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

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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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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

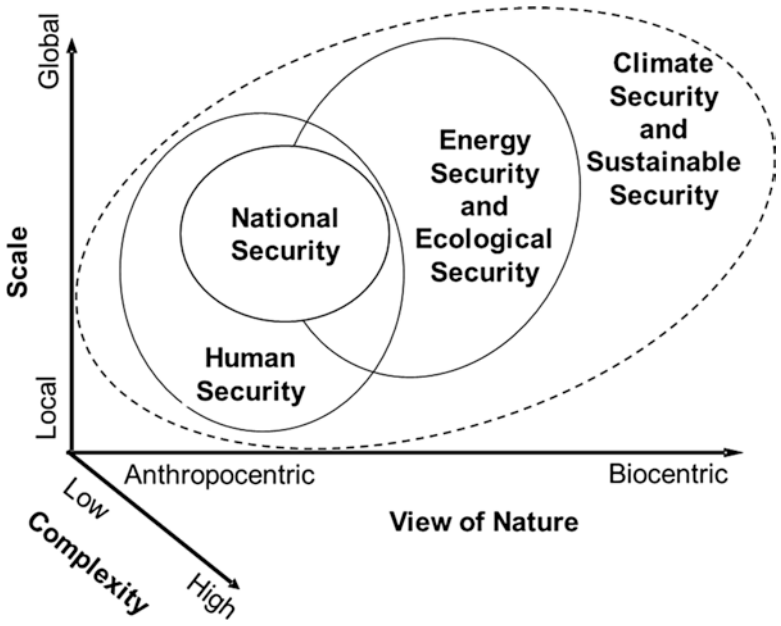

Fig. 1 The paradigm shift from human and national security to climate and sustainable security

