutions set up. Reports of issues of at least 20-25 families located in Council flats in Shirley, elderly and disabled people have been registered with Red Cross but need medical attention, swollen ankles, diabetes....

(continued)

<u>**Day 7: Tues 1st March 2011:**</u> Updates from Police, Fire, CDEM & Kohanga Reo, Rotorua Maori nurses run out of their own medical supplies and produce an itemised list of emergency supplies to be topped up
<u>**Day 8: Wed 2nd March 2011:**</u> Updates from Marae, Police, Fire, CDEM, Kohanga Reo, Maori Nurses Visits & needs assessments with Whanau of Maori mental health & disability services underway. Te Arawa Nurses request for basic medical supplies denied by CDHB.Working on a strategy to remove barriers for this request.Ngai Tahu asks for meeting with CDHB officials to work through this issue.
<u>**Day 9: Thurs 3rd March 2011:**</u> Operation Suburb and first field reports completed with main concerns being: Isolation and lack of services; Sanitation and sewerage discharge flowing into streets; Lack of access to water; Complaints about no portal-loos in Avonside; Noted there is about 50% occupancy in Avonside. MARAE Status: Nga Hau e Wha Marae still not cleared for use; Tuahiwi 200 meals prepared per day and taken to whanau in need; Rapaki – GP on standby, no internet access, 8 houses "red", Counsellor on site, in process of drafting evacuation plan; Kaikoura – preparing for 50 new arrivals, food is sufficient; Otautahi Runaka met with Diplomatic Corps to discuss rubble from the sites of the tragedies being given to families & Blessing of the Burwood landfill for more rubble to be temporarily stored. NZ Police: Mihi whakatau for Japanese Diplomats and families (Blessing ceremony) at Burnham Military camp, Cultural guidance and support for Coronial Unit established. Blessing for site. Blessing of the CTV site for all rescue workers and the rubble that is to be taken to designated landfill sites: Blessing of the memorial stones that will be given to families of victims – ceremony conducted at Burnside High School. Evening meal at Rehua for Israeli DVI contingent
<u>**Day 10: Fri 4th March 2011:**</u> MP Rahui Katene: Tuahiwi Marae cooking 200 meals a day, Kaumatua are refusing to accept money for this, food is being sent into city by whanau members using their own transport: Tuahiwi advises they expect to be on stand-by for 6 weeks: Rahui requests funds from TPK to provide Tuahiwi with funds so Marae can continue providing food and TPK actions request and deploys personnel to Rapaki and Tuahiwi. Otautahi Runaka prepares paper to define difference between regular rubble and kokakoka tapu (sacred rubble). Nobody has access to any of this rubble except through Ngai Tahu, Police & NZ Fire service.
<u>**Day 11: Sat 5th March 2011:**</u> 400 houses visited in Eastern suburbs: 480 calls to 0800 kaitahu line, 21 calls from 0800 quake;124 referrals made to Maori health and social services, The flying squad, builders, labourers, transport providers: Key issues – homelessness, many whanau do not have water containers, relocation assistance, lack of access to water, whanau unable to go to welfare centres
<u>**Day 13: Mon 7th March 2011:**</u> Nga Hau e Wha Marae to be given clearance and will be an EQ Recovery Assistance Centre supported by CDEM, CCC, MSD. OPERATION SUBURB – Maori Wardens visited 160 houses in New Brighton, 42 calls to 0800kaitahu, 2 referrals to 0800 quake, 39 referrals to health and social services, builders, labourers. It is noted that after almost 2 wks of no water, power or sewerage, people do not appear to be coping well. Nga Hau e Wha Marae to be opened as an EQ Recovery Centre – hundreds are visiting. Most pressing issue – access to toilets and unattended health issues. Te Arawa Nurses continue to work in the areas. Concern regarding people with disabilities including deaf and blind not being visited in the same way Maori are being visited.Need more people on the ground to help with these visits.
<u>**Day 14: Tues 8th March 2011:**</u> 49 houses visited 27 calls to 0800 quake requests for info and financial assistance, 2 calls to 0800Quake.33 referrals made to Maori health and social service; Ceremonies/Blessing for Chinese families to visit morgue at Burnham Military camp; Farewell arranged for Israeli DVI team and contingent from Japan supporting families of victims killed in earthquakes: Nga Hau e Wha Marae is cleared by engineers and supported by CDEM as an EQ Recovery Assistance Centre (RAC). Maori trauma/therapeutic team, Positive Directions Trust, ORA Network, Ngai Tahu staff, EQ Recovery Coordinators, Community Law Centre, CCC Maori Liaison, IRD liaison,

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Day 15-22: Wed 9th -Wed 16th March 2011: EOC Updates; Maori Community Hui 16/3/2011 "Where to next" after the national emergency is over?
Consultation Paper to be developed from 16/3/11 hui and feedback from Maori community to 21/3/2011 hui
Day 23-27: Thurs 17th- Mon 21st March 2011: 21/3/11 Consultation Paper on Maori Recovery Plan tabled by S McMeeking for feedback.
21/3/11 Ngai Tuahuriri (Manawhenua representatives) feedback to Hui is that the Maori Recovery plan is not needed and planning and decisions will be through TRONT Te Awheawhe Ruwhenua Working Group.
21/3/11 Report on the activities of the KSG is tabled by Jane Huria. Except for Nga Hau e Wha all Marae have stopped EQ emergency and relief. Nga Hau e Wha Marae will remain open. Govt and community social service agencies are on standby. Over 100 Earthquake recovery coordinators are still operating to assist with relocations, financial hardship, insurance and repairs. Community Showers still available at Cowles Stadium, Avonside, Kaiapoi.
The way forward is identified clearly by Ngai Tuahuriri representatives at the Hui:
• Iwi and Manawhenua as statutory partners to CERA;
• Ngai Tahu will comment on CERA's Recovery Plan and Council's Plans CBD Rebuild
• He Oranga Pounamu will liaise with CERA on Maori health and social wellbeing
• Mahaanui Kurataio Ltd will liaise with Councils on city planning
Maori Response Network Shut Down

Appendix B: Kaikoura Earthquake 2016 Maori Recovery Network MRN Timeline

The Kaikoura Time Line as reported in situational reports (the accuracy of these are difficult to confirm), field/diary notes, meetings/hui, reports and data gathered at Takahanga Marae in Kaikoura from 19th to 23rd November 2016. This timeline is from the perspective of Maori and the Takahanga Marae in Kaikoura.

Earthquake Occurs: 12.02am on the 14 November 2016 a 7.8 earthquake strikes NZ near the coastal town of Kaikoura. Access to Kaikoura is cut off by landslides. All roads and rail connections are out indefinitely with bridges down. The only access is via helicopter. There is confusion within Civil Defence Emergency management CDEM (http://www.stuff.co.nz/national/nz-earthquake/86654229/Timeline-of-the-7-8-quake-and-response-reveals-plenty-of-room-for-improvement.)
The boat harbour had been rendered almost useless due to the seismic upheaval of the coast line and there are many stranded tourists. The 111 phone line fails and by 12.57am there is confusion amongst CDEM as to whether a tsunami warning should be given as a 2 metre tsunami had already hit the town.
14 November 2017 Monday Day 1
"Slow shaking and then the power went off and I got thrown across the room. I lost my glasses and was completely in the dark." One survivor's experience of the earthquake.

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Two deaths have been linked to the quake, and more than 20 people were injured. Transport was disrupted including state highway 1 between Blenheim and Picton, State Highway 6 between Blenheim and Nelson and State Highway 7 between Springs Junction and the Waipara are all closed. Several bridges on the state highway network were reported as damaged and closed. Hanmer Springs is cut off. Rail networks in the lower North Island, and between Christchurch and Picton, are closed. All InterIslander ferries had been cancelled. (http://www.civildefence.govt.nz/resources/Kaikoura-earthquake/#tpk).
Kaikoura was effectively and the only access was by helicopter.
By midday, about 40 tourists had been airlifted. The NZ Defence Force (NZDF) expects to make 16 flights in total today, each one taking about 12 people with priority for those with medical conditions, pregnant women, families with children and the elderly. The Chinese Embassy charters a helicopter and starts to evacuate Chinese nationals; this causes confusion amongst non-Chinese about how they should be evacuated. This is confused further by responsibilities for camper vans and cars as hire companies insist that it remains the responsibility of those that hire the vans to get them back.
Ngai Tahu (Iwi) Fishing empty any supplies they have in Kaikoura for the response and Iwi Representatives arrive with satellite phones. They have been able to divert their own helicopters to assist and set up the Marae response at Takahanga Marae. They start to bring food in bound and take children and grandmothers/aunties out bound to Cheviot and then onto Christchurch by road.
Nonetheless, there are estimated to be about 600 to 700 tourists wanting to leave Kaikoura. The Marae opens doors for those affected by the earthquake despite not having power, water, toilets or food. The big issue is no water. (https://diplopundit.net/2016/11/page/3/).
On Monday night, between 70 and 100 people remained at Takahanga Marae with nowhere to go. That was a significant drop on the 700 people who had stayed at the marae following the earthquake in the early hours of Monday morning. (https://diplopundit.net/2016/11/page/3/).
This is reported on National Television and local Maori stay away from the Marae and thus the Maori Response to the 225 families on the Marae database is immediately hampered.
15 November 2017 Tuesday Day 2
Radio New Zealand RNZ reporter Tim Graham in Kaikoura said basic supplies in the town appeared to be running low. A queue of about 200 was outside the local New World supermarket and bread was being rationed to about two loaves per customer. The local petrol station was backed up with vehicles.
The Red Cross was also sending helicopters to take tourists to a welfare centre north of Christchurch and St John paramedics were to be flown in to relieve crews and deliver supplies. Two navy ships are sailing to Kaikoura overnight from Auckland, picking up supplies on the way, and are expected to arrive by tomorrow.
The Takahanga Marae deputy chairperson, Major Timms, says the town's concrete water tank has split in two. The Marae yesterday fed about 700 people in the aftermath of the quake and is expecting large numbers again today.
Mass evacuations are due to begin this morning. The estimates are that 1,200 tourists are believed to be stranded in Kaikoura: 50 helicopters will also help evacuate them.
The first wave of responders from Christchurch arrive including a Controller, Emergency Operation Centre (EOC) staff including an operations manager, engineering support, planning and intelligence, welfare manager and staff, building and structural engineers. (http://ipwea2017.co.nz/wp-content/uploads/2016/06/Innovation-n-Resilience-abstracts-as-at16-Dec.pdf).
CDEM acting national controller Shane Bayley said anyone who wanted to get out would be able to do so on helicopter flights throughout Tuesday, weather permitting. (http://www.cowraguardian.com.au/story/4293029/quake-leaves-communities-stranded/?cs=12).
Those staying in Kaikoura are battered by thunder storms and aftershocks.

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Power and communications were still “intermittent” and there was a big effort going on to get the inland roads into Kaikoura up and running but it will take a couple of days.
Interestingly, the US Embassy’s updated message directs anyone with friends or family in Kaikoura to make their way to the Takahanga Marae Welfare Centre to register with the Red Cross to be on the evacuation list. It is not clear to the Marae how or where this has come from and moreover, the Red Cross was never established at the Marae.
16 November 2017 Wednesday Day 3
6,500 meals supplied by the Marae at this point.
The amphibious sealift vessel HMNZS Canterbury evacuated around 450 people out of Kaikoura to Christchurch. The Royal New Zealand Air Force’s 3 Squadron evacuated another 60 people and delivered two tonnes of aid to Kaikoura, bringing to about 660 the total number of people evacuated from the quake-damaged town. Surveillance aircraft from the United States Navy and the Japan Maritime Self-Defense Force also conducted surveys of quake-damaged areas, focusing particular attention on inland and railway routes.
Canterbury fishing crews are frantically relocating exposed paua (or abalone) back underwater. Parts of the coast seabed have been raised by 2- 5 metres. This would later become a major issue for the Marae. Paua Industry Council chairman Storm Stanley said the patches of raised seabed stretched from the Kaikoura coast through to Cape Campbell in Marlborough. Thus, affecting many of the region’s most important paua grounds and reefs, he estimated tens, if not hundreds, of tonnes of the edible sea snails had been left high and dry. With paua able to survive for only few days out of water, he said Kaikoura and Marlborough crews were racing to save the animals. (http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11749080).
Between 700 and 1,000 people still require evacuation. HMNZS Wellington starts to survey the Kaikoura harbour to find a suitable area for the HMNZS Canterbury to begin evacuating people. HMNZS Te Kaha and USS Sampson are also en-route to provide support.
50% of Kaikoura has access to the town’s water supply. Door to door welfare checks are continuing. People are being asked not to donate goods to the affected regions at this stage. (http://www.civildefence.govt.nz/resources/Kaikoura-earthquake/#tpk).
It is noted that it would be useful if the National News did not keep saying how resilient it was in Kaikoura as people that perhaps should be seeking assistance were holding back and being resilient when perhaps they really are the ones seeking assistance. One example of a 3 bedroom house with 32 extended family members staying in it…plus their 4 dogs outside. They felt OK but it was evident that they should receive assistance. Other examples of those not coming forward was for food parcels…these were more common later as the response continued. In addition, it was noted that news about the situation in Kaikoura was faster from overseas sources than locally…. And moreover that the National news reports did not seemingly tie up with the reality on the ground.
17 November 2017 Thursday Day 4
“At 1.00am the HMNZS Canterbury docks at Lyttleton Harbour back in Christchurch successfully evacuating 449 people out of the quake affected community of Kaikoura. Many were tourists taken to the safety and comfort of welfare centres in Christchurch” reported CDEM.
“Yesterday also marked the first successful vehicle passage through the Inland Road (Route 70). The NZDF will be conducting further assessments of the road today. The road is still high risk and is not yet open to private vehicles. We are doing everything possible to get the road open, but we’re asking people not to attempt to use the route for access in or out of Kaikoura until we’ve finished the urgent work needed to open it safely”. (http://www.civildefence.govt.nz/resources/Kaikoura-earthquake/#tpk).
This would be short lived.

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"We have completed the successful evacuation of everyone who wanted to leave Kaikoura yesterday on the HMNZS Canterbury. Only tourists who did not express their wish to be evacuated are remaining in Kaikoura".
"More than 800 people have been evacuated from Kaikoura by NZDF and they are being supported by Canterbury CDEM Group".
Many evacuees are foreign visitors and embassies from their countries were there to greet and comfort them. Embassies include Australia, Korea, UK, Germany, France, USA and Japan. Wrap around support is being provided to make them feel safe, provide translation services, and assist them with either returning home, or continuing with their planned travel.
Some of the ships from the International Naval Review have arrived in Kaikoura, ready to support the delivery of relief supplies.
HMNZS CANTERBURY is being loaded with relief supplies at Lyttelton and will soon sail to Kaikoura.
The Prime Minister announced earlier today a $7.5 million wage subsidy package for affected businesses. A hotline is set up which many cannot access due to re-charging phone issues. This is welcomed on the Marae. (http://www.maoritelevision.com/news/regional/Kaikoura-businesses-grateful-government-national-response).
18 November 2017 Friday Day 5
"Responders are working hard to assess damage, restore lifelines, utilities, complete the infrastructure repairs needed and restore access. We will be focusing on those rural isolated and vulnerable households and continue to work with communities through the transition from response to recovery" say CDEM.
"Despite reports, the Inland Road is NOT open to the public and will not be open to the public by Saturday. There is concern that cracks may open and slips may occur due to the current deteriorating weather. Teams working to open the Inland road were pulled out on Thursday due to unsafe conditions….It is not known how long it will take for this route to be clear and safe. Members of the public must not attempt to access the road." Reports CDEM. (http://www.civildefence.govt.nz/resources/Kaikoura-earthquake/#tpk).
The Marae/Maori continue to have issues engaging with Govt departments in Kaikoura. The Ministry for Social Development MSD express concerns about their safety and are apparently swapped over for a Christchurch based team. Stories are emerging of one lady that walked from one isolated bay with a 3, 5, 7 and 13 year old girls. It is clear that there are un-identified needs in the rural areas and while some communities are coping well others are not.
19 November 2017 Saturday Day 6
Government officials and volunteers hoping to rescue paua clashed near Kaikoura. Volunteers were told by officials from the Ministry of Primary Industries MPI that they were breaking the law and could be arrested. About 300 volunteers were preparing to move the stranded paua to the sea when MPI officials arrived and told them to stop. Volunteer Ben Kepes said the MPI action was "bizarre". "There was quite a bit of disquiet. Some people just wanted to go ahead and do it anyway, but the organiser said we had to comply," he said. The MPI has denied reports that it sent a letter to volunteers today stating they can continue moving paua along Kaikoura's coastline. MPI insisted that the paua should be left where they are above water, as "it's a normal habitat" where they can survive. Volunteers were frustrated. MPI staff were originally helping the 300 strong team but that changed yesterday when new advice from the department said people should leave them alone. Volunteer Ben Kepes called the move an example of bureaucracy getting in the way of common sense and pragmatism. (http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11751344).
Marae folk now attending the EOC meetings but having serious issues in getting petrol chits to visit and assess rural Maori families. The food bank is rationalised and categorised for field teams and locals seeking assistance through the Marae.

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20 November 2017 Sunday Day 7
Reported food in the supermarkets and money in the Eftpos machines but this was minimal and did not cover basic items or pricing. "All the cheap stuff has gone and no meat" was the comment at the Marae.
Volunteers say they will defy a ban and continue rescuing paua along Kaikoura's coastline at the first low tide tomorrow after being granted a permit from the Runanga (local Maori Authority). The Runanga based at Takahanga Marae strongly supported the volunteers and Mike Vincent states that the volunteers are "back in business" and that "We are going to be saving paua." (http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11751841).
Tonnes of paua along the coastline have died but many are still clinging to rocks protected by kelp. At a hui at the Takahanga Marae in Kaikoura the Runanga representatives said they wanted the rescue efforts to continue. Paua had an important place in the Runanga's culture as was reflected in the marae's meeting house carvings.
"A particular focus is reaching isolated rural communities and families to ensure that their needs are being met," says Sarah Stuart-Black the Director of CDEM.
"Services to affected towns continue to be restored and additional services such as port-a-loos, shower units, fuel and groceries are being supplied. Another NZDF convoy delivered additional food and water to Kaikoura today which was good news." The inland road (Kaikoura Emergency Access Route) remains closed. "We know that the closure of the road is causing frustration for some people and we are doing everything we can to move people and goods to where they need to be. It's a case of balancing the provision of essential supplies to those who need them and ensuring that people stay as safe as possible" she said.
The Canterbury CDEM Group are working with the New Zealand Transport Agency to manage control of the road using a permit system combined with closures when necessary as the risk changes. (http://www.civildefence.govt.nz/resources/Kaikoura-earthquake/#tpk).
After a week of looking after visitors and earthquake response workers, Takahanga Marae served its last community meal, making it 10,000 meals in 6 days. This is despite NOT being a Civil Defence Post, a designated Welfare centre or having or water supply and according to the Marae. The meals came about because the Council/EOC just started sending people up from 8am on Monday. There is frustration on the Marae. In addition, local Maori have stayed away from the Marae because of the crowds that they are seeing on National Television. The role of food distribution would be presumably taken up by food parcels through the NZ Red Cross but it is not clear.
Marae social workers and locals continue to have issues getting petrol chits that hampers distribution and assessment operations (2 Maori women were allegedly assaulted). The Mayor makes his first visit to the Marae. There are apparently conflicting messages from the EOC and CDEM. EOC were saying there is no timeline for the road access due to overhanging rocks while on the other hand CDEM seem to provide confirmed dates (see Friday 18 November). Noted that check points are not manned at night and this seems to be allowing people through to poach paua; EOC don't seem concerned. The Marae is also fielding comments that Maori have stock piled food.
21 November 2017 Monday Day 8
As of Monday 21st, there were also 47 aftershocks in the M5.0-5.9 range, and 3 aftershocks in the magnitude M6.0-6.9 range.
Brett Cowan representing the Runanga said he had visited Goose Bay to see the paua rescue effort for himself and believed they were doing a professional job and had good processes.
Drone checks made of Peketa for burials remains that may have been exposed by slips. EOC are very helpful and sympathetic which was greatly appreciated by the Marae leadership. On the other hand the Marae has a freezer full of dip to use up. Door to door knocking is well under way with the te Putahitanga Navigators that were flown up from Christchurch.

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A few Kaikoura Councillors meet on the Marae with local Maori leaders. This is the first time.
22 November 2017 Tuesday Day 8
A MPI spokesman said a ministry scientist had gone back to inspect relocated paua on Tuesday. The scientist would consult with other scientists before a decision could be made about whether to sanction the rescue efforts. Science had to prevail. (http://www.stuff.co.nz/national/nz-earthquake/86759696/paua-rescuers-wait-for-officials-blessing).
Those based at the Marae and the te Putahitanga Navigator staff having issues getting petrol to be able to do surveys. Sense on the Marae is that Maori do not seem to have a place at the table. For example, Maori burial sites are being seen as archeologically sites rather than sacred cultural sites. There is confusion over who will be looking after the food distribution and exactly where that will happen. It seems that it will be at least 2 weeks before the local supermarket will open and any items are the expensive brands and people from the Marae have been living on sweets such as "jelly babies, jet planes and fruit bursts".
The Harbour will need 40,000m^3 to be excavated which will take at least a year to complete. Until then only smaller craft than usual will be able to use it. Thus, there will be staff down turns to come.
Issues with the original Declaration of Emergency between different Territorial Authorities are now being aired as people reflect back on the disaster and consequent issues with the response.
23 November 2017 Wednesday Day 10
By noon on Wednesday 23 November there had been 4,879 aftershocks detected.
EOC have developed an earthquake support factsheet with partner agencies, with information for anyone affected by the earthquake. This includes advice on:
• Stress, counselling and support
• Accommodation and housing
• support for rural communities
• Iwi, hapū and whānau Māori support
• Financial support for individuals and businesses
• Insurance and EQC claims
• Schools and Early Childhood Centres
• Children and young people
• Health and hygiene
• Animal welfare
• Tourism and international visitors
24 November 2017 Thursday Day 11
"Work is continuing on the Kaikoura Emergency Access Route (Inland Road), with Mt Lyford residents granted conditional access last night" reported by EOC.
"I understand residents are feeling frustrated that there is no public access along this road, but the people on the ground are doing everything they can to ensure the road is safe before it is open to the public. Today's decision to provide conditional access to residents up to Mt Lyford is a positive step." (http://www.scoop.co.nz/stories/AK1611/S00757/kaikoura-earthquake-media-release-19-24-november-2016.htm).
Because aftershocks are expected to continue, access to the Kaikoura Emergency Access Route (Inland Road) and other roads can change at any time.
Last night the local CDEM Controller decided to evacuate residents from Goose Bay as a precautionary measure, after a dam created by a landslide was discovered. Geotechnical engineers advised that the size of the dam and the forecasted bad weather meant it could breach anytime. (http://www.scoop.co.nz/stories/AK1611/S00757/kaikoura-earthquake-media-release-19-24-november-2016.htm).

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25 November 2017 Friday Day 12
"The Kaikoura Emergency Access Route (Inland Road) is in a much better condition than it was 10 days ago and work is continuing to get the road open so businesses can start operating again." Plans are proceeding to provide a safe and coordinated road evacuation from Kaikoura for some residents and visitors from 1p to 3pm today. This is for one-way travel from Kaikoura in a southward direction only. ('http://www.civildefence.govt.nz/resources/Kaikoura-earthquake/#tpk).
27 November 2017 Sunday Day 14
Volunteers and organised groups continue to relocate affected paua. Mike Vincent, founder of the paua rescue group, estimated they had relocated between 20 and 50 tonnes of paua. He said MPI and commercial divers who had inspected the relocated molluscs were "pretty impressed" with the results.
"They couldn't find any dead stuff. Everything that's been positioned was still there and looking good." Vincent said the volunteers had not been able to save all the paua. The smell of dead sea life was mostly "a weedy smell", because seagulls had cleaned up most of the dead paua, he said. "Nature's doing its thing, mate."
The volunteers would continue their work in coming weeks, as the New Zealand Transport Agency allowed access to more areas of the coast. Vincent said they had left areas with a lot of bull kelp until last, because the paua would be able to survive in the damp environment out of the sun. "We just want to get on with is so we can save as much as possible," he said. "It's been a massive effort and I would like to thank Te Runanga-o-Kaikoura, MPI and the Kaikoura Paua Relocation and Relief effort for their combined support for the continued relocation of our precious taonga". (http://www.stuff.co.nz/national/nz-earthquake/86954957/kaikouras-relocated-paua-doing-well) (http://www.maoritelevision.com/news/regional/efforts-relocate-kaikoura-paua-continue).

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Building Energy Resiliency in the Asia Pacific – Providing Transition Pathways for a More Secure and Sustainable Future

Neil Greet

Abstract The global energy system is under stress with volatile oil prices, the challenge of climate change and economic uncertainty bearing down. Now is not the time to pretend that a 'business as usual approach' across the Asia Pacific energy sector is a viable strategy which provides resilience. Currently, energy policy is stove piped and sector biased which does not reflect the multifaceted nature of energy. Addressing energy security in vulnerable cities requires a change in thinking. The traditional International Energy Agency (IEA) definition of "energy security as the uninterrupted availability of energy sources at an affordable price", doesn't come close to addressing complex uncertainty. Energy planners in the Asia Pacific must consider the interconnected vulnerabilities of: technological innovation; resource climate management and security; geo-strategic competition; demographic shifts, efficient governance; social cohesion and trust; and hybrid and asymmetric threats. Failure to change the way nations think on energy is a failure to prepare for change.

Keywords Energy security • Sustainability

1 Introduction

The Asia Pacific region will face enormous challenges in the coming decades. Much speculation will be on daily grind of political divisions and the spectre of conflict whether it be economic or military, but the greatest threats arise from the mega trends of climate change and demographics. It is these long-term trends of extreme discontinuity that see the world facing challenges of immense proportions across the food, water and energy nexus. Supply of secure energy to growing and heavily

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_8

urbanised populations facing greater threats from climate change is a critical manifestation of the fusion of the mega trends.

Addressing energy security in the Asia Pacific requires a change in thinking. The traditional International Energy Agency (IEA) definition of "energy security as the uninterrupted availability of energy sources at an affordable price" (International Energy Agency, Definition of Energy Security 2017), doesn't come close to addressing complex uncertainty. This definition explicitly supports the complacent view that continuing economic prosperity is assured through well-developed energy markets. Yet the global energy market is being disrupted, in ways not seen for a century, and energy systems are grappling with increased risk. To prepare for uncertain future, the energy security paradigm must be changed to explore complex and systemic vulnerability.

Climate change exasperates energy system vulnerabilities particularly in cities. Asia-Pacific cities are at risk from disaster where half the region's people live in urban areas, and by 2050 that proportion could rise above two-thirds. Many cities already struggle to provide basic services such as roads, water supplies, and sewage disposal, leaving the poorest people, especially those in slum areas, highly exposed to sudden shocks. Around 740 million city dwellers in Asia and the Pacific are now at 'extreme' to 'high' disaster risk – often living in multi-hazard hotspots that are vulnerable to cyclones, earthquakes, floods and landslides.

So how can the cities of the Asia Pacific address future energy security shocks? A resilience based approach requires addressing not just the shocks—earthquakes, fires, floods, etc.—but also the stresses that weaken the fabric of a city on a day to day or cyclical basis. By addressing both the shocks and the stresses, a city becomes more able to respond to adverse events, and is overall better able to deliver basic functions in both good times and bad, to all members of the community.

Transitioning to a resilient energy framework is about adapting to disasters and mitigating future uncertainty. While transition pathways cannot ignore the starting point of existing systems, the fundamental goal is to prepare for future uncertainty and avoid the potential catastrophic and systemic failure of life giving energy systems. All nations in the Asia Pacific must change the way energy is considered in national policies and the way it is delivered to the community. Failure to change the way nations think on energy is a failure to prepare for change.

2 Redefining Energy Security for the Asia Pacific

Achieving energy resiliency in the Asia-Pacific requires a definition that acknowledges system complexity across the four key domains of:

- economic and national security,
- food and water security,
- sustainable development and environmental security, and
- social stability and energy stress.

These dimensions represent the domains where energy security create vulnerabilities. It is in these domains that stakeholders identify how energy insecurity arises or how energy security can be obtained.

The domains reflect the lens through which energy security is viewed, and the chosen lens is a function of the stakeholder's interests and mandates. For example, examining energy security through an environmental lens means that energy insecurity can arise due to the production of greenhouse gases and other pollutants, and a source of increased energy security is reduced reliance on fossil fuels.

Time is a key factor across all the dimensions. If only a short period is considered, there is a focus on shocks in energy supply or demand, or other rapid onset consequences. The time factor is often described in terms of short-, medium- and long-term energy security risk factors. For petroleum products, for example, sources of increased security for short-term risks are building up or accessing oil reserves, rationing of petrol, and emergency energy conservation initiatives. If medium-term risks are considered, sources of security improvement including building additional generation plants, augmenting existing transmission lines to meet predicted summer peak load, or introducing new product energy efficiency standards. If long-term risks are the focus, sources of security could include decoupling energy consumption and economic growth, decarbonising the economy, or bolstering energy diversity through nuclear power.

A multi-dimensional view recognises that there is often a conflict between stakeholders in different dimensions over the sources of increased energy security. More importantly, the identification of competition between domains of energy security leads to active negotiation between parties and management of conflict instead of accepting entrenched disagreements and continuation of 'stovepiped' solutions. The dimensions are not mutually exclusive but invariably overlap and are interrelated. In some dimensions, sources of energy insecurity are sources of security in other dimensions and vice versa.

3 Energy Security, National Economic Security and National Security

National economic security, national security and energy security are highly interrelated and can reinforce and undermine one another. Both national economic security and national security are concerned with protecting sovereignty and independence as well as advancing national interests and values internationally. Economic security focuses on sources of economic harm whereas national security focuses on foreign powers and increasingly non-state actors.

The importance of energy to economies is reflected in the fact that large economies can spend up to 5% of their GDP on importing oil while smaller energy-importing countries can average 10%. The amount varies considerably with the global price of energy as the USA spent over 8% during the 1979 oil crisis.

The last few decades have seen growing globalisation where national economies have become increasingly integrated into the international economy through trade, foreign direct investment, capital flows, and the spread of technology. In terms of national security, growing economic development has also generally delivered societal and political stability. However, economic globalisation carries significant attendant risks. The very nature of integrating into an international system involves introducing vulnerabilities through economic dependencies. Unexpected interruptions to exports and import supply chains are a fundamental vulnerability and need to be actively risk managed. If the supply chain is not well managed, it can lead to economic and social dislocations such as losses in jobs and industries that are priced out of the market due to cheaper imports, inequity, inflation due to the internationalising of domestically produced inputs, and trade imbalances.

For energy intensive and energy importing countries, such as China, Japan and the USA, reliance on foreign countries' supplies can be viewed as a significant national security risk as it grants other countries the potential to apply undue pressure. The dependence on foreign energy can also mean that an importing nation can suffer collateral damage because of a dispute along the energy supply chain. One example of this relates to the natural gas pipeline from the gas fields in Russia across Ukraine to Europe. In 2009, a dispute over payments between Russia and Ukraine escalated and resulted in Russian gas flows through Ukraine being halted for 13 days. The consequence was that supplies to south-eastern Europe were cut.

Dependence on international supplies of energy also results in an importing country's economy being affected by price changes due to global shifts in supply and demand. For countries that have import pricing parity, energy price changes pass through the economy rapidly affecting inflation, and demand and supply of goods and services. For countries that regulate energy prices, price rises can be mitigated by increasing energy subsidies which over the longer term can become a huge burden on an economy and distort economic activity. The alternative is removing the subsidies; however, the consequence can be politically contentious and even lead to physical violence. An example was the violent protests following the decision by the Indonesian government to cut fuel subsidies in July 2013.

Concern by energy importing nations over a lack of resources can be a contributing cause to tensions between countries, sometimes even leading to war. An historic example from the Asia Pacific region was in 1940 when the United States placed an embargo on all oil exports to Japan, which was a contributing factor to the invasion of oil-rich Indonesia (then Dutch East Indies).

Within countries, the distribution of wealth from resources has been a prime cause of struggles, rebellions and even civil wars. Protection of energy security has been a major driver for US foreign policy as seen in the Carter Doctrine which states that any outside force seeking to control the Arabian oil producing region would be deemed to be an attack on America.

The link between energy and economic development is not only a concern for energy importing nations. For nations that depend on energy export income as a substantial component of their government revenue and foreign exchange, there is an obvious link between energy security of (export) demand and national economic security. Some Middle Eastern countries obtain up to 80% of their governmental income from oil exports, and any disruption will have enormous economic ramifications. For these countries, disruptions to their oil income can lead to unpleasant options: ballooning budget deficits as they continue to maintain their welfare and economic growth; or widespread joblessness, poverty and even political protests that can lead to regime change.

Since the terrorist attacks in the US on 11 September 2001, a new focus of energy security has arisen globally. It has been the protection of energy production infrastructure from malicious attacks. In the decades prior to 2001, the threat of a malicious attack on energy infrastructure was a low risk. After 2001, protection of energy infrastructure against terrorist attacks became a priority. Nowadays, there is a much greater threat spectrum being considered in relation to energy infrastructure. Threats now include politically motivated violence, abduction and hostage taking, cyber-attacks, blackmail, and theft of valuable materials such as copper wire.

In summary, from a national economic and national security perspective, key sources of energy insecurity arise due to:

- The globalised nature of the economy exposing energy exporters and importers to risk.
- The politicisation of Australian energy supplies by importing nations, thus affecting demand.
- The location of energy facilities and the route of supply chains.
- The dependence on foreign oil, needed for military operations.
- The ‘protection’ of a Nations energy supplies affecting sovereignty and territorial independence.

4 Energy Security, and Food and Water Security

While national security and economic security are well understood tools of the nation state in globalised activities, there are rising challenges to security. Climate change, food security, water security and energy security are interrelated as reflected in Fig. 1.

Increase in food production has been one of the world’s greatest achievements in the past century as the population has grown from 1.6 billion in 1900 to over 7 billion in 2014. This has required massive direct water inputs, notably for irrigation and water intensive processes. Modern food production is also heavily energy intensive in terms of fertiliser, on-farm transport, food processing, storage and transporting.

Water production, both for agricultural and non-agricultural purposes, requires enormous energy inputs. This includes the pumping and use of ground water, production of desalinated water, and treatment of wastewater. Energy is also used in potable water treatment, transport and distribution.

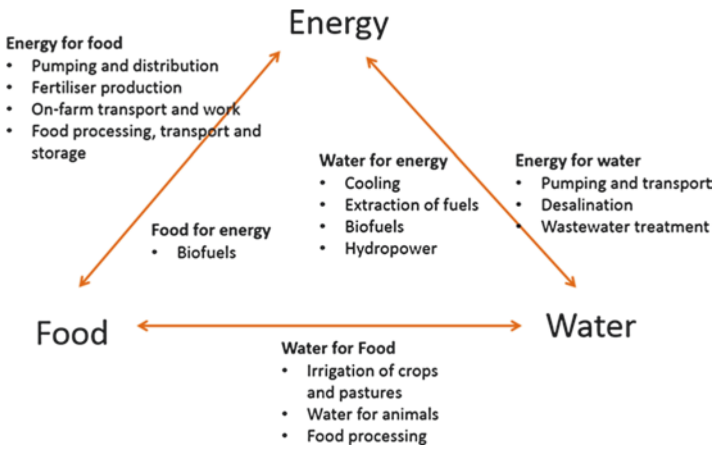

Fig. 1 The climate, food, water and energy security nexus

Energy production requires substantial volumes of water particularly hydroelectric power. Water is also used in the extraction, transport and processing of both fossil and synthetic fuels.

The use of water in energy production can have a significant impact on freshwater resources. It not only affects the availability of water downstream but it can also affect both groundwater and surface water in terms of its physical and chemical properties. An example of the multiple consequences can be seen in the extraction or use of water in fracking: high-pressure hydraulic fracturing of underground rock formations for natural gas and oil. The injection of chemicals can cause their leaching or movement of contaminates into the surrounding aquifers. Water withdrawn from the coal beds can also cause water loss from surrounding aquifers. Both can reduce the agricultural potential of the area that is dependent on ground water. In addition, the water extracted from the coal bed is contaminated and if released without the proper environmental consideration, can have a negative impact on surrounding water courses, land and coastal areas.

Most renewable power requires far less water than thermal power plants in the production of energy, but as with conventional energy sources, renewable energy requires considerable quantities of water to process raw materials to build turbines, solar panels, wave generators and steel/concrete supporting infrastructure. Finally, water is used extensively in the growing of biofuels. Globally, the IEA predicts that water consumption to produce energy will double in the next 25 years, primarily due to the increase in coal-fired power plants and increased biofuel production as seen in Fig. 2.

The impact on climate change because of energy consumption is well identified. The burning of fossil fuels, principally coal for power generation and refined oil products for transport, is the dominant source of anthropic carbon generation. Climate change also affects demand for energy due to increased cooling and heating, as well as driving additional engineering work to develop a more resilient built

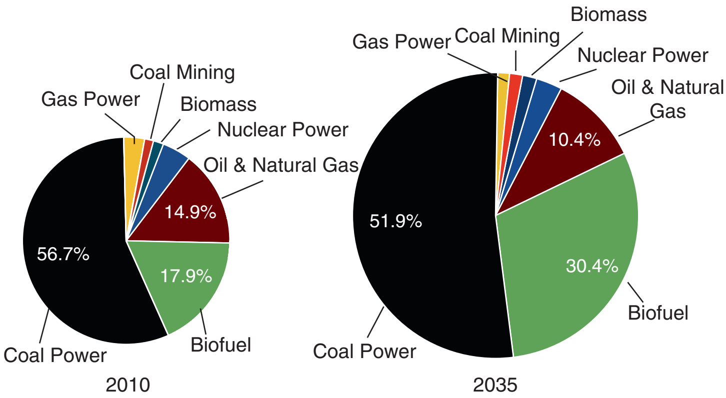

Fig. 2 The growth in water use for energy production (Source: International Energy Agency, current policies scenario)

environment. It also impacts on the availability of water, due to changes in precipitation and evaporation. Climate change also affects food production, through changing growth rates, and water consumption.

From a food and water security perspective, key sources of energy insecurity arise from:

- Dependence on inorganic fertilisers that consume vast amounts of natural gas in their production.
- Heavy reliance on liquid fuels and electricity across the food supply chain.
- Dependence on energy for producing desalinated and running potable and wastewater systems.
- Reliance of hydropower on rainfall and runoff.

5 Energy Security, Sustainable Development and Environmental Security

While national economic, national security, food, water and human security are all interrelated with sustainable development and environmental security, these latter two issues can be treated discretely, as unlike the former where the focus is on human related referents, the latter two focus on the environment itself as the referent.

Environmental security involves the minimisation of anthropogenic threats to the functional integrity of the biosphere, while sustainable development values maintaining environment quality as a way of meeting the present without compromising the ability of future generations to meet their own needs.

A priority of both sustainability and environmental security in relation to energy is to prevent the degradation of local ecosystems and other global systems. Examples include preventing the depletion and degradation of aquifer and surface water sources, over-exploitation of agricultural land for biofuel production, air pollution from fossil fuel burning, and greenhouse gas production from fossil fuel burning.

Sustainable development and environmental security recognises that the environment needs to be protected for its own sake as well as for utilitarian reasons. It also recognises that environmental change can intensify or trigger threats to other referents of value including social, economic, and political stability. Issues of environment transcend borders, as abuse of a country's natural resources can impact globally. This perspective of energy places a priority on energy resource management that prevents ecosystem damage, as well as the sustainable generation and consumption of energy.

Energy-related issues for sustainable development and environmental security over the long term have been air pollution and carbon gas production. Air pollution has the longest history due to the burning of coal and transport fuels. As flue gas, vehicle fuel emissions and other fossil fuel pollution standards have improved, this issue has become less important than carbon gas emissions from these fuels. Since the late 1980s, greenhouse gas concerns have become important globally. In the Asia Pacific, the largest carbon emitter is the stationary energy sector, notably coal and gas powered plants.

Another growing energy issue linked with energy security is unconventional gas energy extraction such as fracking. It is controversial because of its potential impact on aquifers, agricultural production and people's health and welfare in mining areas. Opponents have linked it to environmental security. Advocates instead argue that it increases the supply of gas which in turn holds down prices for individual consumer and bolsters economic output, all of which speak to different perspectives of energy security – security of supply, reducing energy stress and national economic security.

From a sustainable development and environmental security perspective, key sources of energy insecurity arise due to:

- Global damage to the biosphere due to greenhouse gas emissions.
- Increase in water consumed in extracting and transforming energy.
- Environmental damage caused by the extraction of oil and gas.
- Coupling of economic growth and energy consumption.

