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Insurance-related instruments for disaster risk reduction

Pablo Suarez
Joanne Linnerooth-Bayer

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Prepared by
Pablo Suarez and Joanne Linnerooth-Bayer

With contributions from J. Syroka, M. Victor Brans, R. Mechler and S. Hochrainer

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LIST OF ACRONYMS

AMRT	Agricultural Risk Management Team (World Bank)
ARC	Africa Risk Capacity
AOSIS	Alliance of Small Island States
CAT DDO	Catastrophe Risk Deferred Drawdown Option
DFID	United Kingdom Department for International Development
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ELF	Emergency Liquidity Facility
EUSF	The European Union Solidarity Fund
GAR	Global Assessment Report on Disaster Risk Reduction
GFDRR	Global Facility for Disaster Reduction and Recovery
GDP	Gross Domestic Product
GIRF	Global Index Insurance Facility
GTZ	Gesellschaft für Technische Zusammenarbeit
HARITA	Horn of Africa Risk Transfer for Adaptation
HFA	Hyogo Framework for Action
IIASA	International Institute for Applied Systems Analysis
IFI	International Financial Institution
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society
ISDR	United Nations International Strategy for Disaster Reduction
MCII	Munich Climate Insurance Initiative
MFI	Micro-Finance Institution
NGO	Non-governmental organization
SME	Small and Medium Enterprise
SMS	Short message service
UN	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Organization
UNEP FI	United Nations Environment Programme Financial Initiative
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WFP	World Food Programme
WMO	World Meteorological Organization

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EXECUTIVE SUMMARY

1. INTRODUCTION

Strategies and measures for disaster risk reduction (DRR) are not being implemented at the scale called for by the Hyogo Framework of Action. Part of the problem is that, from the perspective of decision makers with resource constraints, it is risky to invest in something that reaps benefits only in the case of a relatively unlikely event (such as a hurricane or a drought). People and institutions are understandably prone to invest in choices that yield less uncertain benefits. DRR, in itself, can be perceived as a risky endeavor – especially from the financial perspective.

One way to circumvent this problem is by promoting DRR through incentives and other features embedded in market-based financial instruments, which offer financial stability or reliable access to funds to help cope with the consequences of extreme events. Since not all risks can be cost-effectively reduced, especially those that occur only very rarely, forward-thinking DRR stakeholders tend to seek options for financing the remaining or residual risks. Insurance and other disaster risk sharing approaches can serve households, national governments and humanitarian or development organizations, not only to *complement ex ante DRR* by ensuring or accelerating financing for post-disaster activities (like relief, recovery and reconstruction), but also as a *conduit for ex ante DRR*, guiding investment decisions that would result in fewer losses if a disaster materializes in the future.

The objective of this paper is to assist disaster risk reduction stakeholders analyze whether - and how - insurance and other market-based risk transfer instruments can help increase resilience to disasters.

While there are numerous publications addressing disaster risk financing, this paper is specifically directed to DRR practitioners. Emphasis is given to how insurance and related instruments can (i) promote or impair comprehensive disaster risk management, and (ii) guide decision makers towards productive investments in vulnerability reduction.

Insurance-related instruments can be viewed as an *integral part* of risk reduction measures. This is illustrated through familiar examples outside of the disaster area, where such instruments can:

- enable loss-averting measures after the event (e.g. health insurance covers hospital expenses that might otherwise be prohibitively expensive after an accident);
- provide necessary safety nets (e.g. unemployment and "social" insurance schemes allow low-wage workers to start promising but risky business ventures pulling them out of "working poverty" and reducing their vulnerability);
- convey price signals that incentivize risk reduction (e.g. car owners may be more inclined to install an alarm system if this reduces the cost of theft insurance premium);
- stipulate risk reduction behaviour (e.g. house buyers can be required to install smoke detectors to be eligible for a mortgage);
- enable vulnerability reduction (e.g. without liability insurance, ambulance personnel may refuse to engage in risky but often life saving interventions)

Applying these concepts to the realm of natural hazards requires taking into consideration several processes that shape catastrophe risk, including development, climate change, the evolving role of markets, and progress in science and technology (such as those that enable “index-based” insurance contracts, which are written against a readily measurable physical trigger, as opposed to conventional indemnity-based insurance (which is written against *actual* losses).

2. MARKET-BASED INSTRUMENTS FOR GOVERNMENTS

Risk financing can provide timely post-disaster capital to governments, donors that support governments and regional risk pools through three principal types of financial instruments: insurance, alternative insurance instruments (e.g. catastrophe bonds), and contingent credit contracts.

Insurance instruments distribute disaster losses across a pool of at-risk firms and governments, whereas alternative insurance instruments, such as c*atastrophe bonds*, distribute losses across willing investors. These instruments lessen the risk of insufficient capital when a disaster strikes, thus reducing the *ex post* down-stream human and economic consequences. They also remove risks from governmental balance sheets, inviting investors to commit capital to a country (which, in turn, can contribute to reduce vulnerability in the long term).

By "pricing" risk, insurance instruments also provide incentives for *ex ante* risk reduction measures. For example, if premiums are lowered for governments that retrofit their public infrastructure against seismic risk, an incentive is created to take on these investments. Ill-conceived insurance instruments can, however, be plagued by moral hazard and perverse incentives (encouraging investments in risk-prone areas or sectors), or by subsidies that may significantly distort prices or competition – ultimately increasing disaster exposure, vulnerability and losses. At the same time, there are approaches that can counter moral hazard and even link market-based instruments to reducing disaster losses, as the following examples illustrate:

- A pilot insurance project in Ethiopia supported by the World Food Programme was designed to pay claims to the government based on a drought index, in the time window between observed lack of rain and actual materialization of losses. This allows stakeholders to address food insecurity threats in ways that prevent the depletion of farmers' productive assets, thus enabling households to produce more food during subsequent seasons, reducing future demand for humanitarian aid.
- As a recent pilot project in Peru shows, it is possible to design index insurance instruments linked to a *forecast* of imminent, avoidable loss. Peru typically experiences El Niño-related flooding in February. This piloted instrument provides forecast-based payments to the insured in January, to be used for a wide range of disaster management measures from planning water flow in dam operations to adjusting cash flows in anticipation of likely income reduction.
- Governments that join regional risk pools can negotiate lower-cost insurance contracts, as well as require risk reduction measures for pool eligibility. Examples include the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which enables risk reduction by providing governments with access to information on hazard impacts on populations, land area, ports and airports, and the Africa Risk Capacity (ARC), an innovative proposal aiming to provide participating African governments with financial weather risk management tools and funds to manage extreme events and also incentivize disaster risk reduction, planning and response. ARC sets out to do this through a regional contingency funding mechanism for planned responses to weather emergencies through the establishment of an African-owned risk pooling entity.
- Catastrophe bonds, such as the recent issue in Mexico, have not yet been linked directly to DRR measures. Indirectly, however, the Mexican bond will provide immediate and reliable post-disaster payments to the government, allowing authorities to reduce losses through timely relief and rescue operations. As a novel idea, a more direct link might be possible if instruments are designed to fund *the incremental costs* of adding risk reduction measures to reconstruction efforts.

Unlike insurance and catastrophe bonds, c*ontingent credit* ensures access to loans in times of crisis - a safe option for governments with limited post-disaster financing choices. This was the case in Mongolia: the government secured liquidity in the aftermath of severe winter storms to provide relief and as reinsurer to its livestock insurance program. Importantly, contingent credit

can be linked to *ex ante* DRR as shown by the World Bank's CAT Deferred Drawdown Option, which requires eligible countries to have in place a disaster risk management (DRM) program. The loan may be "drawn down" after a disaster unless the government has received prior notification that their DRM program is not being implemented in accordance with the agreement.

Despite the significant benefits of these instruments, and their potential for promoting risk reduction, their high costs may be prohibitive (mainly due to the expenses of insuring correlated risks). Governments with lower-cost alternatives (i.e. reserves, budget diversions, donor assistance, or loans) are generally not advised to purchase market-based instruments. An analysis of financial vulnerability to natural hazards (i.e. the "resource gap") reveals that even considering the alternatives, many countries face a high risk of insolvency and impoverishment after disasters – with potentially catastrophic results for the most vulnerable. In these cases, a balanced portfolio is recommended, combining DRR investments with risk transfer instruments. Because the most vulnerable countries are also the least able to afford these instruments, donor organizations and international financial institutions are increasingly supporting risk-financing strategies.

3. MICROINSURANCE INSTRUMENTS

At the micro level, households and businesses in developing countries are gaining access to new ways to manage disaster risks, particularly with the emergence of index-based financial instruments that link the payout with a measurable *event* that causes loss (thus reducing transaction costs, as well as the risks of moral hazard and adverse selection that plague other risk-sharing schemes). Microinsurance can support DRR in a variety of ways as described below:

- Microinsurance can be bundled with loans to promote investments in measures that reduce vulnerability to extreme events. In Saint Lucia, a program offering home improvement loans targeted to reducing risks of multiple hazards required owners to join a microinsurance scheme.
- Bundling microinsurance with a loan package can also promote productive investments that help the most vulnerable escape disaster-related poverty traps. In Malawi, farmers taking part in an insurance scheme based on a drought index are able to access loans for improved seed, making them more productive and less vulnerable to future droughts. If the premiums in such schemes were set to reflect long-term climate forecasts, they would additionally provide signals for planting crops suited to expected rainfall conditions – therefore promoting DRR.
- Like the Peruvian macro-insurance case mentioned above, index-based microinsurance could be linked not to an observed event but to the *forecast* of an event likely to cause catastrophic damage, in order to provide timely funds for pre-disaster risk reduction activities.
- Finally, microinsurance can be designed with vulnerable communities specifically with the goal of reducing the direct losses likely to be caused by future natural hazards. The HARITA pilot project in Ethiopia offers cash-constrained farmers the possibility to pay the microinsurance premium with DRR-oriented labor.

