

# Chapter 1

## Approaches towards Effective Disaster Risk Coping Strategy and Regional Cooperation on Disaster Management

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## CHAPTER 1

# Approaches towards Effective Disaster Risk-coping Strategies and Regional Cooperation on Disaster Management

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### 1. Introduction

Natural disasters, whether they occur in advanced or developing nations, can destroy people's livelihoods. Extreme natural and man-made events have recently hit both developed and developing countries. Witness the ongoing effects of the devastating earthquake, tsunami, and nuclear radiation crisis in the Tohoku region of Japan, that has killed tens of thousands of people and resulted in damage of around US\$200 to 300 billion (Cabinet Office, 2011). Hundreds of thousands of lives were also lost in the Indian Ocean tsunami, Hurricane Katrina, and earthquakes in central Chile, Haiti, the Sichuan province of China, northern Pakistan, and the Hanshin area of Japan. Disasters are created not only by nature but also by humans. The tsunami disaster in Tohoku was accompanied by a serious technological disaster involving a nuclear power plant's leaking radioactive matter. Around the world, economies are still being suffering from the global financial crisis triggered by the 2008 Lehman Shock. Nations in Africa are still at war and involved in smaller conflicts, and terrorist attacks, and the threat of terrorist attacks are having serious impact even on advanced nations. Natural and man-made disasters show distinct rising trends across the globe: Natural and technological disasters have been increasing more rapidly in frequency, in terms of the average occurrence of disaster per country per year, than financial crises and violence-related disasters (Cavallo & Noy, 2009; Kellenberg & Mobarak, 2011; Strömberg, 2007).

As we continue our ceaseless efforts to recover from different disasters around the world, we are rediscovering the importance of advance preparations, such as drawing up emergency plans, disseminating and teaching emergency knowledge, conducting evacuation drills, constructing early warning systems, and investing in infrastructure. Moreover, we began to realize the importance of risk finance schemes such as individual- and national-level parametric insurance arrangements as an indispensable part of ex ante interventions. How should we protect ourselves and the people of the entire world from catastrophe? In this Chapter, we will summarize different approaches towards effective disaster risk-coping strategies, and regional cooperation on disaster management.

This Chapter is organized as follows. In Section 2, we set conceptual framework of disaster risk management and coping mechanisms/strategies. Section 3 discusses innovative frameworks such as microcredit, microinsurance, and regional insurance pooling scheme to strengthen ex ante risk management capacities. In Section 4, we summarize policy implications to enhance effective insurance capacities by encompassing schemes against a variety of natural and man-made disasters.

## **2. Conceptual Framework**

### **2.1. Household-level Strategies**

In response to the wide variety of shocks caused by natural and manmade disasters, households have developed and employ formal and informal insurance mechanisms. We classify such uses of insurance mechanisms into ex ante risk management and ex post risk-coping behaviors. First, household risk management strategies are defined as activities for mitigating risk and reducing income instability before the resolution of uncertainties. These strategies might include investments in earthquake-proof housing, an insurance contract subscription, and access to an early-warning system. It has been known that these ex ante management strategies are cost-effective instruments to mitigate losses due to disasters (World Bank and United Nations, 2010). This is driven mainly by the significance of the welfare costs of disaster risks. Using the framework of the Arrow-Pratt risk premium, we can capture the negative welfare costs of risks by

calculating how much money households would be willing to pay to completely eliminate income variability. Mathematically, such an amount of money is represented by  $m$  which satisfies the following relationship:  $u(\bar{y} - m) = E[u(\tilde{y})]$ , where  $u(\cdot)$  is a well-behaved utility function,  $\tilde{y}$  is a stochastic income,  $\bar{y}$  is its mean value, and the variable  $m$  represents a standard risk premium. Taking a first-order Taylor expansion of the left-hand-side around  $m=0$  and a second-order Taylor expansion of the right-hand-side around the mean income gives:

$$\frac{m}{\bar{y}} = \frac{1}{2} \underbrace{\left( -\frac{u''(\bar{y})\bar{y}}{u'(\bar{y})} \right)}_{\text{Coefficient of RRA}} \times \underbrace{\left( \frac{\sqrt{\text{Var}(\tilde{y})}}{\bar{y}} \right)^2}_{\text{Coefficient of Variation}},$$

