Chapter 1
Community, Market, and Government Responses to Disaster

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1 Background

Natural disasters, whether in advanced or developing nations, regularly take lives, ruin livelihoods, force large-scale evacuations, and disrupt manufacturing chains. A series of recent disasters, including the 2013 Typhoon Haiyan (Yolanda) in the Philippines, the 3/11 compounded disasters in Tohoku, Japan in 2011, the 2008 Sichuan earthquake in China, and the massive floods in Thailand in 2011 underscored the high impact of catastrophes on people and economic development. Data from a variety of organizations indicate that the number of disasters and the amount of damage caused have both been increasing in recent years. No government policy or set of programs can prevent the occurrence of natural hazards, whether earthquakes, tsunami, or typhoons. However, higher levels of disaster preparation, investment in engineering and infrastructure resilience, and deeper community awareness can at least partially mitigate damage arising from disasters in terms of the number of casualties and economic impacts.

In East and Southeast Asia, leaders have noted and reiterated the need to enhance disaster management cooperation for the region at a number of recent high-level forums. For example, regional leaders participating in the special ASEAN-Japan Ministerial Meeting in April 2011 emphasized the need to strengthen such cooperation through sharing of exercises and lessons-learned as well as conducting

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training and capacity building programs for disaster preparedness, emergency response, relief, and reconstruction efforts. The Chair's statement at the 18th ASEAN Summit held in Jakarta, Indonesia in May 2011 noted the potential transboundary impact of accidents at nuclear plants in the aftermath of the Fukushima incident. Also, a series of East Asia Summit (EAS) meetings focused on enhancing disaster management beginning with the 4th EAS in Cha-am Hua Hin, Thailand in 2009 through the eighth EAS in Brunei in October 2013. In the chairman's statement of the 8th EAS, it has been reported that the leaders of participating countries exchanged views on regional and international issues such as disaster management as well as food and energy security and climate change. At such meetings, researchers also emphasized that the differentiated type of disaster or external shock—for example, the nuclear power plant meltdowns at Fukushima Dai-ichi or the flooding in Bangkok—should drive specialized responses from government and civil society.

In general, disasters can be classified into four major groups (Sawada 2007). Natural disasters comprise the first category which includes hydrological disasters (floods), meteorological disasters (storms or typhoons), climatological disasters (droughts), geophysical disasters (earthquakes, tsunamis and volcanic eruptions), and biological disasters (epidemics and insect infestations). The second type of disaster revolves around technological disasters, i.e., industrial accidents (chemical and oil spills, nuclear power plant meltdowns, industrial infrastructure collapse) and transport accidents (by air, rail, road or water transport). The final two disaster types involve manmade disasters which include economic crises (hyperinflation, banking crisis, and currency crisis) and violence-related disasters (terrorism, civil strife, riots, and civil and external wars).

The Center for Research on the Epidemiology of Disasters (CRED) in Belgium, collects and organizes detailed, long-term time series data on natural and technological disasters per country. Professors C. Reinhart of the University of Maryland and K. Rogoff of Harvard University similarly constructed cross-country panel data on economic crises and disasters resulting from the violence of war. Figure 1.1 brings these streams of data together to show the average occurrence of the four types of disaster per country per year. While natural and technological disasters have been rapidly increasing, financial crises and war have maintained stable patterns over time. These long-term trends indicate the importance of community, market, and government-based preparations and responses in reducing the damage arising from disasters.

Decision makers in Asia have recognized the vulnerability of the region to these shocks, especially due to natural disasters. According to the World Disasters Report (International Federation of Red Cross and Red Crescent Societies (2010)), Asia remains most the natural disaster prone continent as Table 1.1 displays below. On average between 2001 and 2010, Asia experienced more than 150 disasters per year (40 % of the world total), with more than 200 million people in the area (88 % of the total) affected every year, and more than US$ 41 billion in annual damage (38 %). Yet the availability of formal insurance mechanisms varies significantly even across developed countries in the region, not to mention in developing nations.