As promising as these developments appear for supporting DRR, microinsurance today reaches only a very small fraction of low-income farmers, herders, households and their intermediaries. Lessons drawn from reviews of microinsurance pilots show very substantial obstacles to scaling up systems targeting the most vulnerable under current conditions. Much can be learned from the "bottom of the pyramid" approach, which puts people's *wants* (not needs) at the center of new enterprises. Innovative approaches such as game and video-enabled processes can help extend the benefits of risk sharing instruments to the most vulnerable communities.

4. CONCLUSIONS

As evidenced by a number of initiatives for managing risk at the macro and micro levels, market-based risk sharing instruments can increase disaster resilience, not only as an *ex post* complement to pre-disaster risk reduction but also as an *ex ante* vehicle to promote vulnerability reduction,

hazard management and disaster preparedness. However, insurance and related instruments are not a panacea: many important challenges remain, including weak regulatory systems, the risk of corrupt practices among all relevant stakeholders, insufficient understanding of the instruments, and the difficulties of estimating risks (particularly in light of climate change). Possible negative outcomes include the rapid growth of complicated schemes that do little to actually improve the resilience of the most vulnerable while transferring wealth to the already wealthy, or badly designed financial instruments that actually encourage investments in places or endeavors that are too risky. At the very least, scaling up financing systems to reach the world's most vulnerable will require dedicated support from the international development and climate adaptation communities.

There are valid reasons for further exploring market-based options for disaster risk sharing. The remarkable progress in linking science, technology and risk transfer instruments over recent decades has enabled DRR practitioners to better anticipate future conditions, reduce vulnerabilities and take early action to avoid losses. DRR can be greatly enhanced if forecasters, risk managers and financial experts build common ground, and design smart DRR-oriented market-based instruments. The DRR community can significantly benefit from collaboration with the disaster risk financing community. The stage is set to jointly and creatively develop and deploy new linked financial/DRR solutions, and to overcome obstacles in scaling up existing ones.

1. INTRODUCTION

Disaster risk reduction measures can be perceived by decision makers as risky endeavors – especially from the financial perspective. Weighted against alternative decisions that would yield almost certain, relatively imminent results (like transportation- or food-related expenses), options that yield benefits only if an unlikely event occurs are understandably less tempting to many people and institutions. Yet there are very good reasons for investing today for a safer tomorrow – i.e. dedicating available time and resources to measures likely to reduce losses in the future in the event of a flood, drought, earthquake or other hazards. As stated by the Hyogo Framework for Action (HFA), "sustainable development, poverty reduction, good governance and disaster risk reduction are mutually supportive objectives, and in order to meet the challenges ahead, accelerated efforts must be made to build the necessary capacities at the community and national levels to manage and reduce risk" (ISDR 2005, 1).

At the 2005 World Conference on Disaster Reduction, HFA was adopted by 168 members of the United Nations, who committed to significant advances in disaster risk reduction (DRR) by 2015. Yet, as shown by the first biennial Global Assessment Report on Disaster Risk Reduction, "globally, disaster risk is increasing for most hazards" (ISDR 2009, 5). Financial considerations can help in understanding why we are collectively failing to do better on the HFA commitments. At the same time, HFA explicitly calls countries to "promote the development of financial risk-sharing mechanisms" in its section on reducing underlying risk factors (ISDR 2005, 11). DRR policymakers and practitioners can, through improved understanding of the rapidly-changing array of market-based financing instruments, better shape the success (and avert failure) of disaster management. Hence, ISDR has invited this contribution to the second Global Assessment Report on Disaster Risk Reduction (GAR), to be launched in May 2011.

Numerous publications offer comprehensive overviews or practical guidance about market-based disaster risk financing from various perspectives, such as agricultural production, fiscal stability or climate adaptation (see Box 1.1:). While all emphasize the need to view these instruments as part of a comprehensive risk management approach, for the most part the overviews and guidance documents have not explicitly addressed an audience of DRR practitioners.

This paper aims to support disaster risk reduction stakeholders in examining the role of insurance and other risk financing instruments for increasing disaster resilience.

Particular emphasis is given to:

- *How market-based schemes can promote or impair comprehensive disaster risk management*
- *How opportunities offered by traditional and emerging risk financing approaches can be used to guide decision makers towards investments in vulnerability reduction.*

This paper is organized as follows: The rest of Section 1 discusses complementarities between risk reduction and risk transfer strategies, offering an overview of various market-based disaster risk financing mechanisms (including but not limited to insurance), and takes a wider look at disaster financing in the context of ongoing processes, such as development, climate change, and innovation in the fields of technology and finance. Box 1.3: , at the end of this chapter, offers some basic information about organizations that can assist or collaborate with disaster management stakeholders interested in practical steps to pursue design and implementation of risk financing initiatives. Chapter 2. describes a variety of risk-sharing instruments available to governments and other stakeholders managing risks at the macro level - including the opportunities and limitations associated with these instruments, for comprehensive risk management. Chapter 3. provides an analysis of one of the most rapidly growing financial tools for disaster management at small scales: microinsurance. Chapter 4. concludes by synthesizing key points, also outlining recommendations for setting up an enabling environment for smart risk financing initiatives as part of comprehensive disaster risk management.

Box 1.1: Some reference materials on market-based risk financing for disaster managers

Adaptation and Climate Change: Linking DRR and Insurance (Warner et al 2009): published jointly by ISDR and MCII, concludes that if appropriately embedded among risk reduction measures and with the right incentives, insurance has important potential to reduce disaster risk and advance adaptation.

Financial protection of the state against natural disasters: a primer (Ghesquiere, F and O. Mahul 2010): A comprehensive, in-depth review of risk sharing instruments and how they can support governments developing countries cope with the financial needs resulting from natural disasters, including managing excess volatility.

Index insurance and climate risk: prospects for development and disaster management (Hellmuth et al. 2009): rich in case studies and insights on how to support the most vulnerable, this publication by the International Research Institute on Climate and Society and partners explicitly mentions options for integrating risk reduction in insurance.

Managing agricultural production risk (World Bank 2005) reported on the progress being made in risk transfer approaches to manage agricultural production risk, focusing on innovations in developing countries that can also be used for other sectors exposed to disaster risks. Especially (1) use of index-based insurance; and (2) layering risk to facilitate risk transfer.

Protecting the poor: A microinsurance compendium (International Labour Organization 2006): With over 600 pages covering from principles and practices to operations and institutional options, this compendium covers the full spectrum of microinsurance as a social protection tool, including but not limited to disaster risk.

The Potential for Scale and Sustainability in Weather Index Insurance for Agriculture and Rural Livelihoods (Hazell, et al 2010). With detailed case studies and recommendations for donors and governments, this paper by IFAD and WFP examines the challenge of designing and implementing scalable and sustainable products for poor farmers.

Weather Index Insurance Programs – A Guide for Implementers and Promoters (World Bank, forthcoming). Developed by the Agricultural Risk Management Team, discussion paper targets program implementers in the pre-feasibility and feasibility phases of index insurance program development, covering key conditions and considerations.

1.1. Risk financing as an integral part of disaster risk reduction

Disaster risk reduction (DRR) is defined as the concept and practice of reducing disaster risks through systematic efforts to analyze and manage the *causal factors* of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (ISDR 2009). Lessening vulnerability implies addressing the conditions of a community, system or asset (determined by physical, social, economic, and environmental factors or processes) which make it susceptible to the damaging effect of a hazard.

As evidenced by the literature reviewed in the 2011 ISDR GAR, ex-ante DRR measures and strategies can not only yield substantial benefits in terms of lives and livelihoods during and after extreme events but can also help in reducing poverty, safeguarding development and adapting to climate change, with positive effects on broader global security, stability and sustainability. Still, households, business owners and government officials typically underinvest in loss-prevention measures (see Box 1.2.). While these measures can yield high dividends, clearly not all risks can be cost-effectively reduced, especially those that occur only very rarely. So how can policy makers encourage risk-reduction investments while also improving the economic capacity to cope with disasters?

Box 1.2. Behavioural Considerations for DRR

In hazard-prone areas, property owners often do not invest in cost-effective loss reduction measures; farmers rarely plan their crops taking account of rare weather events; and government agencies typically do not invest adequately in infrastructure or enforce regulations designed to reduce the likelihood and consequences of catastrophic events. Affected parties take action only after the disaster occurs.

How can one explain these choices? The field of behavioural economics can help. First, the problem is often framed imperfectly: experts focus on likelihood and consequences as two key elements of the risk. But decision makers rarely seek out probability estimates in choosing between alternatives (Huber et al. 1997). People have a hard time gauging how concerned to feel about a 1 in 100,000 probability of a catastrophic event without points of comparison. (Kunreuther, Novemsky and Kahneman, 2001).

Second, there is evidence that individuals (as citizens, business leaders or elected officials) tend to ignore risks with perceived likelihoods falling below some threshold of concern. Many property owners residing in hazard-prone communities dismiss the risk as negligible until after a disaster occurs. Even sophisticated risk experts in developed countries disregard some hazards. (Kunreuther and Michel-Kerjan, 2004).

There is a third reason why many people don't act until after a crisis has occurred. Individuals and firms have short time horizons when planning for the future so they may not fully weigh the long-term benefits of investing in loss reduction measures. This myopia is even more pronounced where there is only a small chance that the individual or organization will benefit from having taken such action. The upfront costs of mitigation loom disproportionately high relative to the delayed expected benefits over time. Applied to businesses and government decision making, short-term horizons can translate into a NIMTOF perspective (Not In My Term of Office): If a major crisis occurs "I hope it is not on my watch".