6 Energy Security, and Social Stability and Energy Stress

The social stability and energy stress dimension encompasses what in security studies is termed 'human security', as it places people and society, rather than nation states, as the referent to be protected from harm. The focus of the dimension is on people and ensuring their security across the physical, employment, social and lifestyle spectrum. It recognises that people's security is essential for societal and political stability, thus providing the bedrock for equitable, sustainable, and peaceful economic growth.

The availability of affordable energy is a key source from which human security can be obtained, but conversely, a lack of it can be a source from which insecurity originates. Rapid changes in prices are also a source of insecurity. For energy consumers, in the short term it is difficult to adjust rapidly to increased prices. This is because demand is often inelastic and can only be reduced by major purchases such as more energy efficient equipment, insulation, or equipment that uses another energy source.

Over the long term, the new price can be accommodated by most people. However, this is not the case for people who have limited financial means. People in lower socio-economic groups often have higher proportional energy costs and restricted financial means to adjust to the new changes. These people often live in areas underserved by public transport, meaning they have limited ability to switch from their car to public transport, and they live in poorer housing stock which is less energy efficient. These people often have limited incomes, meaning that they can be energy stressed or experience energy poverty. Energy poverty can be defined in several ways. One is where households lack physical energy sources, such as having no electricity or gas connections. Another is where households spend more than a certain percentage of their household expenditure on energy.

The IEA defines energy poverty as a lack of access to modern energy services. These services are defined as household access to electricity and clean cooking facilities (e.g. fuels and stoves that do not cause air pollution in houses) (International Energy Agency, Definition of Energy Poverty 2017). Access to affordable and reliable energy services is crucial to reducing poverty and improving health, increasing productivity, enhancing competitiveness and promoting economic growth. The lack of access to modern forms of energy often tends to go hand-in- hand with a lack of provision of clean water, sanitation and health care. Inefficient and unsustainable cooking practices also have serious implications for the environment, such as land degradation and contributing to local and regional air pollution.

In 2011 the World Bank released the flagship report; "*One Goal Two Paths*" with the purpose of addressing energy access and related developmental issues in East Asia Pacific. Encouragingly the report found that achieving universal access to modern energy is within the reach of countries in the East Asia and the Pacific Region in the next two decades. This report outlined an ambitious program for the eradication of energy poverty across the region by 2030 by urging governments to work simultaneously on two paths:

- First, achieving universal electricity access by accelerating both grid and off-grid programs while employing appropriate policies and innovative technical solutions to reduce costs, improve reliability, and provide timely service to all households.
- Second, a major push is needed to increase access to clean cooking fuels (natural gas, liquefied petroleum gas, and biogas) and advanced cooking stoves, particularly for biomass in poor rural areas (World Bank Report 2011).

The report acknowledges the East Asia and Pacific Region as diverse and this means energy poverty solutions are not a 'one size fits all' approach. Box 1 describes energy poverty in South East Asia and Box 2 in the South West Pacific.

Box 1: South East Asia Energy Poverty

The IEA 2013 South East Asia Outlook estimated that 134 million people in Southeast Asia, or 22% of the region's population, currently do not have access to electricity and around 280 million people rely on the traditional use of biomass for cooking, almost half of the region's population. Access to modern energy services is low in Southeast Asia relative to most other parts of the world, with the exceptions of Brunei Darussalam, Malaysia, Thailand and Singapore (which have reached high levels of access). Indonesia accounts for almost half of the population of those living in the region that lack access to electricity, partly reflecting the difficulties involved in providing access to modern energy services in the largest and most populous archipelago in the world. Rural areas are home to 80% of the people in Southeast Asia without access to electricity, primarily reflecting the added difficulties of providing electricity in communities with low population densities (International Energy Agency, IEA South East Asia Outlook 2013).

Nevertheless, significant progress has and is being made in improving access to modern energy services across the region. For example: The deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the German-Indonesian chamber of industry and commerce (EKONID) have jointly implemented the "renewables – Made in Germany" initiative under the Project development program Southeast Asia (PEP SEA). Alongside with Indonesia's steady economic growth, the domestic demand for electricity annually rises by 10%. In reaction to a looming electricity shortage, Indonesian government has, among taking up various measures, pledged to increase the share of renewable energy in the country's energy mix from 10 to 25% in 2025. In addition to that, the electrification rate of Indonesia ranges at around 74%, leaving some 16.8 million Indonesian households off the grid. With about 7000 inhabited islands, it is difficult to electrify many remote settlements. Consequently, hybrid island systems combining several energy sources become increasingly attractive. With plentiful solar irradiance due to Indonesia's location on the equator, photovoltaic solar power is an obvious and cost competitive first choice for hybrid solutions (Republic of Indonesia 2013).

Box 2: Energy Poverty in the South West Pacific

Energy poverty is widespread in the south West Pacific. It is estimated that 70 per cent of households in the region don't have access to electricity and 85 per cent don't have access to clean cooking energy technology. Unlike South East Asia the situation does not appear to be improving. There has been limited progress in widening access to electricity in rural areas of the Pacific – Which is where the vast majority of un-electrified households are situated. This is particularly true in Papua New Guinea (PNG), Solomon Islands and Vanuatu, where electrification rates are lowest.

Unfortunately, government resources that are dedicated to rural electrification in the Pacific are limited with subsidies directed toward electricity consumption in urban areas far outstrip government funding for installation of off grid systems in rural areas. These priorities should be reversed. Increased funding needs to be directed towards rural electrification using off-grid systems, and at the same time, universal subsidies for power consumption among (primarily) urban households should be abolished and replaced by lifeline tariffs that protect low income households (Island Business News Fiji 2015).

From a social stability and energy stress perspective, key sources of energy insecurity arise due to:

- A high percentage of household expenditure on energy.
- Growing numbers of people who are energy stressed or experiencing energy poverty.
- Significant energy price changes that have political consequences.
- Politically expedient decisions to hold down energy prices that degrade medium and long-term energy security.

7 The Fragile Nature of Energy Systems

Access to energy is a core enabler of modern economies. This centrality makes the provision of energy services an important global security consideration and critical to achieving viable and sustainable societies across the world. Yet the global energy system is complex and increasingly fragile. Oil prices are now climbing out of 2 year doldrum but remain sluggish (Oil Price Online News 2017). Volatility in oil prices generates uncertainty and uncertainty inhibits or confuses the investors and means global forces surrounding energy cannot be taken for granted (University of Oxford Institute for Energy Services 2017).

Shocks to supply and demand within the global oil system that are unforeseen by the 'conventional wisdom' of the industry are not new. In 1973 the shock of the oil

Box 3: The 1973 Oil Crisis

With the 1973 the Arab–Israeli conflict as backdrop OPEC countries increased oil prices by 70% and oil producers had started what was to be a five-month embargo on selling oil to the US and other supporting countries deemed supportive of Israel. These decisions made oil supply a political weapon leading to the global price of oil rising and tightening of supply. These effects manifested at a time when many nations experienced inflation, growth stagnated and recessions occurred.

By the mid-1970s, in addition to the disruption of oil supplies, many advanced economies found themselves simultaneously experiencing stagnation and inflation. These twin effects, which became known as stagflation, was startling to economists as the dominant macroeconomic conceptualisation of the time considered that stagnation and inflation were mutually exclusive.

Some key response measures adopted included: introducing oil rationing and distribution control, Diversifying the sources of oil supply especially away from Middle East, and Diversifying the energy mix through replacing oil with natural gas, nuclear power and renewable source (International Energy Agency 2007)

crisis highlighted the volatility of oil supplies and prices in a geo-politically fragile world. Box 3 summarises the 1973 Oil Crisis and response.

Forty years on from the 1970s oil crises, the relevance and applicability of the measures put in place are worthy of revaluation against new and emerging circumstances. The Middle East continues to be a geopolitical hotspot, and while OPEC is not as powerful as it was in the 1970s and certainly lacks cohesiveness as a decision-making body, it still controls approximately 80% of the worlds proven crude oil reserves (Organisation of Petroleum Exporting Countries (OPEC), Annual Statistical Bulletin 2016). Oil with its peculiar mix of market forces and geopolitical interconnections has the potential to break open old wounds from the 70s oil crises.

But oil is no longer the singular geopolitically sensitive energy resource as global energy governance structures now struggle to keep pace with technological change, disrupted markets and an ever-increasing complex array of commercial interests. Each energy generation source such as gas, coal, renewable, or nuclear power brings with it a different technology, market, distribution networks, governance and regulation.

This is starkly obvious in the global LNG market as it needs to change rapidly within the next 3 years as supply increases by about a third over currents figures. At least $130 billion of this global investment is in the Asia Pacific, and within a few years possibly as early as 2018 Australia will be the world's largest LNG producer (Commonwealth of Australia, Department of Industry and Science 2015). The expanded investment in global LNG aims to reduce vulnerability in supply and price of oil and provide degrees of certainty to the gas industry.

Box 4: The Asian LNG Hub and Leadership Challenge

The Asian LNG trading hub may soon sit next to those in America and Europe. China through its energy policies will influence this gas trade, with a stated objective to reduce coal fired electricity. As countries in Asia become more dominant in the new global gas market the sea-lanes that connect these regions are increasingly important and while the United States has been the principal guarantor of security for these routes since 1945, there is no guarantee that this will remain unchallenged. Any change in the Indo-Pacific sea-lanes could have significant implications for Australia as it strives to deliver the anticipated LNG boom to the growing market (National University of Singapore Energy Studies Institute 2015)

On 26 May 2014, PNG became a player in the global LNG market with the first shipment of LNG from ExxonMobil PNG Limited's US$19 billion LNG Project to the Tokyo Electric Power Company. PNG, long captive to development income but a resource-rich nation, will deliver natural gas to meet the growing demand of Asian markets over the long term. It is within the interests of all Asia Pacific Nations to see an independent and prosperous PNG move from being reliant development investments to being part of regional growth (Australia Papua New Guinea Network 2015)

The Asia Pacific nations will require remarkable agility to address not only their own prosperity but balance international and regional demands as the gas market changes. Box 4 provides a snapshot of the evolving 2017 Asian LNG Hub and the security and leadership challenges that come with changed market conditions.

A dominating characteristic of the global energy system is the ongoing management of uncertainty. The 1970s Oil Crises brought corrections to economic, political and governance systems that provided surety for a robust market based system that continued to fuel economic growth. Sustainable energy markets must be able to address the inherent nature of fragility associated with uncertainty and avoid relearning past mistakes, if the promised expansion of prosperity and growth is to continue. Thus, thinking about how to embed resilience into practices and policy within the energy industry is an important step. Importantly one interpretation of resilience is as an antagonist to fragility.

8 A Resilience-Based Approach

A resilience-based approach to energy continuity ultimately entails strategic choices about how to sustain supply and reduce potential for disruption of supply chains. Enhanced resilience for energy systems is not an ephemeral concept but a pragmatic goal that requires comprehensive understanding and appreciation of the challenges

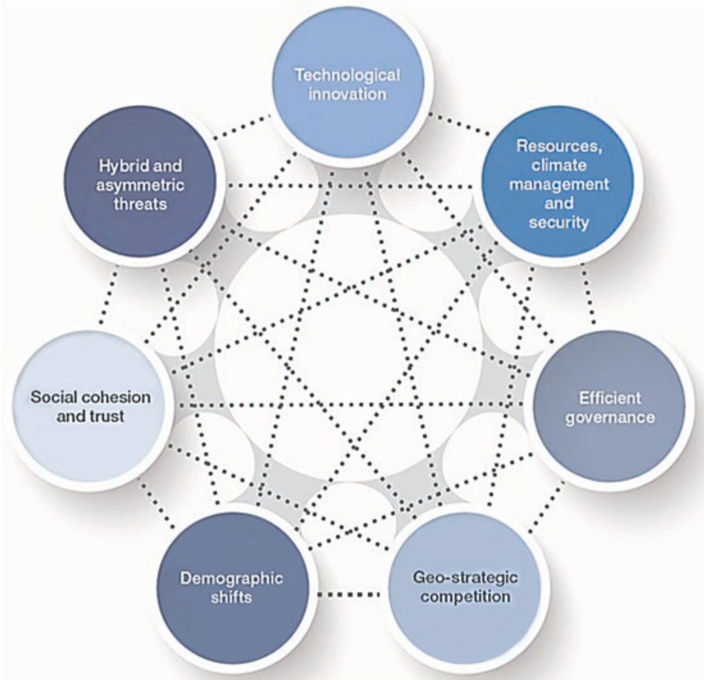

Fig. 3 Vulnerability factors for interconnected Energy Systems (Source World Economic Forum 2015)

of managing complex technical systems and the nature and sources of disturbances that can occur and that are likely to occur.

For a stable economy, this means the alignment of policy, practices and decision making across public and private sectors to ensure wide geographic stability of energy supply. If this stable system of supply is impacted by the effects of disturbance, there must be a planned capability to regain and sustain optimal capacities for energy production and utilisation should significant losses occur.

A critical factor enabling achievement of energy resilience at an international level is the comprehensive analysis of vulnerability within and external to each national energy ecosystem. The ecosystem construct encompasses the interdependencies of modern systems of infrastructure and includes energy components from generation, transmission and usage. Also important is the realisation that certain high value energy sources occur via global supply chains.

Assessing continuity needs of complex supply chains is not a simple undertaking. The World Economic Forum has defined a framework (Fig. 3) depicting vulnerability factors deemed pertinent to globally interconnected systems, and by extension the global energy marketplace.

These systemic vulnerabilities can be defined as:

Technological Innovation Technology offers both innovative and disruptive pathways not yet envisaged. Innovation in the energy sector will continue to improve, and this will be driven by the need for both generators and consumers to address the ongoing trilemma of security, affordability and environmental outcomes. Innovation will drastically change the electricity grid. Some recent advances include low emissions electricity generation technologies, distributed energy resources such as digital metering, rooftop solar PV, battery storage systems and electric vehicles. It has been predicted that innovations in data collection and analytics ('Big Data') will have a disruptive effect on the electricity sector by facilitating the integration of unprecedented levels of renewable generation. Future innovations could come in many other forms (Commonwealth of Australia 2016).

Resources, Climate Management and Security The effects of climate change and resource scarcity stand to play a big part in geopolitics and shape the international energy landscape over the coming years. The Asia Pacific needs an agile system with levers to control economic change and cannot afford an energy sector tied to narrow generation choices and cumbersome technology, which cannot adapt and does not reflect global advances. Climate change can cause extreme weather conditions, damage and deplete natural resources and affect livelihoods and food security. This impacts both individuals and economies, with developing economies experiencing the most adverse effects. In addition, climate change is believed to contribute to the increasing number of natural disasters, about 70% of which occur in the Asia-Pacific region. Thus, it is imperative that regional economies, which account for approximately 60% of world energy consumption, find ways to reduce the use of fossil fuels to meet energy demands. As the region becomes increasingly industrialised and the population shifts from rural to urban areas, these consumption levels are set to rise (APEC 2017). Recognising climate change as a vulnerability and closely linking it with energy strategies, will minimise risks and create new economic opportunities. The American Security Project's "Global Security and Defense Index for Climate Change" shows that Asia-Pacific nations overwhelmingly perceive climate change as a threat to their national security. South and Southeast Asia particularly face several security challenges driven by climate change in the next few decades, including food shortages, water crises, catastrophic flooding, greater frequency and intensity of hydro-meteorological disasters, population displacement, and increased public health issues (The Centre for Climate and Security 2015).

Efficient Governance Networks such as supply chains require levels of governance that matches the complexity of the system itself. Components of governance include trade transactions, dispatch and arrival, as well as maritime sections and in-port elements. Supply chains that are over governed are likely to be expensive and uncompetitive, while too little governance may lead to fragility and reduced levels of control. Sound managerial oversight would require a balance between the two extremes.

Geo-Strategic Competition In the energy domain geo-strategic competition for market share is multifaceted with nation states and multi-national corporations often acting together as an expression of national energy security strategies. New emerging risks are posing ever greater threats to the energy sector, impacting both the physical structures and the capital returns needed to evolve the energy system to a more sustainable future. Without a solid understanding of the nature of these risks, appropriate adaptation of infrastructure design and of financing mechanisms it is possible an investment impasse could threaten to cripple global energy systems. Since 2000 many countries in the Asia Pacific have ramped up energy diplomacy to advance national interests. Energy diplomacy recognises that due to global interdependent energy markets, cooperation on energy issues is generally attractive at a multilateral and bilateral level.

Demographic Shifts From a macro view, as the Asia Pacific population grows and its economy expands, the dependence on electricity will increase. Most nations have entered or are on the cusp of a period where working-age people comprise a significant population share. This puts the region at a favourable juncture to reap the demographic dividend and advance human development—meaning the requirement for energy consumption is increasing at enormous rate (UNDP 2016). Future energy policy will need to address this long-term growth of population accompanied by greater urbanisation and growing expectations of materially comfortable lifestyles. Japan like other developed countries will have an ageing population with greater health needs and requirement for more energy. With these changes comes an ever-increasing demand for energy in all forms, and governing these developments will pose a significant challenge for all future national governments.

Social Cohesion and Trust Across all Asia Pacific nations, access to secure and affordable energy is a basic expectation of society. Affordability and continuity of supply have often been issues central to public debate and political dialogue. In the Philippines in 2014 consumers and militant groups held rallies in several parts of Metro Manila and at the Supreme Court after a private distributor of electricity, private power suppliers, and a government regulator sought approval for a 30 per cent hike in power tariffs (Gulf News Philippines 2017). The public questioned the comfortable collusion between distributor, supplier and regulator, with no capacity for community engagement. Recently in Australia the Prime Minster made the importance of community clear in laying out his agenda for energy policy in 2017 when he stated ‘families and businesses need reliable and affordable power’ (Prime Minister Commonwealth of Australia 2017). Black outs during extreme weather events are widely considered as poor contingency management by energy businesses and the Government thus eroding trust. The United Kingdom Energy Research Partnership provides an example of what needs to be to be done to address failed community engagement on energy issues. It made a call for a strategic narrative in its *Report on Public Engagement* in May 2014. However, while the public is largely supportive of the need for transformation in energy policy, the trust in the government and energy industry is low (United Kingdom Energy Research Partnership 2014).

Hybrid and Asymmetric Threats Energy infrastructure is heavily dependent on cyber control systems predominantly SCADA (Supervisory Control And Data Acquisition) and PLCs (Programmable Logic Controllers) systems using network connectively through wireless, internet, dark fibre, microwave, satellite or priority local area networks. The widespread use of these systems has heightened the energy sector's dependence on computer and information technology to monitor consumption and to drive production, transformation, transmission and distribution of supply. While these systems have reduced operating costs, increased reliability and enhanced transparency, opportunities to exploit weaknesses have increased, particularly where systems are open networked and operate across networks.

9 Building Energy Resilient Systems

The achievement of energy resilience will require changes by not only the energy industry, but all Asia Pacific societies and economies and it must be planned to take effect over years and decades. These strategic options provide for risk mitigation against external shocks, both financial and physical, but importantly provide for transitions to alternate energy sources, technologies and processes.

There are three strategic options that will address Asia Pacific energy resilience:

- Reform electricity grids,
- Address evolving transport energy demand, and
- Future energy proof cities.

Simply put; it is a plan to face future uncertainty by addressing supply and demand across all communities. Piecemeal reform that address only electricity supply or separately the changing demand in one country simply make the region less resilient. It is systematic 'grand strategy' that the Asia Pacific needs to meet energy security goals.

10 Reform Electricity Grids

Thermal energy in Asia remains a major electricity source, with coal-fired power plants in China alone generating almost 75% of the nation's electricity. Coal-fired plants currently provide consistent, reliable electricity to the grid at relatively low economic cost. Decisions on how this 'base load' electricity generation is to be replaced over coming decades will have a significant impact on the growth and development of renewable and other forms of energy generation. It will also have a considerable impact on regional sustainability and productivity over the long term.

The current electricity grid is based on centralised power generation and interconnected distribution architecture which creates systemic vulnerabilities. The large cities get their power primarily from clustered electric power producers now located away from the urban centres. Electricity is then transmitted over long distances, across vulnerable, high-voltage infrastructure. The grid is well managed by network businesses, but has little flexibility and many vulnerable points of failure that can result in the collapse of large segments.

Existing technologies such as microgrids, in concert with proven distributed electrical generation systems generated by renewables can become a feature of the new smart grid. Indeed, evolving systems that will use distributed electrical generation plants such as commercial-scale hydrogen engines, fuel cells, small modular reactors, offer unexplored advantages. The potential for smart grid technologies with emerging energy storage systems can increase electrical generation and distribution resilience.

A microgrid is a small-scale version of a traditional power grid. It draws energy from clean sources such as wind and solar power, as well as from conventional technology and can be connected to a larger electric grid, but also work independently. The concept of localised power generation is not new as prior to 1940, most utility grids were self-contained, with power plants located close to the markets they supplied. It wasn't until the middle of the twentieth century that utility grids became today's sprawling networks where central power generation facilities distribute power to homes and businesses hundreds of miles away. In the last 10 years, the modern microgrid has emerged as an alternative to the local utility.

The ability to work independently from the larger utility grid, known as "islanding," makes the microgrid attractive to many essential services providers. "Islanding" is in many ways a more sophisticated concept of 'back-up' generation, maintaining power during outages. However, the unrealised potential of microgrids is that it is part of the future smart grid. For example, the University of California San Diego's Campus microgrid provided valuable energy to the San Diego Gas & Electric system, during wildfires in 2007. The Utility asked for assistance in keeping the grid up when fires had destroyed key infrastructure. In response, the University's curtailed load on the microgrid providing a critical 7 mw of power to the main grid. This is a game changer for the way in which utilities manage the grid, as rather than being an island, the microgrid was a partner to the Utility (Smart Cities Council: Case Study: University of California San Diego Microgrid 2012).

Solar PV and off grid applications can transform the lives of those people currently deprived of access to electricity who cannot rely on their grid. A range of novel concepts are under investigation and are expected to capture an increasing share of the PV market over time. This is technology disruption that all Asia Pacific nations must prepare for. Box 5 provides a snapshot of the research being undertaken in solar technology across the Asia Pacific.

The potential for smart grid technologies with emerging energy storage systems in concert with renewable energy can increase electrical generation and distribution resilience. The widespread deployment of these technologies requires new capabilities in the storage systems system as well as integration with overall power system operation. The key issues are the identification and realisation of requirements for the technologies themselves as well as the communication, information, protection

Box 5: Advancing Solar Technology in the Asia Pacific (APEC Energy Working Group 2016)

Further advances in solar technologies are under way. Thin film cells, which are made from compounds like cadmium telluride, copper indium gallium arsenide (CIGS), or amorphous silicon (A-Si), are being developed for PV use. These advances reduce the amount of material used in creating solar cells and can be "printed" on flexible surfaces, potentially reducing cost and increasing ease of application. Researchers are also working with nanomaterials, including polymer films that are less than 100 nanometres thick that could replace silicon cells and nanomaterial-based coatings that repel water and that prevent dust and debris from sticking to panels.

SLIVER solar cell technology was developed at the Australian National University and is being commercialised by Transform Solar in Boise, Idaho for use in low cost photovoltaic panels. SLIVER cells are thin mono-crystalline silicon solar cells fabricated using standard fabrication procedures. However, instead of fabricating one solar cell from a single silicon wafer, several thousand small (1 cm^2) cells are produced from a single wafer. A single 200 mm diameter wafer can supply sufficient solar cell area to populate a 1 m^2 photovoltaic module.

At the Hong Kong Polytechnic University researchers combined three layers of materials to maximise efficiency. The main layer is perovskite, a mineral composed of calcium and titanium, which absorbs a broad range of the visible light spectrum and conducts electricity well. It is paired with a bottom layer of silicon, a traditional solar panel component which complements perovskite by absorbing a different set of wavelengths.

At the Solar Energy Research Institute of Singapore the Organic Solar Cell Group focuses on the development of the science and technology of solution-processed organic solar cells. Organic cells aims to use organic, rather than inorganic materials to absorb sunlight and convert it to electricity. A range of conductive polymers, carbon fullerenes and other materials are being examined, which it is hoped will enable continuous, low cost production processes to be established. Hybrid organic and inorganic cells are also being investigated. Research programs aim to explore new materials, improve efficiency and stability, as well as developing processes that can be used for commercial production.

and control infrastructures that provide interoperability and integration of the technologies. Box 6 provides a snapshot of the research being undertaken in distributed energy across the Asia Pacific.

Natural disasters directly threaten energy supply, not only does the functioning of industry, transportation, and communication and computer systems depend on a continuous energy supply, but our complete style of living collapses when energy fails. Furnaces, refrigerators, and other electric appliances don't work. Neither do

Box 6: Advancing Distributed Energy Technology in the Asia Pacific (APEC Energy Working Group 2016)

Distributed energy (that is, using batteries to bring power to areas where wiring or reliable supply is not available) may have a relatively small direct economic impact but have a transformative effect on the lives of people. Batteries in their various forms constitute the most widely known energy storage technology. Lithium ion (Li-ion) batteries are widely used in consumer electronic devices such as laptop PCs, as well as in electric and plug-in hybrid vehicles. The Li-ion battery market is expected to double in the next 4 years to $24 billion in global revenue.

Significant performance and cost improvements are also expected in Li-ion batteries over the coming decade. The average cost of owning and operating Li-ion batteries for utility grid applications (a function of multiple variables including battery prices and cycle life) could fall from $500 per MWh to between $85 and $125 per MWh by 2025. This could make Li-ion batteries cost competitive for some grid applications and for providing distributed energy, Other important energy storage technologies include molten salt, flow cells, fly wheels, supercapacitors, and even conventional lead acid batteries (including recycled batteries). Other promising battery technologies that are currently under development but may not be commercially viable by 2025 include liquid metal, lithium-air, lithium-sulfur, sodium-ion, nano-based supercapacitors, and energy cache technology.

At the Chinese Taipei Industrial Technology Research Institute researchers have opened the structure of graphite (i.e., graphitic foam) to speed up the charging/discharging reactions of the battery cell. Thus, the battery cell exhibits great durability as it can stand up to 10,000 charge-discharge cycles without capacity decay, and can be charged within 1 min. The graphitic materials used for the battery cell are as flexible and supple as paper, and very stable. The basic component of the liquid electrolyte is aluminium salt, so it is stable at room temperature. The battery can withstand drilling tests during the discharge process and continue to supply electricity, attesting to its safety. This breakthrough battery technology will compete with the traditional lead acid battery when applied in large energy storage devices, lightweight electric scooters and motorized bicycles. In addition to small smart devices, aluminium-ion batteries could be used to store renewable energy in electricity grids, electric motorcycles and bicycles.

the electric pumps that deliver drinking water and help treat sewage. Without electricity for homes, hospitals, food stores, and vital municipal services, many of the most important needs go unmet. On the other hand, electricity power networks have developed to become large and highly complex technical systems, geographically extended, with differing degrees of connectivity, requiring complex operation in real time to balance supply and varying demand.

The complexity of power system networks makes the task of maintaining a highly reliable operation a difficult one, even in normal conditions. Facing short unexpected interruptions has been a challenge for modern power system design and control, and much effort is placed on keeping the system in secure states rather than alert ones. Nevertheless, these efforts occasionally fail, and major blackouts have occurred because of isolated faults. Thus, it would be impossible to keep normal interconnected power system operation when major natural disasters occur. Instead, the challenge is to curtail the impact of disasters on the power system and to carry out recovery actions to minimise social disruption.

A reliable electric power supply following disasters is too important to be left to the same old approaches of the past. Manufacturers, regulators and standards development organisations must improve the design and construction of power, communications, and computer equipment that can better cope with the impacts of those disasters in electrical networks. Historically, emergency response teams have had only one recourse in such a crisis which is to use gasoline or diesel-powered engine generators to provide emergency power. Unfortunately, generators that run-on fossil fuels like gasoline and diesel oil have constraints. Foremost the requirement for fuel creates a need for a point of entry (airfield or port) with a supply chain using road transport. All aspects of this supply chain maybe compromised because of the disaster and the need for fuel supplies competes with other resources. As described in Case Study 1 below there are methods of improving the resilience of electricity supply in the face of disasters.

Sophisticated cyber-attacks with physical impacts are now a major threat to the electrical grid. As digital control systems, can be vulnerable to remote attacks, physical proximity is no longer needed to inflict damage on infrastructure. Electrical power and the internet are two interconnected critical services and all commercial and industry networks are open to computer based attack. Each of these different parts of the energy industry have varying degrees of cyber protection, ranging from open to sophisticated protection on critical infrastructure. Infrastructure is critical to power, and satellites (space based infrastructure) is critical to the internet. For example, a Ukrainian regional electricity distribution company suffered service outages on 23 December 2015 due to a third party's illegal entry into the company's computer. Russian security services were thought responsible for the incidents. In terms of national security, a nation's economy can be disabled through cyber-attacks on electrical infrastructure without waging traditional war (Wired.com 2016). There is an increased need to understand the relationship of cyber-attacks on energy infrastructure within a national security framework.

With the grid of the future, electricity will be produced closer to consumers, from a wide variety of sources, and stored or shared until needed. This new production paradigm will be driven by technological advances, demand for increased flexibility, more secure and lower-cost power, and a growing public demand for cleaner energy sources. Moving away from large singular nodes of generation with comprehensive networks will also better protect communities against cyber threats and natural disasters. There will be new ethical questions and business models to address the application of a future smart grid, and critically existing business must have

Case Study 1: Energy Demand and Response to Typhoon Haiyan Disaster

Typhoon Haiyan caused catastrophic damage throughout much of the Philippine islands of Leyte, where cities and towns were largely destroyed killing at least 6268 people on November 8, 2013. Restoring electricity to a disaster area is vital for this area to undertake urgent disaster recovery activities. Unfortunately, after every disaster, it usually takes months to bring electric utilities in order to bring the grid back to life. During all those months, people of the Philippines were left without access to electricity. To recover from such a disaster, access to electricity source is vital for at least four areas:

Refrigeration: preservation of medicines, vaccines, food;
Water: pumping and making the water drinkable is impossible without electricity;
Telecom, using phone or internet: communication with families, rescue teams, Red Cross;
Light: the day should not be over when the sun goes down.

Electriciens sans Frontières cooperated with other NGOs such as Doctors Without Borders to provide electricity to medical centres and also to makeshift schools. The first team of volunteers installed lighting in the healthcare tents set up around the Guiuan hospital, which was destroyed by the typhoon. They also wired the operating and delivery rooms, and the maternity ward welcomed its first four babies that same evening.

Because of the scale of the destruction, both generator sets and solar-powered lamps were used. UNHCR was able to distribute solar lamps to 6000 families. The idea behind these solar lanterns is to bring some normalcy to these communities so people are safe for instance it can prevent people from being harassed when they go to toilets. The solar lantern, which provides illumination from 6 to 8 h, also allows the charging of cell phones – used by affected people.

In contrast to the vulnerability of centralised energy infrastructure, solar photovoltaic panels can make a huge difference to disaster-hit areas. Life for Haiyan survivors was improved by emergency solar power, bringing a continued and affordable source of electricity and making disaster response and co-ordination much easier while centralised power lines are still down. The standalone operations of solar energy systems make them a valuable cost effective resource due to low operating costs and the capability for sustainable solution.

viable transition options to encourage change. All nations of the Asia Pacific cannot wait to be shocked by the future without a plan for a reformed electricity grid. Planning processes, models, and tools should be modified now to include distributed generation and distribution applications, energy storage solutions, and smart-grid technologies into future investment cycles.

Recommendation 1: The Asia Pacific Nations perhaps through the Asia Pacific Economic Cooperation (APEC) Energy Council integrate and improve National, and community planning process, models and tools to foster opportunities for the adoption of new technologies, microgrids and diverse energy generation which strengthens resilience and provides a twenty-first century electricity grid for all regional members.

11 Address Evolving Transport Energy Demand

If the domestic electricity grid is critical to the resilience of the built environment, then in the same way liquid fuels are fundamental to logistics resilience. Currently, across the Asia Pacific the transport industry is almost wholly dependent on oil. In the near and medium term, there are limited alternatives to substitute other fuels for fossil based liquid fuels used for transport. Consequently, liquid fuel supply poses an enduring risk to the region's economic resilience, national security, food security and social stability. The key mitigation strategies which are all lessons from the 70s oil crises, are to have strong liquid fuel supply chains, hold emergency oil stocks, have a domestic refinery capability, and maintain an emergency fuel distribution system for times of shortage. All nations within the Asia Pacific undertake these actions to various degrees but it is questionable if this achieves liquid fuel security.

There are significant geopolitical issues affecting liquid fuel security supply chains. For example, conflicts and disasters in oil producing and refining countries could disrupt supply lines. Another issue is National Oil Companies, such as Petro China and Saudi Aramco, which are beginning to dominate the production and refining of oil at the expense of private oil companies. National Oil Companies as their name suggests have strong strategic and political links to their Governments and almost 80% of the world's proven-plus-probable reserves of conventional and unconventional oil are controlled by National Oil Companies or their host governments. China's net crude oil imports continue to grow and could reach 8.0 million barrels per day by 2025 with the greatest volume coming from the Arabian Gulf. A key approach by China to managing its energy security risks is to expand its National Oil Companies' role in global supply chain risks. Persistent faith in global supply chain stability could be sorely tested in the future if such National Oil Companies make decisions based on national energy security interests rather than commercial interests.

With infrastructure enhancements, continued diversity in sourcing and supply chain management of imported petroleum products will mitigate unexpected geo political tensions ultimately a future maritime strategy must address the security of petroleum supply lines. Even though the United States is rapidly decreasing its dependence on Middle Eastern oil, Australia along with Japan and South Korea are highly dependent upon the security of sea lanes for energy imports (and other commercial trade). While it is unlikely that the United States will significantly reduce its provision of sea lane security in the Indo-Pacific there are envisaged scenarios of limited conflict or increased competition which may have some effect on sea lanes. Given the shared dependence upon energy trade, there is a shared interest in maintaining basic freedom of navigation and communication via sea lanes. However, shared interest does not equate to consensus on how best to cooperate. There are significant and ongoing questions about whose responsibility it is to secure sea lanes, and who should bear the costs of guaranteeing their security (National University of Singapore Energy Studies Institute 2015).

If there are potential vulnerabilities in traditional liquid fuel supply chains, then changing transport energy demand is a reasonable strategy to enhance energy resilience. Freight could be shifted from road to rail, and while this requires infrastructure investment and Government commitment to shifting behaviours by the freight industry, this type of change can be achieved through policy. Improved public transport will reduce demand on the number of vehicles and the requirement for fuels. In the coming decade, technological advances will completely disrupt the transport energy value chain.

Electric vehicles, including hybrid electric, plug-in hybrid and all electric, have an advantage over liquid fuels, with the fuel supply drawn from a mature grid. The major benefit of electric vehicles will come from shifting energy consumption from liquid fuels to electricity and there is also potential to use electric vehicles to actively reduce peak demand levels. Electric vehicles that are connected to a charging station during a peak demand period could have their batteries drawn down to help provide power to the network. Having this capacity could reduce the need for network businesses to expand the electricity network to cope with high usage periods, which could also help to lower power prices.

Hydrogen is an alternative fuel that can be produced from domestic resources. Clean, economical, and safe hydrogen production and distribution for use in fuel cell electric vehicles is now a proven technology. The Davos World Economic Forum January 2017 confirmed industry commitment to renewable hydrogen as a core part of the global economy. Fuel cell electric vehicles are beginning to enter the consumer market in localised regions domestically and around the world. Box 7 highlights the latest advancements by Hyundai in hydrogen fuel cells.

Autonomous vehicles or driverless cars are an innovation already legal in several states of the United States America. The driverless car by employing several technologies will reshape the complete design of vehicles. In time, there will be fewer requirements for many safety features as artificial intelligence will reduce accidents resulting in a lighter and smaller vehicle that uses less fuel. In combination, electric and autonomous vehicles will completely disrupt the transport energy value chain. The overall impact of these changes will be to reduce land based vehicle reliance on petroleum products and shift further energy demands on the electricity grid. Aircraft and shipping will however be reliant on petroleum fuel for several decades yet.

To sustain energy resilience Asia Pacific nations must manage the looming disruption and not be surprised by change. The transition from the present view of transport energy to a different profile will involve changes to the existing pattern of

Box 7: The Hyundai Hydrogen Car (Hyundai Hydrogen Car Report 2017)

At the 2017, Geneva Motor Show, Hyundai unveiled the fourth generation of hydrogen fuel cell technology making the vehicle capable of travelling up to 800 km between refills. The Hyundai FE (Future Eco) Fuel Cell Concept is 20% lighter than the ix35-based fuel cell vehicle, and achieves 10% greater efficiency. The power density of the fuel cell stack is increased by 30%, boosting range substantially over the third-generation technology. The concept car includes an internal air humidifier that recycles water emitted by the car's fuel cell – it combines hydrogen and oxygen to make electricity used to power the electric motor, and water – creating a more comfortable cabin environment. It also comes with portable battery packs – charged by the car's energy output – to power passenger devices and an electric scooter stored in the boot.

production, transformation, transport and utilisation across all sectors of the economy against a backdrop of evolving social and environmental demands. It will require changes to the 'fleet' of current vehicles and infrastructure. This means that energy resilience must be seen in terms of decades rather than years, and linked with long-term industry and community based strategies. There needs to be a program that incentivises the development of transport technologies that will provide affordability and reliability, while reducing its strategic vulnerabilities.

Recommendation 2: Each Nation in the Asia Pacific must address the response to transport energy industry innovation disruption. Future planning must address affordability providing a mechanism for long term stability, demand management and incentives. Emphasis needs to be placed on adapting demand behaviour in concert with the community expectations. Ideally this will be placed on the Agenda of a multilateral forum such as APEC or EAS.

12 Future Energy Proof Cities

Cities are where electricity and transport energy coalesce into sustaining urban life. More than 50% of the Asia Pacific's population live in cities, which use more than 50% of regional energy consumption and currently produce more than 40% of the region's greenhouse gases. On current trends by 2050 more than 66% of the people in the region will live in cities. In some countries like Australia that figure is more like 90% of people in urban areas. The physical, economic, social and political complexity of cities creates distinct challenges and opportunities for energy provision.

Firstly, dense, mixed use urban forms can reduce the unit cost of transport and energy infrastructure and enable adoption of efficient transit systems and low carbon heating and cooling networks. However, density can also lead to adverse effects such as urban heat islands and reduce the local availability of renewable resources such as solar and wind.

Secondly, many cities face dynamic challenges including rapid urbanisation, demographic change and economic change. Many city governments and utility providers struggle to keep up with the pace of growth, while others in contracting economies struggle to remain viable while providing even basic services.

Thirdly, the legacies of existing urban form, buildings and infrastructure tend to "lock-in" energy consumption patterns and available sources and vectors of energy. This legacy includes complex tenancy and land ownership arrangements as well as physical patterns of development. Rapid change can only occur through highly context-sensitive initiatives.

Finally, the governance of cities – many of which have considerable authority, influence and budgetary powers – can be critical to the design and delivery of locally appropriate, effective solutions for energy systems which also deliver other city drivers – such as air quality, economy and resilience.

This convergence of actors participating in a dynamic energy market with cities is referred to as transactive energy. That is a "system of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter" (Barrager 2016).

Although the idea of a market operating in a dynamic balance in response to supply and demand signals may appear unremarkable in the context of many other industries, the implications for our energy systems are profound. The move to a real-time market-based model of electricity supply and demand means that system will no longer be "controlled" by a central grid operator. Instead, the network will migrate to an energy ecosystem which is kept in a state of dynamic equilibrium through the balancing effect of price signals established by millions of participants. The dichotomy of producers and consumers will evolve into a spectrum of roles which includes "prosumers" which act on both sides of the market, along with additional roles for ancillary grid services providers such as ramping and balancing.

The complexity, density and diversity of energy consumption in cities makes them potentially key drivers and major beneficiaries of the transactive energy model. Rapidly growing cities have the strongest value case for "leapfrogging" to a transactive energy system. Such investments would focus on distributed energy systems, such as renewable energy, energy storage, microgrids and demand management technologies. Recent research by Arup and Siemens, indicates operational cost reductions ranging between 8 and 28% and a return on investment (ROI) between 3 and 7 years (Dr Robert Care 2016).

For developed cities applying distributed energy systems allows urban building owners to have better information on energy consumption, the tools to control and reduce energy and the access to a market which translates the energy savings and control investments into financial returns. In all cities, the transactive energy model could enable integration of the electric grid with heating to deliver even greater environmental benefits, lower carbon emissions and improved energy resilience. Transitioning away from fossil fuel heating to renewable and low carbon sources will inevitably involve a transition towards electricity as the main input energy for heating systems, especially in cities, where alternatives such as biomass and solar thermal are less suitable, due respectively to air quality impacts and the density of energy demand compared with available roof space for solar generation.