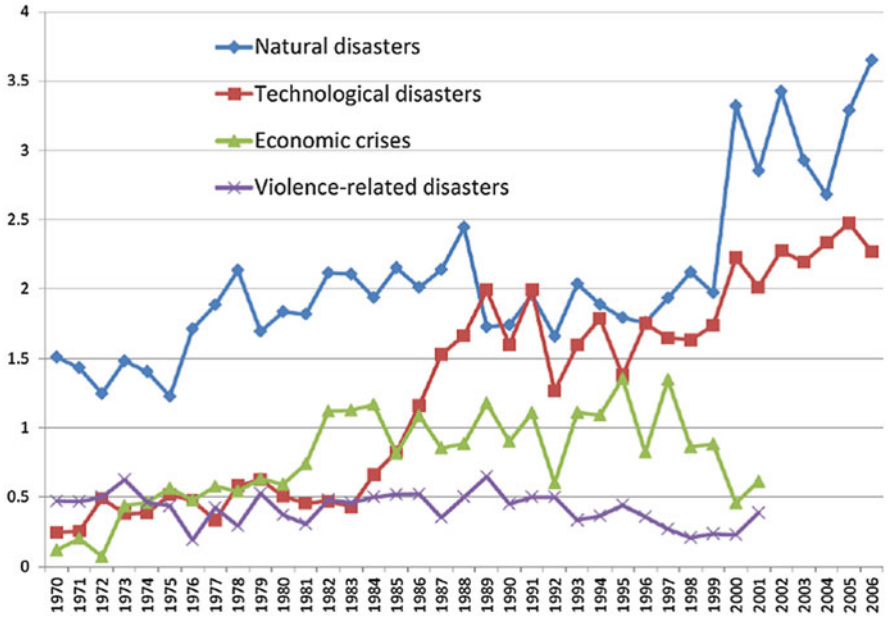

Fig. 1.1 Frequency of four types of major disasters in the world (Average per country). *Note*: Data from CRED (natural disaster and technological disaster) and Reinhart-Rogoff databases (economic crisis and war)

Table 1.1 Distribution of disasters by continent, number of disasters, number of victims, and damage (Annual average figures between 2001 and 2010)

Continent	Number of natural disasters	Number of victims (in millions)	Estimated damage (in billion USD)
Africa	65	14.91	1.1
Americas	92	8.27	50.27
Asia	153	207.92	41.61
Europe	58	0.74	13.4
Oceania	16	0.12	2.97
Total	384	231.95	109.35

Source: Guha-Sapir, Hoyois, and Below (2013)

For example, the Japanese Cabinet Office (2011) reported that the total property losses from the Tohoku compounded disaster in March 2011 could amount to more than US$250 billion. According to the private re-insurer Munich Re (2012)[1] and World Bank (2012),[2] private insurance covered only US$ 40 billion (16–20 %) of

[1] http://www.munichre.com/en/media_relations/press_releases/2012/2012_01_04_press_release.aspx.

[2] http://wbi.worldbank.org/wbi/Data/wbi/wbicms/files/drupal-acquia/wbi/drm_kn6-2.pdf.

the overall damage from the tsunami, earthquake, and nuclear meltdowns. In the case of the Great Hanshin-Awaji Earthquake of Japan in January 1995, the formal insurance coverage rate was even lower (Sawada and Shimizutani 2008). These figures can be compared with about US$13 billion of the US$16 billion in total property losses covered by private insurance in the case of the February 2011 earthquake in Christchurch, New Zealand.

Obviously, disasters pose threats to both short and long term development in an affected region by disrupting production and flows of goods and services, worsening the balance of payments and government budgets, and derailing programs and activities focused on economic growth, income distribution, and poverty reduction. Disasters also impose negative effects on social structures and the environment.

In response to the "wicked problem" of disasters and catastrophes, this book uses new data and a broad set of theoretical approaches to illuminate multi-level disaster mitigation and recovery tactics in East Asia. Importantly, this volume looks to a variety of types of disasters in the region along with and pre- and post-disaster mitigation and response mechanisms to lay out political, social, and economic policy implications for research. It forwards a number of policy recommendations for reforms at the national level and explores the prospects for a regional cooperation framework. We hope that results from the study provide policy approaches which improve the effectiveness of market and non-market disaster management systems within each country studied and assist in forging a framework for collaboration and joint research across Asia.

2 Community, Market, and Government

In preparation for or the aftermath of a disaster, a variety of market and non-market mechanisms are indispensable for people to maintain their livelihood. To illustrate such mechanisms, we have structured this book into three sections based on community, market, and government levels of research, extending a framework of community, market, and state in the economic system of Hayami (2009) as seen below in Fig. 1.2.