In addition to risk reduction, risk management includes strategies for financing the remaining or residual risks. Risk financing strategies are not restricted to conventional risk pooling and transfer (insurance) but encompass a full range of formal and informal, post- and pre-disaster mechanisms. These mechanisms or options are illustrated in Table 1, which gives examples of formal and informal risk financing instruments for agents at different scales: households and small and medium enterprises (SMEs) operating at the micro scale, microfinance institutions, donors and others operating at the meso scale, and governments as macro-scale operators.

Table 1: Examples of insurance and non-insurance mechanisms for financing risks (adapted from Linnerooth-Bayer et al, 2010a)

	Micro-scale risk financing Households/SMEs/ Farms	***Meso-scale risk financing*** Financial institutions, donor organizations, etc.	***Macro-scale risk financing*** Governments
Non-insurance mechanisms			
Solidarity	Post-disaster government assistance; humanitarian aid	Government guarantees and bail outs	Bi-lateral and multi-lateral assistance
Informal risk sharing	Kinship and other mutual arrangements; remittances		Diversions from other budgeted programs
Inter-temporal risk spreading	Micro-savings; micro-credit; fungible assets; food storage	Emergency liquidity funds	Reserve funds, regional pools, post-disaster credit; contingent credit
Insurance mechanisms			
Risk pooling and transfer /insurance	Micro-insurance; crop and livestock insurance; weather hedges	Re-insurance	Sovereign risk financing; regional catastrophe insurance pools
Alternative risk-transfer		Catastrophe bonds	Catastrophe bonds; risk swaps, options, and loss warranties, catastrophic risk deferred drawdown options

One of the most prevalent strategies for coping with the consequences of weather disasters, referred to here as *solidarity*, operates at all scales in the form of government support, humanitarian aid and other common forms of domestic and international assistance. Social solidarity often complements mutual arrangements among family or community members, or what is referred to as *informal risk sharing*. The augmented flow of remittances following a disaster is a good and important example of this type of informal financial mechanism. Alternatively, or in addition, households can save cash or assure the availability of fungible assets to provide capital for future investments in risk reduction and for post-disaster relief; or they can make pre- or post-disaster credit arrangements. For the same purposes, not only households but also governments can save, for example by creating catastrophe reserve funds. Savings, credit arrangements and reserve funds are all forms of *inter-temporal risk spreading* since they provide resources or require payments at some time in the future.

Similarly, micro-finance institutions (MFIs), which offer post-disaster credit in the event of a disaster, may be unable to provide this service because they, themselves, may face post-disaster capital deficits due to defaults on loans issued before the disaster. To deal with this type of meso-level problem, the Emergency Liquidity Facility (ELF) was created in Costa Rica with the participation of bi-lateral and multi-lateral organizations, as well as private investors, to provide needed and immediate post-disaster liquidity at break-even rates to MFIs. Of equal importance, ELF provides fledgling MFIs with technical know-how to help disaster-proof their operations.

However, without access to financial services, individual savings are often in the form of physical possessions that can be sold in times of need. Physical capital may be vulnerable to the destruction of disasters, and also to post-disaster commodity price decline due to market saturation. As an example of a donor institution addressing this problem, DFID is promoting mobile banking and special savings accounts earmarked for disaster recovery, into which a portion of remittances can be directly deposited.

As these examples show, an integrated financial strategy for disaster risk management can exploit a range of insurance and other options that help cope with the aftermath of a disaster, and should provide the support necessary to ensure access to these options for the most vulnerable.

1.2. Risk financing as a vehicle to promote disaster risk reduction

Insurance and related risk-transfer instruments, like most of the risk financing instruments described in the preceding section, are often conceived of as tools that mostly activate financial flows during or after an extreme event, in order to help cope with already-incurred substantial losses and reduce the magnitude of negative consequences. In other words: there is a widespread perception among the general public, including perhaps DRR practitioners, humanitarian workers and vulnerable people, that insurance-like instruments do nothing to prevent or mitigate the impact of hazards. A valid case often presented against insurance schemes is the possibility of moral hazard - i.e. risk of the insured party altering the outcome of the insured event (for example by driving recklessly if the car is insured and will be replaced after a crash).

Yet there are many ways in which insurance and similar instruments can actually promote ex ante risk reduction through market-based approaches. Well-known methods include:

- Price signals: for example, car theft insurance can encourage the reduction of theft risk if premiums are reduced for those who install an anti-theft alarm system in their car, therefore reducing the probability of the hazard materializing
- Making products contingent on certain conditions: for example, mortgage loans can require the installation of smoke detectors in the property being purchased, in order to accelerate the

response in case of fire and therefore reduce the magnitude of the loss once the fire hazard materializes.

- Providing needed safety nets and enabling vulnerability reduction: for example, unemployment and "social" insurance schemes allow low-wage workers to start promising but risky business ventures pulling them out of "working poverty" and reducing their vulnerability

Insurance and related instruments can also lead to the reduction of ex post losses. Again well-known examples include:

- Enabling post-event loss-reducing activities: for example, health insurance enables persons confronting a serious illness to receive hospitalization and medication that, without the insurance, are inaccessible, thus reducing the human losses from disease;
- Providing needed safety nets: emergency medical workers, without liability insurance, could not provide risky interventions that save lives.

Chapters 2. and 3. will discuss these types of risk reduction strategies as they relate to insurance for catastrophic natural disasters, targeting an audience of DRR practitioners that may not be aware of the available options at macro and micro level. Before proceeding to the central issue of this paper, namely addressing disaster risk reduction via specific risk financing approaches, the next section sets the stage for thinking of risk management in its broader context.

1.3. Disaster risk management in context

When considering options for a comprehensive disaster risk management approach, a large set of issues and processes shaping present and future conditions must inform the analysis of financial instruments. Paraphrasing the French philosopher Paul Valéry, it could be argued that the trouble with our times is that the future of risk management is no longer what it used to be: hazards, vulnerabilities and capacities are changing, often in ways that catch DRR practitioners unprepared. The Feinstein International Famine Center (2004) incorporated environmental factors in its comprehensive review of the global hazardscape, and provided international non-governmental organizations (NGOs) with a valuable outline framework for strategic planning in light of a multiplicity of likely challenges during the coming decade. Lagadec (2007) surveyed new and unconventional crises such as the 2004 Indian Ocean tsunami and the terrorist attacks of September 11, 2001, in proposing a set of reforms aimed at equipping disaster management institutions with frameworks to manage threats and opportunities that used to be unthinkable. This section focuses on four issues relevant to market-based instruments for improving disaster resilience: development, climate change, the role of markets vis a vis governments, and new technologies. Throughout the rest of the paper, these issues should be viewed as lenses through which the reader can reflect on the appropriate role of insurance and other market-based disaster risk transfer instruments.

1.3.1. Development

Many early writers on disasters and development, including Quarantelli (1978), UNDRO (1992), Blaikie, et al. (1994), have drawn attention to the multi-faceted interactions between natural disaster risk and human development. On the negative side, disasters destroy human, social and physical capital eroding development gains. Significant long-term macro-economic effects from disasters have been studied (see, eg, Mechler 2004). These long-term impacts can mean prolongation of poverty traps and hunger, lessened access to education, health services, safe housing, drinking water and sanitation, or degradation of the environment. As emphasized in the report *Reducing disaster risk: a challenge for development* (UNDP 2004), considerable incentive for rethinking disaster risk stems from the goals laid out in the Millennium Declaration.

Conversely, poorly planned development projects may increase disaster exposure, vulnerability and losses; for example by encouraging settlements on steep slopes, along floodplains or other hazard-prone areas, or supporting mono-cropping without the diversification necessary to build resilience against weather shocks. However, sustainable and "smart" development can reduce risks by addressing the underlying exposure and vulnerability of communities, including their access to economic and political tools.

According to Pelling (2003) despite 30 years of study, international development policy appears to have made little progress in generating protection for vulnerable people from the preventable losses of disaster. Part of the reason for this lack of progress lies in the sidelining of disaster in development studies and practice. Risk financing has received particularly little attention in the two-way causality between disasters and development.

Insurance and non-insurance financial instruments can, by providing timely capital following extreme event shocks, reduce the long-term economic and human damages of disasters. Insurance-related instruments have the additional advantage of setting a "price" on risk and in so doing creating incentives for far-reaching behavioral and institutional changes to further reduce disaster exposure and vulnerability. Indeed, financial instruments can, by providing safety nets and removing risks from balance sheets, enable poor households and farmers to take on higher-risk and higher-return activities that also promote development, and may offer the most vulnerable means of escape from disaster-related poverty traps.

The compelling benefits from risk financing strategies, and especially pro-active risk-transfer schemes, do not however imply that financial security will unconditionally promote economic growth or even human development. Nor is it suggested that poor households, farmers and others should necessarily invest in risk-transfer schemes. It should be borne in mind that insurance and other financial instruments have a high opportunity cost in terms of productive investments in the economy and human development (see Table 1). In a later section we will examine the costs of these risk sharing schemes in terms of resources diverted from other human needs and development projects.

1.3.2. Climate Change

The Intergovernmental Panel on Climate Change (IPCC 2007) reports that the frequency, intensity and geographic distribution of some weather-related hazards are already changing (see Figure 1). This threatens to undermine the resilience of poorer countries and their citizens to absorb loss and recover from disaster impacts. Climate change is thus a global driver of disaster risk (ISDR 2009).

The United Nations Framework Convention on Climate Change (UNFCCC), in its Article 4.8, explicitly calls upon developed countries to consider actions, including insurance, to meet the specific needs and concerns of developing countries in adapting to climate change. Insurance and other financial instruments can play a key role in adaptation by providing the security necessary to shoulder the uncertainties inherent in undertaking the management of changing climate risks (Linnerooth-Bayer, et al. 2010a), and the UNFCCC has commissioned a series of papers as part of its "Workshop on insurance-related actions to address the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and from the impact of the implementation of response measures" (UNFCCC 2009).