This indicates that, approximately, the fraction of average income that a household would be willing to give up can be calculated as half of the coefficient of relative risk aversion multiplied by the square of the coefficient of variation of income. Sawada (2007) shows the estimated welfare costs of risks in India and Pakistan. These results indicate that the welfare cost of risks is at least 10% and can be 30-50% of household income. Since natural and manmade disasters can generate larger income volatilities than these income fluctuations, the welfare costs estimated here may be regarded as lower-bound estimates of the negative welfare impacts of natural or manmade disasters.

These figures indicate the importance of ex ante risk management mechanisms and strategies in reducing the welfare costs of disasters. However, it is often difficult by nature to elaborate such mechanisms and strategies because the disasters are typically characterized by rare events, and sometimes even worse, they are unforeseen. Also, disaster risks may be correlated in nature, which could not be diversified away within a region or country. Thus, the aggregated macro welfare cost can be non-negligible. Indeed, Barro (2009) found that macro welfare loss due to disasters can be as large as 20% of welfare. The significance of potential risk management implies two important issues. First, it is indispensable for government to strengthen national and regional level market and non-market insurance mechanisms against natural disasters. Second,

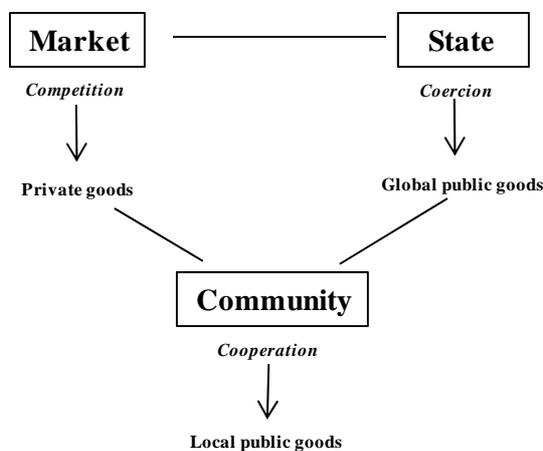
risk-coping strategies become important because even if households, communities, and governments adopted a variety of risk management strategies, a disaster can happen unexpectedly, causing serious negative impacts on household welfare.

Accordingly, against these unexpected natural disasters, it is indispensable for people to adopt ex post risk-coping strategies which are defined as ex post strategies to reduce consumption fluctuations and to maintain desirable levels of livelihood. In general, the existing literature identifies the following different mechanisms for coping with risk. First, households can employ different market mechanisms, such as credit markets, to reallocate future resources to today's consumption, insurance market transactions to eliminate losses resulting from disasters, and ex post labor market participation to utilize market returns to human capital. Second, people can adopt self-insurance mechanisms such as consumption reallocation by cutting back luxury expenses while maintaining total calorie intakes and dis-saving financial and physical assets, i.e., utilization of precautionary saving. Finally, households can adopt non-market insurance mechanisms such as public transfers from the government, and informal private aids from networks based on extended family, relatives, and communities. Against unexpected natural disasters, ex post risk-coping is indispensable

## **2.2. The Market, State, and Community Triangle in Disaster Management and Coping**

The general risk management and coping strategies mentioned above imply the divided roles of market, state, and community as elaborated by Hayami (2009). As is shown in Figure 1, the economic system is composed of three domains, i.e., market, state, and community, interacting with each other.

**Figure 1: The Community, the Market, and the State in the Economic System:  
A Framework by 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. Naturally, the market has an advantage in matching the demand for 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 the local public goods such as the provision of reciprocal social safety nets, the conservation of commons, and the enforcement of informal transactions.