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

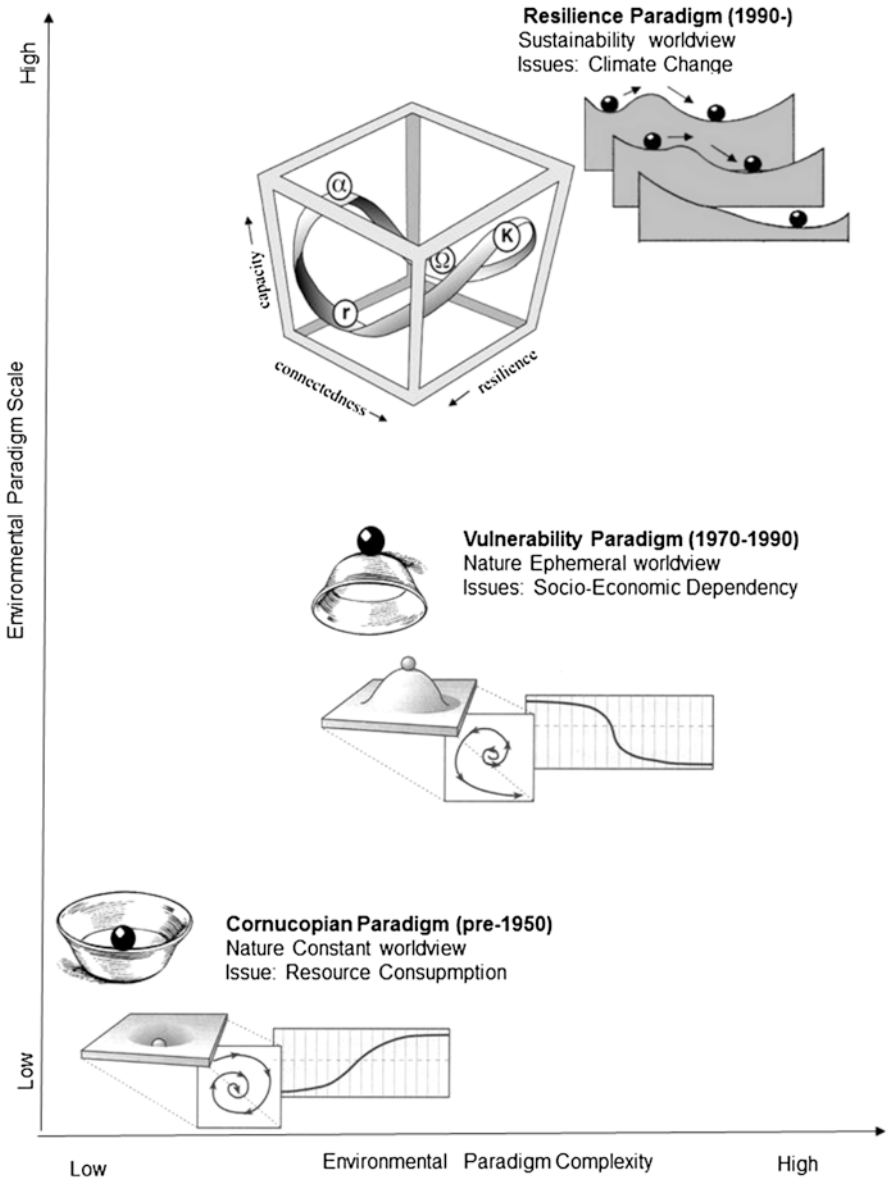

Fig. 2 The resilience paradigm

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.

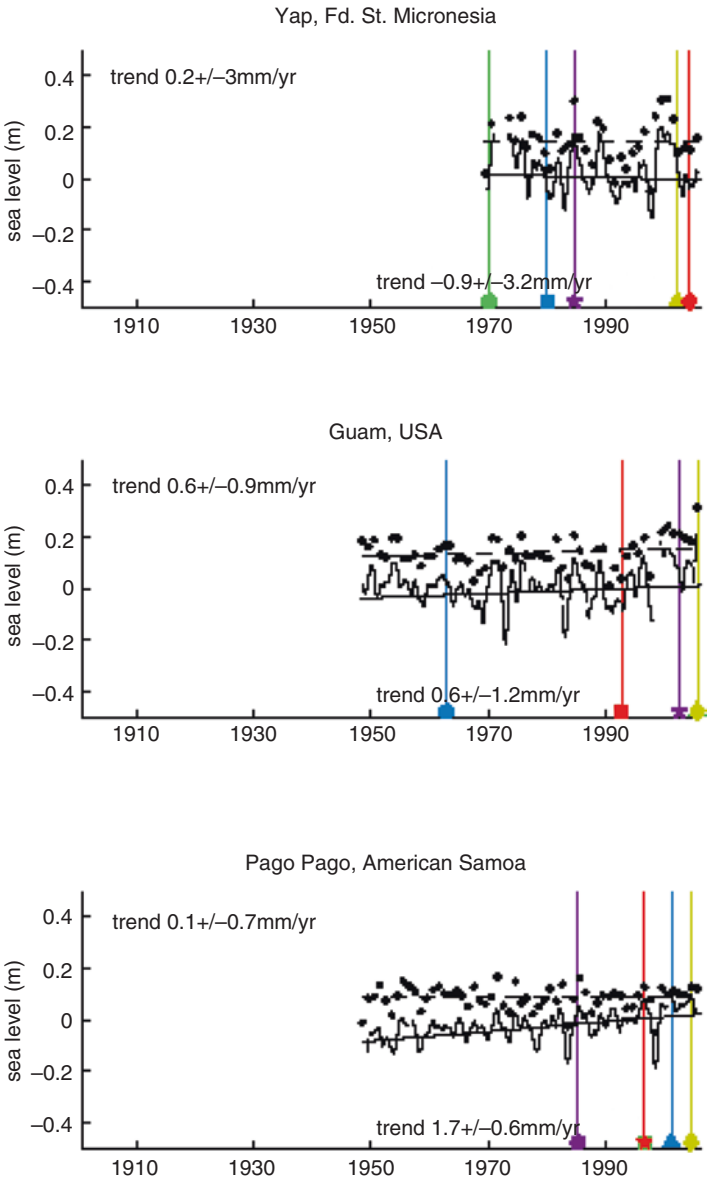

Fig. 3 Observed rates of relative sea level rise for select US Flag and Affiliated Pacific Islands. These are Pacific Region Integrated Climatology Information Products (PRICIP) derived data products that can be found at http://www.pricip.org/

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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