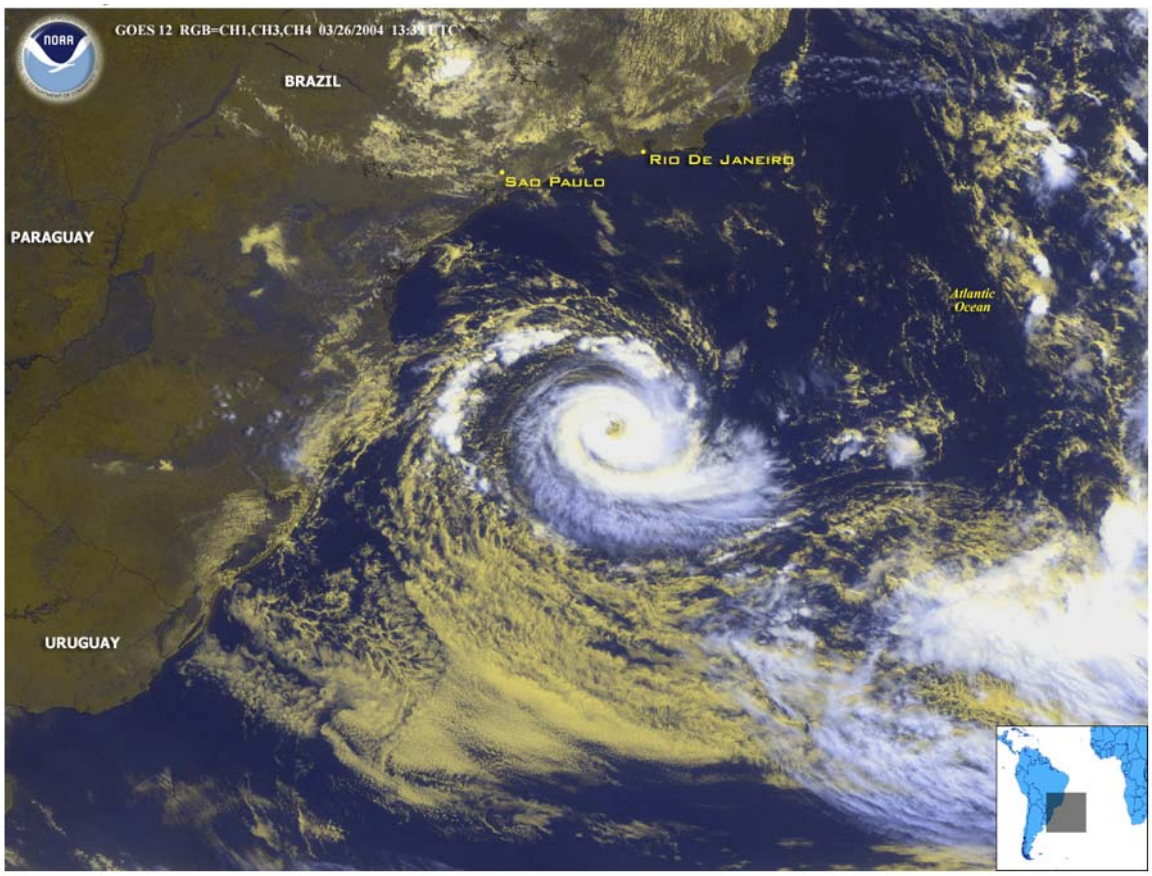

Figure 1: Hurricane Catarina on March 26th, 2004. This was the first documented hurricane in the southwestern Atlantic Ocean (Pezza et al. 2009). It hit the coast of Brazil two days later, with estimated winds of over 150 kilometers per hour. At least three people died. Until then it had been generally accepted that hurricanes could not form over the South Atlantic due to insufficiently warm sea surface temperatures and other factors (Gray 1968). This extreme event illustrates how global climate change may be increasing the risk of unprecedented disasters. (Source: NOAA 2005).

As conditions worsen for assets or endeavors particularly sensitive to climate risks, insurance can also generate signals for calling off investments in certain locations or activities. Micro-insurance schemes like the Ethiopian pilot described in Box 3.9 can actually contribute to adaptation on two levels: decreasing vulnerability to crop losses (by providing farmers with cash for food in times of drought), and by decreasing the magnitude of future losses.

Interactions between climate change and financial risk transfer can be complex. Based on models of regional climate change, researchers have estimated the near- and long-term potential climate impacts on the Malawi micro-insurance scheme (Hochrainer et al 2008). Although such predictions are limited by input data as well as the climate and insurance models employed, it was demonstrated that over the next ten years, climate-change induced stress will likely decrease the financial robustness of the Malawian insurance pool, with even more dramatic negative effects in the following decade. Without outside assistance, either the premium hikes or the additional back-up capital required to render the program robust can spell disaster for Malawi's and other schemes operating at the margin of financial viability. Heightened premiums also restrict farmers in obtaining needed farm inputs, ultimately encouraging them to adapt to climate change by seeking non-farming livelihoods.

Two proposals for including insurance in an adaptation strategy have recently been put forward to the UNFCCC for consideration (Linnerooth-Bayer et al. 2010b). The Munich Climate Insurance Initiative (MCII) and the Alliance of Small Island States (AOSIS) are proposing provisions to support preventive measures and to enable micro- and national insurance systems in vulnerable developing countries, through the provision of technical assistance, capacity building and possibly absorbing a portion of the insurance costs. At this writing, it is too early to gauge whether insurance mechanisms will be part of the eventual agreements that may result from the UNFCCC process in the years ahead. Regardless, of the emerging adaptation architecture, insurance is however likely to remain on the international agenda. Yet sceptics warn that if it is to help the most vulnerable, the insurance option requires careful thinking (Dixit and McGray 2009).

Despite the promise of risk transfer instruments as vital element in any overall disaster risk management strategy, they are not a panacea for adapting to climate change. There are concerns not only about affordability, but also adverse adaptation incentives, and attribution of the burden. Moreover, due not only to the relative prevalence of weak institutions and financially illiterate publics, but also because of the reduced reliability of static approaches (to quantification of climate-related hazard parameters), there are vast challenges to scaling up insurance systems.

1.3.3. Role of market forces

While expansion of risk financing is being widely promoted by numerous private sector organizations, NGOs and multilateral agencies, it is not without detractors – particularly given the ongoing debates about the role in the recent global financial crisis of government intervention (or lack thereof) versus free market forces. The invisible hand of competitive markets brought forward by Alan Smith is often portrayed as the best mechanism to allocate resources. Over the past few decades, the search for market solutions for the provision of public goods has been a driving force in development thinking – but there is also a discourse arguing that this approach can be taken too far because it tends to reduce the relative power of local, regional and national states vis a vis the forces of capital.

In vehemently arguing for more attention to a number of problematic aspects of market-oriented risk sharing instruments, Senholz (2009) cites (i) tackling symptoms instead of causes - thus distracting from necessary risk-reducing changes in the way economic activity is organized; (ii) asymmetries in knowledge and resources that may lead to private approaches crowding out successful public and communal initiatives; (iii) linking people's livelihoods and well-being to inherently volatile international financial markets, and (iv) privatizing risk transfer and thus creating problems for coverage and the redirection of public monies into private profit.

As will be illustrated with examples, donors and IFIs are increasingly engaged in supporting insurance programs. In some cases, such as in a recent set of microinsurace pilots developed in twelve villages across Africa in the context of the Millennium Villages project (Holthaus et al 2009), donors fully or even partially pay the insurance premium. A serious concern is raised, especially in light of climate change: Will subsidized insurance (like post-disaster food aid) keep farmers farming marginal lands when, ideally, they should switch to more suitable occupations? Non-subsidized insurance, the argument goes, will give proper price signals to those in marginal occupations for making these kinds of transformations, and thus discourage this and other forms of mal-adaptation.

Arguments against subsidization have a great deal of validity, but do not necessarily rule out all forms of donor support for micro-insurance. Some types of support actually correct market failures and are thus less price and incentive distorting. For example, in the Mongolian livestock insurance case discussed in section 3.4 , an upper layer of risks (i.e. catastrophic winter weather leads to over 30 per cent animal mortality) is borne by the government with backing from the

World Bank (Mahul and Skees 2006). The designers of this program argue that because the market usually fails to provide insurance for this upper layer, subsidizing is less price-distorting than with lower layers of risk. This arrangement, referred to as social insurance, not only renders the system more affordable to herders, but also protects local insurers against high claims and insolvency (Mahul and Skees 2006).

Reflecting on index insurance instruments for the poor, Hess and Hazell (2009) distinguish between two fundamentally different objectives affecting the design and delivery of risk transfer products: *protection* and *promotion*. Protection schemes are designed to safeguard livelihoods and assets (basically an alternative to more traditional relief programs). Promotion schemes, on the other hand, aim to help manage risks among those with viable businesses, such as small-scale commercial farming. The authors argue that protection schemes targeting the most vulnerable must inevitably be subsidized and require special delivery channels, whereas schemes that promote development should be channeled through private intermediaries – and do well without major subsidies if linked to a value proposition (for example by enabling participants to obtain new productivity-enhancing technologies or to participate in high-value markets that can significantly raise their expected incomes).