To address the roles of the market, the state, and the community in facilitating disaster management and coping, it will be useful to classify two different types of risks by the level at which they occur, i.e., idiosyncratic and aggregate risks. Idiosyncratic risks affect specific individuals and/or firms while aggregate shocks affect groups of households, an entire community and region, or a country as a whole. This distinction is important because the geographic level at which risks arise determines the effectiveness of market and non-market institutions in dealing with risk.

On the one hand, a risk that affects a specific individual can be traded with other

people in the same insurance network through informal mutual insurance and a well-functioning formal insurance or credit market. In the last two decades, micro-development economists have shown that households have, to some extent, developed formal and informal risk-coping mechanisms against a wide variety of idiosyncratic risks (Townsend, 1994). The community-based mutual insurance mechanism can be effective, provided that all the members contribute due informal insurance premiums, according to the principle of reciprocity dictated by customs and norms (Hayami, 2009). The community can enforce the collection of due contributions from community members by means of the reputation/opprobrium/ostracism mechanisms. In short, the community can play an important role in weathering losses caused by natural disasters, if such losses are largely idiosyncratic.

Yet, according to the NatCatService data of one of the largest reinsurance companies, Munich Re, the proportion of insured losses of overall losses caused by disasters in the world is quite limited, around 20% on average.<sup>1</sup> Currently, formal insurance mechanisms combating natural disasters are quite limited. Indeed, studies based on micro-data show the overall ineffectiveness of formal and informal insurance mechanisms in dealing with natural disasters (Kohara, *et al.*, 2006, Sawada & Shimizutani, 2007 & 2008).

On the other hand, a risk that affects an entire region cannot be insured within the region and thus community mechanisms can only function imperfectly. Natural, technological, and manmade disasters are likely to fall into this category of aggregate or covariate risks. As we have seen, efficient risk sharing mechanisms are likely to be absent, especially for a natural disaster as a rare, covariate event. In fact, the extent to which a risk is idiosyncratic or correlated depends considerably on the underlying causes. These risks should be covered by well-designed formal market or similar arrangements backed by the public enforcement mechanisms in which region-specific risks are diversified away across regions. If these mechanisms cannot work properly or are difficult to set, households are forced to insure themselves against shocks by using self-insurance measures. For example, by analyzing a 1998 survey of areas

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<sup>1</sup> In the formal insurance market, the insurers need international reinsurance markets to pool disaster risks. Yet, it is known that reinsurance markets and trades of catastrophe (CAT) bonds are still thin.

affected by Hurricane Mitch, Morduch (2004) found that for 21% of households, the main response to the hurricane was not to use savings, nor to borrow money; the main response was a drastic reduction in consumption. This suggests that these households are constrained from borrowing against shocks. By investigating how victims of the Great Hanshin-Awaji (Kobe) earthquake in 1995 coped with their unexpected losses, Sawada and Shimizutani (2005) found that households without borrowing constraints can borrow and/or dissave to respond to damages caused by the earthquake, while those under a constraint are unable to cope with housing losses effectively.

### **3. Towards Effective Disaster Risk-coping and Regional Cooperation on Disaster Management**

To facilitate more effective disaster management by strengthening complementarities among the market functioning under the price signals, the state enforcement mechanisms, and the community informal insurance mechanisms, we can learn insights from previous empirical studies. 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, early warning systems that are developed, and infrastructure and other risk management mechanisms that are well developed 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 noticed this, Yang (2008) used data on the storms around the world of the past 30-plus years to show that the economic damage has been enormous. This tells us that, to prepare ourselves for natural disasters, we should balance emergency information

systems and infrastructure that prevent damage to people with market-based insurance systems that prevent economic damage. In a study of the Chuetsu Earthquake, Ichimura, *et al.* (2006) found that earthquake insurance and public transfers had functioned quite well.