The first part of this volume focuses on local community and family level responses and policy programs while the second section looks at the market-based mechanisms focusing on production networks, urban management, and market insurance mechanisms. The third portion involves five chapters that investigate government-level disaster management, such as agricultural development, food securities, and environmental sustainability. While our framework implies divided risk management and coping strategies based on different market and non-market mechanisms, the roles for markets, the government, and community in disaster mitigation and response often overlap. The framework is also corroborated by the risk governance concept of International Risk Governance Council (IRGC) in which the governance of global, systemic risks requires cohesion

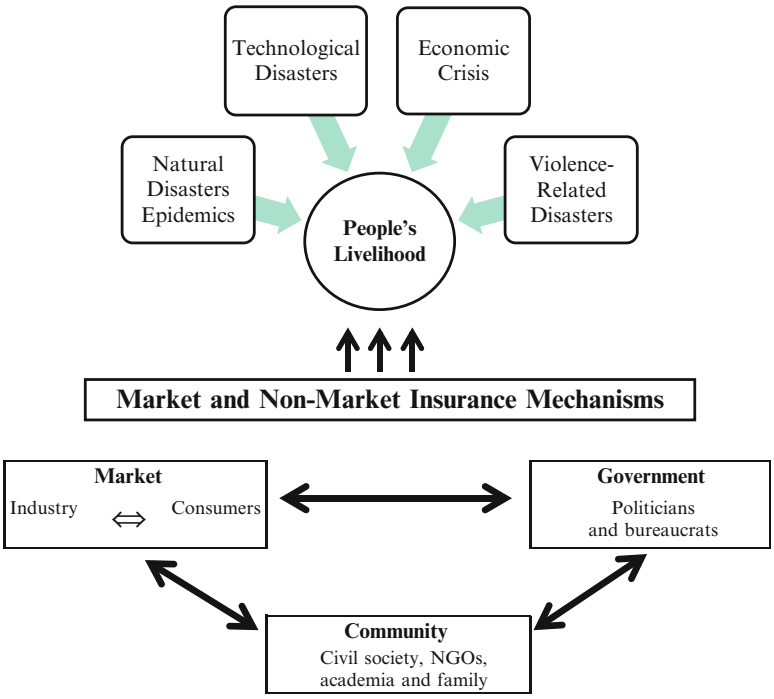

Fig. 1.2 Risk governance in the system of community, market, and government. *Source*: Authors' figure based on Hayami (2009)

between countries and the inclusion within the process of government, industry, academia and civil society.[3]

The market serves as the mechanism that coordinates profit-seeking individuals and firms through competition using price signals. Naturally, the market has an advantage in matching the demand and supply of private tradable goods. Potentially, risks can be traded in credit and insurance markets, but it is often difficult to trade risks of disasters which are characterized by rare and unforeseen events. Hence, insurance market mechanisms are incomplete at best in trading disaster risks. This is a typical case of market failure. When markets fail, the government works as the institution that forces people to adjust their resource allocations by regulation or fiat so that resource misallocation due to market failure can be corrected. Typically, the government plays an important role in supplying global or pure public goods that private forms may be reluctant to provide. A public insurance mechanism for disasters is an example of such public goods. Disaster risks can be diversified away through governmental tax and expenditure mechanisms as well as other intertemporal resource smoothing mechanisms through the government's budget. In sum, market and government mechanisms play mutually

[3] http://www.irgc.org/risk-governance/what-is-risk-governance/.

complementary roles when markets are not functioning well against disasters. Yet, the government may also fail due to misbehavior of selfish politicians and bureaucrats who maximize their own benefits. To fill the gap in resource misallocation arising from the market and government failures, community enforcement mechanisms based on social capital also play an indispensable role. A local community guides residents and members to work voluntarily and collectively based on historical social interactions and norms. The community facilitates the supply of local public goods, enforces informal transactions, and preserves reciprocal social safety nets.[4] In the aftermath of a disaster, community's mutual insurance as well as family's self-insurance mechanisms can amend the lack of effective market and government insurance mechanisms (Paton and McClure 2013; Paton et al. 2013). Hence, the complementarity among market, government, and community is the key for a successful disaster management and reconstruction system.

Previous empirical studies can provide insights into how more effective disaster management can be facilitated by strengthening complementarities among markets functioning using price signals, government enforcement mechanisms, and the community informal insurance mechanisms. In a study of the Chuetsu Earthquake, Ichimura et al. (2006) found that both earthquake insurance and public transfers had functioned quite well. According to Kahn (2005), natural disasters occur in advanced and developing nations alike, but when a nation is democratized and has better governance, the number of casualties is drastically reduced. This is because more democratic and transparently governed nations better communicate and share disaster risk information, develop early warning systems and infrastructure and undertake other risk management mechanisms to prevent or mitigate the impact of disasters. Because the global insurance market for natural disasters is far from complete, the government plays an important role in disaster management and rehabilitation. Also, a report by the World Bank and United Nations (2010) describes how Bangladesh, where frequent cyclones have affected several 100,000 people, has significantly reduced the number of casualties. It has done so by investing in emergency infrastructure such as improving its early warning system, which operates via radio, and building numerous cyclone shelters.