1.3.4. Progress in science and technology

Rapid progress in technologies, methods, financial instruments and educational approaches has led to innovation in how people, governments, businesses and humanitarian organizations manage disaster risks (Suarez 2009). For example, in early 2008 Kenya became the first country to use cash transfers through mobile phones for emergency response (Datta et al. 2008). M-Pesa is a cash transfer service that enables users to send electronic cash to mobile phone users in Kenya by short message service (SMS), without a bank account. Recipients can redeem this for conventional cash at agent outlets. During the post-election violence crisis in the Kerio Valley of northwest Kenya, the NGO, Concern Worldwide, decided to use M-Pesa instead of the usual approach of carrying and distributing food. A total of about $50,000 was disbursed to beneficiaries in 570 households; they were able to locally buy food and other necessities, therefore supporting the local economy. Mobile-enabled cash transfers allowed the NGO to overcome the challenges posed by the terrain and the security situation in timely, safe and cost-effective ways. The evaluation of this pilot (Brewin 2008) highlights valuable lessons for scaling up this approach.

For over a decade, new developments at the interface of finance and climate science have set the stage for promising new approaches to risk-transfer. These include instruments such as weather derivatives, catastrophe bonds and index-based weather insurance (Geman 1999). While conventional indemnity-based insurance is written against actual losses, index-based weather insurance is written against a physical trigger, such as insufficient cumulative rainfall during the germination period for a certain crop. In other words, index-based insurance indemnifies against *events* that cause loss, not against the actual loss (Turvey 2001). As an alternative to traditional insurance, index-based contracts allow for objective and transparent triggers, which can be used to determine when and to what extent assistance may be required. Key advantages of this are greatly limiting transaction costs and eliminating moral hazard. Importantly, index-based contracts allow disbursement of payouts as soon as the weather event is measured - in the case of droughts, expedient payments reduce the need for farmers to sell vital assets in order to cope with the disaster.

The accelerating pace of scientific and technological development is strengthening capacity to measure hazard-related variables, communicate data in real time to relevant stakeholders (including financial institutions and disaster risk managers), and apply it to models for estimating crop production, flood damage and other relevant systems susceptible to disaster losses. More

secure and accurate measurement options will increasingly influence both the pricing of index-based financial products and the demand from end users (World Bank 2005). New technologies also offer possibilities to expand the reach of customized of capacity building: The World Bank Agricultural Risk Management Team has developed Agrisktraining.org, a suite of training materials including a range of courses with slightly different foci and audiences (i.e. some discuss risk management broadly and are mainly targeted towards policy makers and those with limited background in risk transfer, whereas others are targeted towards practitioners and provide technical training on the design of risk transfer programs).

Given the likelihood of even more opportunities for innovation created by ongoing scientific and technological advances, now is the time to establish robust foundations, build capacity and expertise to help institutions prepare for a future offering many new ways to integrate risk financing into disaster risk reduction.

Box 1.3: Key entities in risk financing

While a comprehensive list is beyond the scope of this paper, this box lists key stakeholders and publications of potential relevance for DRR policymakers interested in designing or implementing risk finance instruments:

Access to Insurance Initiative: Led by the Gesellschaft für Technische Zusammenarbeit (GTZ), the mission of this initiative is to generate, validate and disseminate knowledge on how appropriate regulation and supervision can facilitate the provision of greater access to insurance markets for low-income clients.

Global Facility for Disaster Reduction and Recovery: GFDRR is a partnership of the International Strategy for Disaster Reduction (ISDR) system to support the implementation of the Hyogo Framework for Action. It is supporting numerous feasibility studies and other activities for insurance and other forms of risk financing in developing countries.

Global Index Insurance Facility: GIIF was established to develop and promote weather, disaster and commodity price risks in developing countries. A multi-donor trust fund aims to provide capacity building, technical assistance and other ways to promote market growth of indexable contracts (possibly including subsidies for premiums).

International Labour Organization: The ILO's Microinsurance Innovation Facility encourages insurance providers to develop and promote sustainable microinsurance models and products suited to the needs of the world's working poor.

United Nations Capital Development Fund: As both a facilitator and investor, UNCDF financial sector development programmes are designed to create enabling environments for financial service providers.

United Nations Development Programme: In line with its vision of transforming economies, UNDP's Environment Finance Group provides guidance to public authorities on how to choose and design financing schemes to create conditions that allow markets and private investment flows to address pressing environmental problems.

United Nations Environment Programme – Financial Initiative: UNEP FI is a global partnership between UNEP and the financial sector. Over 170 institutions, including banks, insurers and fund managers, work with UNEP to understand the impacts of environmental and social considerations on financial performance.

United Nations International Strategy for Disaster Reduction: The UN ISDR aims at building disaster resilient communities by promoting increased awareness of the importance of disaster risk reduction as an integral component of sustainable development.

United Nations Framework Convention on Climate Change: UNFCCC Article 4.8 calls upon developed countries to consider actions, including insurance, to meet the specific needs and concerns of developing countries in adapting to climate change.

Weather Risk Management Facility: Established through collaboration between the World Food Programme and the International Fund for Agricultural Development, this facility aims to facilitate access

to index-based risk management tools for smallholder farmers, and develop replicable models that have a potential for being scaled up.

World Bank: With its critical mass of risk transfer knowledge, the World Bank Group (WB) has been at the forefront of innovation in climate risk financing. The WB Catastrophic Risk Insurance Working Group convenes sixteen of its units engaged in insurance-related initiatives. According to Mahul (2008), WB interventions in catastrophe risk markets should be guided by five key principles: (i) promote catastrophe risk financing in the dialogue on DRM with developing countries; (ii) enhance competitive catastrophe risk markets; (iii) use risk-based price signal to encourage catastrophe risk management, (iv) limit public subsidy programs to those that minimize distortions of market price signals; and (v) develop customized catastrophe risk solutions.

World Food Programme: As the food assistance arm of the UN, WFP has invested in the development of financial instruments that enable predictable and timely transfers to address drought risk, and is championing innovative contingency financing approaches.

World Meteorological Organization: As the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, WMO is facilitating the provision of products and services relevant to risk financing, such as guidelines for standardized data and forecasts, coordinated research on patterns of risk, and modernization of observing networks.

Additionally, numerous other stakeholders are playing important roles in the risk financing field from the private sector, research and non-governmental organizations, including:

Academic institutions: Numerous research organizations are contributing to the field of risk financing, including the *International Research Institute for Climate and Society* (IRI), and the *International Institute for Applied Systems Analysis* (IIASA). Additionally, many universities are creating risk financing graduate programs and research centers.

Non-governmental organizations: A growing number of NGOs are working on innovative risk financing. For example, *Oxfam America* is currently testing an index-based insurance scheme in northern Ethiopia that directly leads to risk reduction measures (see Box 3.9). *Opportunity International* is carrying out its faith-inspired mission to serve the poor through microfinance, including the index-based weather insurance pilot in Malawi mentioned above. The *Munich Climate Insurance Initiative* (MCII), initiated by academics, NGOs, IFIs and insurers at a meeting in Munich in 2005, convenes key stakeholders to explore insurance-related solutions to help manage the impacts of climate change.

Private sector: Major reinsurance companies are involved in risk financing initiatives. For example, SwissRe has pioneered weather risk transfer schemes in developing countries, and launched its Climate Adaptation and Development Program to further risk transfer solutions; Munich Re is a key supporter of MCII, and the annual international microinsurance conference; Partner Re is the commercial risk-taking company to underwrite indexable weather and other indexable natural catastrophe risks in developing countries through GIRF, and Axa Re was awarded the contract for the WFP scheme in Ethiopia. Numerous other companies, including some based in developing countries, are engaged in risk financing at the country level, such as Basix in India. Some private sector firms have a not-for-profit arm engaged in training, advocacy and development activities.

2. FINANCIAL INSTRUMENTS FOR DISASTER RISK MANAGEMENT: HOW CAN THEY HELP GOVERNMENTS INCREASE RESILIENCE?

2.1. Introduction

Since not all risks can be cost-effectively reduced, especially those that occur only very rarely, policy makers are seeking advice on financing the remaining or residual risks in order to assure timely relief, recovery and reconstruction. Risk financing is thus an integral part of risk management. This section examines financial instruments for governments and asks how they can both increase resilience and encourage cost-effective vulnerability reduction.

Government authorities choosing not to retain full financial exposure to catastrophe risk can exchange financial risk for a fixed price or premium. Instruments that make such trades possible are referred to as market-based risk-transfer instruments. The most common of these instruments is commercial insurance, but there is growing interest in alternative risk-transfer instruments, such as catastrophe bonds and contingent credit, as well as in regional catastrophe pools that increase diversification and reduce insurance premiums.

Several recent publications are helpful in gaining familiarity with insurance and other disaster risk financing instruments. Drawing from the substantial experience of the World Bank, Ghesquiere and Mahul (2010) offer a comprehensive, insightful primer prepared for policy makers interested in strategies to increase the financial response capacity of developing country governments in the aftermath of natural disasters, while protecting long-term fiscal balance. Their analysis addresses the types of instruments currently available, their relative costs and speed of disbursement, and how these can be combined to provide cost-effective financing for the ensuing phases of a disaster. Other useful references examine the principles for public intervention in catastrophe risk financing, including reports by Mechler (2004), Cummins and Mahul (2008) and Hochrainer and Pflug (2009). Syroka and Wilcox (2006) argue convincingly for the use of contingency financing to achieve forward-looking management of disaster risk portfolios, especially in the application of international disaster aid finance. UNISDR has published a report on links between insurance and risk reduction from the perspective of adaptation to climate change (Warner et al 2009).

