Economic and Welfare Impacts of Disasters in East Asia and Policy Responses

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1. Background

Natural disasters, whether they occur in advanced or developing nations, can destroy people's lives. There is no preventing the occurrence of natural disasters, whether earthquakes, tsunami, or typhoons. However, it is possible to prevent or at least mitigate damage arising from disasters, both in terms of the number of human casualties and economic impacts, and preparedness is what makes a key difference. Indeed, at the recent high-level forums in East Asia, such as the 4th East Asia Summit (EAS) in Cha-am Hua Hin, Thailand, held on 25 October 2009, the Fifth EAS on 30 October 2010 in Hanoi, Viet Nam, the Sixth EAS in Bali, Indonesia, on November, 2011, and the Seventh EAS in Phnom Penh, Cambodia, on November 2012, the leaders noted and reiterated the need to enhance disaster management cooperation for the region. The Special ASEAN-Japan Ministerial Meeting in April 2011 also emphasized the need to strengthen such cooperation through sharing of exercises and lessons-learned as well as conducting 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 7 - 8 May 2011, noted the potential trans-boundary impact of accidents at nuclear plants in the aftermath of the Fukushima incident. They agreed that ASEAN should engage as appropriate in information-sharing and promote transparency on relevant nuclear related issues in the region. The aim was to achieve the goal of building disaster-resilient societies and move towards a safer community by the year 2015. The 4th ERIA Governing Board Statement on June 3, 2011 also recognized that knowledge sharing and exchange of technologies relating to disaster risk management on a regional basis is essential.

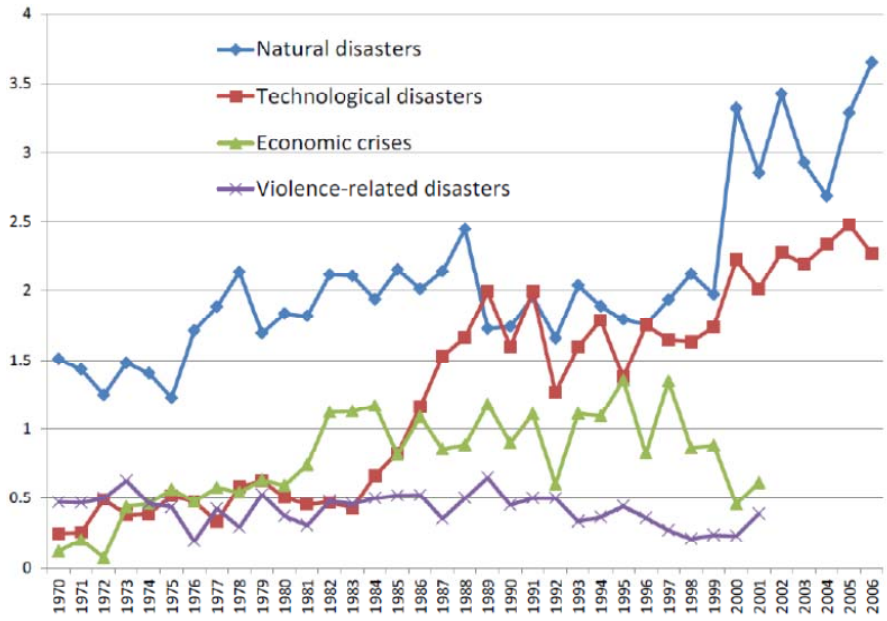
In general, disasters can be classified into four major groups (Sawada and Shimizutani, 2008). The first type is natural disasters which comprise hydrological disasters (floods), meteorological disasters (storms or typhoons), climatological disasters (droughts), geophysical disasters (earthquakes, tsunamis and volcanic eruptions), and biological disasters (epidemics and insect infestations). The second type of disaster is technological disasters, i.e., industrial accidents (chemical spills, collapses of industrial infrastructure) and transport accidents (by air, rail, road or water transport). The final two disasters are manmade which include economic crises (hyperinflation, banking crisis, and currency crisis) and violence (terrorism, civil strife, riots, and war).