Having noted the importance of the government in complementing the lack of effective market-based mechanisms for disaster risks, Yang (2008) used data on the world's storms of the past 30-plus years to show that their economic damage has been enormous, finding that for poorer countries, hurricanes stimulated to significant increases in migrants' remittances, filling about four-fifths of estimated damages. This suggests the importance of community- or family-based informal insurance network against disasters. His research also informs us that we should balance emergency information systems and infrastructure that prevent injury to people with community- and market-based insurance systems that prevent economic damage, so as to prepare ourselves for natural disasters. The contributors to

[4] In doing so it can conserve, for example, common land along with other common pool resources such as local irrigation facilities (cf. Ostrom 1990).

this volume build on the qualitative and quantitative research done in the past to provide cutting edge assessments of disaster reduction and preparation in Asia.

3 Overview of the Book

Our edited volume begins with a recognition of the power of community and family ties. Residents of communities are the actors who face risks and hazards associated with disasters and pre-existing social cohesion and networks may assist them in mitigating the effects of these events. Such social infrastructure allows individuals to share resources and information, work as a group to overcome collective action problems, and also mitigate exit during crisis.

3.1 Family and Community Ties

In Chap. 2 Daniel Aldrich investigates the new mechanisms through which social capital and networks assist with disaster recovery, departing from traditional approaches which have focused primarily on factors external to disaster-affected communities. These new mechanisms include the choice between "exit" and "voice" in the sense of Hirschman (1970), elimination of barriers to collective action; and provisions of informal insurance and mutual aid. Through examples such as the 1923 Tokyo earthquake, the 1995 Kobe earthquake, the 2004 Indian Ocean tsunami, and the 2011 compound disaster in Tohoku, Japan, Aldrich seeks to underscore a potentially efficient and cost effective response to crises.

Aldrich suggests a new paradigm for thinking about disaster recovery and for designing emergency management responses. Moving beyond "bricks and mortar" approaches to recovery, his chapter stresses that the ties between residents may serve as a critical engine during what may be a long and difficult recovery process. Rather than merely responding to disasters as they occur in the future, visionary decision makers in these and other countries should move to embrace a social-capital based approach to policy making. Bringing residents to the forefront and increasing community involvement in planning will ensure a strong future for these important countries.

Sann Vathana, Sothea Oum, and Ponhrith Kan use Chap. 3 to focus on Cambodia, mapping the pattern of risks faced by the poor and vulnerable in rural areas where the consequences of natural disaster pose an increasing threat to their livelihoods. The damage caused by flood and drought is comparable, although the flood of 2011 was the most extensive of recent disasters. Chapter 3 presents the linking of social protection interventions to address the entitlement failure of poor and vulnerable people suffering from the negative impacts of flood and drought on welfare captured by household consumption.

Because the data analyses in this chapter show that ex post supports from the government or NGOs were ineffective, there is a strong need at the policy level to design social protection interventions to emphasize ex-ante instruments rather than the ex post response to natural disasters, focusing on emergency assistance and relief. Cash transfer programs provide direct assistance in the form of cash to the poor. Ex-ante cash transfer programs can play a crucial role in strengthening poor households' resilience by encouraging them to invest in business rather than spending on food. Microfinance schemes can also facilitate ex-ante income diversification that can bolster households against widespread natural disasters.

In Chap. 4, Le Dang Trung focuses on Vietnam which is located in one of the five cyclone centers on the planet and therefore is prone to many natural hazards. More than four storms and three floods hit Vietnam per year. Trung's chapter provides an evidence-based welfare assessment of natural disasters, and recommendations to policymakers, to help the country move toward effective disaster risk management. More specifically, the chapter examines the welfare impact of Typhoon Damrey which hit Vietnam in September 2004 using the propensity score matching method applied to micro-data from the Vietnam Household Living Standard Survey (VHLSS) 2006. Research finds that the storms greatly affect household welfare and livelihoods captured by rice production, household income, food expenditure, household expenditure and house repairs over the 12 months: While short-term aftermaths are tremendously high, the impact of natural disasters can also persist, bringing down living standards for some time.

Based on a review of existing studies, the chapter suggests an array of recommendations with the hope that they can make positive contributions to the policy-making process in Vietnam, enabling it to achieve its declared goals. The recommendations focus on measures and approaches relevant for national implementation of effective programs such as the National Target Program to Respond to Climate Change (NTP-RCC) as well as regional collaboration such as adaptation and mitigation framework for South Asia to cooperate in climate change and food security policies.