The purpose of this chapter is to help decision makers concerned with risk reduction in understanding market-based risk-transfer instruments at the macro level, including the opportunities as well as limitations in their use for comprehensive risk management. Particular emphasis is given to how governments and other stakeholders can use financial instruments in order to:

- provide incentives for vulnerability reduction,
- enable the reduction of medium- and long-term disaster consequences, and
- support post-disaster fiscal stability to protect long-term development objectives

This chapter is further structured as follows: Section 2.2. presents key reasons for government entities to consider market instruments to transfer disaster risk. Section 2.3. provides an overview of the most important risk-transfer instruments, with case studies and practical ideas on how disaster management organizations can use these instruments to pursue risk reduction goals. Section 2.4 discusses the costs and risks involved. Section 2.5. explores the circumstances under which governments are likely to find risk transfer options desirable, examining the theory, the alternatives and the crucial issue of resource gaps. Section 2.6. concludes by arguing for a balanced risk management portfolio.

2.2. Rationale for public sector risk transfer

There are three principal reasons for governments, especially in countries with high exposure and vulnerability to hazards, to consider arguments for and against market-based financing instruments (Linnerooth-Bayer et al. 2005). First, governments are typically responsible for large portfolios of public infrastructure assets subject to risk. Compared to wealthy countries, in developing and transition countries the ratio of public sector losses to overall losses can be significantly higher. For example, public-sector losses from the 1997 Polish floods were 45 per cent of total losses, compared to 20 per cent in the case of the 1993 mid-western US floods (Linnerooth-Bayer, et al. 1999).

Beyond repairing public infrastructure damages, another reason for vulnerable governments to consider proactive risk financing is to guarantee sufficient capital for emergency relief and assistance to affected households, businesses and communities. If governments lack the necessary infusion of post-disaster capital to rebuild critical infrastructure, restore homes and provide humanitarian assistance, indirect costs can greatly surpass the direct losses of a disaster. As Pakistan's millions of flood victims without sufficient food and water bear witness, these costs can have dire human and economic dimensions. Such delays can also trigger secondary economic and social effects, such as deterioration in trade, budget imbalances and an increase in poverty (Benson, 1997; Freeman et al., 2002; Barnett et al. 2008). Honduras, as one example, experienced difficulty in repairing public infrastructure and assisting private sector recovery from the devastation of Hurricane Mitch in 1998. Five years later, the GDP of Honduras was 6% below pre-disaster projections (Mechler, 2004; Telford, et al., 2004). As another example, many Ethiopian households, lacking government assistance, sold productive assets to survive the 1984-85 drought-induced famine. These households continued during the 1990s to experience considerably less annual per capita growth than those which had not experienced the drought (Wiseman and Hess 2007).

The most critical third piece of the rationale for developing and emerging-economy countries to engage in pre-disaster financing is their higher propensity for post-disaster resource deficits. Governments of developing countries typically face diverting from their budgets or from already disbursed development loans to finance post-disaster expenses, also relying on new loans and donations from the international community. Historically, these sources of post-disaster finance too frequently prove inadequate to fund a timely humanitarian response. At this writing, less than two percent of $5.3 billion in assistance promised at an aid conference two months after Haiti's 2010 earthquake disaster has been delivered (Johns and Fox 2010).

2.3. Market-based financial instruments for sovereign states

In this section we discuss three of the most typical sovereign risk-transfer instruments and arrangements - including commercial insurance, catastrophe bonds and contingent credit. Text boxes in each subsection illustrate some of the possibilities for further developing these financial tools to help advance disaster risk reduction.

2.3.1 Insurance: sharing risk across space and time

Insurance provides indemnification against losses by pooling risks in exchange for a premium payment. Persons or governments affected by a disaster benefit from the past or recent contributions of the many others in the pool not affected, and thus receive a pay-out greater than their premium payment. By distributing disaster losses across a pool of at-risk persons and governments, insurance lessens the risk of insufficient capital when a disaster strikes and thus. reduces the down-stream human and economic consequences. By providing timely financial assistance following extreme event shocks, and by removing the risks from governmental balance sheets, investors may be more willing to commit capital to a country. The next subsections

examine (i) insurance for governments (sometimes called sovereign insurance), (ii) insurance for donors that support governments and (iii) insurance pools among small sovereign states.

2.3.1.1 Insurance for governments

Governments wishing to insure their assets and guarantee sufficient capital for response and relief activities turn, not to local insurers, but to reinsurers (or insurers that operate internationally) because of their capacity to absorb risks of even large countries. Governments can also act as insurers of last resort for private or public/private insurers, and in this capacity may purchase reinsurance in order to transfer some of their risks outside of the country. The reinsurance market's capacity has grown significantly—from less than $40 billion in 1994 to about $70 billion in 2002 (Swiss Re. 2004). The September 2001 attacks on New York City greatly impacted world reinsurance capacity and prices, including those for natural disaster risks. Since then, reinsurance capacity has decreased due to events such as Hurricane Katrina and the financial crisis (Aon Benfield 2009), causing reinsurers and regulators to reexamine capacity requirements.

Although governments in the past have seldom purchased catastrophe insurance (often for good reason as discussed in section 2.4.1), there are recent exceptions. Responding to lessons learnt from Hurricane Mitch, the Honduran government insured its quasi-private public infrastructure, including airports, telecommunications and energy facilities (but not roads and other transport and water infrastructure). Barbados and the Czech Republic are among the few developing and transition countries now insuring public infrastructure (Linnerooth-Bayer and Mechler 2007).

Catastrophic risks are becoming more insurable as risk-estimating methods and computer technologies improve, and as better knowledge reduces the problem of adverse selection.[1] However, catastrophe models and other methodologies for estimating risks can never yield unambiguous measures. Historical data on rare events is by definition sparse, and changing climatic, land-use and other conditions require scenarios representing an uncertain future. In part due to these ambiguities in risk estimates, insurers have pulled out of some catastrophic risk markets.

Box 2.1: Opportunities to reduce disaster risk through insurance

Insurance mechanisms sharing risk across space and time could be designed in ways that provide incentives to lower the magnitude of future losses associated with extreme events. For example:

a) Risk reduction as a prerequisite for insurance contracts: In order to strengthen resilience to future disasters, it is possible to require as a precondition to qualify for the insurance policy the implementation of measures that minimize the susceptibility of clients to the direct impacts of natural hazards.

b) Risk reduction as a lever to lower insurance premiums: Properly designed insurance instruments actually "price" risk based on probability of loss, and can thus create incentives for vulnerability reduction.

c) Forecast-based insurance for risk reduction: While most insurance payouts are triggered by an event that causes loss, it is possible to design insurance instruments that are tied to a forecast of imminent, avoidable loss – therefore allowing government and other stakeholders to prepare for the likely shock and reduce the magnitude of possible human and economic losses. See below the Peruvian example linking insurance to El Niño seasonal forecasts (case study 1).

[1] Adverse selection arises from a situation of asymmetric information between insurers and those seeking insurance, which can result in more high-risk persons purchasing insurance than those with lower risks.

Turning to the link between insurance and risk reduction, it is important to note that ill-conceived insurance instruments can be plagued by moral hazard and perverse incentives (encouraging investments in risk-prone areas or sectors), or by subsidies that may significantly distort prices or competition – ultimately increasing disaster exposure, vulnerability and losses. At the same time, as indicated in Box 2.2: , there are approaches that can effectively encourage risk reduction through insurance instruments.

Box 2.2: Contingent insurance in Peru to reduce losses associated with El Niño forecasts

The seasonal nature of rainfall in Peru and other parts of the world is influenced by the temperature of ocean waters, which under certain circumstances change in somewhat predictable ways. In the case of Peru's coastal region of Piura, seasons with extreme rainfalls are often preceded by the El Niño phenomenon – an unusual warming of the tropical Pacific Ocean that can be observed and measured with a lead time of months (Glantz 2001).

Working with local, regional and national governments, as well as with private financial institutions and other stakeholders, GlobalAgRisk Inc. (2010a, 2010b) is helping to develop a financial instrument that disburses a payment in relation to a seasonal prediction (i.e. triggered by an observed index related to El Niño), so that the insured entity receives an amount of money that can be used to mitigate losses that would likely occur in the absence of the insurance policy. This makes it a special class of insurance that fits better as contingent insurance (where the magnitude of payment is dependent on the premium actually paid, rather than the loss incurred). The most severe consequences of an extreme El Niño would manifest as floods during the month of February. The intent of the policy is to provide payments for the insured in January, to be used for a wide range of purposes, therefore enhancing both risk coping and risk reduction measures in the face of the enhanced threat of flooding.

Options for ex-ante risk management could range from maintenance of urban drainage systems and optimization of dam operations, to strengthening of irrigation infrastructure in banana plantations, as well as adjusting plans for cash flows to take into account likely loss of income. The most significant progress is a request in the Piura Regional Government budget to purchase the El Niño Insurance in January, 2011, to protect against the possibility of catastrophic flooding that could begin in early 2012 with a severe El Niño. This project led to new thinking and opportunities regarding the potential for "forecast index insurance" - in particular with regard to El Niño Southern Oscillation, which can affect seasonal patterns of rainfall, temperature or tropical cyclones in parts of Africa, Asia/Pacific and the Americas.

2.3.1.2 Insuring donors that support governments

Like governments, donor organizations provide assistance, sometimes in the form of cash payments, for post-disaster relief. In the case of large-scale droughts and other disasters, donor organizations and the institutions they support can become strapped for cash (particularly in the crucial time window between the observed natural hazard and its manifestations of avoidable losses - such as long-term health impacts due to malnutrition in children that can be addressed by timely food distribution). In such cases donor organizations, themselves, might consider insurance for rapid deployment of assistance, or alternatively they may help arrange insurance for vulnerable governments. This was the reasoning behind an innovative idea by the World Food Programme (WFP) to set up an insurance program to relieve its limited capacity to provide timely cash to the Ethiopian government in the case of extreme droughts (see Box 2.3:).