The 21st Conference of the Parties of the United Nations Framework Convention on Climate Change (COP 21) held in Paris December 2015 marked a pivotal moment when non-state actors – in particular cities – were formally recognised as having a fundamental part to play in delivering a low carbon future for the planet. Cities can take direct local action and in many places mayors have a political mandate for climate and environmental action even when support and leadership at a national level are more equivocal.

One of the fundamental energy resilience vulnerabilities in cities is climate change. In the context of cities, resilience has helped to bridge the gap between disaster risk reduction and climate change adaptation. It moves away from traditional disaster risk management, which is founded on risk assessments that relate to specific hazards. Instead, it accepts the possibility that a wide range of disruptive events – both stresses and shocks – may occur but are not necessarily predictable. Resilience focuses on enhancing the performance of a system in the face of multiple hazards, rather than preventing or mitigating the loss of assets due to specific events.

The robustness of essential city networks becomes particularly important in severe environmental events. Energy networks underpin the operation of sufficient, safe and reliable citywide water and sanitation. Electricity power lines may be damaged by storms, and if failure occurs, resourceful teams from the utility companies can respond quickly in line with coordinated and pre-prepared emergency plans. But efficient and effective response is only part of delivering resilience. Energy systems with redundancy can accommodate surges in demand or disruption to supply networks. Engineering design and construction must deliver protective infrastructure which is robust and will not fail catastrophically when design thresholds are exceeded.

Engineering standards and guidelines only change after the establishment of a significant body of evidence or when forced by catastrophic failure. While this means sound practices aren't changed until modern techniques are proven and tested, the slowness of the process and complex governance means change can be very slow. Out of date practices leading to infrastructure failure in extreme weather events will reflect very poorly on governments, the engineering profession and builders. While in the past impact resistant infrastructures were built, today's system complexity and increased incidence of extreme weather require a shift towards having energy infrastructures operating under a 'graceful degradation' schema. 'Graceful degradation' is a systematic understanding of failure modes and effects which can make design of energy systems more secure, more reliable and can contribute to the quicker restoration of services in case of disruptions.

In time, new design considerations can be implemented in the energy system and associated city infrastructure, but the non-retrospective nature of most regulation leads to a significant range of compliance across the city. Given that existing properties with aging electrical infrastructure form 90% of the building stock, at any one time, a greater focus is needed on how existing buildings can be made more resilient. City Administrators need to improve infrastructure asset management in terms of continuity, insurability and long-term value thus anticipating future problems. As natural disasters recur, those municipalities able to respond faster and with better business continuity will grow in value compared to others.

Accounting for 70% of all natural disasters, the Asia Pacific is highly prone to climate change impact. One of APEC 2015's priority areas is "Building Sustainable and Resilient Communities", (APEC 2015) to foster cooperative efforts to strengthen APEC community's energy-resilience and sustainability affected by natural disasters. The aim is to provide 'build back better' opportunities that will support the wider goals of building smart and sustainable cities. There is the opportunity to create an important self-correcting feedback loop across the APEC economies by combining 'build back better strategies with 'smart and sustainable' cities.

Complimentary to APEC's 'smart and sustainable' cities is the Rockefeller Foundation 100 Resilient Cities (100RC) which is dedicated to helping cities around the world become more resilient to the physical, social and economic challenges that are a growing part of the twenty-first century. 100RC supports the adoption and incorporation of a view of resilience that includes not just the shocks—earthquakes, fires, floods, etc.—but also the stresses that weaken the fabric of a city on a day to day or cyclical basis. Examples of these stresses include high unemployment; an overtaxed or inefficient public transportation system; endemic violence; or chronic food and water shortages. By addressing both the shocks and the stresses, a city becomes more able to respond to adverse events, and is overall better able to deliver basic functions in both good times and bad, to all populations.

Recommendation 3: Multilateral initiatives for Resilient Cities in the Asia Pacific continue to receive funding. Implementation of Resilient Cities embrace an advanced cohesive strategy that aims to improve electrical and transport infrastructure in cities.

13 Conclusions and Recommendations

The global energy system is under stress with volatile oil prices, the challenge of climate change and economic uncertainty bearing down. Now is not the time to pretend that a 'business as usual approach' across the Asia Pacific energy sector is a viable strategy which provides resilience. Currently, energy policy is stove piped and sector biased which does not reflect the multifaceted nature of energy. The major cause of this concerning failure to adequately address energy fully is decades of policy focussed on economic benefit and assured supply, with lesser emphasis on other drivers of change. Energy policy which is reinforced by well formed, agenda driven narratives that do not reflect the true interconnected nature of energy has manifested in ill-informed and increasingly combative political and social discourse on energy. Developing energy resilience strategies is essential to changing the way energy policy and implementation is approached across the Asia Pacific.

This chapter sets out a way to change the thinking. Firstly, the concept of energy security must be changed to consider all potential threats to energy security. A multidimensional approach that considers economic and national security; food and water security; sustainable development and environmental security; and social stability and energy stress, is critical for setting the framework for changed thinking. Thus in this framework the interconnected vulnerabilities that the energy sector faces: technological innovation; resource climate management and security; geostrategic competition; demographic shifts, efficient governance; social cohesion and trust; and hybrid and asymmetric threats become clearer. As a strategy for energy resilience three options for energy supply are developed to address the systemic nature of the energy system vulnerabilities. These strategies are:

- Reform electricity grids,
- Address evolving transport energy demand, and
- Future energy proof cities.

The Chapter makes the following three recommendations:

- The Asia Pacific Nations perhaps through the Asia Pacific Economic Cooperation (APEC) Energy Council integrate and improve National, and community planning process, models and tools to foster opportunities for the adoption of new technologies, microgrids and diverse energy generation which strengthens resilience and provides a twenty-first century electricity grid for all regional members.
- Each Nation in the Asia Pacific must address the response to transport energy industry innovation disruption. Future planning must address affordability providing a mechanism for long term stability, demand management and incentives. Emphasis needs to be placed on adapting demand behaviour in concert with the community expectations. Ideally this will be placed on the Agenda of a multilateral forum such as APEC or EAS.
- Multilateral initiatives for Resilient Cities in the Asia Pacific continue to receive funding. Implementation of Resilient Cities embrace an advanced cohesive strategy that aims to improve electrical and transport infrastructure in cities.

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From Data Modeling to Algorithmic Modeling in the Big Data Era: Water Resources Security in the Asia-Pacific Region under Conditions of Climate Change

Jason Levy and Ross Prizzia

Abstract Advances in computing technologies allow machine learning algorithms to automatically, repeatedly and quickly apply complex mathematical calculations to water resources and environmental security challenges. The concomitant increase in “big data” research, development, and applications is also driving the popularity of real-time automated model building and data mining for these security problems under conditions of climate change. The last decade has seen considerable growth in the theory and application in Artificial Intelligence (AI). It is shown that machine learning, a subset of AI, constitutes a data analysis method that focuses on the development of algorithms that can iteratively learn from data to uncover previously “hidden insights” for environmental security managers in the Asia Pacific. It is concluded that deep machine learning (i.e. deep learning) can help to reduce losses to ecosystems, livelihoods, and businesses. In particular, these losses can be more likely prevented and minimized through the use of data and algorithmic modeling that improves community resilience by institutionalizing sustainable hazard mitigation within accepted processes of water resources community planning and economic development *before* disasters happen. Key environmental threats including foods, population extinction, water quality and climate change are considered. The difference between the algorithmic modeling and data modeling cultures are summarized with reference to the schools in which they originate, the assumptions they work on, the type of data they deal with, and the techniques used.

Keywords Big data • Sustainability • Resilience • Algorithmic modeling

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_9

1 Introduction

The last decade has seen considerable growth in the theory and application in Artificial Intelligence (AI). Machine learning is a type of AI in which an algorithm (i.e. a "machine" comprised of equations and matrices) analyzes data (without being limited to a particular representation of data) in order to learn a model and look for patterns. In this way, the algorithm both learns from and makes predictions on data, without explicitly relying on rules-based programming. In the broadest sense, these fields aim to 'learn valuable information' about the environment within which the system operates. In other words, machine learning constitutes a data analysis method that focuses on the development of algorithms that iteratively learn from data to uncover previously "hidden insights". As these models are exposed to new data they are able to independently adapt and learn from previous computations, historical relationships and data trends to "produce reliable, repeatable decisions and results" (SAS 2016). In this way, machine learning automates the analytical model building process. By training a machine learning model with existing data (model training) one fits the model parameters.

Resurging interest in machine learning is due to a number of factors. First, there has been an exponential growth in the volumes and varieties of available data (i.e. the ubiquity of big data in every field). Computers are storing terabytes of data which are now generated at an unprecedented rate from many sources (including telescopes scanning the skies, sensors collecting pollution and natural resources data, social media feeds, industrial quality control data, and information about the commercial preferences of consumers). Second, there is an urgent need to automate the analysis and comprehension of the data. Physicians must scan thousands of images in search of tumors, astronomers attempt to recognize novel objects based on planetary and stellar images stored on tape or disk while geneticists study microarray data to understand genetic effects. Third, the data is more publically available due to the rise in the open-source and open-content movements (from crowdsourcing to open-source policy and governance). Fourth, there has been a rise in cheaper and more powerful computational processing, together with less expensive data storage. Advances in computing technologies provide modern machine learning algorithms with the ability to automatically, repeatedly and quickly apply complex mathematical calculations. Fifth, the concomitant increase in "big data" research, development, applications and its intelligence is also driving the popularity of real-time automated model building and data mining.

Machine learning provides environmental security managers in the Asia Pacific with the ability to perform real-time optimization (based on the environmental datasets available) as the programs can teach themselves to learn, look for patterns and make predictions. In deep machine learning (i.e. deep learning), hierarchical representations of the observational data are calculated, where the higher-level features are defined from lower-level ones using multiple information processing stages (Schmidhuber 2015). Machine learning approaches now are capable of quickly and automatically (without human intervention) producing realistic models, analyzing complex datasets and delivering high-value predictions to accurately guide decisions – even on a very large scale. Recent years have seen many widely publicized examples of machine learning applications including image processing (e.g. the detection of tumors in x-rays and endangered marine species in the environment), self-driving vehicles, online recommendation offers (e.g. offers provided by Amazon and Netflix), and fraud detection.

Algorithms have been developed to process large, complex datasets and to deal with the uncertainty in the gathered high dimensional data. They can also be used as a more accurate and informative alternative to data modeling on smaller data sets (Breiman 2003). In the early stages of research in machine learning and related areas, similar techniques were discovered in relatively isolated academic silos, but there is now a broader collaboration among various research communities. The machine learning paradigm is anticipated to become even more pervasive and disruptive than the previous technologic waves of personal computing, the internet and mobile smartphones. In the early stages of research in machine learning and related areas, advances were carried out in relatively isolated academic silos, but there is now a broader collaboration among various research communities. The machine learning (ML) paradigm is anticipated to become even more pervasive and disruptive than the previous technologic waves of personal computing, the internet and mobile smartphones.

Sometimes conflated with the data mining subfield (which focuses more on exploratory data analysis), the main two subfields of machine learning are supervised learning and unsupervised learning. In supervised learning, a machine learning algorithm is trained using a "training dataset" (i.e. prototypical/representative/exemplar situations for which the desired output is known). "Validation data" (not encountered during training) is then used to test the algorithm's ability to predict the output. Here, the focus is on accurate prediction and the "generalization performance" of a method to previously unseen data, i.e. the method 'generalizes' to this unseen data.

On the other hand, in unsupervised learning the aim is to find accurate and dense (compressed) data descriptions. Conceptually, there are two sources of data for model training and evaluation: test data and training data. The training data (only) is used to set and adjust the model parameters. Note that if the test data was used to parameterize the model there would no longer be an independent evaluation of model performance. An unbiased estimate of this "generalization performance" can be obtained by measuring the test data performance of the trained model. However, the test data must be generated from the same underlying process that generated the training data. While the Bayesian statistical approach is not the only paradigm for describing machine learning and information processing, it is often convenient to consider the process of machine learning as updating (learning) the prior and posterior distributions as new data arrives. The more data that is input into algorithms the better the resulting predictions and decisions. However, the increased reliance and pace of machine learning advances bring new challenges. For example, the training data in machine learning applications use historic data to predict future trends and needs, providing old answers to new questions. This so called "algorithmic

Table 1 Concepts pertaining to algorithmic modeling and data modeling

Algorithmic modeling	Data modeling
Artificial intelligence/machine learning/ computational statistics/statistical learning/ computational intelligence/soft computing	Statistical modeling
Training, learning and automation	Fitting
Supervised learning	Regression/classification
Networks, graphs Deep learning (hierarchical representations and Hyperparameters)	Model
Weights	Parameters (numerical characteristic of a population)
Data mining algorithm, machine learning algorithm	Predictive modeling
Generalization	Test set performance
Unsupervised learning/data mining	Exploratory analysis, density estimation, clustering

determinism" problem tends to reinforce prior biases, reproduce established patterns of behavior, and deepen social divisions.

The foundation of the scientific process involves working with data and checking theory against data. While in many situations data models are the most appropriate approach to solve an environmental security problem, the field of statistics has displayed an unjustified vested interest in data models, even given large quantities of error-filled data (Dempster 1998; Breiman 2003). In order to remain a relevant and creative field, the environmental security community must reach out to other disciplines for collaborative work and apply tools to solve real world problems (rather than focus on the type of data model that can be created). While the best solution could be a combination of an algorithmic model and a data model (or maybe either in isolation) scientific rigor requires being open to the use a wide variety of tools. Algorithmic modeling and data modeling use different names for similar concepts as shown in Table 1.

2 A Tale of Two Paradigms for Modeling Security Challenges in the Asia-Pacific

When analyzing data, statistics is used to achieve two goals: prediction and inference: Inferential statistical analysis includes testing hypotheses and deriving estimates to infer properties about a population and obtain information about the underlying data mechanism. There are two paradigms in the statistical modeling community:

- Generative modeling culture which uses statistical data models (data modeling) and
- Predictive modeling culture which uses algorithms (algorithmic modeling).

The selection of either data modeling or algorithmic modeling must be justified based on the nature of the problem and on the data. Statistical data models, overwhelmingly favored by the statistical community, assumes that a given stochastic data model generates the data ("generative modeling"). Data modeling involves developing stochastic models which fit the data and then making inferences about the data-generating mechanism to deduce properties of the underlying distribution. Breiman (2003) notes the over-reliance of the statistical community on data models to the exclusion of a more diverse set of tools. This has resulted in a number of shortcomings in the statistical community: the inability to solve some of the most complex, interesting and important contemporary problems.

On the other hand, the theory of algorithms prioritizes prediction (the goal of modeling is predictive accuracy) and assumes the data generation mechanism to be unknown. Accordingly, data models are rarely used in the algorithmic community. While industrial statisticians have used algorithmic modeling for decades (Daniel and Wood 1971) there is little work in statistics that focuses on predictive modeling. As an exception Grace Wahba's smoothing spline algorithm research is built on reproducing kernels in Hilbert Space (Wahba 1990). Machine learning approaches have also made significant impacts in the interdisciplinary field of bioinformatics by facilitating discoveries in genomics and proteomics. Zhang and Singer (1999) applied recursive partitioning in the health sciences.

Beginning in the mid-1980s, important new machine learning algorithms for data fitting became available including neural nets and decision trees. A burgeoning predictive modeling community began using the new algorithmic modeling tools to solve complex prediction problems that are less applicable to data models: self-driving vehicles, speech recognition, image recognition, nonlinear time series prediction, handwriting recognition, and prediction in financial markets. The "black box" theory of the algorithmic approach observes a set of inputs $(X_1, X_2, \ldots, X_n)$, a set of outputs $(Y_1, Y_2, \ldots, Y_n)$ and seeks to find an algorithm (f_x) that will be a good predictor of $(Y_1, Y_2, \ldots, Y_n)$ in the test set. One assumption made in the theory of algorithms is that the data $(X_1, X_2, \ldots, X_n)$ is drawn independent and identically distributed (iid) from an unknown multivariate distribution. The "strength" of f_x as a predictor provides their predictive accuracy. In the case of iterative algorithms, convergence is desired (i.e. candidate solutions for each iteration tend to get closer and closer to the desired solution). For example, in their work on Classification and Regression Trees (CART), Breiman et al. (1984) demonstrates the asymptotic convergence of the CART algorithm to the Bayes risk by letting the trees grow as the sample size increases. Vladimir Vapnik's support vector machines – based on the construction informative bounds on the generalization error (infinite test set error) of classification algorithms—have proved to be more accurate predictors in classification and regression then neural nets (Vapnik 1995, 1998). Since the mid-1980s advances in the methodology of machine learning approaches has been explosive, together with concomitant increases in predictive accuracy.

The field of environmental security is witnessing an inflection point in which artificial intelligence (AI) becomes the next technologic shift: in many environmental security fields AI paradigms are replacing data modeling approaches in general and statistical models in particular. Environmental managers can leverage AI technology in multiple ways when searching for environmental patterns. Within the data analytics field, AI focuses on making predictions (known as predictive analytics in commercial settings). While machine learning makes fewer assumptions than statistical modeling there is not a clear dichotomy between the two approaches. Key lessons in the development of algorithmic models are discussed by Breiman (2003): the multiplicity of good models (Rashomonic effect), the conflict between simplicity and accuracy (Occam's razor) and the curse (or blessing) of dimensionality (Bellman).

3 Stochastic Water Modeling in the Asia-Pacific Region: Climate Change, Environmental Quality and Extinction Risk

Water-related problems are particularly acute in Asia. Although Asia is home to more than half of the world's population, it has less freshwater—3920 cubic meters per person per year—than any continent other than Antarctica. Almost two-thirds of global population growth is occurring in Asia, where the population is expected to increase by nearly 500 million people within the next 10 years. Asia's rural population will remain almost the same between now and 2025, but the urban population is likely to increase by a staggering 60%. As population growth and urbanization rates in Asia rise rapidly, stress on the region's water resources is intensifying. Climate change is expected to worsen the situation significantly. Experts agree that reduced access to freshwater will lead to a cascading set of consequences, including impaired food production, the loss of livelihood security, large-scale migration within and across borders, and increased economic and geopolitical tensions and instabilities. Over time, these effects will have a profound impact on security throughout the region (DeRusha et al. 2017).

Southeast Asian countries such as Cambodia which border the Mekong River are extremely vulnerable to flooding. In the last decade, Cambodia has halved its poverty rate and improved the living conditions of its population. However, because of extreme climate events that regularly descend on the country, Cambodia remains one of the most disaster-vulnerable countries in Southeast Asia. In 2013 alone, losses caused by floods added up to USD $356 million. However, disasters and climate change also present an opportunity to promote what the United Nations Development Program (UNDP) refers to as "risk-informed development" (UNDP 2015). Communities affected by climate disasters learn to work together to create effective, multi-disciplinary approaches to respond to and recover from disasters as well as promote disaster risk reduction.

In 2013, a combination of heavy rains and the swelling of the Mekong River caused widespread damage to infrastructure and crops, the death of 168 people, most of them children, and devastation to 20 provinces. Following the floods, the Cambodian government requested that UNDP work with various partners to carry out a post flood early recover needs assessment. Drawing on the expertise of UNDP's country office, as well as the skills and knowledge of government partners, NGOs, and civil society organizations, measurements of the flood damage and an assessment that clearly articulated the needs of the various communities were accomplished (UNDP 2015).

Sea-level rise, erosion, and coastal flooding are some of the greatest challenges facing humanity from climate change. Recently at least five reef islands in the remote Solomon Islands have been lost completely to sea-level rise and coastal erosion, and a further six islands have been severely eroded. This is the first scientific evidence that confirms the numerous anecdotal accounts from across the Pacific of the dramatic impacts of climate change on coastlines and people (Albert et al. 2016). These islands lost to the sea range in size from one to five hectares. They supported dense tropical vegetation that was at least 300 years old. Nuatambu Island, home to 25 families, has lost more than half of its habitable area, with 11 houses washed into the sea since 2011. This is the first scientific evidence, that confirms the numerous anecdotal accounts from across the Pacific of the dramatic impacts of climate change on coastlines and people (Albert et al. 2016). Previous studies examining the risk of coastal inundation in the Pacific region have found that islands can actually keep pace with sea-level rise and sometimes even expand. However, these studies have been conducted in areas of the Pacific with rates of sea level rise of 3–5 mm per year – broadly in line with the global average of 3 mm per year. For the past 20 years, the Solomon Islands have been a hotspot for sea-level rise. Here the sea has risen at almost three times the global average, around 7–10 mm per year since 1993. This higher local rate is partly the result of natural climate variability. These higher rates are in line with what we can expect across much of the Pacific in the second half of this century as a result of human-induced sea-level rise.

Many areas will experience long-term rates of sea-level rise similar to that already experienced in Solomon Islands in all but the very lowest-emission scenarios. Natural variations and geological movements will be superimposed on these higher rates of global average sea level rise, resulting in periods when local rates of rise will be substantially larger than that recently observed in Solomon Islands. We can therefore see the current conditions in Solomon Islands as an insight into the future impacts of accelerated sea-level rise. The study included the coastlines of 33 reef islands using aerial and satellite imagery from 1947 to 2015. This information was integrated with local traditional knowledge, radiocarbon dating of trees, sea-level records, and wave models (Albert et al. 2016).

Other new sea rise research relevant to the Asia Pacific revealed that important focal parameters of tsunamigenic earthquakes, particularly fault dip direction, can be extracted from tsunami-borne EM fields with the potential of electromagnetic (EM) fields being used in tsunami early warning. Knowing the direction in which the fault dips could be helpful for tsunami early warning, as the direction sometimes determines whether a rise wave or a backwash hits a particular costal area. By 2100, a realistic low-end projection is an additional 1 foot of sea level rise globally, with an upper end projection of 4 feet or higher causing sea level rise which not only threatens infrastructure over the long-term but a rising sea exacerbates the flooding effects of storm surges and high tides (Walsh et al. 2014). During severe storm events, water that surges onto US military installations from the sea can damage installation infrastructure or training areas and risk from sea level rise and storm surge are not limited to low-lying islands and atolls. While portions of Guam are well above sea level, most of the infrastructure is on or near the coasts and remains exposed to sea level rise and storm surge (ORLN 2015). Potentially heavier and more frequent precipitation will also affect installation maintenance costs and require additional flood or erosion control measures. Military capabilities and readiness are degraded when airstrips, piers, roadways, communication, energy and other infrastructure are unavailable due to flooding or erosion. Losing access to these facilities is potentially equivalent to temporary anti-access to an area, requiring the US Department of Defense (USDOD) to consider the capability thresholds required in the Area of Responsibility (military geographic region) (AOR), and design resiliency and redundancy into infrastructure plans to maintain these thresholds (Walsh et al. 2014). Pacific installations also need to be especially resilient to natural disasters such as tropical cyclones, as they not only need to maintain capabilities after an event, but often serve as a base of operations (Walsh et al. 2014).

Global climate variability and change is increasing the frequency and severity of natural disaster events and environmental security risks in the Asia-Pacific region. Climate change threatens the fabric of life for people throughout the Asia Pacific – it affects key health, environmental and social dimensions including access to clean water, food production, and the sustainability of ecological systems and the urban built environment. Severe weather is predicted to become more frequent and destructive. For example, higher temperatures may lead to droughts, crop failures, food insecurity, the mass migration of "climate refugees" across international borders and increased conflict among nations competing for scarce resources (particularly among upstream and downstream nations). Warmer air holds more moisture, which portends record-breaking rainfall and more intense storms. Even the conservative estimates for the rising temperatures and changing ocean levels will cause some significant issues in the Asia-Pacific Region. Sea rise for coastal cities may be extremely damaging, especially as people and population densities continue to increase in coastal areas of the Asia-Pacific. Emergency managers, security professionals and governments must promote climate adaptation and mitigation measures that protect communities in the Asia-Pacific region. In particular, citizens of states in the Asia Pacific are highly vulnerable to the negative impacts of climate change and many inhabitants are already suffering from increasing heavy rainfall and floods, water shortages, storm surge, hurricanes, coastal erosion and droughts. Accordingly, the inhabitants of many regions have become "canaries in a coal mine" with respect to the adverse effects of climate change. For example, a small community living in the Pacific island chain of Vanuatu has become the first in the world to be formally relocated as a result of climate change.

Climate change may also contribute to a more energetic hydrological cycle, leading to more intense and frequent storms that cause runoff which carries pollutants from industrial and agricultural areas to nearby waterways. Heavy storms can also overwhelm the sewer system and send raw sewage and polluted stormwater into nearby streams and rivers. There are additional threats to rivers from climate change in the Asia-Pacific region: lower flows, rising temperature, more frequent droughts and changing precipitation patterns contribute to higher pollution levels (less water to dilute pollutants in rivers, lakes and streams). Higher water temperatures also lower dissolved oxygen levels and cause algal blooms which can kill marine life and degrade ecosystems (biochemical processes and organism growth rates are regulated to a large extent by temperature). An increase of atmospheric carbon dioxide and/or other greenhouse gases is projected to cause climate warming in the Asia-Pacific region which could significantly alter Dissolved Oxygen (DO) characteristics in water bodies. These changes are in turn expected to have a profound effect on indigenous fish populations. The earliest models of water quality involved two linear deterministic differential equations of biochemical oxygen demand (BOD) and dissolved oxygen (DO) based on the pioneering work of Streeter and Phelps (1925). The seminal Streeter-Phelps equations form the foundation for many of today's sophisticated water quality models in the Asia-Pacific region. A water quality mode1 typically describes the chemical, physical, and biological processes that occur in a water body, such as the reaction of chemical constituents and the uptake of nutrients by living organisms. The propagation of uncertainty through a stochastic water quality model is shown in Fig. 1.

Consider a river with multiple reaches and a treatment plant discharging at the head of the reach, as illustrated in Fig. 2. Mass or energy balance equations are often used to describe the dynamics of constituent concentrations of natural water bodies. The health of aquatic systems (algae, fish, micro-organisms, etc.), aesthetics (such as odor and color), potability, taste, and so on depend upon the resulting concentrations of dissolved oxygen. DO levels naturally cycle over the course of a day (and throughout the year) as shown in Fig. 3. In the steady state conditions resulting from the natural balance of various chemical and biological processes, the DO concentration fluctuates about a saturation concentration (*Os*). Whenever

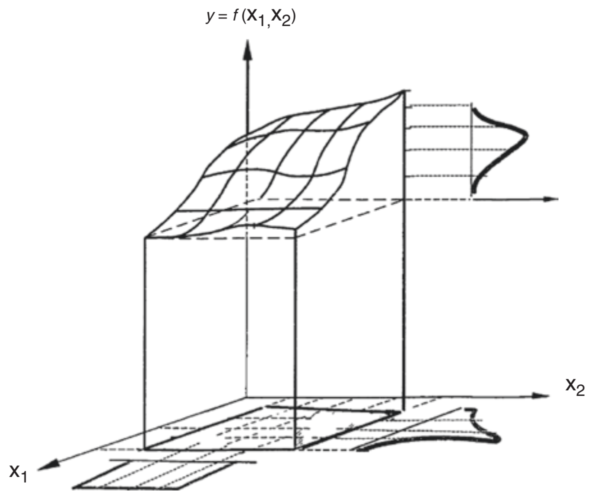


Fig. 1 Propagation of the continuous probability distributions through a water quality mode1

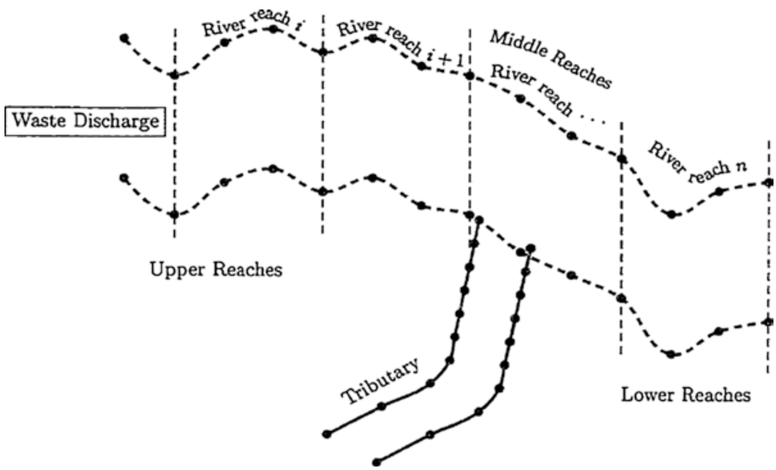


Fig. 2 River with multiple reaches

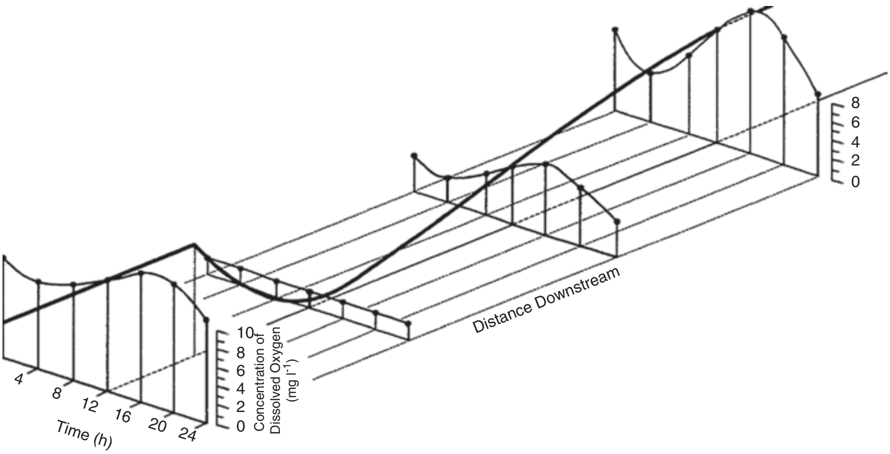


Fig. 3 Dissolved oxygen (DO) vs time

untreated waste waters are discharged into the stream, the concentration of DO may be adversely affected. Consider a steady-state stochastic DO models which address three water quality constituents: DO, carbonaceous biochemical oxygen demanding substances (CBOD) and nitrogenous oxygen demanding substances (NOD). Coupled CBOD-NODDO reactions are an important component of water quality modeling. It is known that CBOD is increased by nonpoint load sources of carbon *(S_c)* and decreased by oxidation *(k_i),* sedimentation*,* and adsorption *(L).* NOD is also increased by nonpoint load sources (S_N) and decreased by oxidation *(k_2).* Finally, DO is supplied by re-aeration (k_3) and photosynthesis (P) and decreased by respiration (R), CBOD (k_l), and NOD *(k_2)*. The following three deterministic differential equations have been used for describing the water quality of a river (Zielinski 1988):

$$\frac{dC}{dt} = -\left(k_1 + \mathcal{L}\right)C + S_C \tag{1}$$

$$\frac{dN}{dt} = -k_2 N + S_N$$

$$\frac{dO}{dt} = k_3\left(O_s - O\right) - k_1 C - k_2 N + P - R$$

Where the photosynthetic term, P, in Eq. 5.4 is represented by

$$P_m \sin\left[v\left(t + \varnothing\right)\right] \tag{2}$$

These equations describe how a spike input of CBOD, NOD (or other organic material) generates the classic transient DO "sag curve" (Fig. 3). In Eq. 2, P_m is the maximum rate of photosynthesis. The units of the state variables in Eq. 1 are now defined:

- C is the carbonaceous biochemical oxygen demand (CBOD) in mg/L;
- N is the nitrogenous oxygen demand (NOD) in mg/L;
- O is the dissolved oxygen concentration (DO) in mg/L

Next, the four decay constants are defined:

- k_1 is the CBOD decay rate per day;
- L is the sedimentary and adsorption loss rate for CBOD per day;
- k_2 is the decay rate of NOD per day; and k_3 is the reaeration rate per day.

In addition, O_s is the saturation concentration of oxygen in mg/L while R is the loss rate of DO due to respiration in mg/L/day. Finally, S_c and S_N are the nonpoint source loads of carbon and nitrogen respectively in mg/L/day. Replacing the state variables C, N, and O with X_1, X_2 and X_3 respectively, Eq. 1 can be re-written in matrix form:

$$\frac{dx}{dt} = Ax + b \tag{3}$$

Where the 3×1 column vector x is

$$\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \tag{4}$$

The 3×3 matrix A is given by

$$\begin{bmatrix} -(k_1 + \mathcal{L}) & 0 & 0 \\ 0 & -k_2 & 0 \\ -k_1 & -k_2 & -k_3 \end{bmatrix} \tag{5}$$

While the 3×1 column vector b is

$$\begin{bmatrix} S_C \\ S_N \\ P_m \sin\left[v\left(t + \varnothing\right)\right] - R + k_3 O_S \end{bmatrix} \tag{6}$$

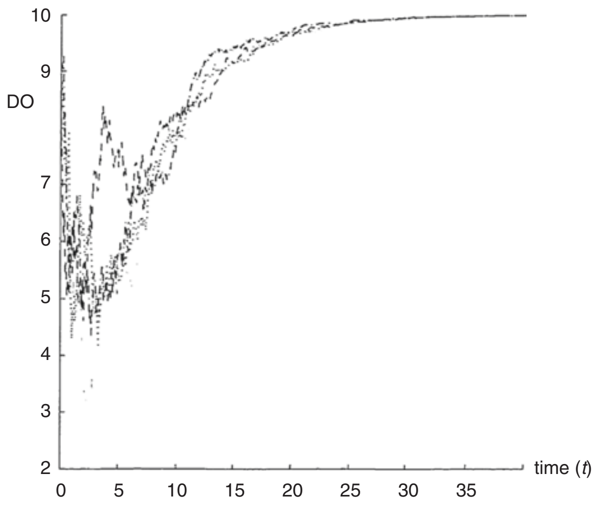
Accordingly, Eq. 3 becomes

$$\frac{d}{dt}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -(k_1 + \mathcal{L}) & 0 & 0 \\ 0 & -k_2 & 0 \\ -k_1 & -k_2 & -k_3 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} S_C \\ S_N \\ P_M \sin\left[v\left(t + \theta\right)\right] - R + k_3 O_S \end{bmatrix} \tag{7}$$

Sample paths of DO vs. time are calculated in MATLAB and shown in Fig. 4 which illustrates four sample paths of DO vs time. Given any specific location along a river, the probability density function (pdf) of DO that corresponding to this location can be produced. Figure 4 illustrates the DO density functions corresponding to locations X_1 and X_2.

Climate change may already be causing a reduction in the amount of the life-giving gas that is dissolved in sea water in the Asia-Pacific region, thereby causing

Fig. 4 Four paths for dissolve oxygen vs time



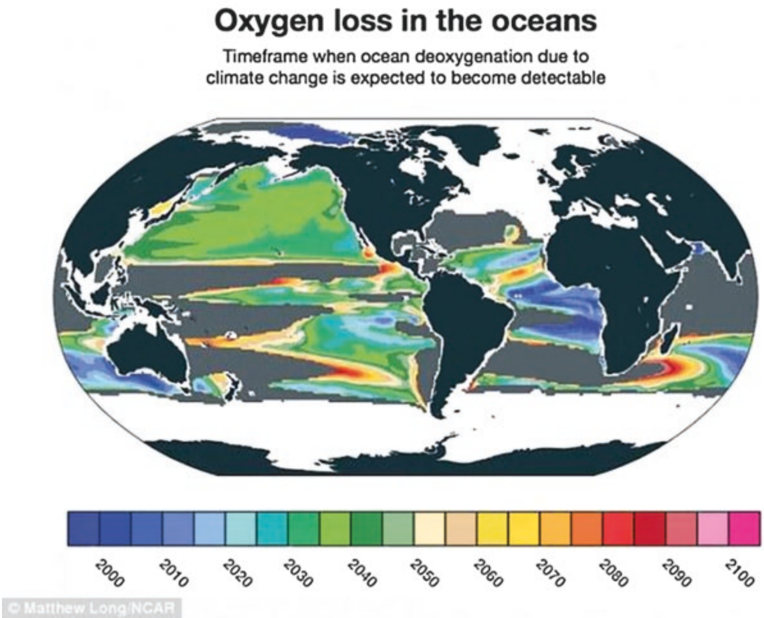


Fig. 5 Climate change and oxygen loss in the oceans (Long et al. 2016)

many sea creatures, including fish, squid, crabs and shellfish, to struggle to breathe (Long et al. 2016). Tropical regions are suffering from oxygen loss while much of the Pacific Ocean will be hit in by around 2040 as shown in Fig. 5. The effects of this loss of oxygen will start become noticeable across widespread areas of the oceans between 2030 and 2040.

4 Statistical Models of Extinction in the Asia Pacific Region

While the threats of global warming pose a grave threat to the well-being and survival of species in the Asia Pacific region, many models for population dynamics fail to consider the risk of extinction. Consider the exponential population growth model for a population P:

$$P' = aP, \ a > 0 \tag{8}$$

Since the exponential growth pattern cannot continue indefinitely, the *logistic* (*inhibited growth*) *model* is often used:

$$P' = bP(L - P) = aP - bP^2 \text{ with } \mathrm{L = a / b} \tag{9}$$

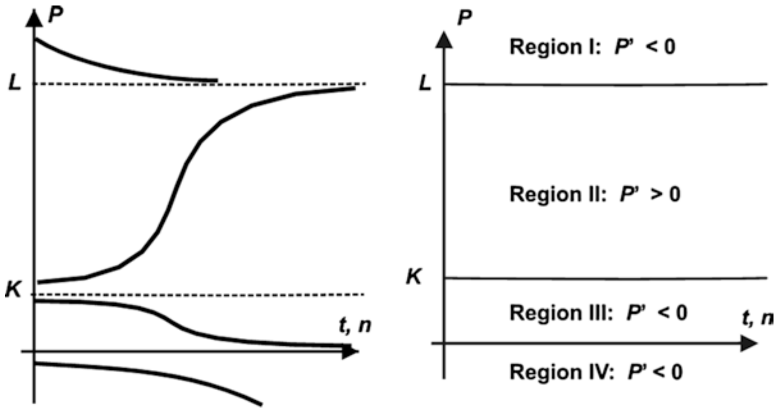


Fig. 6 Extinction and growth models. Solution patterns for logistic-type growth and for extinction (**a**) growth curves (**b**) growth regions. Different regions of the t-P plane for logistic-type growth and extinction

When $a > 1$ and b is a positive constant less than a the solution has the S-shaped logistic pattern shown in Fig. 6a where the horizontal asymptote L is referred to as the *carrying capacity of the environment*. Note that the change in the population depends on both the size of the population P and the difference between the current population and L (also referred to as the *limit to growth* and the *maximum sustainable population*). The inflection point seen in the S-shaped logistic curve of Fig. 6a, shows where the population is growing most rapidly and occurs at $P = ½\,L = ½(a/b)$. Three other growth possibilities are shown in Fig. 6a. Under conditions of climate change it is important to consider how to model the extinction of species. A catastrophic change in the local conditions such as a significant rise in temperature can change to such an extent that a species may become extinct. Accordingly, the classic logistic growth model should take into account the risk that a population decays toward extinction. As shown in Fig. 4a there is a *minimum sustainable population*, *K,* a level below which a species cannot be maintained. Throughout the Asia Pacific region, experts predict that populations of many different species are dropping below K for a number of reasons linked to global climate variability and change. Once this occurs, it is mathematically expected that the population begins to decay toward zero. We now highlight three equilibrium levels, one for a zero population, another corresponding to the maximum sustainable population L, and a third corresponding to the minimum sustainable population K, These three equilibria create four regions in the t-P plane for logistic-growth and extinction, as illustrated in Fig. 6b. Consider the behavior of the solutions in each of the four regions of Fig. 6b. In both Region I (where P > L) and Region II (where K < P < L), the solutions behave similar to the logistic model: the solution tends toward L. Specifically, in Region I the solution decays toward L whereas in Region II the solutions rise toward L, eventually in an asymptotic manner. Finally, in Region III ($0 < P < K$), the solutions decay toward zero whereas in Region IV ($P < 0$) the solutions decay toward negative infinity.

The one-dimensional first passage time problem is now considered, where the region under consideration is an interval $x_1 \leq x_0 \leq x_2$. We are interested in examining the time T it takes the process $x(t)$ starting at x_0 to first reach the boundary $x = x_1$ or $x = x_2$ as shown in Fig. 7. This so-called *First* passage time varies from realization to realization, so the mean (expected) first passage time $M(x_0)$ is of interest. Other notations for $M(x_0)$ include time $E[T_x]$ .Consider a practical first passage time example: a bomb has exploded a few miles outside of Tokyo, the capital of Japan. It is of interest to estimate the expected time it will take the dispersing molecules of poisonous gas to first reach the urban boundary of Tokyo under the molecular bombardment of air molecules. As another, consider a recent oil spill off the coast of China. It is of interest to estimate the first time that the oil will reach Hainan island or other ecologically sensitive areas. The first passage times for type-B and type-D barriers are shown in Figs. 7, 8 and 9.