In Chap. 5, Nipon Poaponsakorn and Pitsom Meethom analyze the causes of Thailand's 2011 flood, its impact on agriculture and household expenditure and income, and the government's response. They find that highest recorded rainfall, including five tropical storms, unregulated land-use patterns, and flood mismanagement are the causes of the major flooding in Thailand in 2011. Using 2009 and 2011 Socio-Economic Survey data, the empirical results show that the flooding caused significant negative welfare impact, reducing total household expenditures by 5.7–14 %. These findings are consistent with the reported negative national GDP growth of 8.9 % in the fourth quarter of 2011. The study finds that the 2011 floods had a negative impact on the money and wage incomes of some middle income households in the flooded areas.

The chapter underscores several weaknesses in the current information for flood management. Despite the huge volume of information on the impact of flooding on output and damage to property, no government agency has paid attention to computerizing the flood data-base and information system and strengthening the

capability of their information centers. As precautionary policy measures, important ideas need to be urgently implemented, notably construction of a digital elevation map, investment in satellite images, including updated land-use patterns, and the digitization of village boundaries. Moreover, the capability of statistical agencies and agencies responsible for flood management should be urgently strengthened in the following areas: data collection, data base development, data processing and reporting using IT, and human resource development. Secondly, these agencies should be encouraged to communicate and exchange information and ideas with other data users.

While residents, families, and communities face hazards first during disasters, other institutions can mitigate their risks and reduce their exposure. Markets connect consumers and households to insurance frameworks and share risks across societies. Individual firms and businesses may have their operations disrupted by disasters, but production networks can help mitigate such events and allow for the delivery of goods and services even following catastrophe. We also recognize that firms operating well beyond the direct effects of a disaster may have their ability to produce goods paralyzed by production network disruptions. Our book now turns to look at the role of markets and production networks during and after disaster.

3.2 Market and Production Networks

Mitsuyo Ando in Chap. 6 attempts to shed new light on domestic and international production networks in machinery industries, and examines how economic crises and natural disasters affected the networks, mainly from the viewpoint of Japan's exports. Ando finds that regardless of whether creating a demand or a supply shock, the economic or natural disasters revealed the stability and robustness of production networks in the machinery sectors. In order to respond to massive shocks, firms try to save costs by preserving existing transaction channels for parts and components. As a result, exports in machinery parts and components tend to be sustained and are likely to recover rapidly even if they are temporarily disrupted. These findings suggest that firms' production networks can function as an effective insurance mechanism in weathering negative consequences of natural and manmade disasters.

Even the behavior of firms involved in the production networks and suffering from the floods in Thailand also confirms the existence of strong "continuation" or "centripetal" forces, and the deployment of efforts to keep production networks in being, in consideration of the various transaction cost implications of discontinuing a network. Once production networks are moved away from the original locations, it is not easy to get them back. It is also important to deal with various concerns in the business environment, lest private firms utilize the crisis as a trigger for removing production blocks to other countries.

Brent Layton in Chap. 7 looks closely at the effect of the series of earthquakes which struck New Zealand between 2010 and 2012. While the economic impact of these disasters was possibly as high as $25 billion US, a number of institutions

helped to mitigate the damage across the democratic, developed nation. However, Layton underscores that the insurance itself complicated the recovery process by creating large number of alternatives for individual business owners and home owners.

The availability of insurance—or the struggle to ensure that homeowners and building occupants feel fully compensated for their losses—has introduced an additional element of waiting into the recovery process in New Zealand. As a result of high mobility and government policies which have barred reconstruction in the worst affected areas of the downtown areas, businesses must make decisions in a period of high uncertainty. Layton concludes with policy recommendations to help reduce some of the challenges facing Christchurch in its rebuilding phase, including clearer guidelines for residents on which areas will be open in the future for rebuilding.

In Chap. 8, Ikumo Isono and Satoru Kumagai focus on the recent flooding in Thailand to underscore the ways that production networks respond to large scale crisis. Using spatial simulation based on economic modeling they seek to understand how flood-caused disruptions of manufacturing facilities and therefore the shipping of goods across countries can change GDP across the region. Interestingly, despite the severity of the flooding and widespread media coverage of the catastrophe, there are mixed results for provinces across Thailand because of the mobility of resident firms.

For some areas, such as Rayong and Chonburi, the authors predict in-migration due to firms relocating and therefore positive effects from the disaster. Moreover, across all of Thailand the overall effect of the flooding is predicted to be less than previously forecast. To ensure that actual results match these predictions, the authors urge a combination of government support for firms seeking to relocate to less flood-prone areas and the reduction of transactions costs for firms trading across boundaries.