The Center for Research on the Epidemiology of Disasters (CRED) in Belgium, organizes detailed, long-term time series data on natural disasters per country. The Center also disseminates data on technological disasters. For economic crises and disasters resulting from the violence of war, Professors C. Reinhart of the University of Maryland and K. Rogoff of Harvard University (both in the U.S.) produce cross-country panel data.

Figure 1 shows the average occurrence of each of the four types of disaster per

country per year. We can see that while natural and technological disasters are increasing rapidly, financial crises and war are maintaining stable patterns. Even so, they are not showing any trends toward reducing in frequency. These disaster trends indicate the importance of careful preparations in reducing the damage arising from disasters.

Figure 1: Occurrence Frequency of Four Types of Major Disasters in the World (Average per Country)



Note: Prepared by the author based on the database of the CRED (natural disaster and technological disaster) and the database of Professors Reinhart and Rogoff (economic crisis and war).

According to the World Disasters Report (2010), Asia is the continent most prone to disasters (see table 1). During the past decade Asia experienced more than 2,900 disasters (40% of the world total), affecting more than 2 million people (85%), killing more than 900,000 people (84%) and causing more than US$ 386 billion in damage (39%). Yet, availability of formal insurance mechanisms is quite diversified even across developed countries in the region, not to mention in

developing nations. Cabinet Office (2011) reported that the total property losses of the Japanese earthquake tragedy in March 2011 would amount to more than US$ 200 billion or even 250 billion, but according to Munich Re (2012)[1] and World Bank (2012)[2], only US$ 40 billion or 16-20% of the overall damage was covered by private insurance. In the case of the Great Hanshin-Awaji Earthquake of Japan in January 1995, the 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 that was covered by private insurance in the case of the February 2011 earthquake in Christchurch, New Zealand.

Table 1: Distribution of Disasters by Continent, Total Number of Disasters, People Affected, Deaths, and Damage from 2000 - 2009

	Total Number of Reported Disasters	Number of People Affected	Number of People killed	Estimated Damage (in millions of US dollars (2009 prices))
Africa	1,782	306,595	46,806	12,947
Americas	1,334	73,161	32,577	428,616
Asia	**2,903**	**2,159,715**	**933,250**	**386,102**
Europe	996	10,144	91,054	146,414
Oceania	169	658	1,665	12,612
Total	7,184	2,550,273	1,105,352	986,691

Source: The International Federation of Red Cross and Red Crescent Societies (2010)

Obviously, the costs of disasters would pose threats to both short and longer term development in the region, by disrupting production and flows of goods and services, worsening the balance of payments and government budgets, derailing economic growth, income distribution, and poverty reduction. Disasters also pose negative

[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

effects on social structures and the environment.

In response to these emerging issues, this study intends to address the impacts of prevailing disasters on aspects of economies such as production, demand, and welfare in East Asia, and to draw economic policy implications at national and regional level. The study will cover the ASEAN +6 economies and will comprise chapters addressing two aspects: first, the past and potential impacts of disasters on production, demand, regional development, and welfare, captured by income, poverty and health outcomes and, second, in-depth analysis on the economic policy implications of disasters at national and regional level.

This project aims at creating policy recommendations for reforms at the national level and explores the prospects for a regional cooperation framework. Results from the study are expected to provide policy indications on how to improve the effectiveness of market and non-market disaster management systems within each country studied, as well as recommendations towards forging a framework for regional cooperation.