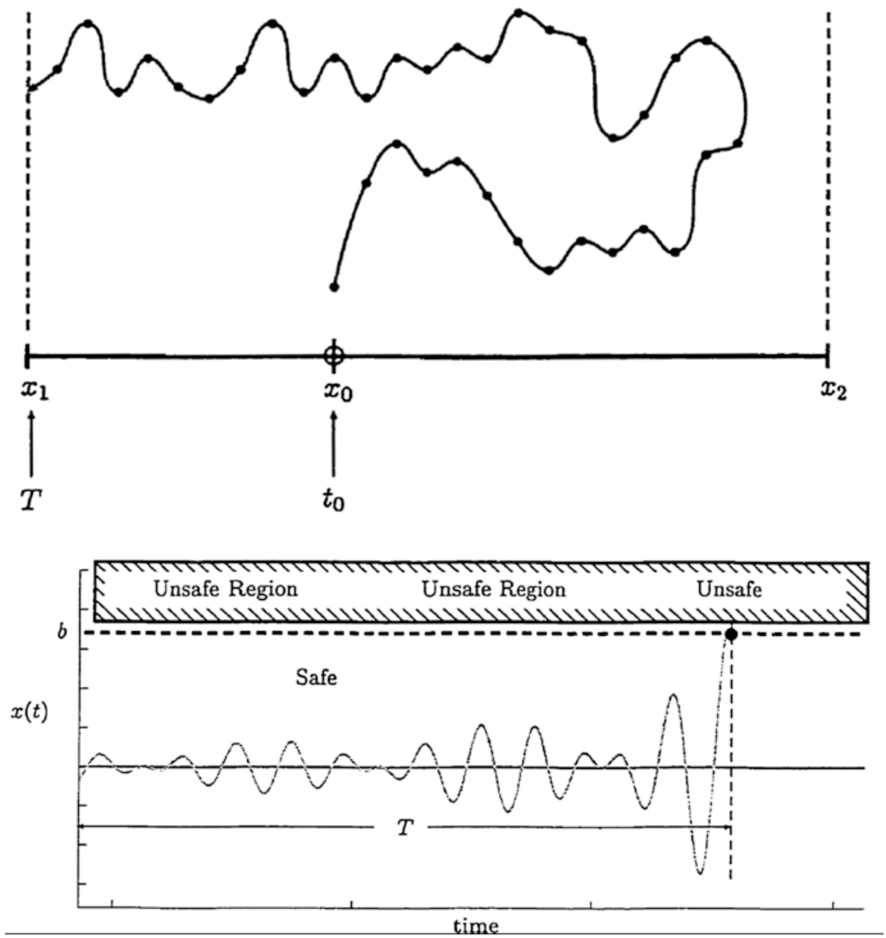


Fig. 7 First-passage time T for type-B barrier (x < b is safe)

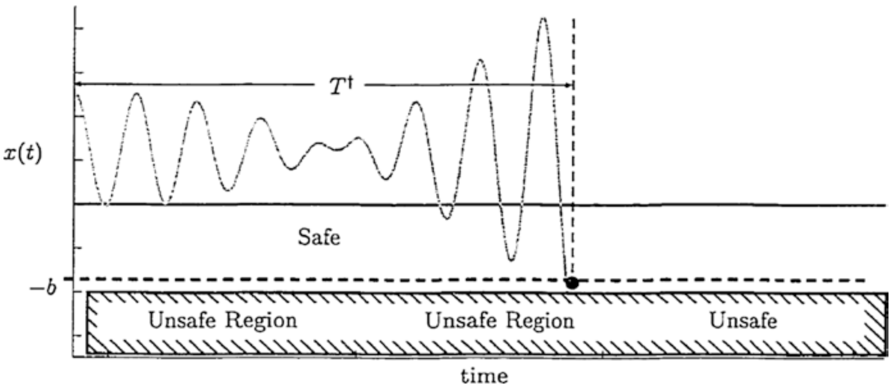


Fig. 8 First-passage time $\boldsymbol{T}^\dagger$ for type-B barrier (x > −b is safe)

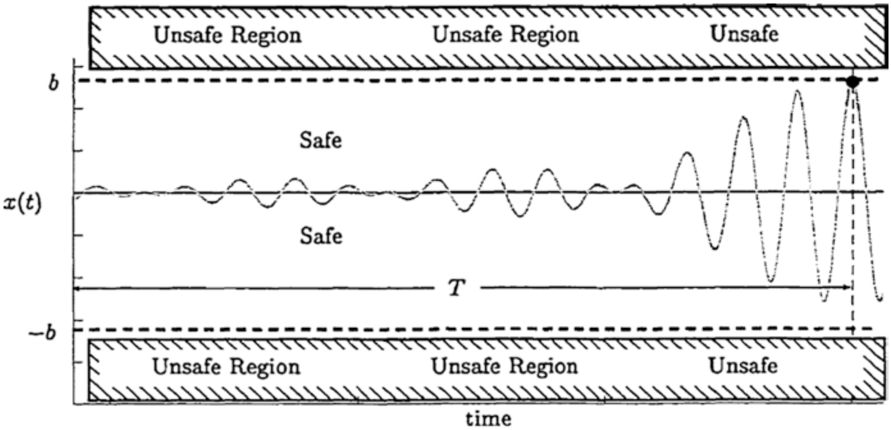


Fig. 9 First passage time T for type-D barriers

First passage time problems have been studied extensively using linear oscillators: consider the oscillator with response y(t) which is related to the wide-band random excitation F(t) by the differential equation:

$$F(t) = \ddot{y} + 2\zeta\omega_n \dot{y} + \omega_n^2 y \tag{10}$$

where the constants ω_n and ζ represent, respectively, the undamped natural frequency and the damping ratio of the vibratory system. The excitation *F(t)* is taken to be a wide-band random process with zero mean. A commonly studied first passage time problem for linear oscillators is to determine the probability distribution of the time T that it takes for y(t) starting from an initial amplitude level ***T*** to reach

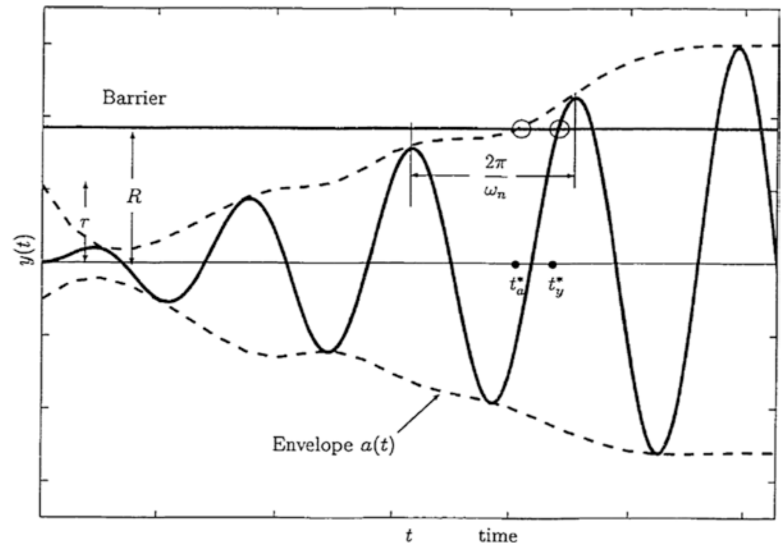


Fig. 10 Sketch of y(t) and a(t) crossing the barrier *R*

the barrier R (see Fig. 10). Political and economic forces often lead to extinction pressures. Stochastic simulations can help to calculate the "risk" of stock collapse at low abundance or high fishing pressure.

5 Climate Informatics and Extinction Risks in the Asia-Pacific: A Machine Learning Approach

The impacts of present and potential future climate change loom large in the Asia-Pacific region. Algorithmic models can help to improve understanding of the climate system. The global climate system is characterized by complex phenomena that are imperfectly observed and simulated. Machine learning approaches constitute a valuable approach given the growing supply of climate data from satellites and environmental sensors. Given the massive scale of the climate data an algorithmic model should be considered to analyze these challenges. There is a growing discipline known as *climate informatics*: it is proposed that the field of climate informatics will improve knowledge discovery and help to address key climate science questions in the Asia-Pacific. Recent achievements in machine learning for climate informatics highlight important new problems for machine learning and possible collaborations. The dugong ("sea cow") is one of the species highly sensitive to climate change. Like other populations of large marine mammals dugongs are under threat of extinction.

Found in waters off the northern half of Australia globally dugongs are classed as "vulnerable to extinction". To assist in conservation efforts, scientists in the Asia-

Pacific region track these endangered populations to identify their numbers, size and location. However, manually identifying dugong population from small planes is slow, expensive and sometimes hazardous. Accordingly, marine mammal researcher Dr. Hodgson from Murdoch University in Western Australia and Dr. Frederic Maire, a computer scientist at Queensland University of Technology are using drones fitted with cameras to help collect dugong data. In particular, Maire's automated detection system uses Google's machine-learning program TensorFlow (a free open source machine learning platform), to provide easier and more accurate population estimates. In particular, the deep learning neural network identifies dugongs by their size and color. The system currently has an 80% accuracy rate (i.e. it identifies 80% of dugongs they found manually in images.) The detector's accuracy improves as it learns from a wider set of negative examples (anything in the sea that might look like a dugong, like wave crests and shadows) and positive examples (Maire et al. 2015). The machine learning tools helps the scientists to identify dugongs from aerial photography of the ocean on tens of thousands of images. By being able to improve detection performance over time and to identify threatened populations on a large scale, conservationists will have a more accurate way to understand the impact of human activities and climate change on endangered species. It is expected this approach may scale well for dugongs and other sea mammals such as humpback whales and dolphins.

6 Policy Solutions to Promote Water and Climate Security

Both machine learning and statistical modeling approaches must be supplemented by robust policy solutions to enhance resilience to climate and water hazards. In February 2015, mayors and municipal leaders from the Asia Pacific region met to discuss a more coordinated response to and recovery from the effects of climate change. The resulting report called for community engagement, innovation, and local and global partnerships that would help prevent and manage risk. On March 18, 2015, the World Conference on Disaster Risk Reduction (DRR) was held in Sendai, Japan and attended by over 6500 participants including 2800 government representatives from 187 governments. The Public Forum had 143,000 visitors over the 5 days of the conference making it one of the largest UN gatherings ever held in Japan (UN 2015). Representatives from the 187 UN member states adopted the Sendai Framework for Disaster Risk Reduction 2015–2030**,** the first major agreement of the Post-2015 development agenda. The Sendai Framework is a far reaching document for disaster risk reduction with seven targets and four priorities for action.

The seven global targets to be achieved over the next 15 years include substantial reduction in (1) global disaster mortality, (2) numbers of affected people, (3) economic losses in relation to global GDP, and (4) disaster damage to critical infrastructure and disruption of basic services. It also aims to achieve (5) an increase in the number of countries with national and local DRR strategies by 2020, (6) enhanced international cooperation, and (7) increased access to multi-hazard early warning systems and disaster risk information and assessments. The four priority actions are (1) understanding disaster risk, (2) strengthening disaster risk governance to manage disaster risk, (3) investing in DRR for resilience, and (4) enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation, and reconstruction (UNOPS 2015)

The Sendai Framework calls for concrete indicators of progress towards set goals to be measured against the disaster losses in the decade after the adoption of the 2005 Hyogo Framework for Action. To reach its goals, the Framework calls for actions to not only protect populations and promote quick recovery, but also to prevent new risks such as those caused by ill planned urban growth in areas subject to flooding, landslides, and effects of climate change (Weru 2015). Integration with global regimes to mitigate and adapt to climate change and promote sustainable development is among the key objectives of the Sendai Framework, as is inclusively addressing risk through economic, governmental, structural, legal, social, cultural, educational, and health-related sectors, and UN organizations.

6.1 Australia Climate Change Adaptation

Like other countries in the Asia Pacific region, Australia faces the twin challenges of dealing with extreme weather-related disasters and adapting to the impacts of climate change. Recognizing the enormous environmental and socio-economic toll climate disasters have on the country, the Australian government called for action to develop an integrated approach across and between the different levels of government to address the impacts of climate change. A team of researchers from Griffith University and RMIT University was funded over 1 year (2012) by the National Climate Change Adaptation Research Facility (NCCARF) to develop the foundations for a nationally consistent approach to disaster risk management and climate change adaptation that would provide a set of appropriate reforms to governing institutions. The research team focused on a three-way comparative case study of the 2009 Victorian bushfires, the 2011 Perth Hills bushfires, and the 2011 Brisbane floods. The research involved an analysis of the reports generated by the official inquiries into these disasters, interviews with key stakeholders, and stakeholder workshops in Perth, Melbourne, and Brisbane. The final research report, entitled "The Right Tool for the Job: Achieving Climate Change Adaptation Outcomes through Improved Disaster Management Policies, Planning and Risk Management Strategies", offered data driven insights and recommendations that range from the conceptual to the practical. First, it was argued that a reconceptualization of terms such as 'community' and 'resilience' is necessary to take into account socio-economic diversity and allow for more tailored, context-specific risk analyses and responses. This is particularly important with regard to policymaking and planning processes and community engagement. Second, it was suggested that the high level of uncertainty inherent in disaster risk management and climate change adaptation requires a more interactive approach to policymaking and planning. Third, some specific institutional reforms were proposed that included:

1. Creating a new funding mechanism that would encourage communication and collaboration between and across different levels of government as well as promote partnerships with businesses and the community,
2. Improving community engagement through new resilience grants run by local councils,
3. Embedding climate change researchers within disaster risk management agencies to promote institutional learning and more integrated risk-context analyses, and
4. Creating an inter-agency network that encourages collaboration among organizations to support the proposed reforms.

The Australian research project is an example of how government can overcome political, social, and economic barriers in the interest of national preparedness for impending disasters. The findings of the research project offer guidelines for improving mitigation and adaptive responses as well as a starting point for better integration of disaster risk management and climate change adaptation. Efforts such as this one are of benefit to countries of the Asia Pacific region and the world.

6.2 Role of International Organizations in Climate Change Preparedness in the Asia-Pacific Region

In 2011, the United Nations Office for Disaster Risk Reduction – Regional Office for Asia and Pacific (UNISDR AP) issued a comprehensive report that provided a summary of how disaster risk reduction (DRR) and climate change adaptation (CCA) are undertaken and integrated in the Asia Pacific region. DRR is the concept and practice of reducing disaster risks through analysis and management of causal factors. It reduces exposure to hazards and lessens the vulnerability of people and assets. DRR also improves management of the land, the environment, and preparedness for adverse events. As experience with DRR and CCA grows, there is increasing recognition that both share a common focus: reducing the vulnerability of communities and contributing to sustainable development. The high level of climate related risks in the Asia Pacific region make DRR and CCA key policy goals. The 2011 UNISDR AP report provides best practices on how to improve the Asia Pacific regional planning and programming for DRR and CCA and highlights areas for cooperation among regional and sub-regional organizations. It proposes ways and means to support both national and regional stakeholders in DRR and CCA, such as governments, UN agencies, intergovernmental organizations, research and technical organizations, non-government organizations (NGOs), and especially the UN International Strategy for Disaster Reduction (UNISDR) Asia Partnership on Disaster Reduction members, in order to enhance regional planning, programming, and cooperation (UNISDR AP 2011). Follow up on the United Nations (UN) UNISDR AP report showed actual improvement in climate change preparedness in the Asia-Pacific region. This was noted in a subsequent UN report in 2014, "10 years after Indian Ocean Tsunami, Asia-Pacific Region Better Prepared" (UNNC 2014).

The Indian Ocean Tsunami, the world's worst recorded natural disaster, hit the Asia Pacific region in December 2004, killing more than 200,000 people, leaving 1.4 million survivors homeless, and destroying the entire food production systems on which whole populations depended (UNNC 2014). The devastation alarmed the world community. The UN Economic and Social Commission for Asia and the Pacific (ESCAP) and the German Federal Ministry for Economic Cooperation and Development (BMZ) have partnered with the German Ministry contributing 250,000 euros to the ESCAP Multi-Donor Trust Fund for Tsunami, Disaster, and Climate Preparedness, adding to an initial 500,000 euros contribution made in December 2013 (UNNC 2014). The UN report noted that some of the countries that were worst affected by the Indian Ocean Tsunami are now better prepared for disasters and better positioned to respond more effectively.

In the Pacific, as elsewhere, global climate change disasters have their greatest impact at the local level. Studies show that the accumulated impacts of small and medium disasters may be equivalent to, or exceed, those of large disasters. Increases in the frequency of these lower intensity hazards have a major impact on poverty. The countries studied are typical in terms of the current low level of integration of DRR and CCA. While there may be institutional arrangements that suggest some progress with integration at the national policy and institutional levels, the practical reality is that little is happening on the ground at the operational level. Although there is much work to be done, progress at the local level is being made. Tonga is clearly the lead example of local level integration of DRR and CCA. Tonga developed an integrated plan for Disaster Risk Management (DRM) and climate change (including the reduction of GHG emissions) and established a National Advisory Committee on Climate Change to take responsibility for DRM (World Bank 2013). Mainstreaming DRM in development planning can help to address some of the root causes of rising disaster impact. The annual damages from unabated economic development, population growth, and rapid urbanization that exacerbate climate change are expected to triple to $185 billion by 2100, even without factoring in climate change. DRM can help to reverse the current trend of rising disaster impact by acting swiftly and decisively to cut costs and losses due to problems of unchecked development. Lives and assets can be protected with wise policy and planning. However, many developing countries lack the tools, expertise, and instruments to factor the potential impacts of adverse natural events in their investment decisions (World Bank 2013)

The goals of the United Nations Climate Summit in September 2014, were to reduce GHG emissions, strengthen climate resilience, and mobilize political will for a meaningful legal global agreement in 2015, because the 'Hyogo Framework for Action 2005–2015: Building Resilience of Nations and Communities for Disasters' was scheduled to end in 2015. The United Nations General Assembly Resolution 66/199 requested UNISDR to facilitate the development of a Post-2015 Framework for Disaster Risk Reduction. A report which synthesizes consultations held at the regional, national, and community levels throughout the Asia Pacific region on the Post-2015 Framework for Disaster Risk Reduction was particularly targeted at countries and stakeholders from the region. The report describes the consultation approach that has been adopted in the Asia Pacific region and summarizes the key issues and proposals resulting from these consultations. The findings from the report add to the growing body of information needed to deal with climate change.

As more research is conducted, trend analyses of disaster occurrence and impact will address whether their determinants can be established. In Asia and elsewhere, factors that play a role in determining disaster trends are a mix of physical characteristics of the event itself and the socioeconomic context in which they occur. Earthquakes, for example, have short prediction times and therefore allow little time for disaster preparedness. In contrast, slower onset disasters such as droughts and floods are more predictable and generally result in fewer direct victims, but their real cost is in the medium- and long-term and is usually not assessed. Population density, urbanization, and demographic profiles are context-specific factors that are likely to contribute to the number of deaths and degree of damages. DRM policies and practices that are based on evidence can help to prepare for and reduce these and other risk factors.

To provide evidence-based information, reliable and time series data on impact is central. Global databases such as the International Disaster Data Base (EM-DAT), NatCat (Munich Re), or Dartmouth Flood Observatory provide valuable insights into trends and patterns. Substantial progress has been made in standardizing classification systems and definitions at global levels by Munich Re and EM-DAT, but international norms are still needed. Higher resolution impact monitoring data, sample surveys of risk factors, and other methods of gathering information will be required to provide data to develop more effective international DRM policy and practice. Because the cost to accomplish this will be great realistic financing options are essential.

In light of the significant costs of risk financing instruments, the challenge is to identify the appropriate layers of risk to cover, including a risk acceptance threshold, the lowest cost/risk solutions, and links to risk reduction. Strengthening the current innovative financing systems will be key. External involvement of governments, donors, and multi-lateral development banks is required to support communities and local institutions, build risk culture, reduce transaction costs in terms of bringing the products to the people (e.g., by providing support for mobile phone infrastructure), and pay or subsidize premiums. International organizations will continue to play an active role in advancing climate change preparedness in the Asia Pacific region and the world.

7 Conclusions

Algorithmic modeling and data modeling for water resources and environmental security challenges under conditions of climate change in the Asia-Pacific were compared and contrasted. The difference between the algorithmic modeling and data modeling cultures are discussed with reference to the schools in which they originate, the assumptions they work on, the type of data they deal with, and the techniques used. The 2011 Great East Japan Earthquake and other disasters confirm that government's capacity to manage disaster risks is critical in terms of prevention, preparation, response, recovery, and reconstruction. DRM governance must be streamlined as part of the development agenda for most developing countries. The structure and quality of governance of governing bodies at all levels, from central to local to community levels throughout Asia and the Pacific need to be improved to lead DRM initiatives. Moreover, DRM planning calls for widespread public involvement from all sectors of the community as well as from non-governmental organizations (NGOs). Existing evidence points to the crucial role of governance for an effective national DRM strategy and program. This relates to DRM policy and practices both at the national and local level. At the local level, primary issues include:

1. Linking local and national disaster preparedness: Disasters are usually local phenomena and the local governments along with the communities are the first responders. However, large-scale disasters require national or international efforts. Thus, for effective preparedness it is important to have specific links in terms of policy, plan, and action at the national and local level.
2. Coping with the changing nature of disasters: The nature of disasters, especially hydro-meteorological disasters, is changing and becoming more of a local phenomenon (especially in terms of rainfall patterns). This creates an increasing need for local capacities at the government, non-government, and community levels to cope with such disasters.
3. Addressing the needs of diverse communities: Communities vary from place to place and their perception and ways of responding to disasters also vary. Therefore, it is important to decentralize policies and customize them according to local needs and priorities.
4. Learning from past disasters: Accumulating evidence from past disasters suggest that informed and well-prepared local governments and local communities can minimize the impacts of disasters. This is the case even with mega disasters like the Great East Japan Earthquake in which over 18,000 people died mostly from drowning.
5. Increasing global awareness of local needs: Over the past two decades, there has been growing global and regional awareness about the effectiveness of focusing on local needs and priorities. Most of the global and regional frameworks call for local capacity building and policymaking, national developmental strategies, and cooperation among emerging economies of Asia to improve their disaster risk management practices.

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From Gas Explosions to Earthquakes: Case Studies of Disaster Response in Taiwan

Hsien-Ho (Ray) Chang

Abstract This chapter begins with an introduction of the Taiwanese governmental structure, types of hazards, and the development of its disaster management system. I utilized the multiple case study method to review four major disasters that occurred in this country in the past 4 years. Data for the case studies were collected from official after-action reports, academic journals, commercial magazines, and newspapers. The data was carefully reviewed and compared to other resources prior to being reported in this book.

In each case study, I reviewed response activities for each of the four disasters, and then arranged the lessons learned. Based on insights from disaster and risk research, I propose two suggestions at the end of this chapter for improving future response activities under the Taiwanese disaster management organization and response system.

Keywords Taiwanese disaster management organization • Disaster response • 2014 Kaohsiung gas explosion • Formosa fun coast explosion • TransAsia airways flight 235 crash • 2016 Tainan earthquake

1 Introduction

1.1 Introduction of Taiwan

Taiwan is an island located close to the Mainland China. After World War II, millions of Chinese people immigrated to this island and the Central Government, which ruled the majority of China between 1911 and 1949, also moved to Taiwan and established its administration at Taipei City.

To accommodate and manage these new immigrants and original natives on this island, the Central Government established three layers of governments: local governments (which include townships, cities, and counties), provinces (which include three provinces and two major cities), and one Central Government. This

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_10

set-up allocated most of budget in the two major cities, Taipei City and Kaohsiung City—which are one level higher than other local governments—and thus resulted in the concentration of the Taiwanese population within these two cities and their satellite cities. For instance, New Taipei City (NTC), which is across the river from Taipei City, has almost 4 million residents. The majority of NTC residents are from the central or southern areas of Taiwan.

The densely populated areas in both Taipei and Kaohsiung cities and their neighboring areas present many challenges. When special events (such as ball games, concerts, and celebrations) take place in the limited number of open spaces in these cities, these events usually attract massive numbers of citizens. Without proper disaster response and evacuation plans, these events frequently pose hazards for their participants. The theme park flash fire accident in 2015, for instance—which will be discussed later in this chapter—demonstrated the importance of establishing disaster plans at large events. Moreover, since Taipei City is designated as the capital for the whole nation, a commercial and military airport was built at the center of the city to satisfy the needs of businesses, tourism, and politics. Again, the high population density in Taipei City and its neighboring areas impose large consequences to any type of hazard or disaster, whether man-made or natural, that occur in the northern part of Taiwan. For instance, once an airplane crashes in Taipei City, it is highly possible that many buildings will be damaged, which will induce mass fatalities and casualties. The TransAsia airplane crash, for example, interrupted normal operations in the capital. Although the pilot attempted to land away from financial and residential areas, the airplane still hit a highway bridge and destroyed a vehicle that was passing through.

The infrastructure underlying the cities, which reflects the fast population growth in this country, also imposes certain hazards. Kaohsiung City was industrialized in the late 1950s. To transport chemical gases, this city has many underground pipelines. As this city developed, however, many Taiwanese people moved to Kaohsiung and built homes above these pipelines. The propylene explosion in 2014, for example—which will be discussed later in this chapter—illustrates the difficulties with evacuating large numbers of residents when the propylene lines are located directly beneath their homes and communities. Not only that, but as mentioned previously, natural hazards can impose severe consequences in densely-populated cities. The case study of an earthquake will demonstrate the obstacles and challenges to performing urban search and rescue activities in such a heavily-populated city.

Before discussing the responses on these four disasters, I will first introduce the Taiwanese disaster management systems and organizations.

1.2 The Evolution of Disaster Management System in Taiwan

The Taiwanese government established five branches to provide a check-and-balance system over its powers. These five branches consist of: the Executive Yuan, which is in charge of developing and implementing policies; the Legislative Yuan, which is in charge of establishing and approving laws; the Examination Yuan, which is in charge recruiting and evaluating government employees; the Judicial Yuan, which is in charge explaining laws and establishing judicial systems; and the Control Yuan, which is in charge of monitoring and rectifying governmental administrations.

This check-and-balance system encourages the Control Yuan to proactively investigate any possible misconduct and corruption in the other branches of government. Therefore, in the coming case studies, readers will find the majority of investigation reports originating from the Control Yuan; these reports reveal the response activities performed during each disaster, and—most importantly—points out those fallacies so courts can prosecute government employees who failed to fulfill their responsibilities and the expectations of their positions.

The investigations from the Control Yuan, however, only evaluate the effectiveness of disaster responses based on established laws and regulations. Therefore, to avoid possible prosecution and punishment, disaster responders are encouraged to follow regulations and laws that have mostly been set prior to the disaster, and tend to avoid improvising at the scene. In the aftermath of a major disaster, the Taiwanese government will generally focus on revising relevant laws and regulations rather than looking for better strategies to handle similar situations in the future. With more and more disaster researchers advocating the importance of improvisation on the site (Bigley and Roberts 2001; Harrald 2006; Moynihan 2007), how disaster managers and lawmakers create space for responders to improvise on-site is an important issue for improving the disaster response in this island.

The Taiwanese disaster management system has undergone four major phases of change in its history, each initiated in the aftermath of a major disaster, when the Central Government revised established laws and regulations and certain governmental organizations were assigned specific response responsibilities. The four phases are illustrated in the diagram below (Fig. 1).

1.2.1 The First Period (1975–1994)

The major landmark in disaster management during this period is the issuance of "Regulations on Responding to Natural Disasters." These regulations mandated that city mayors should serve as incident commanders and that chiefs of local police departments should serve as deputy incident commanders. During that time,

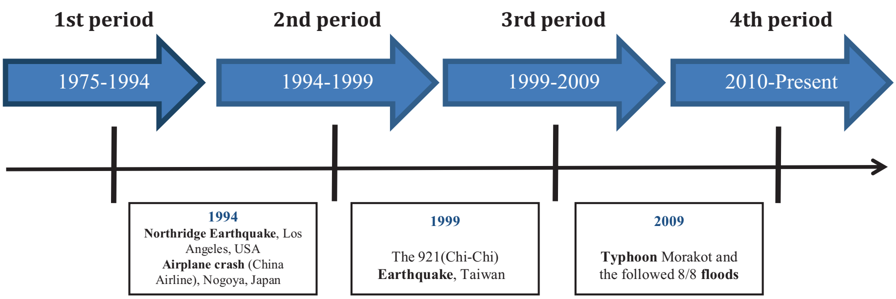

Fig. 1 The 4 periods of development of the Taiwanese disaster management system

firefighters were under the administration of the police chief and both firefighters and police officers in Taiwan took the same training in the National Police Academy, so local police chiefs had no difficulty in commanding both police officers and firefighters. The legislation also combined multiple different disaster recovery and response regulations across different levels of the government. At that time, with a heavy focus on typhoons, floods, and earthquakes as part of its disaster response activities, the Taiwanese disaster management system was divided into three levels: district, local government, and the provincial government. Each level had to establish its own Emergency Operations Center in order to better coordinate response activities to natural disasters.

1.2.2 The Second Period (1994–1999)

As a result of the Northridge Earthquake in the United States and the Taiwanese airplane crash in Japan, the Taiwanese government emulated the Japanese government by adding the Central Government into the disaster management system. Consequently, the Taiwanese disaster management system now had four levels: districts, local government, provincial governments, and the Central Government. Again, each layer had to establish its own Emergency Operations Center in order to coordinate response activities to natural disasters. The National Fire Agency (NFA) was also separated from the National Police Agency (NPA) in 1994 to handle the multitude of residential and commercial building fires that occurred between 1993 and 1994. However, the Taiwanese government improperly compartmentalized and assigned all disaster management duties to this newly-created organization. As a result, when a large-scale earthquake struck Taiwan in 1999, the National Fire Agency found itself unable to handle all phases of disaster management on its own. The lack of coordination on both response and recovery activities spurred discussions on changing the Taiwanese disaster management system, which eventually led to the next period of its development.

1.2.3 The Third Period (1999–2009)

After the calamitous 9/21 earthquake, the Taiwanese government set up the “Disaster Prevention and Response Act (DPRA)” to better manage disasters. This act created a disaster management committee under the Executive Yuan to help agencies coordinate and orchestrate interdepartmental responses to natural disasters. However, the committee shared resources and personnel with the National Fire Agency (NFA). For instance, although the deputy director of Executive Yuan was a director of this committee, the commissioner of the NFA served as the assistant director. As assistant director, the NFA commissioner had the task of both leading NFA in developing disaster management policies while at the same time directing other central departments—such as the Department of Transportation, Department of Defense, and Department of Economy—on disaster management-related issues. Being situated under the Ministry of Interior, however, the NFA had difficulties enforcing its ideas and policies over other departments that are higher on the government hierarchy. Consequently, despite having disaster management responsibilities, the NFA did not have the authority to direct other departments in terms of implementing disaster management policies.

By this time, the Taiwanese disaster management system had been reduced to three levels: district, local, and central. (The provincial level was abolished in 1998 when the Taiwanese government tried to reduce bureaucracy.) However, each level was still required to maintain its own Emergency Operations Center. The NFA set up a main division for disaster management along four sub-divisions for disaster response, education, planning, and prevention. Thus, every local fire department in Taiwan also had to establish its own division of disaster management in order to implement the policies and measures as dictated by the NFA. Once a disaster management policy issued by the NFA was mandated by the Central Government, local fire departments were expected to coordinate with other departments to execute these policies. However, these departments lacked both the authority to enforce interdepartmental disaster management policies as well as the resources to facilitate inter-jurisdictional cooperation. Consequently, disaster management fell completely under the purview of firefighters and evolved primarily into a response-oriented system, where the majority of responsibilities were allocated to firefighters. Cooperation with both governmental and non-governmental organizations became subsequently neglected as well as impeded by organizational culture.

Under this system, when disasters struck, the central government would set up a Central Emergency Operations Center (CEOC) in the NFA. Each disaster response-related department was then required to send one to two representatives to the CEOC. In most cases, representatives were either senior officials or an assistant chief. With their help, the CEOC would collect the latest disaster damage reports and track how local governments were responding to disasters every hour. Local governments, depending on the severity of damage in their jurisdictions, would also open Local Emergency Operations Centers (LEOC). Because local fire departments were responsible for managing and responding to disasters, local fire departments would operate and maintain these LEOCs. The LEOCs were obligated to both report to the CEOC as well as follow the instructions given by the CEOC. Since both the CEOC and LEOC were operated by and located within firefighting organizations, and the majority of disaster management policies were developed and enforced by firefighters, the philosophy of disaster management reflected firefighter-oriented approaches. That is, to many of the participants, disaster management was primarily about responding to the consequences of disasters. As a result, even though the DPRA distributed responsibilities for different types of disasters to various ministries and departments in the Central Government, firefighting concepts prevailed and influenced many of the policies and activities on disaster mitigation, preparation, response, and recovery. Therefore, when a calamitous typhoon and the ensuing floods swept away several southern Taiwanese cities in 2009, the Taiwanese President only changed the NFA's name and assigned more disaster response responsibilities to this agency, but did not establish any new cabinet-level department to oversee the four phases of disaster management or coordinate between the different government departments.

1.2.4 The Fourth Period (2010–Present)

As previously mentioned, the Taiwanese Disaster Prevention and Response Act assigned massive disaster management responsibilities to the NFA and local fire departments without granting them sufficient authority for them to enforce relevant policies. This problem was highlighted on August 2, 2009, when a typhoon named Morakot brought huge rainfalls of more than 2000 millimeters, claimed more than 600 human lives, and caused a loss of NT $90 billion to the island within a 72-h period (Li et al. 2013).

This calamitous event forced the Taiwanese President to appoint a new Secretary of Executive Yuan, along with replacing other ministers and department directors responsible for disaster response. The President also set up an Office of Disaster Preparedness and Response directly under the Executive Yuan to coordinate every department in managing disasters, and renamed the National Fire Agency (NFA) to the Disaster Preparedness and Response Agency. This new name, however, did not confer any additional authority for enforcing disaster management policies and allot for more resources to facilitate inter-departmental and/or inter-jurisdictional cooperation. The Disaster Preparedness and Response Agency was essentially the NFA under a different name.

After the three previous development periods, the current Taiwanese disaster management system has three levels: district, local, and central. Although district governments are required to run Emergency Operations Centers as indicated in the Taiwanese Disaster Prevention and Response Act, once the incident expands or the district government finds that it cannot contain the disaster within a short time, local governments will begin to provide assistance and will also set up a second level of Emergency Operations Centers. Similarly, once a disaster has exhausted the resources of two or more local governments, then the Central Emergency Operations Center will open in order to orchestrate local government efforts and provide resources to affected jurisdictions.

Despite the chaos observed in disaster response during Typhoon Marokat, the Taiwanese government did not change any of the fundamental strategies or philosophy underlying its disaster management policies and organizations. The “Disaster Prevention and Response Act (DPRA)” assigned disaster management responsibilities to various ministries and departments in the Central Government. Some common disasters along with the organization to which they are assigned are listed in Table 1.

In summary, in spite of the different stages of development, there are two major drawbacks to the Taiwanese disaster management system.

First, since disaster management responsibilities are distributed across various ministries, it can become extremely chaotic when a disaster generates various consequences that fall under the scope of responsibility of different departments (such

Table 1 Assignment of different disasters in Taiwan

Ministries	Assigned disasters
Environmental Protection Administration	HAZMAT and water contaminations
Ministry of Economics	Floods, droughts, gas and electricity-related disasters.
Council of Agriculture (a cabinet-level council)	Landslides and cold disasters
Ministry of interior	Typhoon, fire, earthquake, and explorations
Ministry of Transportation and Communication	Aircraft, maritime, and severe traffic accidents

as a typhoon that generates both floods and induces landslides) or impacts a broad area that involves multiple local governments. The response activities in the TransAsia airplane crash were conducted by firefighters, police officers, and military groups, but the Ministry of Transportation and Communication (MOTC) was in charge of operating the CEOC and organizing search and rescue efforts, activities with which they were not familiar (MOTC 2015). Also, since the airplane had crashed at the border of Taipei and New Taipei City, both cities established their own Incident Command Posts (ICPs) at the scene. The presence of two different command posts and separate groups of commanding officers caused confusion for disaster responders. For instance, due to the lack of a Public Information Officer (PIO) on the site, the media mistakenly assumed that one specific person made all decisions, which generated much confusion and debate regarding who was in charge at the site (Peng et al. 2015).

Secondly, the current Taiwanese disaster management system places too much responsibility on the part of firefighters. Although there is a disaster management office and committee within the Central Government that can provide extra resources and assistance to the NFA during disaster, when disaster actually strikes, however, NFA officials are too busy coordinating disaster response activities and developing disaster recovery strategies to seek for aid from this office. As a result, the NFA often finds itself unable to manage large-scale disasters (Hsiung et al. 2010).

When comparing Taiwanese disaster management systems and organizations to American ones, it can be seen that the Taiwanese government has neglected two major concepts of disaster management: (1) disaster management includes four phases (mitigation, preparedness, response, and mitigation), each of which are equally important, and (2) disaster response has to satisfy both agent-generated and response-generated demands. I will further discuss these concepts in the following sections.

1.2.5 The All-Phase Disaster Management Approach

Researchers (Lindell et al. 2007; Neal 1997; Phillips et al. 2012) suggest that each the four phases of disaster management are interdependent and thus impact each other. As a result, they should be treated equally. More specifically, Phillips et al.

(2012, pp. 248–251) suggest that we should not only focus on disaster response, which they labeled as a “response-oriented” disaster management approach since this approach neglects the importance of mitigating hazards, preparing responders and citizens for disasters, and recovering from disasters. Instead, disaster managers should treat the four phases as a complete cycle, with each phase overlapping and influencing each other. The risk analysis conducted during the disaster mitigation phase is the first step to planning and preparing a community for disasters. Training exercises organized during the preparedness phase will guide response activities when disaster strikes. After responders evacuate citizens from impacted areas, they have to consider where to relocate these citizens, so the response and recovery phases are executed almost simultaneously. Furthermore, long-term disaster recovery policies are based on analyses that identify potential risks in particular areas. Therefore, without considering all four phases of disaster management, it is difficult to improve the outcome of disaster response. In the aftermath of a theme park flash fire accident—one of the case studies in this chapter—for instance, the Taiwanese government required event organizers to use the ICS structure to write their own Emergency Operation Plans (EOPs) and report the estimated number of personnel and resources to local governments. However, as many Taiwanese responders do not use ICS to organize their own response activities, this measure failed to link disaster preparedness policy to disaster response, and thus faced many difficulties in being enforced and implemented.

1.2.6 Recognizing Correctly the Difference Between Agent- and Response- Generated Needs and Demands

Quarantelli (1997) suggests that good disaster management must “recognize correctly the difference between agent- and response- generated needs and demands (p. 41).” Response-generated demands are those common to all disasters because they are produced by the very efforts responding organizations make to manage community disasters. Establishing a response system, for example, is defined as a response-generated demand since this is an activity that is performed at the scenes of all disasters, regardless of the type of disaster. Agent-generated demands, on the other hand, are those that derive from the particular disaster agent. For instance, using sandbags to stop flooding water is one such example of an agent-generated demand. Thus, response-generated demands can be fulfilled before disasters, while the agent-generated demands can only be partially anticipated in advance. Failing to distinguish between the two demands or realizing that parts of them can be prepared beforehand would result in responders focusing only on the effects of disasters, thereby ignoring the more important problems of disaster response (Quarantelli 1985).

The following sections will utilize the above concepts to review the response activities for these four disasters in Taiwan. More specifically, I will utilize the multiple case study method to review these cases. More details on this method will be discussed in the following section.

1.2.7 Methods

Based on the previous discussion, this research aims to explore the question of "how the response-oriented disaster management system influences the effectiveness of disaster response in Taiwan." Since this research question focuses on contemporary phenomena in a real-life context and the researcher has little control over the events, compared to other social science approaches, the case study method is the most appropriate method for this research (Yin 2009, p. 2). Moreover, since a single case study is subject to bias because of the limited information it provides (Yin 2009, p. 61), four cases were selected and analyzed in this research. For qualitative research, cases are not selected at random, but serve a theoretical purpose (Moynihan 2009, p. 899). Consequently, case studies rely on analytic generalization, which means that the investigator must strive to generalize the findings from a particular set of results to a broader theory (Yin 2009, p. 43).