Sommarat Chantarat and four co-authors explore, in Chap. 9, innovations in index-based risk transfer products (IBRTPs) in depth as means of addressing important insurance market imperfections. Such market failures have precluded the emergence and sustainability of formal insurance markets in developing countries, where uninsured natural disaster risk remains a leading impediment to economic development. The chapter provides an analytical framework for and empirical illustrations of the design of nationwide and scalable IBRTP contracts to analyze hedging effectiveness and welfare impacts at the micro level, and to explore cost-effective risk-financing options. Thai rice production is used in the analysis, with the goal of extending the methodology and its implications in enhancing the development of national and regional disaster risk management in Asia. Using household level data in estimating basis risk and so simulating contracts' hedging effectiveness, Chantarat et al. find that the optimal provincial contract, based on basis risk, minimizing the combination of moving dry spell and excessive rain spell indices, could result in up to a 25 % reduction in the variations of household income available for consumption. The return to scale in

terms of cost effective portfolio pricing can be achieved as part of a nationwide, multi-seasonal coverage insurance program.

The transparency of these weather indices and control measures could in fact further promote the possibility of cost effective risk transfers in the international market. Numerical results on the potential impacts on household welfare, agricultural loan portfolios and government of this nationwide program under various market arrangements show that the purely market driven program was found to result in more than 50 % reductions in the probabilities of household consumption collapsing to zero, in means and variations of five-year accumulated debt and annual loan default rates. Properly layering insurable nationwide risk, they further found public financing of tailed risk beyond the 20–30 % capped to insurer's payout rates to result in substantial reduction in market premium rates. These in turn resulted in up to twice the impacts of the purely market-driven program, though with substantially smaller budget exposures for the government, relative to the current government program. There could thus be a strong case for public financing of tailed risk in enhancing development values and the market viability of Thailand's nationwide index insurance program.

In Chap. 10, Hiroyuki Nakata identifies the core issues for designing a possible regional insurance scheme or mechanism for East Asia. He seeks to develop a risk sharing mechanism for catastrophe risks to households in the region and provide a consistent explanation for apparent anomalies concerning the demand for catastrophe insurance within the subjective expected utility framework. The key finding is that the number of observations would inevitably be insufficient to warrant a robust probability estimate for a rare event. The inherent lack of such a robust probability estimate leads to diverse probability beliefs.

Nakata concludes that a desirable insurance scheme is the one such as an index-based insurance scheme which can eliminate the possible moral hazard issues inherent to indemnity insurance. Moreover, since voluntary subscriptions are likely to lead to insufficient levels of insurance, an insurance scheme with subscriptions by local governments, in conjunction with ex post payments/compensation to the affected households, would be more desirable. However, the underwriting costs for index insurance may well not be low, whether the index insurance will be supplied and priced by insurance suppliers or traded on the capital market.

Production networks and markets may amortize risks across networks of firms or concentrate them on businesses. However, empirical studies have shown that disaster-affected areas may have low subscription rates of insurance along with missing insurance market for some disaster events such as wildfires, radiation leaks, and terrorist attacks. These outcomes—along with others such as externalities, information asymmetry, monopolies, and increasing returns to scale - are known as market failures, and in such events government decision makers may intervene. The next section of our manuscript looks at the role of government policy and risk management during and after disasters.

3.3 Government Policy and Risk Management

Ilan Noy in discusses operational aspects in facilitating national and regional risk management capacities in Chap. 11. He first presents a typology of disaster impacts that distinguishes between direct and indirect damage. Noy discusses indirect costs in the aggregate by examining variables such as GDP, fiscal accounts, consumption, investment, and the balances of trade and payments, and distinguishes between the short- and long- run. He concludes by identifying necessary future policy changes, in particular the construction of better and more robust early-warning systems, and suggests that the best way to incentivize disaster risk reduction (DRR) policy is through a dedicated fund—a Global Fund for DRR—that will support this work.

Noy proposes that countries should be constantly evaluated for their DRR plans, and given "Seals of Approval." The evaluation process would allow a "grading" of DRR policy and the allocation of the contingent 'seal of approval' for these policies. The positive externality from such a fund, with its associated monitoring and evaluation functions, would enable countries who receive this DRR "seal of approval" to more easily insure themselves explicitly (with re-insurers) or implicitly by issuing Catastrophic Bonds (CAT bonds) and further enable multi-year insurance. All three developments (re-insurance, CAT bonds and multi-year insurance) will be made easier by having a "seal of approval", as that seal will alleviate investors/insurers concerns regarding the moral hazard generated by disaster-contingent financial support.