2. Overview of Chapters

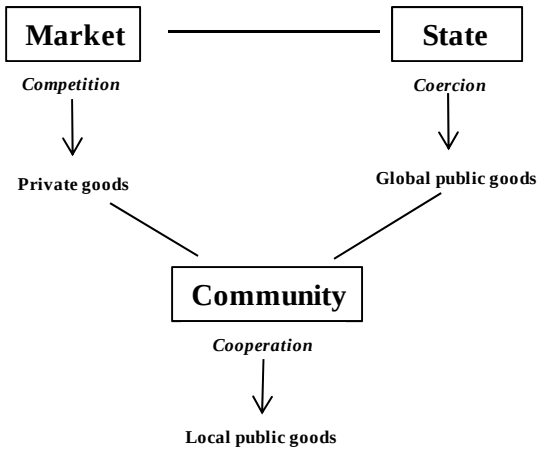
This report is composed of five parts. First, five chapters discuss general aspects of a variety of ex ante risk management and ex post risk-coping mechanisms for dealing with disasters at community, national, and regional levels. Second, three chapters investigate the household-level welfare impacts of disasters by investigating the consumption poverty effect using household-level micro-data. Third, disaster impacts on production networks, urban management, and aggregate

regional economies are examined. Fourth, two chapters focus on the health dimensions of natural disasters. Finally, four chapters investigate other issues of disaster management, such as agricultural development, food securities, and environmental sustainability.

2.1. Overall ex ante Risk Management and ex post Risk-coping Mechanisms for Dealing with Disasters at Community, National, and Regional Levels.

The general risk management and coping strategies mentioned above imply divided roles of market, state, and community.

Figure 2: The Community, the Market, and the State in the Economic System according to Hayami (2009)



Source: Hayami (2009)

According to Hayami (2009), the market is the mechanism that coordinates profit-seeking individuals and firms through competition using price signals (Figure 2). Naturally, the market has an advantage in matching the demand and supply of private tradable goods. The state is the mechanism that forces people to adjust their resource allocations by command of the government. Typically, the state plays an

important role in supplying global or pure public goods. In contrast, the community is the mechanism that guides community members to voluntary cooperation based on intensive social interactions, facilitating supply of local public goods such as the provision of reciprocal social safety nets, the conservation of commons, e.g., village common land and local irrigation facilities and the enforcement of informal transactions.

Previous empirical studies can provide insights into how more effective disaster management can be facilitated by strengthening complementarities among markets functioning using price signals, state enforcement mechanisms, and the community informal insurance mechanisms. 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 owing to disaster risk information that is communicated and shared, well-developed early warning systems and infrastructure and other risk management mechanisms that are well planned to prevent or mitigate the impact of disasters. Since the insurance market for natural disasters is far from complete, the government plays an important role in disaster management and rehabilitation. For example, a report by the World Bank and the United Nations (2010) describes how Bangladesh, where frequent cyclones have affected several hundred thousand people, has significantly reduced the number of casualties by investing in emergency infrastructure such as improving its early warning system, which operates via radio, and building numerous cyclone shelters. Having noted this, Yang (2008) used data on the world's storms of the past 30-plus years to show that their economic damage has been enormous. That tells us that we should balance emergency information systems and infrastructure that prevent injury to people with market-based insurance systems that prevent economic damage, so as

to prepare ourselves for natural disasters. In a study of the Chuetsu Earthquake, Ichimura, *et al.* (2006) found that earthquake insurance and public transfers had functioned quite well.

In Chapter 1, Sawada overviews different approaches towards an effective disaster risk coping strategy and regional cooperation on disaster management. He finds 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, he 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. He also discusses the roles of microcredit and micro-insurance schemes in enhancing the disaster-resilience of individual households and firms.

In the case of economic disasters, the Chiang Mai Initiative (CMI) has been and will continue playing an important role. 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.

Noy in ***Chapter 2*** discusses operational aspects in facilitating national and regional risk management capacities. He first presents a typology of disaster impacts that distinguishes between direct and indirect damage. He 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.

The chapter 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) will be made easier by having a 'seal of approval', since that seal will alleviate investors/insurers concerns regarding the moral hazard generated by disaster-contingent financial support.

In Chapter 3, Nakata identifies the issues that would be central in designing a possible regional insurance scheme or mechanism for East Asia. The main focus is on the risk sharing mechanism for catastrophe risks to households in the region and

providing 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 any idiosyncratic shock generated by a catastrophe, given 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.