### **Innovative Ideas**

There are a few emerging, innovative ideas which strengthen the complementarities among the market, the state and the community in the context of disaster management and coping. Here, we discuss microcredit and microinsurance.

#### *Microcredit*

While it has been rather long known that the remarkable performance of microcredit programs is based on community enforcement mechanisms, multiple roles of microcredit have been identified in the recent literature. Poor households are not just struggling entrepreneurs using microcredit programs for business facilitation. They are complicated households seeking to manage expenses (consumption credit), cope with emergencies (disaster protection), and seize opportunities. Potentially, microcredit programs can play a role in disaster insurance: For example, most micro-finance institutions in Bangladesh introduced a flexible repayment system in 2002, which permits members to reschedule installments during disasters. Also, a Bangladesh microfinance institution, BURO Tangail, initiated a special loan program called “disaster loan” for disaster affected clients in the wake of the disastrous floods of 1998 (Wright & Hossain, 2001). Such a loan program can function effectively as an ex post risk-coping instrument for disaster-affected individuals in poor regions.

#### *Microinsurance*

Another innovative idea is to use a new microinsurance program called “index insurance” or “parametric insurance contracts” which are written against specific aggregate events such as drought or flood defined and recorded at a regional level (Hazell, 2003; Morduch, 2004; Skees, *et al.*, 2004). This type of insurance pays out on storms that exceed a pre-designated speed, rainfall that falls short of a threshold level, and earthquakes that exceed a certain seismic intensity. It is an excellent system that

alleviates the time and costs required by conventional indemnity-based insurance systems to assess damage.

As such, index insurance involves a number of positive aspects; they can cover the aggregate correlated events; they are affordable and accessible even to the poor; they are easy to implement and privately managed; and they are free from the moral hazard, adverse selection, and high transaction costs that have plagued traditional agricultural insurance contracts such as crop insurance schemes. The World Bank and other institutions have been piloting weather-based index insurance contracts in Morocco, Mongolia, Peru, Vietnam, Ethiopia, Guatemala, India, Mexico, Nicaragua, Romania, and Tunisia.

Since natural disasters are typically aggregate events, index insurance is thought to be an appropriate instrument to combat them. Yet, there are three major constraints to designing index-type insurance against natural disasters. First, natural disasters are often characterized by a rare event which makes it difficult to design actuarially fair insurance. Since obtaining historical data on the pattern of natural disasters is hard, it is almost impossible to set appropriate premiums for insurance.

Secondly, and related to the first issue, even if appropriate premiums are set, the poor who potentially should demand insurance against natural disasters may find it difficult to recognize the value of index-type insurance against natural disasters. This may be inevitable, because natural disasters are often characterized by unforeseen contingencies by their very nature, and because the poor seem often to be myopic, with high time-discount rates. Indeed, human beings do tend to ignore rare bad events (Camerer & Kunreuther, 1989). Moreover, the existence of the “basis risk” with which an individual could incur damage but cannot be compensated sufficiently, will also deter demand for index insurance. This problem has been identified as an inevitable drawback of index insurance because index contracts essentially tradeoff basis risk for transaction costs (Morduch, 2004; Hazell, 2003).

Nakata, *et al.* (2010) utilize a unique survey dataset collected jointly by the Research Institute of Economy, Trade and Industry (RIETI) of Japan and the Center for Agricultural Policy in Vietnam (CAP), which they call the RIETI-CAP survey. The dataset is a resurvey of subsamples of the Vietnam Household Living Standards Survey (VHLSS) 2006 households. They employ hypothetical questions on avian influenza

(AI), flood (FL), and drought index insurance in Vietnam. According to their analysis of this unique data set, a past experience dramatically increases the probability assessment of the event (10 and 100 times for AI and FL) and willingness to pay (WTP) for the insurance (30% and 50% for AI and FL). A first loss experience tends to have a large impact on the subjective loss probability, and consequently on the willingness to pay for insurance, especially for flooding insurance (both index and indemnity-based insurance). This indicates that it would be less likely for a household with no past loss experience to purchase flooding insurance, even if the insurance premium is actuarially fair in accordance with the loss probability model of the insurance supplier.