Ngai Chan reviews flood risk management in Malaysia in Chap. 12. While Malaysia lies in a geographically stable region and is relatively free from natural disasters, it is affected by flooding, landslides, haze and other man-made disasters. Annually, flood disasters account for significant losses, both tangible and intangible. He finds that disaster management in Malaysia is traditionally almost entirely based on a government-centric top-down approach. The National Security Council (NSC), under the Prime Minister's Office, is responsible for policies, and the National Disaster Management and Relief Committee (NDMRC) is responsible for coordinating all relief operations before, during and after a disaster. In terms of floods, the NDMRC would take the form of the National Flood Disaster Relief and Preparedness Committee (NFDRPC). The NFDRPC is activated via a National Flood Disaster Management Mechanism (NFDMM). The NFDMM is largely targeted towards handling monsoon flooding. Consequently, this mechanism is less than effective and should be re-modeled into something more pro-active.

At the operational level of flood management, the Drainage and Irrigation Department (DID) is the responsible agency. However, being an engineering-based organization, the DID's approach is largely focused on structural measures in controlling floods. It needs to embrace a more holistic approach towards flood management via a multi-disciplinary effort. Non-structural measures are easy to implement, less expensive and community-friendly, and need to be employed more widely. There is also a need for greater stakeholder participation, especially from NGOs, at all levels in the disaster cycle. Capacity building for NGOs, local

communities and disaster victims is also necessary. The disaster management mechanism should also adopt more non-structural measures, bring in state-of-the-art technology and cooperate internationally with other countries for addressing trans-boundary disasters.

In Chap. 13, Danilo Israel and Roehlano Briones analyze the impacts of natural disasters (particularly typhoons, floods and droughts) on agriculture, food security and natural resources and the environment in the Philippines. In general, they found that typhoons, floods and droughts have an insignificant impact on overall agricultural production at the national level, yet typhoons may have a significant negative impact on paddy rice production at the provincial level. The chapter shows how typhoons such as Ondoy and Pepeng in 2009 have a significant negative impact on the food security of households in the affected areas and that households have varying consumption and non-consumption strategies to cope with the impacts of typhoons. Finally their research illuminates that the different impacts of typhoons, floods and droughts on the natural resources and environment have not been quantitatively assessed in detail, although available evidence suggests that these are also substantial.

Based on their results and findings, they recommend a number of policy changes. First, since typhoons may have significant negative impacts on rice production at the local level as opposed to the national level, assistance for rice farmers and the agriculture sector as a whole should be made more site-specific, zeroing in on the affected areas that actually need it. Second, those assisting affected households and areas in overcoming the resulting ill-effects of natural disasters should consider not only consumption strategies, such as the provision of emergency food aid, but also non-consumption strategies, such as the provision of post-disaster emergency employment. Third, while the available evidence suggests that the natural resources and environment sector is significantly affected by natural disasters, it is currently of less concern, as attention is presently focused on agriculture. It may now be high time to provide concrete assistance to this sector, in particular the provision of defensive investments and rehabilitation expenditures to cope with natural disasters.

Yi-Ming Wei, Ju Liang-Jin, and Qiong Wang focus on disaster risk management in China in Chap. 14. Due to its complicated climatic and geographic conditions and distinct spatial-temporal variations, China is one of the countries severely hit by various kinds of natural disasters with high frequency and wide distribution. This chapter analyzes the impacts of natural disasters on livelihood security of people, agriculture safety, and economic security in the past 30 years. Wei, Jin, and Wang find China's economic system highly vulnerable to natural disasters. Moreover, climate change will further exacerbate the vulnerability of the social-economic development system to natural disasters.

They conclude that in order to deal effectively with the high risk of natural disasters and build a low disaster risk society, there is an urgent need to implement a comprehensive strategy of disaster reduction for sustainable development. They advocate an integrated disaster risk management approach throughout the whole process of natural disaster management. China faces increasingly complex natural situations for disaster management but has insufficient experience both for creating

appropriate institutions and for capacity building. Accordingly, capacity-building for comprehensive disaster prevention and reduction will have to be strengthened, and sustainable development coexisting with disaster risks need be realized, so as to reduce the vulnerability of the socio-economic development system to natural disasters.