Box 2.3: The Ethiopian index-based insurance project

To supplement and partly replace Ethiopia's traditional food-aid response to famine, the World Food Programme (WFP) supported the government-sponsored Productive Safety Net Programme (PSNP) by insuring it against extreme droughts. The contract was designed to provide a maximum payout of about US$7 million for an annual premium of US$930,000 financed through a USAID grant. The PSNP provides immediate cash payments in the event of food emergencies. In the case of very severe droughts, however, this donor/government system is sufficient to save lives, but not to save livelihoods. The WFP thus

designed an index-based insurance system to provide extra capital in the case of extreme drought, the amount being based on contractually specified catastrophic shortfalls in precipitation, measured in terms of the Ethiopia Drought Index (EDI). Rainfall data is taken from 26 weather stations representing the various agricultural areas of Ethiopia. In 2006, WFP successfully obtained an insurance contract based on the EDI through AXA Re, a Paris-based reinsurer (Wiseman and Hess, 2007). A limitation of the WFP Ethiopian system proved to be its integration with other programs targeting those chronically short of food, and especially nomadic herders. The insurance contract did not trigger in 2006 and was not renewed in 2007.

It should be noted that the design of this WFP insurance scheme took into account risk reduction considerations: given the delay between observed drought (which triggers the payout) and the loss of lives and livelihoods likely to occur due to crop failure (which would only manifest months later), the predictable availability of funds allows disaster managers to formulate drought contingency plans tailored to anticipated drought scenarios. Appropriate and timely response is based on an early warning system with reliable baseline and trigger points and a clearly defined target population. This allows the humanitarian intervention to invest in ex-ante measures, not only to address the threat of immediate food insecurity, but to do so in ways that can prevent the depletion of households' productive assets. As a result, subsistence farmers are able to produce more food during subsequent seasons with decent rains - reducing the risk of future food shortages and the demand for humanitarian aid.

This experimental pilot transaction provides only a small amount of contingency funding and would need considerable expansion in order to be prepared to assist the at least 17 million Ethiopian farmers who risk falling into destitution as a result of extreme drought. For this purpose, the second phase of PSNP (2008-10) introduced the idea of coordinating a pool of contingent resources that can be readily allocated in the event that many households become food-insecure (Cummins and Mahul 2008). The potential for combining index-based approaches and safety net tools is, according to Wiseman and Hess (2007), substantial. Well-established safety net programs, such as the PSNP, can be scaled-up relatively quickly. In addition to ensuring that resources can reach beneficiaries before negative coping strategies are employed, there are also spin-off benefits. Most importantly, the predictability of the system and related monitoring/evaluation systems can support more comprehensive contingency planning.

Box 2.4: Opportunities for risk reduction via insurance for donors and the humanitarian sector

Despite frequent calls for ex-ante disaster risk management, funding sources for both donor organizations and the humanitarian sector continue to emphasize post-disaster relief. An unpredictable, often slow arrival of funds makes it very difficult to integrate risk reduction measures into disaster operations. Index-based insurance mechanisms can offer ways to facilitate the integration of measures that reduce imminent as well as future losses into crisis management activities. Two possible options can serve to illustrate:

a) Activate deployment of funds when physical variables indicate serious threat of disaster: Instead of waiting for evidence of human and economic losses to reach the back-donors (often reliant on media coverage), index-based insurance instruments could be set up based on the observable physical variables that precede a disaster (as in Case Study 2 on Ethiopia), or even variables correlated with higher chances of future extreme events leading to avoidable losses. For example, observed or predicted extreme rainfall in the upstream reaches of a large watershed could trigger payouts that would activate contingency plans for managing floods in urban or rural areas downstream. If the reliable funding secured through index-based instruments can help design and implement disaster preparedness measures that save substantial life and assets, this approach may be worth the additional costs associated with an insurance instrument.
b) Bundle risk reduction initiatives into disaster response and recovery measures: Risk reduction thinking consistently gets sidelined during times of crisis, often leading to short-sighted decisions that create new vulnerabilities in the long term. By linking specific events that trigger payouts with explicitly defined post-disaster measures (such as retrofitting of damaged critical infrastructure so that it can withstand future hazards), it is possible for decision-makers to create self-commitment mechanisms – ensuring that the implementation of measures to restore or improve the pre-disaster conditions of the affected community take into consideration the possible threat of future hazards.

2.3.1.3 Insurance pools among small states: safety in numbers

Developing country governments, particularly those of small states, pay international prices for insurance, which are subject to fluctuations often caused elsewhere. Barbados, one of few countries insuring public infrastructure, experienced a ten-fold increase in insurance premiums in 1992 after Hurricane Andrew - despite Barbados not lying in a major hurricane path (Cummins and Mahul 2008). Larger countries can generally absorb the impact of adverse natural events since an affected region can be subsidized by revenues from unaffected regions. This type of geographic distribution of risk is not possible in small island states, like Barbados, which can however benefit from pooling arrangements which extend beyond their borders.

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is an innovative new pool which provides 16 participating governments with immediate liquidity in the event of a major hurricane or earthquake, at a significantly lower cost than if they were to purchase insurance separately in the financial markets (see Box 2.5:). Governments contribute resources to the pool relative to the exposure of their country, and the fund is reinsured in the capital markets. Early cash claim payments received after an event help overcome the typical post-disaster liquidity crunch.

Box 2.5: Caribbean Catastrophe Risk Insurance Facility

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) became operational in June 2007 with the participation of 16 Caribbean countries. These governments contributed resources ranging from US$200 thousand to US$4 million, depending on the exposure of their respective countries to earthquakes and hurricanes. This better-diversified portfolio has resulted in a substantial reduction in premium costs (about 45 – 50%) for the participating countries. The CCRIF fund covers up to 20% of estimated loss, and claims are paid based on an index for hurricanes (wind speed) and earthquakes (ground tremors). Initial funding by donor organizations supported start-up costs and helped to capitalize the pool. The facility can transfer the risks it cannot retain to the international financial markets through reinsurance, catastrophe bonds, or other financial instruments. The accumulation of reserves over time should lessen the facility's dependence on outside risk transfer. Should total insured losses exceed claims-paying capacity, payouts are pro-rated, based on the total amount of expected claims compared to remaining available funds. In addition, donors are adding to the reserves. The governments of Bermuda, Canada, France, the United Kingdom, as well as the Caribbean Development Bank and the World Bank recently pledged a total of US $47 million to the CCRIF reserve fund.

The CCRIF acts much like mutual insurance. It is established as an independent legal entity, managed by a specialized firm, under the supervision of a Board of Directors composed of donor representatives. (Ghesquiere et al. 2006; World Bank 2007)

With reinsurance and pro-rated contracts, CCRIF appears well protected against insolvency. A major concern about the long-term acceptance and viability of the pool, however, is basis risk, which is the lack of correlation of the index-based trigger with the loss incurred. This was illustrated when Hurricane Dean imposed damages on Jamaica in 2007, which were not sufficient to trigger compensation from the pool. This created considerable controversy about the value of the insurance contract, and CCRIF became an issue in the ensuing elections. The following year Haiti experienced three hurricanes collectively causing considerable damage; however, most of the damage was due to flooding and not wind and thus a payout was not triggered. In contrast, the ability of CCRIF to make funds available at a critical hour was demonstrated after the 2010 earthquake: CCRIF funds represented the first payment received by the Haitian government out of all the pledges made internationally and regionally, and accounted for 50% of funds received by the government within the first 10 weeks of the disaster. There is as yet, however, no documentation on how these funds have been administered given the multifaceted weaknesses of

the post-disaster government. The Haiti example underscores the importance of good governance and reliable institutions to administer any sovereign risk financing program, whether it is insurance, credit or donor assistance.

Finally, it is important to point out that transparency and public involvement may be critical for the acceptance of catastrophe insurance pools. In a series of interviews in four Caribbean countries, it was revealed that government officials (outside of finance ministries) and civil society organizations had little knowledge of CCRIF (Pierro, 2010). At the community level there was also little awareness or oversight of the regional insurance pool. This raises the issue of how much public awareness, should (and does) exist for public finances more generally, and how this might be improved.

Box 2.6: Opportunities for risk reduction through pooled risk

"Indexed" or "parametric" risk pools (like the CCRIF) are designed to pay out if a pre-specified event occurs. A key aspect of this design is that there is very little associated moral hazard. Since the payout is not based on actual losses, the insured government has every incentive to reduce potential losses without reducing the insurance payout. This positive incentive (or absence of a negative incentive) for risk reduction is a major advantage of index based insurance pools.

Risk reduction measures taken by pool members could be more directly mandated or encouraged. CCRIF, for instance, is enabling risk reduction by providing governments with access to hazard maps and information on hazard impacts on populations, land area, ports and airports. Recognizing that climate change will greatly impact the island states, CCRIF is reportedly investing significant resources in the development of a quantitative knowledge base for key climate change risks and adaptation strategies for decision making (CCRIF, 2009).

More could be done. While no pooled state can expect to gain from the risk reduction measures taken by another, it is likely to be in their joint interests to share experiences and work together on risk reduction. This could be encouraged, even required, by donor governments and financial institutions that contribute to the capitalization of such a pool.

2.3.2 Catastrophe bonds: tapping international financial markets

An alternative to commercial reinsurance is a catastrophe bond, an instrument whereby the investor receives an above-market return when a pre-specified catastrophe (measured in terms of an index, for example, earthquake intensity) does not occur in a specified time but sacrifices interest or part of the principal following by the event. By hedging catastrophe risk for a payment, catastrophe bonds serve the same purpose as reinsurance. Yet the risks are not absorbed by international insurers but directly by financial markets via investors (for example, pension fund managers), who receive a contingent interest rate calculated on the basis of the estimated risk. Catastrophe bonds can be attractive to investors who wish to add non-correlated investments to their portfolio. Disaster risk can thus be transferred to international financial markets that have many times the capacity of the reinsurance market.