They also found that people may not behave in accord with the subjective expected utility framework as far as AI insurance is concerned. In other words, it is not clear that the subjective loss probability drives the behavior of the people concerning AI insurance. This is not very surprising, since AI involves mutations of viruses, and so there are possible unforeseen contingencies. This makes it harder to agree on the terms and conditions of insurance.

#### *Index Insurance as a Mitigation Device in Human-Made Disasters*

Miguel, *et al.*, (2004) use data from 41 countries in Africa from 1981 to 1999 to find a robust causality between drought, a type of natural disaster, and conflict, a type of human-made disaster. This signifies that preventative action taken against natural disasters could also prevent conflicts. Today, we are capable of issuing early warnings of drought risk based on rainfall measurements and vegetation indices obtained from satellite images. Accordingly, Miguel (2009) proposes a new type of foreign aid-Rapid Conflict Prevention Support (RCPS), which would reduce the risk of conflicts by using this information to estimate droughts and natural disasters, and by transferring aid immediately. Foreign aid provisions would be targeted to drought or other disaster vulnerable countries beforehand. Indeed, Botswana, Africa's economic superstar for the past 40 years, has been implementing a Drought Relief Program (DRP). It can safely be said that the drought insurance played an important role in its success (Miguel, 2009).

### *Regional Index Insurance*

Index insurance or parametric insurance can be designed for disaster risk pooling at regional level. One example is the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which is a parametric, multinational hazard insurance fund for hurricanes and earthquakes that works with the international reinsurance market and was established as the first of its kind in the world. Haiti was a member of the Facility, and after the Haiti Earthquake in January 2010, the government received \$7.75 m in earthquake insurance - around twenty times its premium - as soon as two weeks after the quake. While the amount is not necessarily significant, the Haiti government received insurance payouts very quickly, indicating the importance of preparing a new insurance system such as CCRIF.

Another example is the Pacific Disaster Risk Financing and Insurance Program which builds on the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) through a joint initiative between the Secretariat of the Pacific Community (SPC/SOPAC) founded in 2007, the World Bank, and the Asian Development Bank, with financial support from the Government of Japan and the Global Facility for Disaster Reduction and Recovery (GFDRR). PCRAFI aims to enhance the disaster risk management and to reduce the financial vulnerability of the Pacific Island Countries (PICs) against natural disasters. It will do this by improving their financial response capacities while protecting their long term fiscal balances.

The PDRFI Program provides the PICs with tailor-made advisory services for disaster risk modeling and assessment tools, financial instruments for national disaster risk financing and insurance strategies, and catastrophe risk insurance market development.<sup>2</sup> There are three project components. The first component is institutional capacity-building for disaster risk financing through setting national disaster risk financing strategies, and technical assistance to design and implement their integrated financial strategy against natural disasters. The second component is Pacific

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<sup>2</sup> Countries receiving technical assistance in disaster risk financing and insurance through the PDRFI Program include Papua New Guinea (PNG), Fiji, the Solomon Islands, Vanuatu, Samoa, the Federal States of Micronesia (FSM), Tonga, Kiribati, the Republic of the Marshall Islands, Palau, the Cook Islands, Tuvalu, Nauru, Niue and Timor-Leste. The Pacific catastrophe risk insurance pilot was launched in November 2012 with Vanuatu, Tonga, the Marshall Islands, the Solomon Islands, and Samoa.

disaster risk insurance market development, aiming to offer technical assistance to improve disaster risk insurance solutions in the Pacific. The final component is the Pacific Disaster Risk Financing and Insurance (PDRFI) Pilot Program which is piloting natural disaster derivatives aimed at serving as support measures for disaster prevention and disaster mitigation through a Public-Private Partnership (PPP). The Pacific Disaster Risk Financing and Insurance Program is the first of a series of applications of PCRAFI to be developed in disaster risk management and urban/infrastructure planning.