Chapter 15 by Allen Lai and Seck Tan focuses on Singapore, which is potentially vulnerable to both natural and man-made disasters alongside its remarkable economic growth. They focus on lessons from Singapore's experience in fighting the 2003 SARS epidemic and discuss implications for future practice and research in disaster risk management. Singapore's experience with SARS strongly suggests that risk mitigating measures can be effective only when a range of partners and stakeholders such as government ministries, non-profit organizations, and grassroots communities become adequately involved. This is also critical to disaster risk management. Whether all of these aspects are transferrable elsewhere needs to be assessed in future research. Nonetheless, this unique discipline has certainly helped Singapore come out of public health crises on a regular basis. Singapore's response to the outbreak of SARS offers valuable insights into the kinds of approaches needed to combat future pandemics, especially in Southeast Asia.

Having provided data on community and family ties, markets and production networks, and government policy and risk management, we now turn to broader lessons learned from these studies along with best practices in the field. In the final chapter, Chap. 16, Aldrich, Sawada, and Oum use the studies in the book to provide an overview of effective disaster risk coping strategies and tactics for creating regional cooperation on disaster management. They find that advanced nations can deal with major disasters by managing their own domestic financial resources. But developing nations, which carry diverse risks of major disasters, have weak fiscal groundwork and are less tolerant of such risks. In order to develop formal mechanisms to diversify aggregate disaster risks at national and regional levels, the chapter suggests the need to elaborate on multi-country risk pooling schemes, i.e., regional funds, to cover sovereign disaster risk. Against natural disasters, index insurance at the regional level, such as the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) can function effectively to support the disaster-affected country with immediate liquidity in the aftermath of a catastrophic disaster.

Aldrich, Oum, and Sawada also discuss the roles of microcredit and microinsurance schemes in enhancing the disaster-resilience of individual households and firms. In the case of manmade disasters, the Chiang Mai Initiative (CMI), for example, has been and will continue playing an important role in diversifying disaster risks. Moreover, further development of Asian bond markets will also be indispensable, because bond markets are composed of a large number of individual bond holders, enabling idiosyncratic risks to be diversified away effectively, and it is generally considered that bond markets provide effective risk-sharing mechanisms. To further improve national and regional risk management capabilities, a global system of pooling the risks of the four types of disasters would be effective for both developing and advanced nations to diversify the risks of disasters.

4 Policy Implications

The research presented in this volume sets up a number of concrete policy recommendations for decision makers, NGOs, and communities in East Asia and beyond. First, self-insurance by each individual or family and informal social safety net mechanisms based on community or local enforcement mechanisms should be strengthened and complemented through market and government involvement. The government plays an important role in bridging communities and linking them to the government. Also, market-based insurance arrangements such as microcredit and microinsurance programs should be promoted by government to facilitate consumption smoothing and livelihood sustainability among those affected by disasters.

Second, it is imperative to develop formal mechanisms to diversify aggregate disaster risks at national and regional levels. There may need to be increased multi-country risk pooling schemes, for example regional funds, to cover sovereign disaster risk. Against natural disasters, regional level index insurance schemes can be designed through public-private partnership (PPP) such as index type risk-transfer mechanisms sold by private insurer with extreme losses underwritten by contingent loan schemes of international financial institutions and aid donor agencies to complement the lack of re-insurance coverage.

Third, to further improve national and regional risk management capabilities, it is necessary to facilitate further development of global insurance mechanisms such as re-insurance arrangements and trades of CAT bonds. Moreover, a global system of pooling the risks of the different types of disasters, such as natural and technological disasters, economic crisis, and conflicts, should be designed and implemented for both developing and advanced nations wishing to diversify the risks of natural and manmade disasters. It is also worth pursuing reforms that undertake comprehensive preparations against the risks of a variety of disasters in Asia.

Fourth, complementarities among the market, the government, and the community will be the key. The market is a resource allocation mechanism using price signals, the government is the mechanism based on legal enforcement, and the community is a mechanism based on social norms. Overall safety nets against natural disasters should be provided by an optimal mix of these resource allocation mechanisms. For example, market-based microinsurance programs could be supported by community and government enforcement mechanisms, and regional disaster funds could utilize insurance market transactions. Overall, however, intra-regional government cooperation is indispensable for Asia.

Finally, with investments in human capital in the form of properly trained experts, investments in physical and social infrastructure are indispensable as an ex ante risk management policy in strengthening resilience of individuals, households, communities, and a country. These investments include dams for flood control, seawalls and tsunami barriers, cyclone shelters, a barrier to control soil erosion, irrigation systems for droughts, earthquake-resilient houses and buildings,

disaster early-warning systems, and effective disaster drills guided by experts. Experiences of developed nations in the region such as Japan tell that investments in broader infrastructure dramatically reduced human and physical losses due to natural disasters. Multilateral and bilateral development partners can play an important role in filling the investment gap in these disaster-mitigation infrastructures in developing Asian countries.

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