The reason these particular four cases were selected is because all of them represent unique situations. For instance, the TransAsia airplane was the first plane that crashed in a river by the densely-populated downtown area. The theme park flash fire accident caused the largest number of injuries after the catastrophic Chi-Chi earthquake in 1999. The earthquake in Tainan occurred during the Chinese New Year holiday, which attracted the attention of the whole nation. The propylene explosion was the first petrochemical explosion that occurred within an urban area, so not only did it have a broad impact, but it also killed many disaster responders.

Also, in the aftermaths of each of these disasters, the Taiwanese government, both at the central and local levels, changed and modified disaster response regulations and laws. As mentioned previously, however, these new regulations and laws only had the effect of assigning new responsibilities or introducing new systems to certain response organizations. These laws and regulations worked under the assumptions of the command-and-control model, which presumed that authorities could design a plan and expect people to follow it (Heide 2004, pp. 357–358). However, this assumption neglects the fact that disaster response actually requires a certain degree of improvisation and cooperation between different organizations and responders. When working with the majority of agent-generated response demands, for example, it is not possible to prepare for or regulate them beforehand. Consequently, without taking into account the importance of an all-phase disaster management approach, these new regulations and laws cannot be successfully implemented or enforced.

Last but not the least, all of these disaster response activities illustrate the common fallacies of disaster response in Taiwan. These fallacies include the failure of differentiating between agent- and response-generated demands, an over-emphasis on firefighters' roles and responsibilities during disaster response (which results in a response-oriented disaster management system), and the lack of all-hazard and all-phase disaster management strategies. More examples of these common fallacies will be demonstrated in the case studies. Before we discuss these cases, I will further introduce the data sources in this research.

To better understand the response activities during these disasters, I reviewed the official after action reports from both local governments and the Control Yuan as well as articles from both academic journals and commercial magazines. These articles were searched and downloaded via the Taiwan National Central Library (NCL), where all Taiwanese journal and magazine articles are registered. This method ensures that the case studies do not reflect only the perspectives of governmental officials, but also include the points of views of various Taiwanese emergency management stakeholders, including researchers and non-governmental organizations. Moreover, although the media may not objectively report disaster response activities (Scanlon 2007), the media did respond to some of these disasters and they did have reporters who had spent several days at the disaster scene. Therefore, I also reviewed newspaper articles to better understand how responders made decisions and performed different activities at the site.

Articles and reports from the above three resources were carefully reviewed. Then I arranged details, insights, and discussions to see if there were any conflicting or potentially misleading descriptions. Two recommendations on reshaping the disaster management system in Taiwan will be provided at the end of this chapter.

2 Overview of Four Case Studies Regarding Disaster Response in Taiwan

Following are summaries of each case that provide a basic description of what happened. Since this chapter aims to discuss the lessons learned from response activities during these four disasters, the following case studies will focus on obstacles encountered during disaster response. The context of each case will serve as a primary source for further analysis section later in this chapter.

2.1 Propylene Explosion: 2014 Propylene Explosion in Downtown Kaohsiung City

Around 8 p.m. on July 31st, a strong chemical smell spread throughout the downtown area of Kaohsiung city. Many citizens called the local fire department to report the problem. Since the citizens were unable to differentiate between petroleum gas and other chemical gases, the local fire department was dispatched to respond to the gas leaks. Based on information provided by the citizens, the fire department sent groups of firefighters to various sites. Although the firefighters did use gas detectors, they were only able to identify the gas as being flammable due to the limited functionality of their detectors. As a result, the firefighters employed strategies for handling petroleum gas leaks, which involved turning off petroleum gas valves in the neighboring areas, applying water fogs, and conducting traffic control. These responses proved ineffective, and only prolonged the response time for handling the actual source of the leak (Tseng 2014; Zheng 2014). During this time, the environment protection department from the local government and the area HAZMAT response team provisioned by the central government arrived at the scene. It took them hours to identify that the leaking gas was actually propylene, and even longer to track down the specific underground pipe that was leaking. Around midnight, minutes after the HAZMAT team reported that the leaking chemical material was propylene, small explosions with enough force to raise the metal lids of sewers started occurring within the underground systems. These explosions quickly developed into larger explosions with large flames and fireballs. The massive power generated from these explosions destroyed buildings, roads, and other types of infrastructure, and also killed 20 while injuring over than 300.

In the aftermath of the massive explosion, the Kaohsiung government organized a special committee to investigate the cause of the tragedy. The committee found that propylene gas had leaked from an underground pipe owned by a private company. However, complicating the issue was that several underground pipes from various companies also passed through the same area. Although pipeline maps were kept for the purposes of disaster preparation and response, these maps were managed by the Ministry of Economics, which could not be reached by either the local fire or environmental protection departments during disaster. As a result, responders were unable to identify which pipeline was which and where to close the pipeline valves.

The response to this massive explosion demonstrated the drawback of distributing disaster management responsibilities to different organizations and departments. The central Environmental Protection Administration and its local departments are in charge of preparing for and responding to HAZMAT accidents. However, fire and police departments are usually the first groups to arrive at the scene and deploy response activities. Although the Ministry of Economic manages and maintains maps of underground pipelines, it does not have local branches or representatives who can be reached after working hours, so when a disaster occurs during this time, firefighters are left unable to obtain access to the pipeline maps.

Furthermore, the response to this incident involved three types of governmental organizations located within different levels of the Taiwanese governmental hierarchy. This case illustrates how both horizontal and vertical cooperation and communication within the governmental hierarchy are critical to successfully respond to disasters. If a disaster management system divides these responsibilities and then assigns them to different organizations, it might be difficult to prepare for and respond to those hazards that involve multiple types of disasters. When an airplane crashed in the Taipei City, for instance, responders had to work with representatives from different jurisdictions and organizations. Once again, although the Ministry of Transportation and Communication was in charge of preparing for and responding to airplane crash accidents, local government departments such as fire and police were the first to be dispatched to the scene. The difficulty of working with so many people from different backgrounds and organizations will be discussed in the next case.

2.2 Airplane Crash: 2015 TransAsia Airplane Crash in Taipei City

On February 4th, an airplane operated by the TransAsia airline company crashed in a river at the border of Taipei and New Taipei Cities. Since the establishment of Song Shan Airport in Taipei City in 1936, this was the first commercial airplane crash in the Capital City.

The time of crash was close to 11 A.M., so fire departments from both cities dispatched firefighters to the scene of the accident. Although responders were able to handle this disaster quickly, they still encountered several obstacles.

The first difficulty involved the location of the crash. The plane had crashed in the middle of a river. With the cabin 40 meters away from either bank of the river, responders had to use boats to access the cabin. As the river was also surrounded by levees and emptied out to the Pacific Ocean, tidal waves and levee walls provided additional challenges that impeded the deployment of response activities.

The second difficulty involved the features of the crash itself. The impact of the crash, for instance, left the cabin compressed, with insufficient space for rescuers to perform extrication activities. Furthermore, when responders arrived at scene, gasoline was leaking, so they could not use those any tools with internal combustion engines out of fear of explosion (Chang 2015; TCG 2015). Although rescuers attempted to utilize hand tools to break into the cabin, they quickly realized these hand tools were not strong enough to cut through the solid structure of an airplane. Thus, they had to wait until new battery-driven tools arrived before they could perform search and rescue activities.

Third, for disaster responders, this disaster generated an unfamiliar scenario: maritime search and rescue. Although both cities held disaster drills every year, they never worked together on conducting maritime search and rescue activities (TCG 2015, p. 42). As a result, both cities established their own Incident Command Post (ICP) at the site to coordinate responders from separate jurisdictions.

Again, the fragmentation of disaster management responsibilities made this response difficult. Although fire departments from both cities were sent to the site and were the first ones to initiate rescue activities, the Ministry of Transportation and Communication and the Taipei City Department of Transportation (TCDOT) were, by law, responsible for preparing for, responding to, and recovering from airplane crashes in Taiwan. Thus, while the TCDOT operated the Emergency Operations Center, mayors and staff members from both cities were responsible for decisions made at the two ICPs. Since TCDOT was not familiar with EOC operations and responders from two cities did not have any mechanism to develop strategies and tactics collectively on site, this setup impaired the efficiency of disaster response (Peng et al. 2015, pp. 176–177).

The above issues demonstrate the importance of having both inter-agency and inter-jurisdictional cooperation and coordination during disaster response, especially when dealing with unexpected situations where responders might have to work with people from a number of different organizations. More discussion on this topic can be found in the next case, which demonstrates a scenario that caught disaster responders by surprise.

2.3 Theme Park Flash Fire Accident: 2015 Accident at the Formosa Fun Coast Theme Park

On the evening of June 27th, more than a thousand teenagers participated in a color powder party in New Taipei City. The concept for the powder party originated from American Color Run events. In this scenario, staff members scattered multiple color powders onto every participant, creating a swirl of different patterns on their faces, skin, and clothes.

Unlike the Color Run events in the U.S., however, which take place outdoors with staff members sprinkling colorful powders on joggers, the color party in New Taipei City was held in a large swimming pool that had been drained inside an enclosed area. The organizer had set up a stage in front of the swimming pool, and had hired several employees to scatter the powders.

As the event went on, though, powder accumulated both on the ground and in the air. As the party came to an end, one staff member turned on a high-pressure gas cylinder to spray a large burst of powder over the crowd. Unfortunately, this powder ignited, and the flames—aided by the high concentration of powder particles in the air—quickly spread among the participants. The tragedy ended up claiming 15 lives and injuring more than 450. Since the event was held in a water park, many of the victims had worn swimming suits, which had left much of their skin exposed to the fast-spreading flames, resulting in many of them suffering serious burns.

The local fire department had dispatched the first squad of firefighters to the theme park quickly, but these firefighters soon realized that the severity of the incident exceeded what the local government was equipped to handle. Therefore, the issue was escalated up to the Ministry of Health, which is in charge of managing accidents involving mass casualties and fatalities, who initiated a national medical transportation system and called neighboring cities and counties to assist in responding to this event. Not only did responders have to deal with the large numbers of victims who needed transport to the hospitals, but there were also many obstacles that hampered disaster response.

For instance, the theme park was designed to allow visitors to access the different areas by walking, so it did not have enough space for the passage of emergency response vehicles or the staging of response activities. The swimming pool, where the color party occurred, was also located 600 m away from the main entrance. As a result, when this tragedy occurred, firefighters and emergency medical technicians (EMTs) had to transport the victims individually by stretcher, rather than vehicle, to the park entrance. This actually prolonged the response and transportation time at the first time of response.

Also, due to the fact that the event was held in a drained swimming pool, it was difficult for the participants to escape once the flames started. This phenomenon resulted in the number of injuries quickly spiking during the first few minutes of the incident, eventually leading the event to become a mass casualty accident.

This case also instigated the Taiwanese government to change regulations on public events. In the aftermath of this tragedy, for example, the Central Government released a new regulation that required organizers of all public events that might involve more than a thousand participants to write an Emergency Operation Plan (EOP) and submit it to the local government for approval beforehand.

Also, like the previous cases discussed, this accident involved multiple types of disasters—fire and mass casualty and fatality—and required participation from various organizations operating within different jurisdictions. Again, lack of coordination between various organizations was identified as a major issue hampering response activities, so the new regulation also required the establishment of an Incident Command System (ICS) as a framework to prepare and plan for events involving massive numbers of participants. As many researchers (Buck et al. 2006; Neal and Webb 2006; Neal and Phillips 1995; Quarantelli 2002) suggest, however, ICS alone cannot solve inter-agency coordination problems on site. Trust and relationships must be built before disasters in order to satisfy certain preconditions needed to successfully implement the ICS at the site (Buck et al. 2006; Klein 1999; Moynihan 2007).

Six months after the theme park flash fire accident, an earthquake once again reiterated the importance of coordinating response activities between various groups and organizations. More details on this earthquake will be discussed in the next section.

2.4 Earthquake Response: 2016 Earthquake in Tainan City

Before sunrise, on February 6, 2016, an earthquake with a magnitude of 6.6 on the Richter scale could be felt across all of Taiwan. Since the epicenter was in the southern part of Taiwan, southern cities bore the brunt of the impact with the collapse of several buildings. One high-rise building in Tainan City, in particular, called the Wei-Guan building, which housed more than a hundred families, collapsed. The floors of the collapsed building looked like a stack of pancakes, and the building itself was extremely fragile. Responders feared that any operation, including debris removal, would further destabilize the building and jeopardize the lives of those who were still trapped inside. As a result, the Incident Commander sent various rescue teams into the building to search every room and space.

The earthquake had also destroyed tap water pipelines, so tons of tap water flooded into the collapsed building. The flooded environment along with the fragile building structure further complicated urban search and rescue activities and decreased the number of likely survivors in the disaster. Eventually, the death toll was finalized at 117, with over 491 transported to neighboring hospitals for medical care.

The response to this earthquake demonstrated that disaster responders face not only those unexpected problems that are generated naturally as a result of environmental factors (e.g., the leaking water pipelines and the fragile building structure in this case), but also those generated by people who went to the disaster scene and tried to help. The convergence of so many people trying to assist in disaster management (Barsky et al. 2007; Webb 1999) provided many resources, but also created challenges for responders at the site.

First of all, this earthquake had occurred during Chinese New Year's, a major 2-week holiday period in Taiwan, so many people around the country were off from work. As a result, a lot of people went to the scene and tried to rescue survivors using their methods and tools. As many disaster researchers have suggested (Alexander 2002, p. 164; Lindell et al. 2007, pp. 242–246), disaster response activities need to be coordinated and perimeter control established in order for the scene to be properly managed and contained. However, in this case, there was no perimeter control, so volunteers around the country freely entered and exited the site. Some of volunteers even argued with the disaster responders due to differences in priorities and strategies. For instance, the International Search and Rescue Team in Taiwan, a non-governmental organization, refused to participate in the mission briefing at the ICP to receive instructions and orders from the Incident Commander, so after the first few days of response, they retreated from the scene. The retreat of these volunteers instigated criticism of the Incident Command, with some citizens questioning whether the government should try to better incorporate volunteers into its disaster response system (Apple Daily 2016; Tsai and Chang 2016).

Volunteers were not the only individuals whom responders had to handle. The massive scale of this disaster also attracted a lot of media attention to the scene. Without perimeter control, many reporters also visited the command post and places that were unsafe for them to enter. Furthermore, politicians also entered the scene, and some of them acted as Public Information Officers (PIOs), attempting to communicate with public and governmental agencies.

Based on an article from the Incident Commander (Li 2016), a local fire department, the Tainan City Fire Department, did establish a command system on site to manage all response activities. This system, however, merely oversaw operations (p. 24). Unlike the U.S. Incident Command System, which requires the establishment of the four divisions of operation, planning, logistic, and administration to manage disasters (FEMA 2008), this command system primarily focused on the role of firefighters and thus reflected the firefighting-oriented disaster management concepts mentioned in the previous sections.

I have briefly introduced the four disasters in the above sections. The responses to these disasters revealed a number of fallacies common to disaster response in Taiwan. I will further discuss these fallacies in the coming section.

3 Lessons Learned About Disaster Response

The previous cases demonstrated that the Taiwanese government has a tendency to rely on a firefighting-oriented disaster response system to deal with various types of disasters. As a result, when Taiwanese responders are faced with a mixture of different disasters, the current response system impedes cooperation between various response organizations from different jurisdictions.

For example, a firefighting-oriented response system hampered and delayed the response activities, since firefighters in Kaohsiung city had to wait until personnel from the local environmental protection department and the area HAZMAT team identified what kind of gas was leaking. Similarly, firefighters from both Taipei and New Taipei cities established two separate Incident Command Posts to manage response activities while, at the same time, the Ministry of Transportation and Communication opened the Central Emergency Operations Center since it was in charge of "airplane crash" disasters under current law. Consequently, it is not surprising to see this same system failing to manage volunteers and the media during the Tainan earthquake.

More specifically, after these disasters, two major lessons can be gleaned: (1) Realizing and preparing for the high levels of uncertainty involved with disaster response, and (2) Understanding the need to cooperate with various groups and organizations. More will be discussed in the following sections.

3.1 Realizing and Preparing for the High Levels of Uncertainty Involved with Disaster Response

All four of these disasters brought with them a high level of uncertainty, which is defined as a situation when "the direction of change is relatively well known but the magnitude and probability of events and consequences, and the receptors at risk, cannot be estimated with any precision (Kasperson 2009, p. 338)." Consequently, before the firefighters identified the leaking gas as propylene or located the source of the leak, they could not implement any of the strategies to prevent it from exploding or make a determination on the size of the area from which citizens should be evacuated. Before the airplane crash in the river, responders from both cities had only performed disaster exercises and drills on land, so this type of accident created an unexpected situation that presented responders with brand new scenarios. Before the powder caught on fire and caused so much death and injury, no one had even anticipated that there would ever be a fire hazard in a water park, much less the need to evacuate 500 people within such a short period of time. Last, but not least, current technology and science were still unable to predict the exact timing and locations of upcoming earthquakes, so it was impossible for firefighters in Tainan to have evacuated residents from the Wei-Guan building in advance.

Table 2 Appropriate strategies for different risk/information conditions (Wildavsky 2011, p. 122)

	Amount of knowledge		
Predictability of risk		Small	Large
	High	More resilience, less anticipation	Anticipation
	Low	Resilience	More resilience, less anticipation

All of above issues do not mean that there is nothing that we can do to mitigate hazards with high levels of uncertainty. In fact, given the existence of high levels of uncertainties, one has to think about different strategies beyond the command-and-control approach mentioned in the previous sections in order to coexist with these events. Increasing resilience, for instance, is a strategy to deal with events involving high levels of uncertainties (Bruijne et al. 2010, pp. 13–32). By taking the concept of resilience into consideration, Wildavsky (2011, pp. 77–103) suggests that we need to balance anticipation and resilience strategies when searching for safety. Anticipation is defined as “a mode of control by a central mind; [where] efforts are made to predict and prevent potential dangers before damage is done (Wildavsky 2011, p. 77).” Resilience, on the other hand, is “the ability to improvise and bounce back (Weick 1998),” and requires “the use of generic resources such as knowledge, communication, wealth, and organizational capacity, [which are] the resources that enable us to craft what we need, when we need it, even though we previously had no idea we would need it (Wildavsky 1995, p. 433).” Wildavsky’s suggestions are summarized in Table 2.

In reviewing the laws and regulations established after each of the four Taiwanese disasters, it can be seen that the changes focus on preventing similar situations from occurring in the future. The regulation on “Managing Large Events with Massive Numbers of Participants,” for example, requires that all event organizers predict possible disastrous scenarios and then use the ICS structure to estimate the number of personnel and type of equipment needed to secure the safety of event participants (p. 2). Again, the logic behind these regulations reflects Wildavsky’s strategy of anticipation only, without adding the strategy of resilience into the new regulations and laws; the Taiwanese responders still cannot cope with disasters with high uncertainties. As a result, the director or New Taipei City Department of Health, who participated in the response activities to the theme park tragedy, suggests increasing resilience as an important strategy to prepare for and respond to unexpected disastrous situations in the future (NTCG 2016, p. 52).

One of the core values of implementing resilience as a strategy is cooperation with people of different backgrounds and organizations (Bruijne et al. 2010; Wildavsky 2011, pp. 78–85). I will further discuss this concept in the coming section.

3.2 Understanding the Need to Cooperate with Various Groups and Organizations

As I mentioned before, the current Taiwanese Disaster Management Act assigns responsibilities of disaster management to various organizations based on their duties and roles in the Central Government. This strategy, however, creates chaos and fragmentation of roles when it comes to dealing with disasters. During the Kaohsiung explosion, for example, firefighters and police officers were the first groups to arrive at the scene, but they had to wait for the local department of environmental protection to identify what chemical gas was leaking and then sought help from the Ministry of Economic to identify the exact location of the underground propylene pipeline. The TransAsia airplane crush involved three cabinet-level ministries and two local governments, which created confusion during response and recovery activities.

All of the above examples demonstrate that disaster response requires cooperation, coordination, and communication between various groups and organizations. Without a disaster management organization that coordinates all responsibilities, resources, and personnel for mitigating hazards, preparing for and responding to emergencies, and recovering from effects, every organization would only care about their assigned responsibilities, develop their own priorities, and neglect the overall picture of disaster management.

Moreover, since firefighters are usually the first group to arrive at the scene of disaster, certain Taiwanese fire departments develop a false understanding of disaster response. The Tainan earthquake response, for instance, was coordinated by a command-and-control structure, which only incorporated firefighters (Li 2016, p. 24). Not only was the command-and-control structure unable to cope with complex disastrous situations (Kasperson 2009; Neal and Phillips 1995; Neal and Webb 2006), but this structure also allocated too many responsibilities to firefighters. Local fire chiefs were serving as the initial Incident Commanders for all four disasters while firefighters were taking overly high risks during these extreme events. In such a firefighting-oriented disaster response system, it is no surprise to see that firefighters constituted 20% of deaths in the Kaohsiung explosion (NFA 2014).

The above discussions illustrate the importance of incorporating responders from different backgrounds and organizations. More specifically, to successfully respond to disasters, one has to realize the importance of having both hierarchy and network (Moynihan 2009), which means it is important to insert collaborative networks into the current Taiwanese hierarchical systems to help these responders gain different perspectives before they make decisions. The water theme park tragedy response, for instance, was focused on transporting all patients to the neighboring hospitals at the first time. By setting up this overall strategy, responders utilized any method possible to move those impacted to ambulances (such as using swimming rings and blankets to transport patients). A physician, who is an expert on burn treatment and medicine, believes that the lack of proper protection on burns as a result of the rushed transportation could induce even more severe, life-threatening infections, so he suggests providing treatment to patients on site first before quickly transporting them to the hospitals (NTCG 2016, p. 42). As a result, if the IC had been able to incorporate this suggestion into the response strategies, the whole response might have looked quite different.

Such discussions commonly occur during and after the responses to other large disasters. In the earthquake response, for example, people debated using bulldozers to clean up roads and building debris. As mentioned before, once the IC decided to utilize bulldozers to move the collapsed Wei-Guan building, the pancake-like structure would surely crush and terminate those trapped inside who were still waiting for help. However, without using bulldozers, the collapsed building would block major traffic and raise additional safety concerns. Before the explosion of propylene, as another example, firefighters and police officers were confused on whether or not they should evacuate residents from the impacted areas. Obviously, without the assistance of other departments and organizations, people from a single organization cannot make decisions involving knowledge and professionals from multiple disciplines.

In summary, the responses to these four disasters illustrate the complexity and uncertainty of disaster response, and thus disaster management should not be handled by fire organizations only. As a result, this research suggests that the Taiwanese government establish a cabinet-level disaster management organization to oversee the four phases of disaster management policies and implementation in order to increase Taiwanese responders' capabilities in coping with unexpected situations. Details of these recommendations will be explained in the coming section.

4 Recommendations on Reshaping the Disaster Management System in Taiwan

4.1 Recommendation 1: Establishing a Cabinet-Level Disaster Management Organization

Based on the responses to four major disasters discussed, the establishment of a disaster management organization that is able to coordinate all resources, personnel, and policies associated with disaster management is imperative.

First of all, this new organization should be able to direct all resources to implement a disaster management policy. One of the lessons learned from Hurricane Katrina, for example, is that a disaster response policy must be transferred into effective operational guides and must be understood by various disaster response-relevant organizations and personnel (Moynihan 2007, pp. 22–23). Following this train of thought, without a cabinet-level disaster management organization in charge of setting up overall policies and then overseeing the implementation at different levels of governments and departments, it might be difficult to improve disaster response on this island. The Regulations on Managing Large Events with Massive

Numbers of Participants, as I mentioned before, proposed using the ICS structure to plan for response activities, but this regulation only requires event organizers to utilize the ICS structure rather than traditional response organizations such as fire and police departments. In reviewing the response during the theme park tragedy, even though the Color Party was organized and planned by the ICS, unless the responders also used the ICS to orchestrate their response activities, chaos and confusion could not be avoided. As a result, to successfully respond to disasters, one needs to link disaster preparedness policies to response activities. More strategies to prepare for disaster response will be discussed and presented in the next section.

4.2 Recommendation 2: Preparing for Disaster Response

As mentioned previously, the four phases of disaster management overlap with each other, and a good disaster management organization must oversee all four phases. More specifically, the Taiwanese government has to come up with strategies to mitigate hazards, policies and training to prepare for any possible emergencies, a system to coordinate response activities, and mechanisms for incorporating various organizations during disaster recoveries.

Moreover, the experience and lessons learned from each disaster should be remembered, so that a part of the disaster response activities can be planned and prepared for in advance. One strategy to accumulate experience with large-scale disasters is to allow certain groups of responders to participate in and respond to every major disaster in this country. The All-Hazard Incident Management Teams (AHIMT), for example, are dispatched to various areas around the U.S. to assist with the coordination of on-scene operations (U.S. Fire Administration 2016). As a result, these IMT members are able to accumulate experience in dealing with similar scales of disasters, and thus can better anticipate those common response-generated demands experienced from previous cases of disaster. If responders, for instance, had been aware of those strategies and prior lessons learned from transporting large numbers of citizens to neighboring hospitals during the Kaohsiung explosion, they would have been able to practice similar situations beforehand and thus reduce possible communication problems between various organizations before those disasters in the cities of Taipei, New Taipei, and Tainan.

Last but not the least, the concept of increasing resilience should be added into Taiwanese disaster management policies. As discussed before, a strategy that only focuses on anticipation would not be sufficient to handle those unexpected situations. With the population growth and increasing amount of urbanization in Taiwan, authorities should consider more strategies to coexist with the large-scale disasters that include many unexpected situations.

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The Missing Link in the Global Aviation Safety and Security Network: *The Case of Taiwan*

Ram S. Jakhu and Kuan-Wei Chen

Abstract The article discusses the importance of Taiwan's participation in and contribution to the International Civil Aviation Organization (ICAO). The continuous absence of a notable aviation country situated at the cross-roads of the Asia-Pacific poses a threat to global aviation safety and security, which requires the uniform adherence to accepted international standards and practices, and the real-time exchange of information vital to air navigation. The lives and wellbeing of millions of passengers from around the world, and the safe transit of high value air freight originating from, destined for, or passing through Taiwan means the international community can no longer ignore the presence and importance of this strategic aviation hub in the Asia-Pacific.

Keywords Taiwan • Aviation security • Aviation safety • Regulation of aviation • International Civil Aviation Organization (ICAO) • International organisation • International regulation • Chicago convention

1 Introduction

Flying is safer than ever before in the history of civil aviation,[1] thanks in large part to the International Civil Aviation Organization (ICAO), which for the past seven decades has served as the *global* forum for international civil aviation.[2]

[1] The number of fatal accidents are at an all-time low. Since the late 1970s, when the peak was reached, the number of fatal accidents per year has steadily declined. See "Statistics", online: Planecrashinfo.com, www.planecrashinfo.com/cause.htm; see also "Statistics", online: Aviation Safety Network aviation-safety.net/statistics/; and Nick Evershed, "Aircraft accident rates at a historic low despite high-profile plane crashes", *The Guardian* (24 March 2015), online: The Guardian www.theguardian.com/world/datablog/2014/dec/29/aircraft-accident-rates-at-historic-low-despite-high-profile-plane-crashes

[2] ICAO, "Vision and Mission", online: ICAO www.icao.int/about-icao/Pages/vision-and-mission.aspx

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_11

Recent terrorist attacks in Brussels and Istanbul,[3] coupled with a series of serious, and at times unexplained,[4] aviation accidents over the past few years, have underlined the importance of a global approach to guarantee a safe and secure global air transportation network. Without a doubt, issues of aviation security and safety[5] are matters that, due to the cross-boundary and integral nature of this industry to the world's connectivity and economy, concern all. The uniformity of standards and coordination of operational procedures and technical lingo are indispensable to ensure the safe, efficient and economic operation of millions of flights connecting hubs of population and production around the world. No part of this intricate network of airports, tightly woven web of passenger and cargo screening, and interconnected regions of airspace and air traffic control systems that the globe has been demarcated into, is dispensable. In the effort to safeguard the global governance of aviation, no part of this air transportation network can be isolated or excluded. Indeed, ICAO recently launched the "No Country Left Behind" (NCLB) campaign[6] with the laudable objective of ensuring that *all* States are able to achieve the minimum standards and practices safety and security of promulgated by the United Nations' specialised agency dedicated to civil aviation.

However, despite having near-universal membership[7] and enjoying the participation of 191 Contracting States to the Chicago Convention,[8] there is one missing link to the otherwise truly global effort and involvement in addressing aviation matters that concern all. The continued exclusion of Taiwan is a constant reminder that in concerted efforts to address global challenges and achieve common objectives, some are unfortunately left behind.

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[3] See "Brussels: Islamic State launches attacks on airport and station – as it happened", *The Guardian* (23 March 2016), online: The Guardian www.theguardian.com/world/live/2016/mar/22/brussels-airport-explosions-live-updates; and "Istanbul Ataturk airport attack: 41 dead and more than 230 hurt", *BBC News* (29 June 2016), online: BBC News www.bbc.com/news/world-europe-36658187

[4] Malaysia Airlines Flight 370 disappeared while *en route* from Kuala Lumpur, Malaysia, to Beijing, China, in March 2014. To date, it is still unclear what transpired onboard the fateful aircraft before its disappearance and where the plane is located.

[5] Safety denotes "technical and operational safety of flight" whereas aviation security relates to "safeguarding civil aviation against acts of unlawful interference". Ludwig Weber, "The Chicago Convention" in Paul S Dempsey & Ram Jakhu, eds, *Routledge Handbook of Public Aviation Law* (New York: Routledge, 2016), 9 at 16.

[6] See ICAO, "No Country Left Behind", online: ICAO www.icao.int/about-icao/NCLB/Pages/default.aspx

[7] Paul S Dempsey, *Public International Air Law*, 1st ed (Montreal: Centre for Research in Air and Space Law, 2008) at 8.

[8] ICAO, "Member States", online: ICAO www.icao.int/MemberStates/Member%20States.Multilingual.pdf

2 ICAO Standards and Recommended Practices

In order to ensure every part of the world can enjoy the socio-economic benefits derived from "safer and more reliable commercial air transportation",[9] a continuously developed and updated set of technical Standards and Recommended Practices (SARPs)[10] is in place to cover every conceivable aspect of civil aviation. From the licensing of aircraft personnel[11] to the fundamental rules of the air,[12] from the conditions of aircraft airworthiness[13] to how aircraft accidents and incidents are investigated[14] to global standards for noise and engine emissions,[15] ICAO truly is the *global* forum for international civil aviation.

The very safety and wellbeing of the international travelling public demands aviation standards and practices be uniform across international boundaries. ICAO is charged with the mandate to ensure that international civil aviation develops in "a safe and orderly manner", and that international air transport services "be established on the basis of equality of opportunity and operated soundly and economically".[16] The Chicago Convention, under Article 44, provides the aims and objectives of ICAO are to, among other things, "develop principles and techniques of international air navigation".[17] In more recent years, and certainly a major issue at the upcoming session of the ICAO Assembly,[18] the matter of fostering the

[9] See ICAO, "No Country Left Behind", online: ICAO www.icao.int/about-icao/NCLB/Pages/default.aspx

[10] *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295, ICAO Doc 7300/6 [*Chicago Convention*], art 37. See also Article 54(l). An "international standard" is any specification which States must conform to, while a "recommended practice" is any specification which States "will endeavor to conform" to: see ICAO, *Consolidated statement of continuing ICAO policies and associated practices related specifically to air navigation*, ICAO Doc A36–13, Appendix A.

[11] *Chicago Convention, supra* note 10, art 37(d); and ICAO, *Annex 1 to the Convention on International Civil Aviation: Personnel Licensing*, 11th ed (July 2011).

[12] *Chicago Convention, supra* note 10, art 37(c); and ICAO, *Annex 2 to the Convention on International Civil Aviation: Rules of the Air*, 10th ed (July 2005).

[13] *Chicago Convention, supra* note 10, art 37(e); and ICAO, *Annex 8 to the Convention on International Civil Aviation: Airworthiness of Aircraft*, 11th ed (July 2008).

[14] *Chicago Convention, supra* note 10, art 37(k); and ICAO, *Annex 13 to the Convention on International Civil Aviation: Aircraft Accident and Incident Investigation,* 10th ed (July 2010).

[15] ICAO, *Annex 16 to the Convention on International Civil Aviation: Environmental Protection—Vol I: Aircraft Noise, 7th* ed (July 2014) and *Vol II: Aircraft Engine Emissions*, 3rd ed (July 2008).

[16] *Chicago Convention, supra* note 10, preambular text.

[17] According to Weber these objectives underline the "predominantly technical nature" of the organization. Ludwig Weber, *International Civil Aviation Organization: ICAO* (Alphen aan den Rijn: Kluwer Law International, 2012) at 9.

[18] See ICAO, *Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change*, ICAO Res A38–18. The 39th Assembly is long anticipated to adopt a global measure to arrest gaseous emissions from international civil aviation. Further, the upcoming Assembly session is slated to discuss and adopt the Global Aviation Safety Plan and Global Air Navigation Plan: respectively ICAO, *2017–2019 Global Aviation Safety Plan*, 2nd ed (2016), ICAO Doc 10,004, online: ICAO www.icao.int/Meetings/a39/Documents/GASP.pdf; and *Draft 2016–2030 Global Air Navigation Plan* (2016), ICAO Doc 9750-AN/963, online: ICAO www.icao.int/Meetings/a39/Documents/GANP_en.pdf

sustainable development of international aviation has been added to portfolio of aviation-related matters ICAO must oversee and regulate.[19]

3 A Vital Missing Link in Global Aviation

Located at the crossroads of North Asia and South-East Asia and adjacent to the eastern seaboard of the China, the island of Taiwan has a population of over 23 million. Though small in size, the country is the world's 22nd largest economy and the 18th largest exporting nation.[20] Linked to 135 cities globally through 301 scheduled passenger and cargo routes,[21] in 2015, the 17 airports that dot the island processed over 58 million passengers, of which a staggering 80% were international, cross-Straits or transit passengers.[22] The country's main international portal, Taoyuan International Airport, was the 11th busiest airport by international passenger traffic in 2015[23] and the 15th busiest air freight hub in the world in 2013.[24]

Taiwan's aviation authorities exclusively controls and provides air navigation and air traffic control services in the Taipei Flight Information Region (FIR),[25] which spans an airspace of some 180,000 square nautical miles[26] and overlaps with one of the densest and fastest-growing air traffic corridors in the world. In 2015 alone, the Taipei FIR provided air traffic control, aircraft communications, and meteorology services for over

[19] The Kyoto Protocol gave ICAO the clear mandate to deal with issues of emissions arising from aviation: *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 16 March 1998, 2303 UNTS 148 (entered into force 16 February 2005), art 2(2).

The McGill Centre for Research in Air and Space Law and the Centre for International Sustainable Development Law have together published a series on the very topic of sustainable international civil aviation. These papers, written by scholars and practitioners from around the world, explore the issue of how to mitigate the environmental impact of aviation without constraining aviation growth and development. See *Occasional Paper Series: Sustainable International Civil Aviation,* online: McGill University www.mcgill.ca/iasl/publications/occasional/sustainable-aviation

[20] Central Intelligence Agency, "Taiwan" in *World Factbook 2016,* online: CIA www.cia.gov/library/publications/the-world-factbook/geos/tw.html See also Shelley Rigger, *Why Taiwan Matters: Small Island, Global Powerhouse* (Lanham, MD: Rowman & Littlefield Publishers, 2011).

[21] See Taiwan Civil Aeronautics Administration (CAA), *Annual Report 2015* at 12–13, online: CAA www.caa.gov.tw/APfile/en/download/pliad/1371635616050.pdf

[22] See Taiwan, Ministry of Transportation and Communications, "Air Transport", online: MOTC www.motc.gov.tw/en/home.jsp?id=258&parentpath=0,150,250

[23] Airports Council International, "International Passenger Traffic for past 12 months", online: ACI www.aci.aero/Data-Centre/Monthly-Traffic-Data/International-Passenger-Rankings/12-months

[24] Airports Council International, "Cargo Traffic 2013 FINAL (Annual)", online: ACI www.aci.aero/Data-Centre/Annual-Traffic-Data/Cargo/2013-final

[25] This FIR was already demarcated by ICAO back in 1953. See Ruwantissa Abeyratne, "ICAO admits Taiwan to its premises at its 38th Assembly" (2014) Ann Air & Sp L 647 at 657.

[26] The Taipei FIR borders the FIRs of Fukuoka, Japan; Shanghai and Guangzhou in China; Hong Kong; and Manila in the Philippines: online: Shelley Shan, Unidentified flights aviation risk", *Taipei Times* (1 August 2015), online: Taipei Times www.taipeitimes.com/News/taiwan/archives/2015/08/01/2003624398

1.5 million flights traversing the airspace.[27] Some 14 international airways and 4 domestic airways crisscross the Taipei FIR, and over 70 airlines must traverse the airspace over and around Taiwan in order to access some of the busiest flight routes in the world bridging North and South-East Asia with destinations in North America and Europe.[28] Further, the traffic between China and Taiwan numbering up to 890 flights a week, there is undeniable potential for economic ties and transportation links across the Taiwan Straits.[29] These facts and figures clearly underline how Taiwan's engagement and participation in international air transport can neither be ignored nor sidelined.

4 Exclusion to the Detriment of Global Aviation Safety and Security

Due to several legal reasons precluding Taiwan from becoming a Contracting State of the Chicago Convention and Member State of ICAO,[30] for more than four decades[31] Taiwan has not been able to participate in ICAO international and regional

[27] See Air Navigation and Weather Services, Civil Aeronautics Administration, Ministry of Transportation and Communications, "Operational Performance—Air Traffic Control", online: ANWS www.anws.gov.tw/eng/index.php?act=service_report&code=engchart1 See also *Air Navigation and Weather Services 2015 Annual Report*, online: ANWS www.anws.gov.tw/upload/eng/attachment/3aad810f8162d7a67b355559706795b7.pdf

[28] Air Navigation and Weather Services, "About Us", online: ANWS www.anws.gov.tw/cht/index.php?code=list&ids=17 (in Chinese). For a visualisation of the complex international airways that crisscross the Taipei FIR, see "Asia Upper ATS Route Chart", online: Worldairops.com, www.worldairops.com/ASI/docs/ASI_MAP_ATSRoutesUpper_atWorldAirOps.com.pdf; and ANWS, "Taipei FIR en route Chart", online: ANWS eaip.caa.gov.tw/eaip/history/2015-10-29/graphics/135435.pdf

[29] "Fact Sheet 2015" (29 June 2016). On file with authors.

[30] Article 92 of the Chicago Convention provides the Convention is open for adherence by members of the United Nations, which Taiwan is not. Article 93 of the Convention provides States be admitted to ICAO with the approval of four-fifths vote of the Assembly. See also Weber, *supra* note 5 at 29.

[31] The Republic of China (ROC), Taiwan's official name, was one of the first signatories of the Chicago Convention: see United Nations Treaty Collection, online: UN treaties.un.org/. See also Stefan Talmon, "The Recognition of the Chinese Government and the Convention on International Civil Aviation" (2009) 8 Chinese J Int'l L 135 at 137. The ROC was a member of ICAO until 1971, when the People's Republic of China was recognised and admitted into the United Nations (UN) simultaneously with the expulsion of the representatives the ROC "from the place which they unlawfully occupy at the United Nations and in all the organizations related to it": See *Restoration of the lawful rights of the People's Republic of China in the United Nations*, UN Doc A/RES/2758 (XXVI) (1971).

According to Article 93*bis* (a)(2) of the Chicago Convention:

> A State which has been expelled from membership in the United Nations shall automatically cease to be a member of the International Civil Aviation Organization unless the General Assembly of the United Nations attaches to its act of expulsion a recommendation to the contrary.

See also ICAO, *Representation of China in ICAO*, ICAO Doc 8987-C/1004, 47–49 (8 July 1971); and David MacKenzie, *ICAO: A History of the International Civil Aviation Organization* (Toronto: University of Toronto Press, 2010) at 278.

meetings and conferences. In the words of the country's Civil Aeronautics Administration, Taiwan

> faces an inherent difficulty that is associated with being neither a member state of, nor an observer at, ICAO activities. Most ICAO documents can be obtained, although not directly, in a fairly timely manner but there is no opportunity to take part in the deliberations that result in new standards and recommended practices. Being excluded from ICAO, there is not the good notice of developing standards that permits the planning for their implementation and there is no forum for [Taiwan] to bring its unique requirements to the international civil aviation community.[32]

Due to arcane motivations that simply pale in light of securing global safety and security, there is radio silence between ICAO and Taiwan. As a result, vital international technical and operational standards and information related to air navigation are unavailable to Taiwan and must be obtained or purchased through unofficial channels—often with significant delay and lacking in the necessary technical details and knowhow to ensure their effective implementation.[33] Thus, aircraft flying through Taiwan-controlled airspace may be subject to differing degrees standards and practices as neighbouring flight information regions—the notice of differences of which cannot be officially furnished to ICAO for all States to heed. There simply is no official channel for the Taiwanese aviation authorities to provide ICAO with information and data about the intricacies and practicalities of navigation through the airspace under its exclusive control.