As part of Japan's international cooperation in disaster prevention, the Japanese government announced it would "establish an insurance system as natural disaster support in Pacific island countries" at the 6th Pacific Islands Leaders Meeting (PALM) held in May 2012. Accordingly, this program was established in collaboration with Pacific island countries (governments), the World Bank and private-sector insurance companies.

Let us also touch upon preparations for economic crises. The Group of Twenty nations/regions (G20) and other meetings are discussing the installation of an early warning system that predicts and helps to counter the currency and financial crises that have occurred frequently since 1990. But as Rose & Spiegel (2011) points out, current research has not yet developed a sufficiently reliable early warning system. Preparations for economic crises, however, have been enhanced. In 2009, for example, the International Monetary Fund (IMF) established a new prevention facility against economic crises. In the East Asia region, the Chiang Mai Initiative (CMI), a bilateral currency swap agreement to be implemented in times of a currency crisis, expanded to a multilateral framework (CMIM) in 2010.

## 4. Policy Implications

Advanced nations can deal with a major disaster 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. Different disasters tend to come in combination, as was the case with the Great East Japan Earthquake and conflicts in Africa.

First, it is imperative to develop formal mechanisms to diversify aggregate disaster risks at national and regional levels (Table 1). We may need to elaborate on multi-country risk pooling schemes, i.e., regional funds, to cover sovereign disaster risk. Against natural disasters, regional level index insurance such as CCRIF and PDRFI can function effectively to support the disaster affected country with immediate liquidity in the aftermath of a catastrophic disaster, by using the insurance mechanism. Microcredit and microinsurance schemes can also enhance the disaster resilience of individual households and firms. While the regional index insurance schemes are based on PPP, the microcredit and insurance programs are supported by informal community enforcement mechanisms. Hence, complementarities among the market, the state, and the community will be the keys to success.

In the case of economic disasters, the Chiang Mai Initiative (CMI) has been and will be playing an important role. CMI is a bilateral or multilateral currency swap arrangement pooling foreign exchange reserves, and was designed as an ex post coping mechanism against a financial crisis. Further development of Asian bond markets will also be indispensable because bond markets are composed of a large number of individual bond holders, and idiosyncratic risks can therefore be diversified away effectively. It is generally considered that bond markets form effective risk-sharing mechanisms. In order to diversify the shocks caused by disasters, developed bond markets can potentially play important roles.

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 needing to diversify the risks of disasters. In other words, we should also work on the securities and reinsurance markets to develop a

global disaster insurance system that would encompass various regional frameworks such as CCRIF, PCRAFI, and CMIM beyond existing disaster types.

When we consider the actual form of such a system, there are numerous issues involved, such as whether it would be an institutionalized system like a disaster fund, or something more flexible such as a coordination forum. Yet the Asian region has experienced diverse forms of disasters, including floods, typhoons, earthquakes, epidemics, and the financial crises of the late '90s. It is worth pursuing reforms that undertake comprehensive preparations against the risks of a variety of disasters in Asia.

**Table 1: Towards Effective Disaster Risk-coping Strategies and Regional Cooperation:  
A Summary**

<b>Disaster type:</b>	Natural	Technological	Wars and Conflicts	Economic
	↓	↓	↓	↓
	<b>Overall effectiveness of market and non-market insurance mechanisms</b>			
	↑	↑	↑	↑
<b>Ex post risk-coping:</b>	Credit and labor market, and transfers	?	Drought insurance	Consumption reallocation, labor, and transfers
	↑	↑	↑	↑
<b>Policy instruments I: (for each disaster)</b>	Microcredit/microinsurance	?	Early warning system	Early warning system
<b>Policy instruments II:</b>	<b>Global/regional pooling facility?</b>			

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