Chantarat *et al*. explores, in ***Chapter 4,*** innovations in index-based risk transfer products (IBRTPs) in depth as means of addressing important insurance market imperfections that 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.

Aldrich in ***Chapter 5*** investigates the new mechanisms through which social capital and networks assist with disaster recovery unlike 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, this Chapter seeks to underscore a potentially efficient and cost effective response to crises.

This chapter has suggested a new paradigm for thinking about disaster recovery and for designing emergency management responses. Moving beyond “bricks and mortar” approaches to recovery, it 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.

2.2. Household Level Welfare Impacts of Disasters

This part starts with ***Chapter 6*** by Sann, *et al*. on Cambodia, who map the pattern of risks faced by the poor and vulnerable in rural areas of Cambodia, where the consequences of natural disaster are posing 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. The Chapter 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. Since 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.

Chapter 7, 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. It is estimated that Vietnam is hit by 4.3 storms and more than 3 floods per year. This 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. The Chapter 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 Chapter 8, Poaponsakorn analyzes the causes of Thailand's 2011 flood, its impact on agriculture and household expenditure and income, and the government's response. He finds 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% to 14%. These findings are consistent with the reported negative national GDP growth of 8.9 % in the fourth quarter of 2011. The study also 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 also finds 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.

2.3. Disaster Impacts on Production Networks, Urban Management, and Aggregate Regional Economy

Ando in ***Chapter 9*** 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. The Chapter 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. Even the behavior of firms involved in the production networks and suffering from the floods in Thailand also confirms the existence of strong 'continuation' forces, and the deployment of efforts to keep production networks in being, in consideration of the various transaction cost implications of discontinuing a network.

Since 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.

Chapter 10, Layton examines New Zealand's history of natural disasters and its vulnerability to various types of disaster. The series of earthquakes that affected Christchurch, New Zealand's second largest city, between September 2010 and early 2012 is considered as a case study. The significant effects of the events on the population, labor market, reported crime, urbanization and location of businesses and production of the region are also described.

The case study suggests that New Zealand's arrangements for natural disasters worked well in most regards, given its comprehensive disaster monitoring and management regime. Lessons were also learnt leading to further improvement of the regime. The case study also highlights the advantage of international co-operation in search and rescue, maintaining security for people and property and victim identification in the response to natural disasters. It also suggests that while high rates and levels of disaster insurance ameliorate the financial impact of disasters, they can complicate the achievement of an effective recovery. This is because insurance funds increase the alternatives available to the affected population and investors, in respect of reinvestment and rebuilding the damaged region. The lag before insurers will accept new risks can also create delays and impede the momentum to recovery.

In Chapter 11, Isono and Kumagai discuss the long term economic impact of natural disasters on the countries concerned by using the IDE/ERIA Geographical Simulation Model (GSM) constructed jointly by Institute of Developing Economies (IDE) and Economic Research Institute for ASEAN and East Asia (ERIA). Using IDE/ERIA-GSM and short-run forecasts, the authors estimate the seriousness of the flooding in Thailand in 2011 in relation to long term economic performance. Their simulation results show that the negative long-run impacts of the floods will be

moderate, because many companies' first reaction to the floods was to seek relocation of their production site within Thailand.

They conclude that if the Thai government had not offered good recovery measures, such as facilitation measures to help firms move some production blocks from affected provinces, the flood's negative impacts would have been larger. The government should provide a good disaster insurance scheme, and develop tangible flood countermeasures. However, stimulating R&D activities and innovation is also indispensable. If Thailand had experienced an interruption in R&D activities, and other countries had gone ahead in 2011, the possible negative impacts compared to the baseline scenario would have been much larger.