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[32] Aviation Safety Council, *Crashed on a Partially Closed Runway during Takeoff, Singapore Airlines Flight 006, Boeing 747–400, 9 V–SPK, CKS Airport, Taoyuan, Taiwan, October 31, 2000* [*Aviation Safety Council Report*], Appendix 7.5, "Representations on the draft final report by the Civil Aeronautics Administration, Republic of China" at 7–144 [emphasis added]. Similarly, see Bonnie S Glaser, *Taiwan's Quest for Greater Participation in the International Community*, (Washington DC: Centre for Strategic & International Studies, 2013) at 19.

[33] See remarks of Taiwan CAA Director-General Jean Shen: Jim Hwang, "Towards a Seamless Sky", *Taiwan Review* (1 September 2013), online: Taiwan Review taiwanreview.nat.gov.tw/ct.asp?xItem=208453&ctNode=1446. The fact that Taiwan is not part of the "information loop" and must wait for ICAO to publicly disseminate information vital to air navigation and safety means that "Taiwan's operations are between six months to a year behind the international norm, which hinders its ability to provide safe and efficient air transport services": see Taiwan, Ministry of Foreign Affairs, "Taiwan's quest for meaningful participation in the International Civil Aviation Organization (ICAO)" (April 2011) ["Taiwan's quest for meaningful participation" (2011)], online: MOFA www.mofa.gov.tw/Upload/RelFile/1061/1940/8d6243ff-e966-4d1a-ba01-8afcc115f7d2.pdf

A saving grace, and a means by which Taiwan's provision of air navigation services can be more uniform with international norms and practices, is the fact that Taiwan is a member of Civil Air Navigation Services Organisation (CANSO), the air navigation service providers organization which represent over 85% of the world's air traffic: see Shelley Shan, "Taiwan joins CANSO aviation organization", *Taipei Times* (15 January 2011), online: Taipei Times www.taipeitimes.com/News/taiwan/archives/2011/01/15/2003493568

Exclusion from ICAO, in effect, “has created a gap in the global aviation network, adversely affecting the aviation safety and convenience of all passengers”.[34] “Remaining in the dark” with regard to the rationale and detailed method of implementation has conceivably adverse impact on the “efficacy and competitiveness of Taiwan's civil aviation industry” and results in “potentially dangerous consequences”[35] for the security and safety of international aviation and the travelling public—the very matters ICAO was established to ensure uniformity of global aviation governance.

Following the September 11 attacks, ICAO declared that:

> a uniform approach in a *global* system is essential to ensure aviation security throughout the world and *that deficiencies in any part of the system constitute a threat to the entire global system*.[36]

The Universal Security Audit Programme (USAP)[37] was set up with the noble aim of reducing unlawful interference with aircraft and restoring public confidence in civil air transport by auditing the security oversight systems of States around the

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[34] “Taiwan’s Quest for Meaningful Participation in the International Civil Aviation Organization (ICAO)” (2010) 28 Chinese (Taiwan) Y B Int’l L & Aff 281 at 284 [“Taiwan’s Quest for Meaningful Participation” (2010)]. Glaser writes:

> As a member of the international community in an increasingly interconnected world, Taiwan faces numerous challenges that cannot be addressed unilaterally. […] The exclusion of Taiwan from global networks also carries a cost for international society. Taiwan is a significant provider of official development assistance (ODA), but because it is not a member of the major international donor organizations it has to employ innovative ways of delivering aid through or with nongovernmental organizations (NGOs) and multilateral institutions.

Glaser, *supra* note 32 at 2.

[35] “Taiwan’s Quest for Meaningful Participation” (2010), *supra 34*, at 284–285.

[36] See High-Level Conference on Aviation Security (HLCAS), Montreal, 12–14 September 2012, “Principles governing International Aviation Security Cooperation”, ICAO Doc HLCAS-WP/31 (20 July 2012), Appe B, “*Declaration of the High-Level, Ministerial Conference on Aviation Security* (19–20 February 2002, Montreal)”, Preamble [emphasis added], online: ICAO www.icao.int/Meetings/avsecconf/Documents/WP%2031/PRINCIPLES%20GOVERNING%20INTERNATIONAL%20AVIATION%20SECURITY%20CO-OPERATION.en.pdf See also ICAO, “Address by the Director of the Air Transport Bureau of the International Civil Aviation Organization (ICAO) Mr. Mohamed Elamiri to the International Conference on Arab Aviation Security”, Abu Dhabi, UAE, 7 February 2006, online: ICAO www.icao.int/secretariat/air-transport/Documents/ACAC-SecConf-2006/IcaoElamiriAddress_En.pdf

[37] USAP’s scope covers the standards contained in Annex 17, as well as other security-related provisions in Annex 9: respectively, ICAO, *Annex 17 to the Convention on International Civil Aviation: Security,* 9th ed (March 2011) [*Annex 17*] and ICAO, *Annex 9 to the Convention on International Civil Aviation: Facilitation,* 13th ed (July 2011).

world.[38] Despite the programme's recognition of the importance of the universality and standardisation of security audits across the world, Taiwan's exclusion from the audit system means that aviation security on the whole will never be entirely air-tight. No doubt, identifying and targeting a location where security and screening efforts differ from the global norm can be an easy ploy for potential terrorists to wreak havoc on the global aviation system.[39] In a similar vein, the exclusion of Taiwan from ICAO's Universal Safety Oversight Audit Programme (USOAP), which has as its objective the promotion of aviation safety through the identification of shortcomings and inconsistencies with international SARPs and procedures,[40] simply cannot be justified if truly global safety practices are to be realised.[41]

Another example of the potentially dangerous consequences of Taiwan's exclusion relates to the renaming and reclassification of air routes that traverse or affect the Taipei FIR. Thus, in 2011 ICAO's Southeast Asia Route Review Task Force decided to rename and reclassify an air route going to Taipei without even consulting or informing the proper authorities that are exclusively in charge of the Taipei FIR. As a result, the automated air control system could not accept aircraft travelling on the route with the new international designation, meaning Taiwanese air traffic controllers needed to manually handle each flight, which resulted "a lot of extra work and some safety concerns".[42] Similarly, 2015 saw a situation involving the unilateral adjustment of an air route which would have greatly impacted on the safety of navigation in the Taiwan-controlled airspace. Though adjustments of routes must be notified at the international level and all stakeholders and States should have the right to be consulted, exclusion from ICAO naturally excluded the country's ability to provide its input and or have its views solicited. Fortunately, this

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[38] ICAO, "Background and Evolution", online: ICAO www.icao.int/Security/USAP/Pages/Background-and-Evolution.aspx

[39] "Taiwan's Quest for Meaningful Participation" (2010), *supra* note 34 at 286. As a member of the US House of Representatives Committee on Foreign Affairs notes, the exclusion of Taiwan not only "hurts Taiwan" but also puts "the entire international aviation system at risk" and prevents ICAO "from developing a truly global strategy to address security threats": "Concerning the Participation of Taiwan in the International Civil Aviation Organization", 113th Congress, 1st Session, 159 Congressional Record H3705, at H3707, online: US Congress beta.congress.gov/congressional-record/2013/06/18/house-section/article/H3705-1 See also "Al Qaeda had its sights on Taiwan", *Taipei Times* (6 January 2004), online: Taipei Times www.taipeitimes.com/News/taiwan/archives/2004/01/06/2003086534

[40] ICAO, "USAOP Continuous Monitoring Approach", online: ICAO www.icao.int/safety/CMAForum/Pages/default.aspx

[41] For more on ICAO's USAP and USOAP, see Weber, *supra* note 17 at 101–104.

[42] See Steven D Jaffe, *Airspace Closure and Civil Aviation: A Strategic Resource for Airline Managers* (New York: Ashgate Publishing, 2015) at 164. See also Jim Hwang, "Towards a Seamless Sky", *Taiwan Review* (1 September 2013), online: Taiwan Review taiwanreview.nat.gov.tw/ct.asp?xItem=208453&ctNode=1446 In 2000, as yet another example of ICAO drew a flight route from Manila to Shanghai which passed through Taiwan, via airspace designated by the government of Taiwan for military exercises: see "Taiwan finally wins 'guest' status at ICAO Assembly", *Taiwan Insights* (16 September 2013), online: Taiwan Insights www.taiwaninsights.com/2013/09/16/taiwan-finally-wins-guest-status-at-icao-assembly

instance was resolved as a result of extensive exchanges and discussions between the relevant authorities in China and Taiwan.[43] The above examples highlight valid concerns— not only for safety and wellbeing of millions of passengers and even populations on the ground, but particularly for aircrew and air carriers, for which uniform and standardised air navigation information is much desired as a matter of route efficiency but also as being "essential to maintain a high level of safety".[44]

5 Taiwan's Efforts at Voluntary Compliance and Overcoming Exclusion

Despite being excluded from the forum for engaging in and contributing to global aviation governance, Taiwan appears to subscribe to international standards and to comply with international norms.

Long-term exclusion from direct access to ICAO debates and documents, and the global auditing process has not impeded the achievement of a certifiably good aviation safety record.[45] Indeed, Taiwan's award-winning airline EVA Air has consis-

[43] See *Preliminary conclusion reached between Taiwan and mainland China on the latter's establishment of new flight routes in the Shanghai FIR, including M503*, Press Release, Civil Aeronautics Administration, Ministry of Transportation and Communications (2 March 2015) (English translation). On file with authors.

[44] A pilot voiced concerns that when flying into an airport, pilots should not have to worry about safety risks. As the pilot vividly describes, Taiwan's exclusion from ICAO is a major concern:

> Imagine there is a huge highway that crosses different countries. When you enter Taiwan, the name of this highway is, let's say, Highway 41. But if someone suddenly changes the name of Highway 41 to Highway 52, then there is a huge problem because the flight plan may be rejected and the aircraft barred from entering the Taipei FIR. The pilot may have to take a detour, not having enough fuel for the detour or to declare an emergency. If the delays were to affect the safety and efficiency of Taiwan's airports and the Taipei FIR, we will regret not having Taiwan as a member of ICAO. From a pilot's point of view, information is essential to maintain a high level of safety.

Fred Tan, "Taiwan seeks observer status in aviation body", *New Straits Times* (22 September 2013), online: New Straits Times www.nst.com.my/mobile/nation/general/taiwan-seeks-observer-status-in-aviation-body-1.360795 See also Yeh-Chung Lu, "Safer Skies, Better Global Cooperation: Why Taiwan's Inclusion in ICAO is Necessary" Georgetown Journal of International Affairs (4 September 2013), online: Georgetown University journal.georgetown.edu/safer-skies-better-global-cooperation-why-taiwans-inclusion-in-icao-is-necessary-by-yeh-chung-lu

[45] The US Federal Aviation Administration's International Aviation Safety Assessments (IASA) was established to assess a country's ability to adhere to ICAO's international standards and recommended practices for aircraft operations and maintenance. Taiwan falls under Category 1, a country which is compliant with ICAO standards of safety, see FAA, "FAA Flight Standards Service", online: FAA www.faa.gov/about/initiatives/iasa/media/IASAWS.xlsx. According to the US State Department:

> The US Federal Aviation Administration (FAA) has assessed Taiwan's Civil Aeronautics Administration (CAA) as being in compliance with International Civil Aviation Organization (ICAO) aviation safety standards for oversight of Taiwan's air carrier operations.

tently been ranked one of the safest air carriers in the world.[46] The Taiwan's own national air laws are geared to establishing and maintaining a safe and sound civil aviation system which is compliant with "international civil aviation standards".[47] Much of Taiwan's body of aviation-related regulations and rules are in fact based on regulations and standards promulgated by aviation authorities in the US and the European Union.[48] Indeed, it is largely due to the unofficial technical assistance and auditing initiatives from foreign aviation authorities that permits Taiwan to keep up with international aviation standards.[49] However, being denied direct access to

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See US State Department, "International Travel Information: Taiwan", online: State Department travel.state.gov/content/passports/en/country/taiwan.html

[46] See Jet Airliner Crash Data Evaluation Centre, "JACDEC Airline Safety Ranking 2016", online: JACDEC www.jacdec.de/airline-safety-ranking-2016/. According to Skytrax, a global survey of air passenger reviews, EVA Air is one of the "World's Top-10 Best Airlines", the "Best Trans-Pacific Airline", and one of only eight air carriers worldwide to earn the prestige of being a "5-Star Airline": see "EVA Revealed to Be World's 3rd Most Loved Airline SKYTRAX scored carriers on total of global traveler ratings", online: EVA Air www.evaair.com/en-global/news-releases/2016/2016-08-29-the-most-loved-airlines-on-skytrax.html?filter=

[47] Taiwan, *Civil Aviation Act*, art 1, online: CAA www.caa.gov.tw/APfile/en/download/pliad/1355122508112.pdf. Several provisions of the Civil Aviation Act reflect international practices and/or are reflections of provisions of the Chicago Convention. For example, on the issue of airworthiness standards, Article 23 of the Act provides "the airworthiness standards, which are generally used in international aviation practices" can be adopted. Article 121 of the Civil Aviation Act provides Taiwan's Civil Aeronautics Administration:

> may, making reference to the *standards, recommendations, measures or procedures outlined in relevant international conventions and annexes thereto*, propose [the] adoption of provisions involving international affairs not covered in this Act, for their promulgation and implementation [emphasis added].

On the issue of compensation for damage caused to passengers onboard an aircraft, despite the fact Taiwan is not (able to be) a party to the private international air law conventions governing air carrier liability, Article 93 of the Civil Aviation Act provides the compensation rules will be adopted "reference to international standards for liability". Taiwanese air carriers voluntarily accept the liability rules of any convention and amendment "from the 1929 Warsaw Convention to the 1999 Montreal Convention" that may be applicable. See EVA Air, "Conditions of Carriage", art 15.1.1, online: Eva Air www.evaair.com/en-us/conditions-of-carriage/

Even so, Taiwan's Aviation Safety Council recognised, in light of an air crash at the nation's main international airport, there is a lack of qualified legal personnel in Taiwan's CAA to draft and update regulations relating to aviation in accordance with international norms, as a result of which rules and regulations are "inadequately written": see *Aviation Safety Council Report, supra* note 32 at 182.

[48] *Ibid* at 128–129. See also François Shalom, "Taiwan pushes for place at ICAO table", *Montreal Gazette* (25 September 2013); and Glaser, *supra* note 32 at 19.

[49] Abeyratne, *supra* note 25 at 661–662. As Glaser writes:

> Taiwan's exclusion from ICAO has prevented its civil aviation authorities from obtaining timely information regarding ICAO standards and recommended practices (SARPs), which has impeded Taiwan's efforts to maintain civil aviation practices that comport with evolving international standards.

Glaser, *supra* note 32 at 19. See also François Shalom, "Taiwan pushes for place at ICAO table", *Montreal Gazette* (25 September 2013).

ICAO documents and from partaking directly in the discussion and implementation of ICAO standards and practices, Taiwan's aviation regulations are consequently piecemeal, and at times outdated[50] and conflicting in nature.[51]

The Chicago Convention obliges States to facilitate international air navigation by providing "airports, radio services, meteorological services and other air navigation facilities" in its territory.[52] Annex 15 to the Chicago Convention elaborates how States must gather, manage and communicate vital aeronautical information to ensure "uniformity and consistency" in the information that pilots and air traffic controllers all over the world receive and send.[53] Despite not being a Contracting State of the Chicago Convention, and therefore not bound by obligations flowing from the Convention,[54] Taiwan's CAA maintains a comprehensive electronic Aeronautical Information Publication (eAIP) system that is publicly available and

[50] See Glaser, *supra* note 32 at 19. By way of example of how Taiwan lags behind in adopting standards that are in line with international standards, in October 2006, ICAO and Member States formulated a policy prohibiting liquids, aerosols and gels over 100 ml in carry-on luggage. The policy, deliberated and formulated behind closed doors, was set to be implemented from March 2007. Only in December 2006 did aviation authorities in Taiwan receive information relating to the latest security measures through third party sources, prompting the country's CAA to quickly adopt measures that conform to the international standard. See Jim Hwang, "Toward a Seamless Sky", *Taiwan Review* (1 September 2013), online: Taiwan Review www.taiwantoday.tw/ct.asp?xItem=208453&ctNode=2190

[51] In an accident report following the crash of an airliner at the (then) Chiang-Kai Shek International Airport in 2000, Taiwan's Aviation Safety Council, the body responsible for investigating air accidents noted:

> CAA's knowledge of most updated civil aviation related laws and regulations were impaired by its absence from participation in major international organizations, including ICAO. Limited access to certain civil aviation resources also causes some problems. Regulations originating from the USA's FAA, enacted by one division, may conflict with regulations derives from the JAA of EU, enacted by the other division. In some cases, the shortage of resources leads to difficulty in implementation of some rules and regulations in a timely fashion.

Aviation Safety Council Report, supra note 32 at 128–129, online: Aviation Safety Council www.asc.gov.tw/upload/acd_att/e2e5348e-a4b8-4705-8495--4ffd35e99483.pdf

[52] *Chicago Convention*, *supra* note 10, art 28(a).

[53] As the Annex notes "[c]orrupt or erroneous aeronautical information/data can potentially affect the safety of air navigation", and States must "as far as practicable, avoid standards and procedures other than those established for international use": ICAO, *Annex 15 to the Convention on International Civil Aviation: Aeronautical Information Services*, 12th ed (2004) at 1–1. See also ICAO has also called upon States to establish Performance Based Navigation (PBN) implementation plans to improve the performance, safety and efficiency of global air navigation system: ICAO, *Performance-based navigation global goals*, ICAO Res A36–23. Taiwan has done so largely through the implementation of satellite-based navigation systems.

[54] Article 38 of the Chicago Convention obliges all Contracting States that finds it "impracticable to comply in all respects with any such international standard or procedure" to give "immediate notification to the International Civil Aviation Organization of the differences between its own practice and that established by the international standard". It is practically impossible for Taiwan to do so as the country is not a Contracting State.

accessible.[55] Though not a Contracting Member, and lacking direct access to the latest ICAO with standards and procedures established for international use, Taiwan regularly publishes and disseminates documents which list the ways that rules and regulations in the Taipei FIR differ from ICAO SARPs and procedures.[56] As Taiwan is practically unable to furnish ICAO with vital data that have major implications for the safe navigation and operation of the thousands of flights traversing the Taipei FIR, much data and information is made publicly available online.[57]

Though not permitted to formally ratify the Chicago Convention, the desire to "ensure the highest degree of safety and security in international air transport"[58] is reflected in air transport agreements Taiwan concludes with other States. The Open Skies agreement between Taiwan and the US, for instance, commit both parties to adhere to the minimum safety standards required by the Chicago Convention and its Annexes.[59] In terms of security, though Taiwan as a non-member is unable to ratify ICAO-promulgated conventions related to aviation security, both sides committed themselves to adhere to ICAO standards and norms.[60]

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[55] See Taiwan CAA, "eAIP", online, CAA eaip.caa.gov.tw/eaip. Even in the air transport agreement between Taiwan and Mainland China, both sides agreed to maintain procedures on air traffic control registered in "flight path rules manuals (AIP, Aeronautical Information Publication) that are in common use internationally". See Mainland Affairs Council, *Cross-Strait Air Transport Agreement,* 4 November 2008, online: MAC www.mac.gov.tw/public/Data/96301072771.pdf; and Mainland Affairs Council, *Explanation concerning the Cross-Strait Air Transport Agreement*, 4 November 2008, s IV, para 3, online: MAC www.mac.gov.tw/public/Data/962917501071.pdf

[56] See e.g. *Gen 1.7 Differences from ICAO Standards, Recommended Practices and Procedures of Annex 3 Meteorological Service for International Air Navigation*, online: CAA eaip.caa.gov.tw/eaip/history/2015-03-19/pdf/RC-amdt-en-TW.pdf

[57] Hsiu-chuan Shih, "Taiwan only 'guest' due to China: ICAO", Taipei Times (26 September 2013), online: Taipei Times http://www.taipeitimes.com/News/front/archives/2013/09/26/2003573020/2. The article refutes the suggestions that Taiwan's aviation data be sent to ICAO via China or that China does receive any information from Taiwan.

[58] *Air Transport Agreement between Taipei Economic and Cultural Representative Office and the American Institute in Taiwan*, 18 March 1998, Preamble, online: Airlineinfo.com, airlineinfo.com/openskies/taiwan.pdf. The Taipei Economic and Cultural Representative Office and the American Institute in Taiwan are the *de facto* embassies in each respective countries which, due to the lack of official diplomatic relations, are responsible for signing bilateral agreements on behalf Taiwan and the US.

[59] *Ibid*, art 6.

[60] *Ibid*, art 7. These conventions include: the *Convention on Offenses and Certain Other Acts Committed On Board Aircraft*, 14 September 1963, 20 UST 2941, TIAS No 6768, 704 UNTS 219, 58 Am J Int'l L 566 (1959) (entered into force 4 December 1969) [*Tokyo Convention*]; the *Convention for the Suppression of Unlawful Seizure of Aircraft,* 16 December 1970, 860 UNTS 105, [1972] ATS 16, 10 ILM 133 (1971) (entered into force 14 October 1971) [*Hague Convention*]; the *Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation*, 23 September 1971, 974 UNTS 177, [1973] ATS 24, 10 ILM 1151 (1971) (entered into force on 26 January 1973) [*Montreal Convention 1971*]; and the *Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation, Supplementary to the Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation*, 24 February 1988, ICAO Doc 951, 1589 UNTS 474,[1990] ATS 37,27 ILM 628 (1988) (entered into force 6 August 1989) [*Montreal Protocol 1988*].

In terms of airport safety management, the compliance of the largest international aviation gateway, Taiwan Taoyuan International Airport, with ICAO's standards has been hailed as "impressive", particularly considering Taiwan's aviation authorities have been unable to partake in committees and technical sessions formulating the security and safety considerations in the design and operation of airports.[61] When ICAO called for the implementation of a global and seamless system of air navigation services with the aid of satellite applications,[62] Taiwan became the first country in Asia to introduce and successfully implement the communications, navigation and surveillance/air traffic management (CNS/ATM) system.[63] The know-how and experience from the implementation and use of advanced space-based technology to improve aviation safety and efficiency can be readily shared with other States which are not yet so experienced in this development.[64] In terms of passport security, in 1995 the island was among the first countries in the world to issue ICAO-compliant

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[61] See Steven Leib & Chien-tsung Lu, "A Gap Analysis of Airport Safety Using ICAO SMS Perspectives: A Field Study of Taiwan" (2013) 2 Journal of Aviation Technology and Engineering 63. As the authors note, at 70:

> As Taiwan is not a member of ICAO, its largest airport's level of compliance with the SMM is impressive. Overall, the airport addresses key components of safety hazard reporting, safety risk management, safety assurance, and safety promotion in ways that are consistent with the ICAO SMM.

See also Chien-tsung Lu, John Young & Stewart Schreckengast "Safety Culture: the Perception of Taiwan's Aviation Leaders" (2011) 11 International Journal of Applied Aviation Studies 27. This should be contrasted with the conclusions of a report in the aftermath of a crash at TPE in 2000: *see* "Accident Report Provides Lessons Learned about Preventing Takeoff on a Closed Runway" (July 2002) 59(7) Accident Prevention 1 at 7, online: Flight Safety Foundation flight-safety.org/ap/ap_jul02.pdf. There were even concerns Taiwan's own safety records were glossed over and that the deficiencies of the airport were "downgraded" in the crash investigation: see Tom Ballantyne, "Peers Support sieged pilots", *Orient Aviation* (1 May 2002), online: Orient Aviation www.lite.orientaviation.com/orient-aviation-magazine/airlines/peers-support-sieged-pilots. There are also claims that Taiwan's conduct of aircraft accident investigation is at odds with ICAO standards, the sole objective of which is "the prevention of accidents and incidents" and not "to apportion blame or liability": ICAO, *Annex 13 to the Convention on International Civil Aviation: Aircraft Accident and Incident Investigation,* 10th ed (July 2010), ch 3.1.

[62] See ICAO, *Global Air Navigation Plan for CNS/ATM Systems*, ICAO Doc 9750, AN/963 (2002). The vision according to ICAO is:

> To foster implementation of a seamless, global air traffic management system that will enable aircraft operators to meet their planned times of departure and arrival and adhere to their preferred flight profiles with minimum constraints and without compromising agreed levels of safety.

See also ICAO, *Amendment No. 1 to the Procedures for Air Navigation Services—Air Traffic Management*, ICAO Doc 4444-ATM/501.

[63] Meg Chang, "Taiwan Launches Asia's First CNS/ATM System", *Taiwan Today* (6 October 2011), online: Taiwan Today taiwantoday.tw/ct.asp?xitem = 177,482&ctnode = 1743

[64] See Kuang-shih Yeh, "Taiwan Seeks Meaningful Participation in the International Civil Aviation Organization", online: MOFA http://www.mofa.gov.tw/enigo/News_Content.aspx?n=F9C9A875D719DB70&sms=DE4C0FE1DE37E6E0&s=F508CA8B5B203ACF. Taiwan has expertise in aviation training, air traffic control system upgrades and safety surveillance data acquisition

machine-readable passports; in 2008 Taiwan began issuing the "e-passport", which is compliant with ICAO's security and technical standards.[65]

As illustrated, continuing exclusion from the global aviation security and safety network has not deterred Taiwan from complying with international standards and practices. On the contrary, the country attempts in all possible manners to comply with international standards governing aviation safety and security as best as it possibly can. However, being permanently excluded from ICAO's various committees and technical sessions that discuss, develop and update standards and practices means that often Taiwan "remains in the dark as to the background and context of any new policies or decisions".[66]

6 Pathways to Meaningful Participation and Contribution

There have been concerted diplomatic efforts and support to take Taiwan out of the dark and into the international limelight as far as the matter of Taiwan's exclusion from ICAO is concerned. These efforts and shows of support resulted in appearance of representatives from Taiwan at the 38th ICAO Assembly in 2013 as "guests" of the President of the ICAO Council.[67] Though welcomed as a breakthrough and "an important step forward in [Taiwan's] bid for meaningful participation in ICAO", [68] the first time in over four decades representatives from Taiwan's CAA were able to step into ICAO Headquarters appears to be a one-off invitation predicated on the goodwill of ICAO President and third parties.[69] This falls short of calls by European

[65] Bureau of Consular Affairs, "Taiwan migrates from MRP to e-passport" (2009) 29 Keesing Journal of Documents & Identity 11, online: BOCA www.boca.gov.tw/public/Attachment/98241264371.pdf. For the ICAO standards on machine readable passports, see ICAO, *Machine Readable Travel Documents*, ICAO Doc 9303.

[66] "Taiwan's quest for meaningful participation" (2011), *supra* note 33. In a statement by the Minister of Transportation and Communications:

> For over four decades, due to the lack of direct contact with ICAO, Taiwan's aviation authority, the Civil Aeronautics Administration (CAA), has had to make extra efforts to keep abreast of constant updates of flight safety and security standards set by ICAO. Although we have an excellent record in keeping our systems up-to-date, obtaining the latest ICAO standards has often been a costly and drawn-out process.

Yeh, "Taiwan Seeks Meaningful Participation in the International Civil Aviation Organization", *supra* note 64.

[67] Hsiu-chuan Shih, "Taiwan only 'guest' due to China: ICAO", Taipei Times (23 September 2013), online: Taipei Times www.taipeitimes.com/News/front/archives/2013/09/26/2003573020

[68] Chi Shen, "ICAO invites the Republic of China (Taiwan) to attend the 38th Session of the ICAO Assembly", (2013) 31 Chinese (Taiwan) Yearbook of International Law and Affairs 274 at 275.

[69] The ability of representatives from Taiwan to take part in the 38th ICAO Assembly rested largely due to the approval China. See Steven D Jaffe, *Airspace Closure and Civil Aviation: A Strategic Resource for Airline Managers* (New York: Ashgate Publishing, 2015) at 164. See also Shih, "Taiwan only 'guest' due to China: ICAO", *supra* note 67.

Union,[70] the US,[71] Canada and elsewhere[72] that Taiwan have more "meaningful participation" and more active engagement at ICAO as an observer. Efforts are continuously made to raise awareness of the alarming fact that the safety of millions of aircraft and passengers flying through a heavily-used airspace corridor is neglected due to "diplomatic and political wrangling".[73] This year the request to gain admission to the 39th ICAO Assembly has, as of press time, met with a deafening silence. [74]

There are many examples, particularly on the economic and humanitarian front, whereby Taiwan has demonstrated its ability and willingness to play the role of being vital and responsible a member of the international community.[75] As mentioned

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[70] See EU, *Annual report from the Council to the European Parliament on the Common Foreign and Security Policy (CFSP) in 2012*, EU Doc P7_TA(2013)0453 (24 October 2013) (in German), para 82. See also EU, "Statement by the Spokesperson of EU High Representative Catherine Ashton on the occasion of the participation of Taiwan in the 38th Assembly of the International Civil Aviation Organisation", EU Doc 130,923/01 (23 September 2013), online: European External Action Service eeas.europa.eu/statements/docs/2013/130923_01_en.pdf. See also EPP Group, "Taiwan should be granted Observer Status in the ICAO", online: EPP Group www.eppgroup.eu/press-release/Taiwan-should-be-granted-Observer-Status-in-the-ICAO

[71] See Public Law No 113–17, *An Act to direct the Secretary of State to develop a Strategy to obtain Observer Status for Taiwan at the triennial International Civil Aviation Organization Assembly, and for other purposes*, 12 July 2013. See also American Legislative Exchange Council, "Resolution Supporting Taiwan's Meaningful Participation in the International Civil Aviation Organization (ICAO)", online: ALEC www.alec.org/model-legislation/resolution-supporting-taiwans-meaningful-participation-in-the-international-civil-aviation-organization-icao/; and National Association of Secretaries of State*, NASS Resolution In Support of Taiwan's Participation as an Observer in the International Civil Aviation Organization,* 21 July 2013, online: NASS www.nass.org.

[72] "Taiwan's ICAO observer-bid garners European and global support", *European Business Review* (20 August 2013), online: European Business Review www.europeanbusinessreview.eu/page.asp?pid=1083. See also John Scott Marchant, "Flexibile diplomacy gives new impetus to Taiwan-Canada ties", *Taiwan Review* (17 September 2010), online: Taiwan Review taiwanreview.nat.gov.tw/fp.asp?xItem=118156&ctNode=205

[73] Abeyratne, *supra* note 25 at 661.

[74] Again, attempts to attend the 39th Assembly later this month depends much on the goodwill of ICAO members as well as China. See Mainland Affairs Council Press Release No. 51 (4 August 2016):

> The CAA applied to participate in this year's ICAO Assembly as the authority in charge of international aviation safety and safety of cross-Strait travel. The administration submitted the application under "a proper name" and is willing to follow the relevant rules for participation in ICAO meetings. The government will seek support from the ICAO members and believes that this issue could be resolved through cross-Strait negotiations and *hopes that mainland China could show goodwill to the people of Taiwan*.

[Emphasis added]

[75] These organisations include the World Trade Organization (WTO), the Asia-Pacific Economic Cooperation (APEC), the Asian Development Bank and the International Olympic Committee. Participation is however, according to one commentator, "at the cost of indignities of nomenclature ("Chinese Taipei" and so on) and other affronts". Jacques De Lisle, *Taiwan: Sovereignty and Participation in International Organizations*, Foreign Policy Research Institute (2011), online: FPRI www.fpri.org/docs/media/201107.delisle.taiwan.pdf

previously, it is practically impossible for Taiwan to adhere to the Chicago Convention, let alone become an ICAO Member State.[76] However, already in 1947, with the desire to securing the organisation's stated aims and objectives of safe and orderly global air transportation, the ICAO Council adopted a resolution aimed at securing the participation of Non-Contracting States. [77]

Under ICAO Assembly's rules, Non-Contracting States may be invited by the Council or the Assembly to be present at ICAO as observers.[78] Observers have no voting rights but are permitted to participate in deliberations of the Assembly and its commissions and sub-commissions.[79] On invitation by the body concerned, observers are also able "to attend and be heard" in private meetings.[80] To ensure the input and feedback of stakeholders and parties with a vested interest in aviation, both the International Air Transport Association (IATA) and the European Union are strongly involved at ICAO as observers.[81] Taiwan, or perhaps its civil aviation authority, can be represented as an observer. This is a pragmatic way, in accordance with ICAO's own rules, to ensure universal involvement of all aviation stakeholder, to sideline the divisive topic of statehood and recognition, which has no place at a global forum dedicated solely to foster the safe and orderly governance of global aviation. There is indeed precedence for Taiwan's participation as an observer at a UN body; since 2009, the country has been actively involved and contributing as an observer in the Assembly of the World Health Organization.[82]

Alternatively, representatives from Taiwan's civil aviation authorities can take part in ICAO working groups and projects which permit specialists to be engaged in

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[76] See *supra* note 30. As Weber notes, this provision is nowadays outdated as it was drafted with "enemy States" of the Second World War in mind: see *supra* note 17, at 26.

[77] ICAO, *Proceedings of the Council*, 2nd Session, 1947, ICAO Doc 7248-C/839 at 62–63. The Resolution is contained in ICAO Doc 4595-C/564. See also Abeyratne, *supra* note 25 at 654–655. Glaser cites the example of the Cook Islands, which was not a member of the UN, but joined ICAO as a full member. Glaser, *supra* note 32 at 20.

[78] ICAO, *Standing Rules of Procedure of the Assembly of the International Civil Aviation Organization*, ICAO Doc 7600/7 (2012), rule 5.

[79] *Ibid,* rule 25 and 43(c). For meetings of bodies with limited membership, observers may, on the invitation by that body or the body's officers, be able to attend and participate in the meetings without the right to vote. See also Glaser, *supra* note 32 at 21–22.

[80] *Ibid*.

[81] The EU is an observer at ICAO represented by the European Commission, see: "The European Union at ICAO", online: European Commission ec.europa.eu/transport/modes/air/international_aviation/european_community_icao/. Even the Palestine Liberation Organization (PLO) took part in ICAO as an observer: "PLO Gets Observer Status in the ICAO", JTA (5 October 1975) online: JTA www.jta.org/1977/10/05/archive/plo-gets-observer-status-in-the-icao

[82] See Che-Ming Yang, "The Road to Observer Status in the World Health Assembly: Lessons from Taiwan's Long Journey" (2010) 5 Asian J WTO & Int'l Health L & Pol'y 331. See also deLisle, who notes Taiwan's participation as an observer was an example of the "delicate and intricate dance" to compromise partial inclusion and involvement with its statehood. DeLisle, *Taiwan: Sovereignty and Participation in International Organizations*, *supra* note 75.

and contribute to developing aviation standards.[83] Involvement in the works and deliberations of ICAO's regional office in the Asia-Pacific is also a potential way for Taiwan to gain access and insight into international standards, as well as for Taiwan to inform the international community of its challenges and efforts in securing compliance.[84]

7 Conclusion

Situated in one of the world's most used and congested air, Taiwan's exclusion from ICAO threatens the safety and security of international and cross-Straits air transportation, as well as the wellbeing of the general traveling public. The island is an economic powerhouse with a bourgeoning aviation industry, and it occupies a vital geographic position in the Far East where dozens of international airways crisscross. Taiwan is, therefore, a major node and an unmissable link in the global aviation network.

As information regarding latest international aviation standards and practices are received piecemeal or with long delays, Taiwan's practices are often lagging behind or out of sync with the rest of the world. Even when the civil aviation authorities of Taiwan gains access to ICAO documents, there is a difficult process of second-guessing the rationale behind the annexes and resolutions and how the standards and practices prescribed therein can be implemented to ensure air traffic, communications, safety and security protocols conform to the global norm. This sordid state of affairs is unjustifiable— particularly considering the wellbeing and lives of millions

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[83] Glaser, *supra* note 32 at 22. The Committee on Aviation Environmental Protection (CAEP) is an example, as it allows observers from "States, intergovernmental and non-governmental organizations, including airlines, aircraft and engine manufacturers, environmental NGOs and UN bodies" to take part in its work. See e.g. ICAO, "ICAO Environmental Protection Committee delivers progress on Aircraft CO_2 and Noise Standards", Press Release, COM 4/13, online: ICAO www.icao.int/Newsroom/News%20Doc%202013/COM.4.13.EN.pdf. See also ICAO, "Committee on Aviation Environmental Protection (CAEP)", online: ICAO www.icao.int/environmental-protection/Pages/Caep.aspx#Members

[84] Glaser, *supra* note 32 at 22–23. The author cites involvement in the Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation (CAPSCA) as a feasible way forward, as the framework is a means for stakeholders to be involved in the preventing and managing the spread of diseases through air transportation.

As DeLisle put it rightly, Taiwan is an important player in several fields of activity that requires coordinated efforts and transparency of information and exchange. These include:

> international organs that regulate financial institutions and other economic behavior, shipping, fishing, *civil aviation*, nuclear energy, potential dual-use technology—all areas in which Taiwan is a significant actor whose actions have substantial international consequences.

See *Taiwan: Sovereignty and Participation in International Organizations*, *supra* note 75 [emphasis added].

of passengers and immeasurable amounts of high value air freight originating from, destined for, or transiting through a strategic aviation hub in the Asia-Pacific.

Independent of the controversial matters of statehood and recognition, there is no doubt in practice the authorities of Taiwan exercise "complete and exclusive sovereignty over the airspace above its territory".[85] Taiwan should therefore have the equal opportunity as all other air-faring nations to participate in and contribute to the governance of civil aviation.[86] As Dr. Abeyratne has succinctly argued, "meaningful participation" of Taiwan in ICAO must be:

> based on the implicit but compelling requirement that the very notion of international civil aviation requires, for its safety and sustenance, international participation and cooperation without fragmentation or isolation of segments of the world's populations or nations.[87]

To meaningfully participate in as well as contribute to enhancing global aviation safety and security, Taiwan would need more than the opportunity to attend a triennial meeting of the ICAO Assembly.[88] Its aviation authorities and technical experts need to have the ability to be present at technical meetings and various committees to receive "real time" updates on various aspects of aviation safety and security. Taiwan's aviation sector, from the airports to air navigation, from passenger security checks to cargo security, stand to benefit greatly from technical assistance as well as regular audits to ensure that standards are uniform with global standards. In return, the aviation authorities would be able to provide valuable information and updates on the management of air traffic and navigation in the heavily-utilised Taipei FIR. This is not just for the sake of the country's 23 million inhabitants, but also for the sake of millions of international passengers and crew traveling to and from and traversing the airspace under the country's exclusive control.

As the "global forum" for the "world aviation community", ICAO has committed itself to the "safe and orderly development of international civil aviation".[89] From the standard routine for the screening cargo and passengers to the planning of airports and procedures for taxiing on the tarmac; from the avoidance of airspace over conflict zones to the operational protocols of flight in incremental weather conditions; from the licensing of in-flight personnel to auditing standards and practices and to the regulation of unmanned aerial vehicles, ICAO has by and large

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[85] *Chicago Convention*, *supra* note 10, art 1. As Talmon underlines, the People's Republic of China may claim to exercise sovereignty over Taiwan, "rights derived from the Convention that require control over territory are suspended with regard to Taiwan"*:* Talmon, *supra* note 31 at 159.

[86] Glaser, *supra* note 32 at 2.

[87] Abeyratne, *supra* note 25 at 650. Dr. Abeyratne succinctly notes "Taiwan must have continued and sustained involvement in ICAO and not just attendance at an ICAO meeting where ICAO would pay lip service to international pressure and influence" and suggested ICAO "shed political considerations in favour of safety in air transport". *Ibid* at 661–662.

[88] As suspected by Glaser, Taiwan's attendance at the 38th Assembly "will not by itself guarantee involvement in ICAO Council and technical meetings, and did not mean full access to ICAO SARPs and the deliberations involved in formulating these international norms. Glaser, *supra* note 32 at 19–20.

[89] ICAO, "ICAO Strategic Objectives 2014–2016", online: ICAO www.icao.int/about-icao/Pages/Strategic-Objectives.aspx

secured uniformity across a swathe of aviation-related affairs and ensured flying is safer and more secure than ever before. Even with the passage of seven decades, the organisation's role and importance persists to this day. With new challenges and developments, the organisation will surely retain its role and importance far into the future, as demonstrated in the Strategic Objectives for the years 2014–2016, which include:

- enhancing *global* civil aviation safety, under the Global Aviation Safety Plan;
- improving air navigation capacity and efficiency by increasing the capacity and improving the efficiency of the *global* civil aviation system;
- Enhancing *global* civil aviation security and facilitation;
- Fostering the development of a sound and economically-viable aviation system; and
- Minimising the adverse environmental effects of civil aviation activities.[90]

No doubt, these truly noble objectives will continue to guide and be enshrined in the vision and actions of one of the most successful specialised agencies of the international community.

However, how can global efforts to bolster aviation safety and to streamline the provision of seamless air navigation services by using space-based technologies and tapping into local resources and knowhow not involve a member of the aviation community that has demonstrated willingness to voluntarily align itself with international norms and standards? How can global attempts to identify and neutralise threats to aviation security and to curb the detrimental impact international aviation has on the environment possibly exclude any one region of airspace? These fundamental questions ought to be addressed urgently by the international community, particularly at the 39th Assembly of ICAO.

The time has come for ICAO, as the world's foremost forum charged with the vital role of facilitating and overseeing the orderly global governance of aviation, to take a pragmatic approach in order to ensure that there is no missing link in the safety and security aspects of the truly global industry that is international civil aviation.

[90] *Ibid* [emphasis added].

Universal Participation Without Taiwan? A Study of Taiwan's Participation in the Global Health Governance Sponsored by the World Health Organization

Ping-Kuei Chen

Abstract This chapter focuses on the health risk of Taiwan's absence in intergovernmental health governance networks. It provides a review of Taiwan's bidding strategies for the World Health Organization between 1997 and 2009. The country's participation in the World Health Assembly (WHA) and the International Health Regulations (IHR) network since 2009 was a significant improvement, but this experience failed to extend to other governing bodies. The chapter goes on to discuss the global public health risk of excluding Taiwan from cross-national health cooperation, and why such a conundrum remains difficult to resolve. Taiwan's compliance regarding health governance relies heavily on self-regulation and the help of its allies. The United States has played a key role in enforcing global health regulations on Taiwan. Unlike other sources of threat in health governance, Taiwan currently does not represent a high health risk to other countries. As a result, Taiwan finds it difficult to persuade WHO members to manifest "universal participation" by including Taiwan in various intergovernmental health networks. This pattern of governance, however, lacks transparency. Other countries will find it difficult to monitor or intervene in the event Taiwan's health authority is unable to deal with a transnational health emergency.

Keywords WHO • Global health governance

1 The Missing Link in International Health Governance

Established in 1948, the World Health Organization (WHO) is a United Nations (UN) specialized agency that regulates international health affairs. Looking back at its history, Taiwan used to have close relations with WHO. Chiang Kai-Shek's

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_12

Republic of China (ROC) government was the founding member of WHO in 1948. After Chiang was defeated in the Chinese civil war and retreated to Taiwan, the ROC government maintained its membership for more than two decades. Under the aid and programs directed by WHO, Taiwan gradually improved its primary healthcare system. This connection was cut off when the Taiwanese government lost its UN seat to the People's Republic of China (PRC) in 1971 under UN resolution No. 2758. In the following year, the World Health Assembly (WHA), the main decision body of WHO, passed Resolution 25.1. In this Resolution, PRC also restored its rights as the representative of China in WHO. Taiwan's formal communication with the organization stopped. Taiwanese health officials interacted with WHO through indirect means, usually bridged by unofficial channels.[1]

As the Cold War ended, Taiwan sought to return to the UN and its specialized agencies in 1993. The WHO bidding was first suggested by the public. There were many unofficial activities pushing for Taiwan's return to WHO before the Taiwanese government took the initiative. The most significant example was the efforts made by the Foundation of Medical Professionals Alliance in Taiwan (FMPAT). FMPAT held lobbies for Taiwan's representation in WHO since 1995.[2] These efforts initially received a cold response from the Taiwanese government. The government at the time believed it did not require professional assistance from WHO. The necessity of Taiwan's participation in WHO was relatively weak in terms of health policies (Chang 2010b).

It was not until 1997 that the Taiwanese government developed an interest in WHO. Taiwan specifically chose WHO as its main foreign policy objective (Li 2006). It was a strategic decision with careful consideration. The policy was meant to end Taiwan's diplomatic isolation in intergovernmental organizations. WHO was a good candidate because it dealt with professional issues concerning vital humanitarian needs. The campaigns for WHO observer status were, as Lee summarizes, "a potential means of leveraging participation in other international organisations and, in time, regaining recognition and legitimacy as a sovereign state" (Herington and Lee 2014, p. 6). The Taiwanese government had set up policies to return to the UN since 1993. The participation in WHO activities would set an example for Taiwan's participation in other UN-related activities. Being one of the UN specialized agencies, a successful breakthrough in WHO might have brought positive effects on Taiwan's UN bidding.

The Taiwanese government claimed that its pursuit of WHO participation was non-political and focused on defending the health security of its people. Indeed, the

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[1] For example, Taiwanese officials met officers from WHO Western Pacific Regional Office (WPRO) in 1994 to discuss how to report Taiwan's eradication of polio to WPRO. "The Taiwan Polio Eradication Certification Committee" was established for communication with relevant WHO agency. This committee remained in contact with the WPRO office until it accomplished its task in 2000. For details of the contact between Taiwan and WHO, see Foundation of Medical Professionals Alliance in Taiwan, *Taiwan Genchu Xiaoer Mabi Zheng Jishi*, (台灣根除小兒痲痹症紀實, The History of the Eradication of Polio in Taiwan) (Taipei: Centers for Disease Control R.O.C Taiwan, 2001). Also see (Lin 2003).

[2] For more detail see (Tsai 2004).

claim to "pursue the health of millions of people" became a common propaganda throughout the following years where Taiwan argued that exclusion from WHO would constitute a grave health risk for residents of Taiwan. In addition to the negative effect of excluding Taiwan, the government emphasized the positive role that Taiwan could play in cross-national health affairs. Its modernized primary healthcare system, medical achievements, and the successful national healthcare insurance supported the claim that Taiwan's involvement could be constructive to other countries through WHO.

Nevertheless, the most important reason behind Taiwan's WHO bidding was that WHO regulations offered Taiwan a viable opportunity to participate. Specifically, Taiwan's effort focused on joining the World Health Assembly (WHA), the ministerial intergovernmental meeting held every year in May. Taiwan did not apply for WHO membership because WHA Resolution 25.1 rejected Taiwan's legal status as a state. Taiwan would face the same sovereignty problem in the UN bidding if it attempted to overrule the WHA Resolution. It would be extremely difficult, if not impossible, to successfully obtain a WHO membership. And there was no observer status in WHO. However, the WHA received observers. The WHO Constitution and Rule of Procedure of the WHA regulated an observer status that left a grey area for Taiwan. Under article three of the Rule, Taiwan might participate in the WHA under an invitation from WHO Director-General (DG) without being officially recognized as state or territory. In practice, WHA observers included a variety of sovereignty statuses. They included internationally recognized states like the Holy See, self-governing territories like Palestine, and international non-governmental organizations (INGOs) like the International Committee of the Red Cross (ICRC). The rules offered Taiwan an opportunity to participate in the WHA without clarifying its legal status. Therefore, being a WHA observer was an opportunity to participate in intergovernmental governance that was not available in other intergovernmental organizations (IGOs). This made the WHA bid a primary target for Taiwan's foreign policy.

Since its withdrawal from the UN and its specialized agencies, Taiwan was excluded from rules and institutions that became increasingly important in global governance. In terms of health governance, WHO had become the main body where states formulated and enforced health-related regulations (Frenk and Moon 2013). Global health governance focuses on transnational health risk, such as the spread of infectious diseases, border control and examination, food safety, and joint research and laboratory standards on examinations and treatments. In practice, WHO health governance consists of various networks or regulations, including International Health Regulations (IHR), the Framework Convention on Tobacco Control (FCTC), the International Food Safety Authorities Network (INFOSAN), and the International Medical Products Anti-Counterfeiting Taskforce (IMPACT). WHO contains the negative externalities of transnational health threats by providing public goods or medical services sponsored by developed countries. The networks it established since the end of Cold War allow health policy makers to exchange health information. They create professional cooperation among professional medical experts. WHO members regularly convene to review the progress of WHO projects. This makes WHO an effective monitoring power in global health governance. Although non-governmental organizations (NGOs) are also important contributors to global health, their governing power and ability to build networks between national health authorities cannot match the scale of WHO.[3]

Taiwan was not required to implement rules established among WHO members, but it maintained good records of compliance. Instead of being a deserter of global health regulations, Taiwan showed great interest in conforming to the decisions made in the health governing bodies. Its compliance was grounded in two reasons. The first one was voluntary implementation. Taiwan voluntarily conformed to health-related rules and standards for two reasons. First, it wanted to improve its own health governance by "catching up" to the global standards. These rules created short cuts for health policy formulation or provided reference for law-making in Taiwan. For example, the Taiwanese government voluntarily enforced the guidelines made by FCTC. Taiwan's tobacco control policy depends on the recommendations and research reports developed under FCTC conferences. Secondly, from Taiwan's perspective, its voluntary participation demonstrated the country's resolution to join intergovernmental health bodies such as the WHA and FCTC Convention of Parties. Taiwan's compliance echoed the government's foreign policy, showing that Taiwan was willing to take its part in global health governance. As a result, Taiwan's exclusion made its health authority more willing to implement international standards.

The second reason underlying Taiwan's compliance was the support/pressure from its allies, mainly the US. The US health administration maintained very close relations with its Taiwanese counterpart. The Centers for Disease Control in the two countries, for example, regularly exchanged information. The US usually provided consultations that facilitated the work of Taiwan Centers for Disease Control (CDC). Taiwan gained the latest information about WHO activities from the US representatives who took part in WHO. Taiwan's diplomatic allies also create professional channels that connected Taiwan's internal health governance with the global one. In addition to being privy to information concerning intergovernmental meetings, Taiwanese health officials attended intergovernmental meetings by joining the delegations of its diplomatic allies.

The discussion above shows that Taiwan's participation in global health governance is not entirely isolated.[4] Taiwan closely follows the progress of global health governance, though such involvement is quite limited. And Taiwan's representatives are absent in almost every intergovernmental meetings. Therefore, the Taiwanese

[3] To be sure, NGOs are also important advocates of global health governance. Organizations such as Global Alliance for Vaccines and Immunization, Global Fund to Fight AIDS, Tuberculosis and Malaria, and Gates Foundation have done significant works in the area of health, and they have maintained partnership with WHO. Their programs build up local infrastructure and improve public health. Sometimes WHO relies on their help to provide health aid. However, they rarely establish cross-national networks of cooperation and information sharing. For more on NGOs' role in global health governance, see for example (Brown 2010; Buse and Harmer 2007; Dodgson et al. 2002; Frenk and Moon 2013; The Lancet Editorial 2009; Rushton and Williams 2011).

[4] It should be noted that Taiwan has a vibrant civil society. NGOs based in Taiwan have provided medical assistance and undertaken charity work in different parts of the world. These efforts are part of global health governance. For example, Rollet (2005) discusses the work several Taiwanese NGOs have done in HIV/AIDS prevention and treatment.

government adopts indirect channels to acquire information regarding WHO activities. The most significant problem of Taiwan's current mode of participation is efficiency. The lack of a direct communication channel between Taiwan and the governing body creates an information gap. Taiwan cannot obtain the latest information released by WHO, neither can WHO obtain the latest health information inside Taiwan. Taiwan has no obligation to report its health information to WHO, and WHO will not request information from the Taiwanese government. According to the UN resolution, China is responsible for Taiwan's internal affairs, but in reality Beijing does not administer Taiwan's health affairs and therefore it is unable to report health figures regarding Taiwan. Even if the Taiwanese government voluntarily report its health figure to WHO, WHO might not accept because of the political dispute.

This becomes a problem when it comes to the spread of infectious diseases and food security. As WHO gradually becomes the major governing institution that regulates and shares information on these topics, the disadvantage of Taiwan's exclusion becomes more evident. Taiwan relies on indirect channels to access updates on health emergencies. The delay of information increases the risk of a tardy response to transnational health crises. This was particularly evident during the spread of SARS, which will be elaborated in the following section.

The problem also applies to other states, particularly Taiwan's neighbors. If Taiwan becomes a source of transnational health risk, the global governing institutions cannot intervene or demand enforcement. Taiwan is not connected to any of the information sharing networks managed by WHO. For the most part, WHO counts on the health authority of Taiwan to control infectious diseases or food safety. Once Taiwan fails to contain a health risk, WHO cannot intervene, nor can it provide assistance to prevent further spread of the health risk. Information concerning a local health risk only passes through bilateral communication channels between Taiwan and its neighboring states. WHO members are thus exposed to potential health risks brought by Taiwan, and they can only rely on Taiwan's friendly allies to pressure the Taiwanese government to be a competent and responsible actor when dealing with transnational health emergencies.

This "loophole" in global health governance has been the dilemma for WHO. After all, its governing power is more effective if the rules apply to all actors in international society, yet Taiwan has been an exception. Moreover, Taiwan is not an isolated actor in international affairs. Its open economy and the large amount of trade and visits with other countries make a health risk easily transmittable from and to Taiwan. WHO-sponsored health governance is hardly complete without a direct channel to communicate with and regulate Taiwan's health authority.

2 Breaking Through – Taiwan's Past Bidding Strategy

Taiwan did make a substantial effort to end its exclusion. Despite the fact that being a WHA observer did not necessarily indicate the status of statehood, it was still a sensitive issue and the WHO/WHA bidding was difficult. The political ambition behind Taiwan's pursuit of being a WHA observer had been very obvious.

Unsurprisingly, China adamantly opposed Taiwan's WHO/WHA bidding from the start. Between 1997 and 2008, Taiwan mobilized all its diplomatic relationships to participate in WHO, mostly aimed at attending the WHA. It rallied its diplomatic allies, lobbied foreign governments and their congresses, organized NGO support, and directed media attention to its bids. These activities aimed to raise issue salience and earn international support to fight against China's diplomatic blockade. Every year immediately after the WHA in May, the Taiwanese government began a new round of bidding. The Ministry of Foreign Affairs (MOFA) and Department of Health (DOH, now the Ministry of Health and Welfare) jointly set up main tactics for the next year. They mobilized overseas Foreign Service offices, produced media propaganda, and organized a series of conferences and activities. Government officials regularly established connections with important INGO leaders, foreign government officers, foreign congressmen, and even WHO officers. The Taiwanese government wanted to rally enough support from the international community to outweigh China and its allies. The following table shows Taiwan's bids from 1997 to 2016 (Table 1)

In 1997, Taiwan's first attempt to return to the WHA met with a cold response from the international community. China responded furiously as expected. It claimed that Taiwan is not an independent state under the "One China Principle" and therefore did not qualify to participate in the WHA (Li 2008). Over time, Taiwan accumulated support from the international community. Besides its diplomatic allies, Taiwan gained support from the US government in 2001, and later in 2003, the Japanese government announced its support. Taiwan also gained support from professional INGOs. For example, the World Medical Association (WMA) has been a reliable ally. The International Council of Nurses (ICN) and International Pharmaceutical Federation (FIP) also publicly supported Taiwan.[5] Taiwan obtained much attention from international society. Its bidding efforts raised visibility and forced other states to think about the issue. Unfortunately, even with all this support, Taiwan's attempts did not succeed over the years.

It was not until the outbreak of Severe Acute Respiratory Syndrome (SARS) that the international community began to recognize the risk of excluding Taiwan from the international health network. SARS caught Taiwan's health administration off guard. Taiwan paid a grave cost fighting SARS. It had a total of 346 confirmed cases during the outbreak, and 73 deaths.[6] About 150,000 people were quarantined (Chen et al. 2005). In terms of number of cases and death toll, Taiwan ranked third among all countries during the outbreak. The Taiwanese government argued that the government could have better responded to the spread of SARS if Taiwan had maintained regular contact with WHO. Political obstacle also jeopardized WHO's ability

[5] The WMA was the most dependable ally. The senior officials of the WMA maintained a very good relationship with Taiwan. The WMA has publicly announced its support for Taiwan's participation in WHO since 2001. See the Report of 160th WMA Council Session, accessible on http://www.wma.net/en/40news/20archives/2001/2001_04/index.html

[6] This number is a conservative estimate that represents laboratory confirmed cases using the criteria that WHO published during August 2003. The number of cases is 668 and deaths 181 when applying WHO's criteria in May 2003. The number shows that Taiwan was seriously under the threat of SARS.

Table 1 Taiwan's Bidding Strategies 1997–2016

Year	Meeting	Proposed bids	Name
1997	General committee and plenary meeting, WHA	Inviting Republic of China(Taiwan) as an observer in the WHA	Republic of China(Taiwan)
1998	General committee, WHA	Inviting Republic of China(Taiwan) as an observer in the WHA	Republic of China(Taiwan)
1999	General committee, WHA	Inviting Republic of China(Taiwan) as an observer in the WHA	Republic of China(Taiwan)
2000	General committee, WHA	Inviting Republic of China(Taiwan) as an observer in the WHA	Republic of China(Taiwan)
2001	Executive board, WHA	Inviting Republic of China(Taiwan) as an observer in the WHA	Taiwan (Republic of China)
2002	General committee, WHA	Inviting Taiwan as an observer in the WHA	Taiwan
2003	General committee, WHA	Inviting health authorities of Taiwan as an observer in the WHA	Health authorities of Taiwan
2004	General committee and plenary meeting, WHA	Inviting Taiwan as an observer in the WHA	Taiwan
2005	General committee, WHA	Inviting Taiwan as an observer in the WHA	Taiwan, health entity
2006	General committee, WHA	Inviting Taiwan as an observer in the WHA	Taiwan
2007	General committee and plenary meeting, WHA	To propose Taiwan as a member in the WHO	Taiwan
2008	General committee, WHA	Inviting Taiwan as an observer in the WHA	Taiwan
2009–2016	WHA	WHA observer	Chinese Taipei

Source: Department of Health, Executive Yuan, Taiwan (ROC) (2008), p. 11. The author adds the data after 2007

to provide assistance to Taiwan. WHO dispatched experts to Taiwan 50 days after Taiwan called for help. The delay was due to the lack of China's authorization (Hickey 2006). The SARS incident showed the need for establishing channels of contact between Taiwan and WHO, especially during public health crises.[7]

Since 2003, the SARS experience has become the most powerful argument in Taiwan's bids. The members of the European Union began to urge an arrangement for Taiwan's participation in WHO working groups and technical meetings. The EU later formed the policy of "meaningful participation" regarding Taiwan's relations with WHO (Winkler 2013). However, as strong as the SARS argument was, mem-

[7] China attempted to block Taiwan from interacting with WHO, and claimed that if Taiwan required help, the Beijing government would consider its request and acted on its behalf. See (Tung 2005).

ber states did not form a majority support for Taiwan's bids. Although many members recognized the need for Taiwan's participation, they maintained that supporting Taiwan's bids was a politically sensitive issue.

The number of Taiwan's supporters increased slowly. The support of major countries such as the US and Japan did not rally the majority of WHO members to support Taiwan. The voting records in 1997, 2004, and 2007 showed a disappointing trend. When Taiwan's bid was put to vote in the WHA General Committee for the first time in 1997, 128 members rejected the bid to put the matter in the conference schedule; Taiwan had 19 votes. In 2004, 25 countries agreed to discuss the matter in the WHA, while 133 states voted against it. These were bids to become a WHA observer, which is less sensitive than applying for a membership. But Taiwan could not collect enough support. For the years where voting did not take place, the General Committee rejected Taiwan's proposals, and the WHA then accepted the recommendation of the General Committee not to include the matter in the conference agenda.

The bidding in 2007 was a significant setback. Taiwan made a risky move by challenging the sensitive political issue of applying for a membership in WHO.[8] Taiwan presented this proposal through its diplomatic allies. The WHA put forward a vote to determine whether it would entertain the proposal. There were only 17 affirmative votes. Over 70% of WHO members voted against the proposal, including the US and Japan, both long-term supporters for Taiwan. Among the 25 diplomatic allies of Taiwan, 6 allies did not vote, 1 abstained, and 1 delegate even voted against Taiwan.[9]

In the following year, Taiwan again bid to become a WHA observer. The US and Japan reaffirmed their support. The application for membership proved to be unsuccessful. This experience demonstrates that making strong sovereignty claims only makes WHO members hesitate to support Taiwan, even for the long-term supporters of Taiwan.

The Taiwanese government used to claim that it gained support from the legislatures of various countries and deemed this support a sign of increasing backing from the international community, but this so-called achievement rarely transformed into actual support in the conference hall. These non-binding resolutions failed to force foreign governments to support Taiwan's proposals. For example, the European Parliament had adopted numerous resolutions to support Taiwan. Many parliaments in European countries also had similar resolutions.[10] But the EU countries never

[8] According to interviews conducted by Herington and Lee (2014). The decision to apply for membership was made by President Chen. Some argued that Chen's decision was meant to divert domestic attention. The government was also pushing a referendum to participate in the UN at the same time.

[9] The representative of Costa Rica cast this vote. He claimed that he had misunderstood the voting question. Panama, Nicaragua, the Marshall Islands and St. Lucia were absent from the assembly hall. The Dominican Republic could not vote because it did not pay its annual fee. The Holy See had no right to vote. Haiti voted abstention. The rest of the 17 allies showed their support for Taiwan.

[10] For more a list of parliamentary support. See (Chang 2010a, pp. 475–6).

publicly support Taiwan's bid for the WHA observer. The "meaningful participation" did not guarantee Taiwan's representation in the WHA.

Taiwan did have powerful allies like the US, but the number of supporters was not enough to form a majority and open the door for Taiwan's participation. More importantly, more support from friendly countries did not equally diminish the diplomatic pressure coming from China. Every time Taiwan gained more allies or made a breakthrough, China intensified the diplomatic blockade. The number of countries supporting China actually increased as it put more efforts to fight against Taiwan's bid.

Taiwan's effort to join IHR were an example of the struggle. IHR was a mechanism that helped monitor and control the spread of infectious diseases. WHO first established the IHR in 1969. It was then revised in 2005 to expand its function. The 2005 revision, formally known as IHR (2005), significantly increased the governing power of WHO by setting up rules and guidelines for fighting transnational infectious diseases.

As part of WHO bidding, Taiwan sought to join the IHR. During the second IHR Intergovernmental Working Group (IGWG) meeting in 2005, Taiwan successfully proposed an amendment through its diplomatic ally. The amendment added a "universal application" clause in Article 3.3 of the new IHR.[11] This article vaguely left open the possibility of including Taiwan in the application of IHR because the IHR should apply to every corner of the world.

Beijing was stunned by Taiwan's success in the IHR IGWG. It realized that Taiwan could have influence even if it did not have formal representative inside the Assembly Hall. China was determined to prevent a similar incident with WHO. At the opening of the 60th WHA, China announced in its opening address that IHR had applied to all of Chinese territory and Taiwan was included, which brought furious protest from Taiwan. Furthermore, Chinese government secretly signed a Memorandum of Understanding (MOU) with the WHO Secretariat. The actual content of the MOU was never made public. The only way to speculate as to its contents was the internal guidelines distributed by WHO.

According to the MOU, Taiwan's participation in WHO activities was under tight control of China. Taiwanese experts who planned to attend a WHO meeting were required to apply for the meeting 5 weeks ahead of the conference date and submit the participant list to the Chinese government for approval. During those meetings, "ROC" and "Taiwan" were not to appear on the nametag or participant list. If Taiwanese experts were invited to the conference, WHO was required to also invite experts from China. Higher level officials (ranking over the level of Director-General) were restricted from attending any WHO activities.[12] All communications between Taiwan and WHO were to come through China; this meant Taiwan had to

[11] Article 3.3 of IHR (2005) reads: "The implementation of these Regulations shall be guided by the goal of their *universal application* for the protection of all people of the world from the international spread of disease."

[12] For the impact of the MOU on Taiwan's participation in IHR and FCTC, see (Gau 2008).

receive information concerning health emergencies through Chinese authorities. The MOU represented a significant pushback against Taiwan's WHO bidding.

However, the MOU did not change the mode of Taiwan's participation in global health governance. China intended to be the bridge between Taiwan and WHO in global health cooperation, in order to show its sovereignty over Taiwan. But China could not force Taiwan's health authority to cooperate with it. China set up a contact point with the Taiwan CDC to deliver the information distributed by IHR and INFOSAN. Taiwan, on the other hand, was not obligated to submit its internal health information to its cross-Strait counterpart. Taiwan was reluctant to establish communication with WHO through Beijing. As a result, Taiwan relied more on the existing alternatives, seeking direct communication with WHO or participating in global health cooperation through the US and its allies.

3 The WHA Accession and Taiwan's Participation in Global Health Cooperation

Taiwan's Mainland China policy had changed as the Kuomingtang (KMT) president Ma Ying-Jeou took office in 2008. Ma reestablished a communication channel based on two unofficial organizations, the Strait Exchange Foundation (SEF) and the Association for Relations across the Taiwan Straits (ARATS). The heads of the two organizations, Chiang Pin-Kung and Chen Yun-Lin held regular meetings discussing cross-Strait affairs. Ma proposed a "diplomatic truce" after his inauguration, which ended years of diplomatic conflict between Taipei and Beijing. The cross-Strait reconciliation brought hope that China would be more flexible on the matter of Taiwan's participation in IGOs, especially Taiwan's bid to become a WHA observer.

The sign of change took place in January of 2009. The Taiwan CDC received a notification from WHO concerning Taiwan's participation in IHR. This suggested that Ma's new policy received positive feedback from Beijing. The invitation offered the opportunity to bypass the limitation set up by the 2005 MOU, while the MOU was still in effect. WHO invited Taiwan to establish an IHR contact point to engage in direct communication. Taiwan CDC could receive and exchange information on health emergencies with WHO without the involvement of the Chinese government. More importantly, Taiwan was offered an account and password to log in to the "Event Information Site", where it could review the latest public health emergencies circulated among member states. WHO also promised that it would send experts to Taiwan when a health emergency occurred.[13] These were the primary objectives Taiwan had been asking for since the IHR (2005) was put into practice.

[13] For complete statement, see Centers for Disease Control, "WHO Laihan Tongyi Jiang Wo Naru 'Guoji Weisheng Tiaoli' Yunzuo Tixi" (WHO來函同意將我納入「國際衛生條例」運作體系, WHO agrees to include Taiwan into the operation of International Health Regulations), January 22, 2009. http://www.cdc.gov.tw/professional/info.aspx?treeid=f94e6af8daa9fc01&nowtreeid=f94e6af8daa9fc01&tid=ED71710A997C7988 (accessed Mar 8, 2017).

The IHR invitation created an optimistic expectation for the WHA bid. But it was not until 16 days before the WHA that the DOH received an official invitation from WHO Director-General Margaret Chan. The invitation stated: "I wish to invite the Department of Health, Chinese Taipei, to attend the 62nd World Health Assembly as an observer…" This was the first time the Taiwanese government received an official invitation from the DG. The invitation itself revealed WHO's attitude toward Taiwan. It did not use the word "Taiwan". The name "Taiwan" was not even on the address line. Instead, "Taiwan" was replaced by "Chinese Taipei". The DOH was called "the Department of Health, Chinese Taipei". It showed that WHO was not willing to touch on the sensitive question of sovereignty. The invitation simply gave the Taiwanese government status to participate in the WHA. It did not identify or imply any sovereignty status. Taiwan was still, from WHO's perspective, not an independent sovereign state. WHO deliberately avoided the sensitive sovereignty issue and claimed that "DG has the authority to invite any entity which carries out the function in the field public health." In fact, WHO did not have the concept of "health entity" in its Constitution and regulations.[14] This invitation obscured Taiwan's legal status. It suggested that Taiwan could still break through the legal constraint and participate in international events as long as political coordination was in place.

On the other hand, the title "Chinese Taipei" was not much of a surprise. Mr. Ma once said in an interview: "In terms of Taiwan's participation in WHO, there is no better title than Chinese Taipei at this point of time."[15] This title first appeared in the International Olympic Committee (IOC) in 1981. It was the result of the representation dispute between ROC and PRC in the IOC. The Taiwanese government did not particularly prefer this title. However, this title was proven to be applicable in many intergovernmental organizations such as the Olympic Games and the Asia-Pacific Economic Cooperation. It also served as the abbreviation of "Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu" in the WTO. Nevertheless, this was the first time the Taiwanese government accepted "Chinese Taipei" as its title in an intergovernmental meeting of a UN-related agency.

Taiwan's health officials were very concerned about how WHO would treat them as government delegates. For example, during the first attendance at the WHA, Taiwan's health minister checked his title as soon as he received his conference badge. He went on checking other country's badges to make sure that their titles on

[14] Gau made detailed and elegant analysis from the perspective of international law. See Sheng-ti Gau (高勝惕), Yi Shijie Weisheng Zuzhi Zhi Fagui Lun Taiwan Canyu Shijie Weisheng Dahui Zhi Moshi Ji Yihan (以世界衛生組織之法規論台灣參與世界衛生大會之模式及意涵 The Approach and Meaning of Taiwan's Participation in WHA from the Perspectives of WHO Regulations), in (Bao et al. 2009).

[15] Central News Agency interview on Ma. He was the President-elect at the time. See Li Jiafei (李佳霏), "Ma Yingjiu: Jiaru WHO Meiyou Bi Zhonghua Taibei Genghao De Mingcheng" (馬英九: 加入WHO 沒有比中華台北更好的名稱, Ma Ying-Jeou: there is no better option than using Chinese Taipei to join WHO), *Central News Agency*, April 4, 2008, http://www.epochtimes.com/b5/8/4/4/n2070618.htm (accessed Jan 20, 2017).

the badges were the same.[16] The Taiwan delegates were also concerned with the participant list in the daily-issued conference documents. They went through different language versions of participant lists to cross-check how their titles were translated.

Taiwan's participation in the WHA between 2009 and 2015 followed almost the same pattern. Taiwan sent the list of participants several months before the WHA, and the DG sent an invitation about 2 months before the Assembly opened. The 2016 invitation came rather late. The DG sent the invitation 3 weeks before the WHA meeting. It was widely assumed that the delay was due to the electoral victory of the opposition party, the Democratic Progressive Party (DPP), and the uncertain future cross-Strait relationship. The Secretariat refused to confirm this suspicion.[17]

As an observer of the WHA, the delegates from Taiwan were free to participate in all sessions of the General Assembly and subsidiary technical meetings. They enjoyed the privilege of entering Palais des Nations without security checks. Taiwan's delegate seat in the Assembly Hall was next to other observers. The seating order was arranged according to the time they were granted observer status. Chinese Taipei hence occupied the last seats in the Assembly. They could walk around the Assembly Hall or the conference room and talked freely with other delegates. The delegation also had a mailbox in Palais des Nations, from which they could pick up daily conference materials issued by the WHO Secretariat.

Ma's strategy illustrated a two level game scenario (Evans et al. 1993; Putnam 1988). The improvement of the cross-Strait relationship gave the Taiwanese government leverage to pressure Beijing through domestic politics. Under the doctrine of diplomatic truce, the government claimed in public that engaging China, rather than clashing with it, would bring more international space for Taiwan. This claim tied the hands of Ma's government (Fearon 1997), and the WHA bidding played a key role. The public held high expectations that China would lower its diplomatic barrier and help Taiwan's WHA accession. The failure of the WHA bidding would have resulted in a credibility crisis for Ma's foreign policy. The "diplomatic truce" might have collapsed, and Ma's cross-Strait policy would have drowned with it. It would have decreased Ma's support, shaken the KMT government, and forced Mr. Ma to reconsider his Mainland policy. China would not welcome this development. China preferred KMT to remain in office rather than the DPP; it also preferred Ma's Mainland policy to his predecessor's. Moreover, the domestic criticism in Taiwan further strengthened the "tying hands" effect. The greater the domestic pressure on the WHA issue in Taiwanese politics, the more audience cost Ma had to suffer if the WHA bidding did not work out. China recognized that the domestic audience cost for the Taiwanese government would be high if there was no substantive outcome for Taiwan's WHA bidding. As a result, it made a mutually acceptable arrangement

[16] When Minister Yeh held a bilateral meeting with the Health Minister of Honduras, he took the initiative to check their badges to see if the appellation on the badge was "Mr./Dr." or "Minister".

[17] The WHA invitation was sent to then Health Minister, Been-Huang Chiang. The new Health Minister would be in office before the WHA opening. The Ministry replied that new minister Tzou-Yien Lin would attend the WHA. The Secretariat agreed with Taiwan's request.

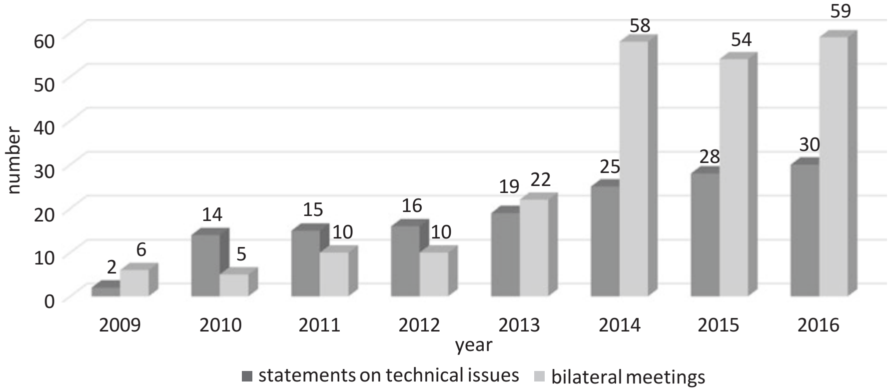

Fig. 1 The participation of Chinese Taipei delegation in the WHA (Source: Ministry of Health and Welfare)

for Taiwan's observership. And it made sure that Taiwan was satisfied with the arrangement so Ma's government could demonstrate the effectiveness of "diplomatic truce" to its people. This domestic-international level of interaction helped, rather than constrained, Taiwan in achieving its goal.

Figure 1 shows Taiwan's interaction with other countries during the WHA meeting over the past 8 years. The Taiwanese delegates became familiar with the participation in the conference. This suggests that Taiwan became more integrated into the global health governance network since the accession to the WHA.

4 The Cross-Strait Relationship and Taiwan's Dilemma in WHO Participation

The WHA accession did not make it easier for Taiwan to obtain a seat in other WHO meetings. The WHO Secretariat deemed Taiwan's participation in the WHA a unique case, and it refused to carry this experience into other WHO activities. Taiwan could not send formal delegates to WHO intergovernmental meetings. The Conference of the Parties (COP) of the FCTC was a significant example. The FCTC intended to carry out reduction strategies for tobacco products. It was under the auspices of WHO, and the COP was its main decision body. Taiwan had been following the FCTC and made its tobacco control policy based on reports and resolutions released by the COP. However, Taiwan was never formally invited after accession to the WHA despite the DOH sending multiple requests.

In the meantime, the secret MOU between China and WHO remained the most important impediment to Taiwan's participation in WHO activities. This secret agreement between China and the WHO Secretariat had formed the principles of all interactions between WHO and Taiwan. The titles of Taiwanese participants, for example, remained to be a problem in IHR and WHO technical meetings. WHO still addressed Taiwan as “Taiwan, China” on its website and in all other official documents as it did in the past. This problem was evident when WHO issued status updates of the H1N1 pandemic on its website in 2009. The H1N1 cases reported by DOH were registered under China’s number of confirmed cases. After the Taiwanese government made a formal protest, WHO added a note specifically indicating these cases were reported by Chinese Taipei.[18] Two months later, WHO replaced the number of cases with a map. The number of cases reported by Taiwan was again included in the figure reported by China.

Another incident showed that the 2005 MOU continued to constrain Taiwan’s participation in WHO. In 2010, the DG office issued an internal memo on the implementation of IHR regarding Taiwan. The memo specifically mentioned that Taiwan, being a province of China, cannot be a formal party to the IHR. This document was leaked in the following year.[19] The document elaborated a standard procedure concerning a contact point between the WHO Secretariat and the Taiwanese government for the implementation of the IHR.[20] It set clear limitations on Taiwan’s direct contact with other WHO members and WHO-related organizations, and also established rules concerning the publication of Taiwan’s health information. Any information from Taiwan was to be published under the title of “Taiwan, China”. This document did not cover the rights and privileges Taiwan enjoyed in the WHA, but it set up rules for Taiwan’s participation in all WHO-sponsored institutions.

The principles of this memo were hardly new. It basically reconfirmed the contents of the 2005 MOU between China and the WHO Secretariat. The only problem here was that the Taiwan CDC had expected WHO to be flexible on Taiwan’s title in its publications. The H1N1 updates broke this expectation. And the internal memo reconfirmed that WHO’s policy on Taiwan had not changed. The fact that China insisted on following the 2005 MOU even after Taiwan’s accession to the WHA showed that Taiwan’s participation in global health governance remained limited. Since 2009, the use of “Chinese Taipei” only applied to the WHA meetings. WHO used “Taiwan, province of China” or “Taiwan, China” to represent Taiwan in other occasions. As these titles reconfirmed China’s sovereignty over Taiwan, the Taiwanese government was reluctant to expand its participation in WHO-sponsored activities. In other words, since neither China nor WHO wanted to replicate the arrangement at the WHA to other activities, it was hard to expect Taiwan to further integrate into global health governance even if the Taiwanese government was eager to participate. It was a great disappointment for the Taiwanese government. It seemed that Taiwan’s participation in WHO only became more difficult after receiving the WHA observer status.

[18] World Health Organization, “Global Alert and Response: Situation updates – Pandemic (H1N1) 2009”, May 2009. Notice the difference between updates 36 and 37 in May 2009.

[19] Qiu Yanling(邱燕玲), Wang Yuzhong (王寓中), And Wang Changmin (王昶閔), “Shiwei Mijian Puguan, Wo Lie Zhongguo Yisheng” (世衛密件曝光,我列中國一省, WHA Secret Document Disclosed, Taiwan to become a province of China) *Liberty Times*, May 9, 2011

[20] The document names the contact point of IHR between Taiwan and WHO is Dr. Max Hardiman, and the focal point of Taiwan-related affairs in the WHO Secretariat is WHO Legal Counsel Mr. Gian Luca Burci.

The political turnover in Taiwan brought less promising prospects for WHO participation. Since the DPP regained office in 2016, cross-Strait tensions gradually increased. The DG reaffirmed UN resolution 2758 and WHA resolution 25.1 in her 2016 WHA invitation. This was the first time that the initiation letter emphasized the One-China principle. The DG office was unwilling to obscure Taiwan's sovereignty issue. China also picked up its strategy of diplomatic blockade, as it had done during the previous DPP administration. In December 2016, São Tomé and Príncipe cut off diplomatic ties with Taiwan and established a formal relationship with China. Panama followed through and severed diplomatic relations with Taiwan in 2017.

This change in the cross-Strait relationship indeed impacted Taiwan's participation in international health affairs. The deterioration of cross-Strait relations led to unfortunate result. For the first time since 2009, Taiwan was not invited to attend the WHA in 2017. This raises the concern about Taiwan's participation in WHO in the future. The problem is not that Taiwan will be blocked from all WHO activities, including the IHR (2005). Taiwan's participation is likely to continue under the diplomatic intimidation from Beijing. There are many opportunities where China will claim its sovereignty over Taiwan; the title of Taiwan's delegation is an example. The real problem is that China's diplomatic coercion may force Taiwan to voluntarily withdraw from global health affairs and become less interested in participating health-related professional meetings. It is expected Taiwan will continue seeking ways to break the diplomatic pressure from China. But China's pressure will narrow down Taiwan's representation in global health governance.

The participation in the WHA and the IHR was an improvement on Taiwan's previous participation in global health affairs, though these experiences could not be replicated to wider health cooperation. Current cross-Strait relations suggest that there is little chance to improve on this limited participation. The basic mode of Taiwan's participation in global health affairs remains unaltered. Taiwan will rely on third parties such as the US and its diplomatic allies to participate in global health affairs.

Will this passive, indirect, and unofficial mode of participation cause a negative effect on global health governance? Indeed, the SARS experience is powerful evidence that Taiwan may suffer from the exclusion. Being left outside the increasingly developed global health network means that Taiwan may not obtain information vital to its health policy making. This is particularly acute in the spread of infectious diseases.

Aside from violating the principle of "universal participation", what impact will Taiwan's exclusion bring to other countries? One must understand how much Taiwan's participation is vital to global health governance. Although Taiwan has shown strong dedication to global health affairs, it does not occupy a key role in global health governance because it is not a source of global health threats. Its absence does not invalidate the governing network established by WHO. On the other hand, Taiwan has good performance in public health administration and a record of voluntary compliance with international standards. Zacher and Keefe (2008) argue that health governance arises when governments feel the threat of transnational health crises. The cost of non-compliance encourages states to increase surveillance and strengthen governance power. Taiwan is the opposite side of the story. The Taiwanese government makes substantive efforts to create a robust public health system, which makes Taiwan less likely a source of public health threats.