2.4. Health Dimensions of Natural Disasters

Satapathy in ***Chapter 12*** provides a qualitative analysis of a broad range of issues in disaster psychosocial support and mental health services in India during the past two decades. The Chapter is limited to analysis of the issues in disasters caused largely by natural hazards. The impact of any disaster on the mental health of the survivors is enormous and affects the post-disaster reconstruction process directly and indirectly. Psychological and mental health services and interventions are very much country and culture specific, although the core recovery objectives and principles may remain similar and constant in all countries. The severity of symptoms is directly related to the magnitude and extent of trauma experienced, and the associated factors either aggravating life conditions or supporting the speedy recovery of the survivors in the aftermath of a disaster.

Evidence-based research in India reveals that to overcome the issues of inadequate mental health professionals, absence of institutional mechanisms for

service provision and ambiguous financial provisions for the same, the existence of community-based psychosocial support and mental health services has been successful in past large scale disasters. Such community-based services, therefore, would perhaps remain as a viable, more culturally approved and less stigmatizing option available to the country. Nevertheless, the ASEAN countries are still evolving with their own successful models of post-disaster mental health care service provision. And learning from and adapting good practice prevailing in one country may result in expediting their initiatives in this regard. Regular experience-sharing platforms in this region would enable all the countries to overcome many challenges so as to achieve their objectives.

Chapter 13 by Lai and Tan is on Singapore, which is 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 grass-roots 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.

2.5. Disaster Management in Agricultural Development, Food Security, and Environmental Sustainability

Chan reviews flood risk management in Malaysia in ***Chapter 14***. 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 ***Chapter 15***, Lassa examines the impact of disasters and climate hazards on Indonesian agricultural and food crops. The findings are that natural catastrophes have already caused a great deal of loss. Loss accumulation over the last decade has caused significant leakage of central government funds and reduced agricultural production. The average rate of losses during 2003-2008 was 1%. Average area expansion was 2% per annum during the same period. This suggests that expansion is always held back by losses, by as much as 1%. Therefore, hazard mitigation and adaptation strategies are needed for all agricultural crops.

Flood management and water management in agricultural fields should be continuously integrated and sustained. In addition, it has become clear that earthquakes and tsunami mitigation in the agricultural infrastructure should also be considered. Global discourse concerning risk management for future drought, within the context of agricultural adaptation to climatic change, suggests needs for developing drought resistance seeds. Agricultural catastrophe insurance has been barely recognized in Indonesia. Most of the losses are therefore largely uninsured, suggesting the importance of new risk transfer mechanisms such as crop insurance programs. The challenge is to find ways of making such a policy a reality in the future in both the local and the national context.

In ***Chapter 16,*** Israel and 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: a) 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; b) typhoons such as Ondoy and Pepeng in 2009 have a significant negative impact on the food security of households in the affected areas; c) households have varying consumption and non-consumption strategies to cope with the impacts of typhoons; and d) 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 the following. 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.

Wei, *et al*. focus on disaster risk management in China in ***Chapter 17***. Due to its complicated climatic and geographic conditions and distinct spatial-temporal variations, China is one of the countries which are severely hit by various kinds of natural disasters with high frequency and wide distribution. The Chapter analyzes

the impacts of natural disasters on livelihood security of people, agriculture safety, and economic security in the past 30 years. They find a high vulnerability in China's economic system 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.

3. Policy Implications

There is a set of important policy implications derived from papers presented in this volume. First, informal social safety net mechanisms based on community or local enforcement mechanisms should be strengthened and complemented through market and state involvement. In particular, microcredit and insurance programs should be promoted by government to facilitate consumption smoothing and

livelihood sustainability among those affected by natural 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, a global system of pooling the risks of the different types of disasters, such as natural and technological disasters, economic crisis, and conflicts, would be effective for both developing and advanced nations wishing to diversify the risks of 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 state, and the community will be the key. The market is a resource allocation mechanism using price signals, the state 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 state enforcement mechanisms, and regional disaster funds could utilize insurance market transactions. Overall, however, intra-regional state cooperation is indispensable for East Asia.

Finally, investments in physical 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, and disaster early-warning systems. Experiences of developed nations in the region such as Japan tell that investments in 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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