Consequently, neither WHO members nor the WHO Secretariat find it necessary to include Taiwan in the current health governance system.

To be sure, Taiwan's participation would make global health prevention more effective and more complete. But the inclusion of Taiwan brings a political risk that neither the WHO Secretariat nor the majority of WHO members are willing to take. As long as Taiwan continues to catch up with global health regulations and receives support from the US, WHO does not see the exclusion of Taiwan as bringing a significant risk to member countries.

The dilemma for Taiwan is ironic. It strives to follow the health regulations set up by WHO in order to demonstrate its capacity to become a responsible member of the international community. The Taiwanese government believes that health cooperation and transparency will break its diplomatic isolation. Taiwan's high compliance, however, is the key reason that WHO feels unnecessary to allow Taiwan's regular presence in WHO activities. Even if WHO is willing to invite delegates from Taiwan, it can only offer titles that the Taiwanese government finds hard to accept.

Indeed, Taiwan was not affected by recent transnational epidemic outbreaks such as Middle East respiratory syndrome coronavirus (MERS), Zika virus, avian influenza, and Ebola. Its geographical isolation also makes it easier for Taiwan to contain local epidemics from spreading to neighboring countries. Additionally, Taiwan finds it easier to filter foreign imported health risks given its modernized custom control and quarantine procedures. But the lack of immediate threat does not suggest that the current governance pattern is reliable, and it is certainly not risk-free. It is not inconceivable that Taiwan could pose a health threat to other countries. The food product scandals are examples. In 2011, the health authority in Taiwan accidentally found that an illegal plasticizer, DEHP, was used as a clouding agent to produce food, beverages, tablets, and powders. Later it was confirmed that the industry had used DEHP for decades. Products made of DEHP were exported to 22 countries (Wu et al. 2012; Yen et al. 2011). In 2014, another food safety incident involving cooking oil was discovered. Food made with recycled oil was exported to 12 countries (Wu 2014).

These incidents suggest that Taiwan can still pose a health threat to its trade partners despite its self-governance. The Taiwanese government has acted swiftly whenever health-related problems emerge, and it has promptly informed the affected countries through bilateral channels. The lack of monitoring mechanism means other countries depend on the merits of the Taiwanese government. There is no enforcement power that pressures the Taiwanese government to report a domestic health incident. Other countries, especially those who are affected, can only press for solutions through bilateral dialogue. The pressure from a global governance power is absent in the case of Taiwan. Moreover, WHO's advisory group cannot intervene even if such assistance helps Taiwan to resolve a health emergency more efficiently. Due to the difficulty acquiring help from WHO, Taiwan relies heavily on the US for technical advice. In sum, Taiwan's current pattern of participating in global health governance creates unnecessary risk for other countries. The restraint on Taiwan's compliance is obscure and uninsured. It is not guaranteed that Taiwan is capable of dealing with the health risk spreading to or emerging from the island. There is little force, if any, to ask Taiwan to behave responsibly in transnational health emergencies.

5 Conclusion: A Latent Security Threat

This chapter reviews Taiwan's WHO/WHA bidding and its participation in global health governance. Taiwan's participation in WHO is not a health issue but a political one. The participation in the WHA was a practical option that avoided the sensitive sovereignty issue. The ultimate goal was increasing Taiwan's representation in intergovernmental organizations. Nevertheless, the Taiwanese government successfully linked global health risk with the agenda of Taiwan's participation in global health governance. The SARS experience showed that Taiwan's exclusion could expose Taiwan to a global health threat, and WHO would have little impact on either assisting Taiwan or preventing communicable diseases from spreading across borders.

The 2009 WHA accession was undoubtedly progress towards including Taiwan in global health governance. The establishment of an IHR contact was a practical solution to Taiwan's participation in activities sponsored by WHO. However, this experience failed to extend to other governance bodies. In the meantime, the cross-Strait relationship has frozen since the political turnover in Taiwan. It is unlikely that Taiwan will make any progress on WHO participation. The absence of Taiwan in 2017 WHA further confirmed that Taiwan's participation in WHO returned to pre-2009 status.

Global health governance is hardly "universal participation" without Taiwan. However, the exclusion of Taiwan does not cause immediate and substantive threats at this moment. In the short run, there is no dire need to fulfill "universal participation" by including Taiwan. It is uncertain whether the current governance pattern can protect other WHO members from any health risks originating in Taiwan. The problem remains that Taiwan's self-governance lacks transparency to the international community. The risk of Taiwan being a source of global health risk may be small, but WHO will find it difficult to contain health threats originating from Taiwan if Taiwan fails to contain a local epidemic outbreak or if it fails to secure the safety of its exported food products. Taiwan is deeply integrated into the global economy. Local health risks will easily transfer to the rest of the world. WHO has no appropriate channel to monitor health governance and health emergencies in Taiwan.

The opportunity for Taiwan's inclusion in the WHO-sponsored global health governance system lies in the health risk Taiwan poses to other countries. WHO and its members are likely to allow greater room for Taiwan's participation if Taiwan is unable or unwilling to maintain good governance. To be sure, the Taiwanese government is unlikely to violate health regulations in order to get the attention of international society. Violation will be a costly move that threatens Taiwan's domestic health system, and it may even bring negative impacts on its trade. The Taiwanese government maintains that being a responsible member will bring more friendship in Geneva and therefore more chances of participation. It is expected that Taiwan will continue to follow the regulations set up by the global health governance bodies. This paints a grim picture of Taiwan's participation in global health governance in the future.

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Dacoity in India: Investigating Thievery and Banditry in the British Raj's Jewel

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Abstract Despite continued anti-banditry efforts, the problem of dacoity persists in India today. Although it has a long history in the subcontinent, relatively little quantitative work has been done on the topic. Using official crime data published by the Government of India and information in the Census of India, this study seeks to evaluate the impact of state-level factors on the prevalence of dacoit crimes in India using multilevel modeling. Certain state-level characteristics do, with statistical significance, impact the prevalence of dacoit crimes in India. Using this analysis as a framework, this study evaluates the importance of characteristics within Indian society that allow the practice of dacoity to continue in quite large numbers. The study seeks to provide Indian decision-makers with new insight to evaluate potential mechanisms to finally bring this century-old criminal activity to an end. By understanding what characteristics increase the likelihood of dacoity, decision-makers will be better positioned to shape effective tools for countering these actions. This research impacts the greater region, not just India. Banditry has a rich and lucrative history throughout South Asia. An empirical study in Indian banditry can provide insights for other states to counter their manifestations of the same problem.

Keywords Dacoity • India • Organized crime • Multilevel modeling • South Asia • Gangs • Terrorism • Crime

1 Introduction

Organized crime and concentrated criminal efforts in India date back hundreds of years. One of the oldest and longest surviving terrorist organizations in history, the thuggees had a reign of terror in India lasting roughly 600 years. Though estimates

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9_13

greatly vary in deaths attributed to the group, some figures suggest upward of two million deaths by strangulation credited to India's 'thags' in honor of Goddess Kali (Rushby 2002; Sheikh 2009). Although not considered a 'terrorist' threat by the contemporary state, India's dacoity problem is a direct descendant from these primitive organizations. Section 391 of the Indian Penal Code states that:

Definition 1 "[w]hen five or more persons conjointly commit or attempt to commit a robbery, or where the whole number of persons conjointly committing or attempting to commit a robbery, and persons present and aiding such commission or attempt, amount to five or more, every person so committing, attempting or aiding, is said to commit 'dacoity'."

Because of the sheer terror derived from the barrage of multiple armed assailants during a dacoit act, this category of crime is considered more serious than a 'robbery' (Nath 1969). This is similar in concept to the community terrorization caused by street gangs. Dacoity, deriving from the Hindi word for 'banditry', was once a grave concern for Indian security, with special task forces being set up to combat the epidemic. One such example was the Thuggee and Dacoity Department, established by the East India trading company in the 1800s to permanently bring an end to this criminal activity (Shah 1993).

Dacoits emerged from what were originally the Thuggees, often regarded as the world's first mafia and longest lived terrorist organization (Dash 2005; Rapoport 1984). A lot of speculation and mystery surround the thuggees. To date, very little scholarly work has been undertaken to study this mystical cult. While relatively few Westerners know about South Asia's thuggees and dacoits, the exotic appeal of banditry has historically garnered some popular attention (Weaver 1996). Thuggee legend states:

> Kali once battled a terrible demon which roamed the land, devouring humans as fast as they were created. But every drop of the monster's blood that touched the ground spawned a new demon, until the exhausted Kali finally created two human men, armed with rumals, and instructed them to strangle the demons. When their work was finished, Kali instructed them to keep the rumals in their family and use them to destroy every man not of their kindred. This was the tale told to Thuggee initiates. (Putnam 2011)

However, Kali herself is not an inherently evil goddess. Mainstream subscribers of Hinduism would characterize her using such phrases as "motherly" and of "impossible beauty" (Dalmiya 2001, pg. 126). The thuggees transformed her image into one of a blood-craving deity, seeking destruction and chaos of the enemy. Similar to more modern terrorist organizations, such as al-Qa'ida and the Islamic State, the thuggees engaged in a process of bastardization of religion to force it to align with their cause, allowing them to claim a divine calling for the work.[1] Noting that religion itself could not be the primary driver for dacoit activity, records show that not all thuggees were Hindus; there was a small portion of Muslim thugs also in their ranks (Wagner 2004). Despite this, all thuggees did share a common ideological affinity to Goddess Kali, reconciling her 'dark' image and cultural narratives with

[1] For further justification of this phenomenon, see: (Omari 2015).

their murderous pleasures. This poses interesting unanswered questions in the ethnic conflict literature in India, as it was a historically rare occassion where Muslims partook in violence generally attributed to fringe elements in Hinduism.

Although the British were relatively successful in eliminating the threat posed by the thuggees, their actions, initially viewed as "exotic criminality" starting as a pseudo-science and evolving into discrimination through statute (Rushby 2002), gave rise to the dacoits. These bandits, while still retaining some affinity to their terroristic roots, have operated for over a hundred years in India, largely as an organized crime network. Terrorist organizations and organized crime are closely related (Wang 2010). Even Richard Quinney's (1970) conflict theory has been applied to both categories of deviancy (Onwudiwe 2007; Gok 2002; McGowan 2016; Bernard 1981; Carter and Clelland 1979). However, the dacoity problem in India has persisted because it is much larger in scope. While few dacoits may still hold true to the original terroristic cause, many engage in these crimes for gains in financial or social capital. This expansion of motivations makes countering the movement more difficult because individuals engage in dacoit acts for a variety of reasons. As such, studying what societal factors impact dacoity levels is essential to aid in minimizing the effect they could have in increasing dacoit crimes in India. Because of this diversity in motivations, Quinney's conflict theory is the ideal theoretical framework for analyzing this phenomenon.

India's anti-dacoity laws stem directly from attempts during the British Raj to eliminate the thuggee threat in the country. During the Raj, the British established task forces with the specific goal of eliminating banditry in the jewel of its empire, also passing the Thuggee and Dacoity Suppression Acts (Wagner 2007). These endeavors laid the foundation for India's efforts to resolve its bandit problem. A richer understanding of dacoity's terrorist past is essential for developing a comprehensive plan for eliminating it from modern-day India. More recent initiatives, such as the Uttar Pradesh Dacoity Affected Areas Act of 1983, have targeted dacoity specifically, aiming to expand restrictions on the organized crime component of the acts over the anti-terrorism nature of the original suppression acts. In 2008, women in Madhya Pradesh were issued gun permits to counter the threat posed by dacoits in their villages (LearnAboutGuns.com 2008). Although the problem lingers, progress has been made. In late 2013, one of India's most notorious dacoits, Malkhan Singh, and his gang members surrendered to Chief Minister Arjun Singh (Khandekar 2013), ending one of the most feared reigns of terror in Chambal's past.

Despite past efforts to end India's banditry problem yielding marginal results, dacoity persists as a major problem in the country. Past efforts have failed to take into account societal factors that could impact why individuals engage in acts of dacoity. This study seeks to evaluate: *To what extent do state-level factors impact dacoity crime at the district-level in India?* This causal modeling can help Indian decision-makers refine their approach to countering this organized crime movement which plagues the nation. This research has larger implications for the organized crime and gang literatures, both in India and abroad.

2 Literature Review

Although more work has been done on dacoits than their thuggee ancestors, this topic is still highly under-researched. The inability to access reliable data contributes to this. To date, there are two major sources of data on dacoity in India: The NCRB, used for this study, and the Center for Systemic Peace's dataset. Similarly, the social science research agenda in India is highly dependent on the topics of interest to the government for research and analysis (South Asia Research Hub 2011), as the Central Government of India provides the majority of funding for social science research in the country. The Indian government's last major national anti-dacoity legislation was enacted in 1848. Consequently, it is not surprising that dacoity has not been a priority for research in the country. Other 'hot topic' crimes, such as rape and intimate partner violence, tend to monopolize the funding agenda. This is particularly true following the story of the violent gang rape of a medical student in New Delhi making global headlines (Narang 2014; Lapsia 2015), which prompted a renewed outcry for gender equality in the country.

Although dacoity is not a scheduled priority for funding purposes at the moment, a series of judicial proceedings in the last decade may increase the salience of this topic. In 2007, the Supreme Court of India (SCI) vacated a sentence and execution order for a dacoity-related crime on the basis of a speech made by the Chief Minister of the region (Supreme Court of India 2007). More recently, SCI acquitted Manmeet Singh of dacoity crimes as well (Supreme Court of India 2015). More liberal high courts are potential indicators of changes in social attitudes (Robinson 2013), which may lead to revisions to Article 391 and associated clauses, modernizing how the country judicially handles dacoit crimes. Even the offenders in the notorious Delhi rape case were charged with dacoity crimes (Special Fast Track Court of New Delhi 2012), though these charges did not receive any attention in the media. However, courts at the state-level are still actively pursuing dacoits. These cases are mentioned in the media if the case involves a foreign national as the offender (PTI 2016). Similarly, Non-Governmental Organizations (NGOs), such as the Human Rights Law Network, are also taking notice of dacoit cases (Human Rights Law Network). The increased attention could also bring about a change on the societal level to further investigate this category of crime. Exposure is necessary to prompt mobilization of the electorate.

Existing research takes limited case study approaches to studying dacoity in the country adopting qualitative methods for analysis, while empirical quantitative research is highly lacking. Most inquiries lack the inclusion of data in the analyses, remaining largely theoretical, with the exception of some basic descriptive statistics released by NCRB (*see:* Floris 1962).[2] However, the lack of data and limited breadth of past inquiries have posed a challenge to establishing causality between dacoit activity and community-level factors. The present study seeks to fill the void in the

[2] In line with this past research, the current study also includes descriptive statistics of the Dacoity variable, as shown in Table 2.

literature by contributing a multilevel quantitative framework as a foundation for building causal models in subsequent research endeavors. Most of the past work is exploratory in nature, seeking to provide some context to the phrase 'dacoit' (*see:* De 2014; Shankar 2013; Wagner 2007; Weaver 1996), which is relatively unknown to most Western researchers.

Most of the published scholarly literature are largely descriptive case studies. Madras and Hyderabad, both southern states, were studied, likely due to their moderate levels of dacoit activity. Arnold (1979) evaluated trends over time in dacoity in Madras relative to famines in the state. He did not seek to make causal inferences but focused on establishing a correlation between the two variables. Bhukya (2007) also focused on famine, but in Hyderabad. While these two studies did not provide quantitative data or advance a proposed causal relationship, they did establish a correlation between socioeconomic status and dacoit crime rates. However, these studies are not generalizable to all of India. Southern India, consisting largely of agricultural economies, suffered much more heavily from the drought and subsequent famines than some of the more urban areas in the north and to the west.

Still descriptive in nature, Chaubey (2006) advanced the first comparative look at dacoity in India; this is the only study published to date on dacoity to include multiple Indian states. His work focused on governmental factors and the role of informal power in authority delegation in the states of Madhya Pradesh and Bihar. Within this analysis of informal power structure, Chaubey (2006) establishes a theoretical framework where political participation outside of the electoral process, such as through civil disobedience, can be associated with banditry and violent crime in the country. This study also brought dacoity back to its terrorist roots, linking dacoits in India to the Naxalite insurgency movement, further justifying the need to evaluate this phenomenon through a lens applicable both to organized crime and terrorist organizations.

Dacoity is not a problem confined geographically to India. Other South Asian countries also have dacoit problems. For example, dacoity is also defined in Articles 391, and 395–402 of the Pakistani Penal Code. However, even less research has been underaken on dacoit acts outside of India. The leading study of dacoity outside of India was conducted by Sahito et al. (2009), who focused their research on Pakistan. While still not causal, they sought to build a comprehensive understanding of the nature of dacoits in Pakistan, providing an interesting case study. For example, they noted that dacoits could easily gain access to medical treatment, particularly in jungle environments. Likewise, they found that dacoits developed a complex intelligence system, including riverine people (people living in the jungle areas, safehavens for the dacoits), harbourers (direct connections to dacoits for financial gains and criminal power), and police (informers in the police who inform dacoits about planned raids).[3] This could provide lucrative insight into the nature of dacoity in Pakistan, particularly if studied through the lens of social network analysis.

[3] For more detail on the dacoit intelligence system in Pakistan, please see: (Sahito et al. 2009, pg. 307–308).

Sahito et al. (2009) found that most Pakistani dacoits remain close to jungle or rural areas. Geospatial analyses of this phenomenon across the region could inform the current discussion as well. The literature is noticeably barren on cross-national analyses of dacoity, likely due to the lack of access to data. Further empirical work can expand these inquiries and set forth a generalized causal model for what factors impact dacoit behavior in South Asia.

2.1 Conflict Theory

Because of the hybridized nature of dacoity in India, this phenomenon can be analyzed through multiple theoretical frameworks, from both criminological and security studies. Quinney's (1970) conflict theory best explains what drives individuals to engage in dacoit behavior. Conflict theory seeks to "focus attention on struggles between individuals and/or groups in terms of power differentials" (Lilly et al. 2015, p. 176). This theory argues that differences in power between various individuals or social groups in a population create tensions (unique differentials), developing an atmosphere of hostility that is prone to criminal behavior. Beyond emphasizing power struggles, Quinney argues the 'social reality' of crime which states that how crime is defined and determined is actually dependent on societal perceptions of deviance. From this perspective, 'crime' and 'terrorism' are both forms of social deviance that are indicated as such by the prevailing societal discourses. Similarly, the term 'dacoity' is created by societal discourse as a hybridization of the two. Crime, including terrorist acts, is "a definition of human conduct that is created by authorized agents in a politically organized society" (Quinney 1970, p. 15).

The struggle between power differentials described by conflict theory is deeply embedded within terrorist organizations and organized crime. These groups have traditionally consisted of disenfranchised individuals who have resorted to the use or threat of use of violence to inculcate fear within the population and to compel the government to conform to their agendas (Department of Defense 2015). The lack of involvement in the political process highlights the struggle between the extremists and the looming agencies of state; the terrorist acts are the radical attempts to minimize the differences between the power differentials. For example, dacoits in India historically targeted the trade caravans, owned by wealthy merchants, to equalize the distribution of wealth. This is particularly true for the more rural areas of the country, which face higher levels of socioeconomic disparity (Hnatkovska and Lahiri 2013). By nature of international relations, governments must respond to violent attacks either occurring within their territories or to those threatening their strategic interests. This social reconceptualization often serves to further marginalize extremists from the current political system, deepening their resolve to achieve their political agendas by other means. The creation of the Thuggee and Dacoity Department in the 1800s by the British as a means to curb the thuggee problem did not actually resolve the issue (Shah 1993). Quite the contrary, India's 'thags' evolved into dacoits, still posing a problem in India to this day. This indicates that certain prevailing societal factors influence an individual's decision to engage in banditry. The primary assumption of a revolutionary struggle to resolve power stratification in conflict theory is embodied in the relationship between terrorist organizations and/or organized crime and government regimes, a relationship that has made relatively little progress in the case of India and its dacoits.

3 Research Design

3.1 Hypotheses

Banditry is associated with power differentials occurring within society. Richard Quinney argued that power differentials lead individuals with lower power to engage with the higher echelons to effect political and societal change (Quinney 1970, 1977). Sometimes, engagements can be peaceful, but if the lower level feels repressed, they can be compelled to violently bridge the power differentials with the elite. As such, one would expect variables indicating power imbalance to significantly impact dacoity levels in the country:

H_1: As literacy increases, dacoity crimes are expected to decrease.
H_2: As unemployment increases, dacoity crimes are expected to increase.
H_3: As civil unrest increases, dacoity crimes are expected to increase.

3.2 Data

Level-1 data on crime at the district-level is being analyzed from the Indian Ministry of Home Affairs' National Crime Records Bureau (NCRB). This dataset is publicly released by the NCRB annually. Individual states report their crime statistics to the NCRB, which is responsible for centralizing the data. The data includes district-level reporting for jurisdictions from 35 States and Union Territories of India, enabling results generalizable to the entire country. Reporting issues are one limitation of this dataset, as it threatens the overall predictive power of analytical models. The NCRB is reliant on what states report to them for data collection purposes. Differing classifications of crime at the officer and district levels create inconsistencies in national reporting levels, particularly whether or not certain jurisdictions decided to prosecute an individual for dacoity crimes in addition to other acts, such as in the New Delhi rape case. Although official reports are likely to be underreported, this is the most extensive dataset available on crime levels reported by jurisdiction.

State-level characteristics are being measured by India's 2011 National Census and the Center for Systemic Peace (CSP)'s "Crime in India: Riots, Murders and Dacoity, 1954–2006." Like in the United States, a census of India is conducted once every 10 years (Ministry of Home Affairs). India utilizes a stratified simple random sample for data collection. The Government employs varying stratifications based on specified geographic size and rurality measures.[4] While the dataset provides large amounts of quantitative data on state-level factors, this data represents a one-time collection. Because the Level-1 data's longitudinal period is roughly one decade, the cross-sectional census data can be used to approximate the generalized linear models, as methodologically employed by Martin et al. (1999). This takes the assumption that state-level factors will not significantly vary on an annual basis. The CSP's dataset contributes measures on civil unrest, measured through riots, in the country. Riots have plagued India for decades as forms of political demonstration by the civilian population (Rajeshwari 2004; Iyer and Shrivastava 2015).

The combined dataset used for the analysis has approximately 3.753% missing data. However, there is no missing data for any of the variables included in this study, as shown in Table 2. The large-N nature of the data, coupled with the lack of missing data, limits the threat to statistical validity of the resulting analytical models. The absence of missing data in the analysis enables the generation of a more stable model.

3.3 Variables

All predictors are continuous variables at the state-level and were grand mean centered to give '0' meaning (the average) and to create an interpretable intercept. Because of the grand mean centering, a '0' value for a given predictor is interpreted as the average value of said predictor. Since all variables are grand mean centered, the regression constant is interpreted as all predictors at average value. Each predictor has a decent amount of variation (as seen in Table 2), increasing the utility of its inclusion in the present study. The outcome being studied for this study is the number of criminal occurrences of dacoity at the district-level (Table 1).

3.3.1 Dependent Variable

The dependent variable, *Dacoity*, has two values coded within the data, one from NCRB and another from CSP. A one-way ANOVA is highly significant ($p < 0.001$), indicating that the two column vectors are significantly different from one another.

For the current study, the researcher made the methodological decision to use the values as reported by NCRB because the Bureau reports how data collection was undertaken, whereas CSP did not provide explicit justification of how it measured dacoity. The researcher notes that NCRB data is limited because it is reliant on reporting from individual states; however, because the Bureau reports its collection

[4] For the full sampling strategy of the Census of India, please refer to: http://censusindia.gov.in/Vital_Statistics/SRS/Sample_Registration_System.aspx#3 (Ministry of Home Affairs).

Table 1 Variable selection

Variable	Operationalization	Citation
Dacoity (DV)	Count; # of Dacoity crimes reported to police	Sahito et al. (2009)
Religion	Percentage; Includes nation's four most popular religions (Hinduism, Islam, Christianity, Sikhism); % of population affiliating with each religion	Bhalotra et al. (2014) and Iyer and Joshi (2013)
Literacy Rate	Percentage; % of population over the age of 10 that are literate	Onuoha (2014)
Unemployment Rate	Percentage; Total number of unem ployed adults divided by the total population	Rosenfeld and Fornango (2007) and Braithwaite and Biles (1979)
Rural Population	Percentage; % Population living in a Rural Area	May et al. (2011)
Riots	Count; # of Riots occurring in the State	Flamm (2005)
Total Population	Rate; Total Population/100,000	Denoeux and Carter (2009)

Table 2 Descriptive statistics

Statistic	N	Mean	Standard deviation	Min	Max
DACOITY	3218	8.383	13.219	0	127
% Rurality	3218	0.807	0.146	0.283	0.996
% Hindu	3218	76.734	19.337	2.750	95.170
% Muslim	3218	13.958	13.885	1.350	68.310
% Christian	3218	3.677	11.848	0.120	87.160
% Sikh	3218	2.930	11.429	0.010	57.690
Total Population (per 100,000)	3218	121.024	117.850	0.012	413.576
# Riots	3218	95.419	132.658	0	3181
Unemployment Rate (%)	3218	58.759	5.299	46.634	65.660
Literacy Rate (%)	3218	58.541	9.930	38.420	83.328

Note: To evaluate summary analyses of the data, this table presents descriptive statistics *before* variables were mean-centered

methodology, threats to validity and reliability are mitigated and accounted for. NCRB codes dacoity as defined in Article 391 of the Indian Penal Code, as noted in Definition 1.

3.3.2 Conflict Theory Variables

Increased literacy is a mechanism used to gain financial and social independence, increasing the salience of this measure for testing the power differentials. The relationship between literacy and crime is a growing body of literature (Iyer et al. 2010). Literacy is measured as the percent of the population above the age of 10 that is considered literate. Similarly, studies have been conducted to evaluate the impact of unemployment on crime, particularly intimate partner crimes (Rosenfeld and Fornango 2007; Braithwaite and Biles 1979). Unemployment is measured by dividing the total number of unemployed adults by the total population of a state, both from the Census of India. Past research has found a relationship between civil unrest and crime (Flamm 2005). For the current study, civil unrest is operationalized by the number of riots occurring in the state during a given year, as outlined by Justino (2015).

3.3.3 Control Variables

In addition to the primary independent variables, Religion and Population Size were also controlled for in the model. Religious conflict is very prominent in India, effecting governmental decision-making processes (Bhalotra et al. 2014). Therefore, religious demographics need to be accounted for in any model seeking to understand social phenomenon in India, particularly those concerning the familial unit (Iyer and Joshi 2013). This study measures the percentage of a state who affiliate with a particular religion, including the four most popular religions in the country: Hinduism, Islam, Christianity, and Sikhism. Similarly, the relationship between population size and crime is often accounted for in empirical analyses globally (Nolan III Nolan 2004; Chamlin and Cochran 2004; Cole and Gramajo 2009). Population is measured using the total count data per one hundred thousand to normalize the scaling of all variables. Multiple studies have evaluated the impact of rurality on crime (Anderson 1997; Aust and Simmons 2002; Baldwin and Bottoms 1976; Barclay et al. 2004).

Because the four religious demographic variables are related to one another, multi-collinearity was a concern. To address this, the researcher conducted a test for multicollinearity. Because VIF < 10 and sqrt(VIF) < 2, the measures pass tests for multi-collinearity and can be employed together in the model without posing a threat to the validity of the study (Melliana et al. 2013). Based on these findings, all four measures were included in the analysis (Table 2).

3.4 Methodology

Original data released by the Indian Census Bureau was reported as count data aggregated at the state-level. This standardized the scaling, enabling logical reporting of regression coefficients. While predictors on different scales do not effect the coefficients in a regression model, standardizing the scale allows for comparative analyses of the model. Some variables, such as the religious measures, record percentages. To standardize units to these smaller numbers, the count data for population measures were converted to a rate per one hundred thousand individuals. This recoding was only for Level-2 state data. The dependent variable, dacoity victimization, at the district-level, was not converted to ratios to facilitate drawing more sensible conclusions from the analysis. Similarly, the count measure for rioting was not scaled to prevent illogical interpretations.

The chi-square in the unconditional model of the DV was highly significant, indicating that hiearchical linear modeling is appropriate for the analysis (Hayes 2006; Woltman et al. 2012; Raudenbush and Bryk 2002). Similarly, the Intraclass Correlation Coefficient indicates that state-level factors account for approximately 3.155% of the variation in the dependent variable. At first glance, this appears to be unusually low; however, the low ICC is somewhat expected within India's nested geopolitical atmosphere. The Proportional Reduction of Error indicates that the model accounts for almost all of the impact of state-level factors on variation in dacoit victimization.

Model	χ^2 P-value	ICC	PRE
Dacoity	<0.0001	3.155%	99.317%

A multilevel negative binomial regression model was conducted to evaluate the impact of the relationship between variables. Past research "suggest that the group-level sample size is generally more important than the total sample size" (Maas and Hox 2005, p. 87). With a total sample size of 3,218 observations across 29 states, this criteria is met, in line with past research. The larger sample size results in lower standard errors, providing more accurate representations of the relationship between variables at the two levels (Łaszkiewicz 2013). Negative binomial regression was used because the variance in 'Dacoity' greatly exceeds the mean (*justification:* Finch et al. 2014).[5] The model accounts for almost all of the Level-2 variation on the district-level dependent variable, as demonstrated by the Proportional Reduction of Error (PRE) value.

The multilevel regression equation used for this study, including grand mean centering of appropriate measures, is:

$$\begin{aligned} DACOITY_{ij} = {} & \gamma_{00} + \gamma_{01}\left(Hindu_j - \overline{Hindu_{.}}\right) + \gamma_{02}{}^{*}\left(Christian_j - \overline{Christian_{.}}\right) \\ & + \gamma_{03}{}^{*}\left(Muslim_j - \overline{Muslim_{.}}\right) + \gamma_{04}{}^{*}\left(Sikhj - \overline{Sikh_{.}}\right) \\ & + \gamma_{05}{}^{*}\left(LitRatej - \overline{LitRate_{.}}\right) + \gamma_{06}{}^{*}\left(Unemployed_j - \overline{Unemployed_{.}}\right) \\ & + \gamma_{07}{}^{*}\left(Rural_j - \overline{Rural_{.}}\right) + \gamma_{08}{}^{*}\left(riots_j - \overline{riots_{.}}\right) \\ & + \gamma_{09}{}^{*}\left(Pop.Total_j - \overline{Pop.Total_{.}}\right) + u_{0j} + r_{ij}, \end{aligned}$$

including measures to test for both conflict theory and control variables (Fig. 1).

[5] This assumption was verified using a test for overdispersion in the R statistical analysis platform.

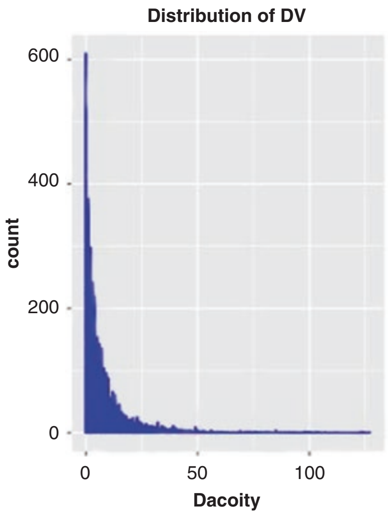

Fig. 1 Distribution of the DV

4 Results and Discussion

Because all predictors were grand mean centered, the regression constant has a meaningful interpretation: the predicted amount of dacoit acts at the average value for each IV. The averages yield a highly significant positive value, indicating that the status quo of societal factors are necessary though not sufficient enough to eliminate dacoity crimes overall. Either the factors must change (i.e. move away from the average) or external programs or initiatives must be put into place (i.e. the enactment of new legislation) to further minimize the likelihood of an individual engaging in dacoit acts. Furthermore, the presence of a non-zero constant is indicative that past efforts to eliminate dacoity in India, derived from the Thuggee and Dacoity Suppression Acts enacted in 1836–1848, have not been fully effective. This finding suggests that New Delhi must fully modernize its anti-dacoit approach. Dacoity is derived from the terroristic ways of the thuggees; perhaps, employing either a counter-domestic terrorism or anti-gang strategy can help resolve this issue, as suggested by the White House's comprehensive plan to combat transnational crime (White House 2011).

We reject H_1 that literacy is negatively associated with dacoit crimes, as *Literacy Rate* is not significant in this model. Although not significant, the relationship between *Literacy Rate* and *Dacoity* does follow the theoretical prediction. As the space between differentials is reduced using education as a mechanism, individuals will be less incentivized to commit dacoit acts. This is in line with the growing body of literature which has found that increased educational opportunity leads to a reduction in terrorism (Hearing Before the Committee on Foreign Relations: United States Senate 2005; Aly 2014; Marsden 2017; Wheatley 2008). As India continues investing in education, dacoit activity is expected to drop. States are already engaged in initiatives to increase education, particularly promoting increased literacy of women (Government of India: Ministry of Human Resource Development 2014; Kingdon 2007). Assuming this trajectory remains going forward, dacoity crimes should continue to decline overall across the nation. The assumption that 'knowledge is power' can be used as a deterrent to engaging in violent behavior to bridge power between the general populations and the social or political elites.

On the other hand, there is a significant relationship between the *Unemployment Rate* and *Dacoity*. As unemployment increases, dacoity should theoretically also increase due to larger gaps between social strata within communities. On average, for every 1% increase in the unemployment rate, the difference in the logs of expected counts of Dacoity is expected to increase by 0.092, controlling for all other variables in the model. Said another way, if all other variables were to remain constant, a 1% increase in unemployment is expected to increase dacoity by approximately one incident per year. As such, there is evidence to statistically support H_2 that as unemployment increases, dacoity crimes are expected to increase. With more individuals out of work and struggling to make the fiscal expenditures necessary to live an adequate lifestyle, discontent will rise and individuals will be more likely to engage in deviancy to provide for their families.

On the spectrum of political action, civil unrest occurs between legitimate participation in the political process and the commission of acts of terrorism to force change (Scacco 2008; Iyer and Shrivastava 2015). As such, an increase in civil unrest is indicative of discontent with social standards, which should, theoretically, lead to an increase in dacoit acts. We accept H_3, which states that as civil unrest increases, dacoity crimes are expected to increase, because Riots are highly significantly related to Dacoity. On average, for a one unit change in *Riots*, the difference in the logs of expected counts of *Dacoity* is expected to increase by 0.004, controlling for all other variables in the model. Practically, each additional riot increases the predicted count of dacoit activity by one additional act.

Although the relationship is highly significant, rioting levels do not have a strong impact on the number of dacoit acts. This is expected, as rioting is a cross between legal political participation and political influence through extra-legal options. Since rioting is a precursor to acts of terror, from which dacoity is derived (Brooks 2009), we expect a weak relationship between the two variables. This furthers confidence in accepting H_3, that civil unrest positively impacts dacoity. Although a one unit increase in both measures is expected to cause one additional act of dacoity, rioting provides more of a practical impact. Each additional riot in a state causes an increased dacoit crime, whereas the unemployment rate of the state as a whole must increase by 1% to effect the same change. From this perspective, anti-riot legislation and protocols will likely prove more impactful on changing dacoity levels than reducing unemployment in the short-term. However, empowering more individuals with financial independence would likely reduce their desire to engage in civil unrest initially. Both measures should be taken into consideration when determining policy changes to target India's dacoity problem.

None of the control variables were statistically significant in the model. However, *Rurality Rate* approached significance. While not significant, the observations provide an interesting framework for future theoretical development. Of the religious control variables, *% Hindu* was the closest to significance. The findings suggest a large positive correlation between Hindu population and the number of dacoit crimes committed.[6] Although some reports show Muslims as members of the thuggee cults, there is no correlation between *% Muslim* and dacoit activity. This speaks to the ethnic conflict literature in India, which has evaluated the impact of religious clashes on Indian society, particularly Hindu-Muslim dyadic tensions (Mitra and Ray 2014; Kausar 2006; Brass 2003). This study also found a negative association between *Rurality Rate* and *Dacoity*. Some criminological theories argue that crime is the result of opportunity, with increased offending occurring when there are higher levels of potential victims (Clarke and Cornish 1985; Cohen and Felson 1979; Felson 1998). As such, the relationship between *Rurality Rate* and *Dacoity* should be further investigated through this theoretical framework, evaluating if dacoity could be viewed as a crime of opportunity rather than an organized and planned social phenomenon. However, *Total Population* was not significant in the model, which could counter the argument for an opportunity crime approach to dacoity research. This research does suggest that more urban environments are more likely to serve as hubs for dacoit activity, in line with research on other forms of delinquency (Table 3).

4.1 Limitations and Future Work

NCRB notes that the validity of its dataset is reliant on the assumption that data submitted to the Bureau by individual states is accurate and complete. This potentially limits the predictive power of the model. Although the researcher used data from municipalities across the nation, if the data is not truly representative of each district, then the results will not reflect the true nature of the relationship between the conflict theory variables and dacoity. Additionally, state-level factors are not locked over time. Although the researcher adopted the methodological decision of Martin et al. (1999) to use a cross-sectional snapshot of the census because the study period spans roughly one decade, developing and implementing a dataset of state-level characteristics that is longitudinal as well may provide more accurate findings. However, achieving such a dataset with accuracy and reliability would be quite challenging. To date, no such data is available for the Indian case study. Census data provides the best snapshot of the country as a whole, but India only conducts a census once every 10 years.

Future work can focus on the collection of more accurate data. An additional data source could be used to try and account for the dark figure of crime, that is, crimes not reported to police. Research centers working in or focusing on the region may have access to a suitable dataset. For example, the Center for Systemic Peace's dataset on dacoity could prove lucrative for future work. However, since this dataset is not comprised from official data, policymakers may be less inclined to act in

[6] Due to the non-significant nature of the findings, the exact coefficient is not meaningful to the discussion. Instead, the almost significant association is of importance for future work on this topic. However, regression coefficients can be found in Table 3.

Table 3 Regression Analysis

	Dependent variable:
	DACOITY
Constant	1.510***
	(0.190)
Literacy Rate (%)	0.031
	(0.019)
Unemployment Rate (%)	0.092***
	(0.035)
% Rurality	2.138[a]
	(1.257)
# Riots	0.004***
	(0.0002)
% Hindu	0.047
	(0.031)
% Christian	0.040
	(0.034)
% Muslim	0.021
	(0.032)
% Sikh	0.019
	(0.034)
Total Population (per 100,000)	0.002
	(0.002)
Observations	3218
Log Likelihood	8672.879
Akaike Inf. Crit.	17,369.760
Bayesian Inf. Crit.	17,442.680

Note: $^{a}p < 0.1$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

response to the research findings. A higher-level model could also improve the accuracy of the regression coefficients while generalizing results to the greater South Asian region, should appropriate data become available. In particular, states across multiple nations could be analyzed to see if, controlling for regime characteristics, the conflict theory variables alone are adequate. This could account for variations in political systems in the region, such as the indirect electoral process used to elect lawmakers in India (Agnihotri 2012). Further quantitative work will allow for reinforcement of the causal relationship found in the present study and generalizability of findings across sovereign lines.

5 Conclusion

Overall, there is evidence favoring the analysis of dacoit crimes through the lens of Quinney's conflict theory. Two of the three conflict hypotheses were accepted through the multilevel negative binomial regression model. *Unemployment Rate* and *Riots* were significant in the model, though the latter is expected as a precursor to extra-legal political violence. *Riots* is the strongest predictor of dacoit crimes in the model. The negative correlation between *Literacy Rate* and *Dacoity* suggests that further educating the Indian population could be a potential pathway for marginalizing this phenomenon. Further research, through a combination of theoretical frame-works, will provide more insight into these relationships, potentially providing new perspectives on how to finally eliminate India's dacoity problem.

This research directly impacts India's approach to ending dacoity. It provides a new analytical framework for decision-makers, at the national, state, and district levels, to enact new policies and procedures to help eliminate dacoity and banditry in India. This study informs the discussion of India's antiquated approach to solving this issue, seeking to expand the discourse from a traditionally anti-terrorism/anti-organized crime focus to a generalized societal phenomenon, centered around focused deterrence. Like other, more violent, forms of terrorism, a large portion of the variation in the DV is explained by factors at the familial and individual level. Similarly, like other organized crimes, society influences the commission of these crimes. As such, the current research also speaks to the growing gang and organized crime literatures transnationally. This research provides a framework for further generalization to the greater South Asian region. Dacoity may be a crime of antiquity, but with further research, it is possible to eliminate banditry in the subcontinent.

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A.J. Masys, L.S.F. Lin (eds.), *Asia-Pacific Security Challenges*, Advanced Sciences and Technologies for Security Applications,
https://doi.org/10.1007/978-3-319-61729-9