The first developing country government to issue a catastrophe bond was Mexico, in order to provide security to its catastrophe reserve fund (Cardenas et al. 2007). In 1996 Mexican authorities created a financial risk management program (FONDEN) including a catastrophe reserve fund. Almost a decade later and after a severe hurricane season, FONDEN was exhausted, leading the Finance Ministry to consider hedging against natural disaster shocks. As a result, in 2006 the authorities engaged in an international risk-transfer transaction to provide financial protection to the fund (see Box 2.7) – and Mexico became the first transition country to transfer its public sector catastrophe risk to the international reinsurance and capital markets.

Box 2.7: The Mexican catastrophe bond

In 2006, the Mexican government chose to insure its catastrophe reserve fund, FONDEN, against major earthquakes with a mix of reinsurance and a catastrophe bond. The resulting contract was linked to a parametric trigger in terms of magnitude and depth of seismicity for the three-year period 2007-09. The catastrophe bond provided cover of US$160 million for a premium/interest totaling $26 million. The major reinsurance company, Swiss Re, issued the bond, which pays an interest of 2.3 percent if payment is not triggered. An insurance claim payment is triggered if:

- an earthquake with specified magnitude and depth is recorded with its epicenter located in one of the specified zones; and if
- there is official declaration of a disaster by a federal agency.

Three regions in Mexico considered at highest risk were thus financially protected. Mexico has received substantial technical assistance from the World Bank and Inter American Development Bank over the years, but, as a middle-income developing country and member of the OECD, Mexico financed the transaction out of its own means. (Cardenas et al. 2007)

Since it is held by an independent authority, one major advantage of a catastrophe bond is the avoidance of political risk, or the risk that the funds will be internally reallocated to other government programs (which plagued FONDEN). As with any risk-financing instrument, there is no guarantee, however, that the post-disaster bond payments will reach those most in need after a disaster - the so-called "last mile".

Other similar instruments include catastrophe futures or options contracts, also designed to provide insurers and reinsurers with an alternative or supplement to traditional reinsurance. They allow parties to hedge catastrophe risk exposure through access to the capital markets.[2] In 1992, the Chicago Board of Trade issued the first catastrophe insurance futures and options contracts based on a loss index that has subsequently been adjusted to better reflect insurer losses. Governments can also engage in risk swaps with another government facing non-correlated risks, an instrument that is used extensively by insurance companies (Cardenas 2008).

The potential of insurance and alternative insurance instruments for transferring the risks of disasters to investors across the globe is enormous. Worldwide losses from extreme disasters are only a small percentage of the world capital market, which deviates every day by several billion dollars. This highlights the scope and potential of transborder risk transfer, especially for governments of poor countries unable to form a viable insurance pool of taxpayers within their borders.

Box 2.8: Opportunities for risk reduction through catastrophe bonds

Given ongoing progress in the scientific and technological foundations of catastrophe bonds and other financial instruments, it is possible and desirable to embrace a long-term vision for nurturing new ways to manage climate-related hazards through innovative risk finance. Satellite-based index triggers, web-based tools supporting financial exchanges and other likely developments can be expected to reduce the cost of formulating and establishing a variety of catastrophe bonds, which are essentially a contract agreed by disaster managers and willing investors. Examples of tailor-made mechanisms could be to:

a) Design bond instruments aimed at funding forecast-based, loss-reducing measures: Instead of triggering payment when the losses are occurring, the transfer of funds could be tied to observable physical variables linked to predictions (i.e. El Niño at seasonal scales, or tropical cyclones that according to computer models have a certain probability of hitting a specific location with a given magnitude within a certain lead time). Thus, financial resources could be made available in a timely manner for carrying out pre-planned measures to reduce the impact of the forecasted event.

[2] A *hedge* is any instrument that provides the contracting parties a payment if they experience losses.

b) Create instruments that provide additional funds during reconstruction, to enhance risk reduction: Investing in risk reduction can be much more cost-effective than investing in post-disaster relief, particularly in cases where recent damage requires new investments in places where the natural hazard that caused damage remains a threat. Therefore, in theory it should be possible to find willing investors interested in investing in catastrophe bonds or similar instruments designed to fund exclusively *the incremental costs* associated with adding risk reduction measures to reconstruction efforts (for example, retrofitting a damaged school so that in addition to serving as a space for educational activities, it can be used as a safe shelter in the event of another disaster in the same location at a future time).

2.3.3 Contingent credit: ensuring access to loans in times of crisis

One of the most common post-disaster financing instruments is a government loan, which in the developing world can be restricted to borrowing from international financial institutions. Since the early 1980s, the World Bank and other IFIs have loaned large amounts of post-disaster capital to governments throughout the developing world. Yet these loans are limited and there is a growing discrepancy between the level of reconstruction resources available from the international community and the growing funding needs of disaster-prone countries.

To partly counter this problem, governments can arrange contingency credit by paying a fee for the option of a guaranteed loan at a pre-determined rate, contingent on a disaster or some other defined event occurring. Contingent credit arrangements do not transfer risk spatially, but spread risk inter-temporally. In exchange for an annual fee, the risk cedent, in this case the government, has access to a pre-specified post-event loan that is repaid under contractually fixed conditions.

Box 2.9: Contingency credit for Colombia and Mongolia

Colombia was the first country to secure contingent capital from the World Bank to provide immediate and less expensive capital to the government when it is most needed. Natural disaster risks in this country are high - on average Colombians face more than one severe flood every year and a strong earthquake every two years. Past disasters, including the 1999 Armenia earthquake, have caused losses up to US$3 billion. At the same time, fiscal operations are heavily constrained by high external debt and debt service payments, which severely limit the ability of the central government to respond to disasters. To ensure sufficient post-disaster capital, the government of Colombia and the World Bank designed a project to reduce the country's fiscal vulnerability by strengthening disaster risk management. This was financed through a World Bank loan including a contingent credit arrangement for US$150 million in order to provide the government with immediate post-disaster liquidity. (Cummins and Mahul 2008)

A similar instrument designed since 2005 for the government of Mongolia, which is acting as a reinsurer of last resort for the nation's Index-Based Livestock Insurance program, protects the government against large livestock losses due to exceptionally bad weather. A US$5 million contingent credit line has been made available by the World Bank (Cummins and Mahul 2008).

Although contingent capital can potentially provide a government with lower cost capital relative to either insurance or the accumulation of reserves, the major disadvantage is that it can also exacerbate a country's debt burden. The desirability of this product thus depends on the country's post-disaster financial profile, and more specifically on its post disaster fiscal situation (Cummins and Mahul 2008).

Box 2.10: Opportunities for risk reduction through contingent credit

Contingent credit arrangements put in place by an international financial institution can, in theory, be linked to risk reduction requirements. This is the intent of the Catastrophe Risk Deferred Drawdown Option (CAT DDO), a new financial product offered to middle-income country governments by the World Bank. Its purpose is to make financing credit immediately available after a disaster and is intended to fill the gap

while other sources of funding, such as emergency relief aid, are being mobilized. Importantly, countries that sign up for the CAT DDO must have an adequate hazard risk management program, including measures for disaster risk reduction, in place. The borrowing government is expected to implement this program, which will be monitored by the World Bank. The loan may be "drawn down" after a natural disaster unless the government has received prior notification that their disaster risk management program is not being implemented in accordance with the agreement (World Bank 2008).

Contingent credit instruments could be designed with additional conditionalities aimed at ensuring that DRR measures are fully integrated into the use of funds after the extreme event. The urgent needs of those made vulnerable by the lack of basic services in the aftermath of a catastrophic event often becomes an excuse to build infrastructure that can't withstand the next event. In other words: *Reconstruction efforts often end up reconstructing vulnerability* - and they constitute the lion's share of post-disaster financial expenses (see Figure 2 further down). In the same way that CAT DDO includes conditions on pre-disaster issues, innovative contingent credit instruments could be shaped to require vulnerability reduction in the use of the released funds.

2.4 Costs and risks of market-based instruments

In the words of experienced financial risk management experts: "Life would be easy for financial planners if financial instruments could be used without regard to cost" (Ghesquiere and Mahul 2010, p.7). This section discusses the relative costs and risks of the instruments described above (including insurance, catastrophe bonds and contingency credit), whereas section 2.5. compares these costs and risks with those of the alternatives - such as relying on donor assistance, diverting funds from other budgeted projects, borrowing on the domestic and international markets or tapping into reserves set aside for this purpose.

2.4.1 Insurance

Sovereign insurance is costly. Over time, governments typically pay more for catastrophe insurance than their expected losses. Figure 2 illustrates many reasons for the high cost of catastrophe insurance (Cummins and Mahul, 2008). Premiums are inflated above the annual expected loss not only by the cost of holding sufficient capital to pay claims in the event of large or multiple disasters, but also by the cost of assuming uncertain contracts and frictional costs (*contingency load*). There is also an *expense load*, which reflects the costs of doing business.

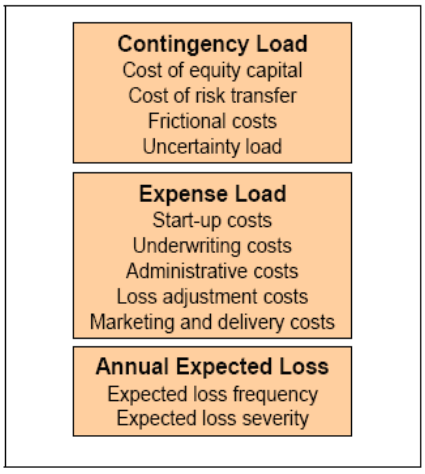

Figure 2: Costs contributing to catastrophe insurance premiums (Cummins and Mahul, 2008).

In sharp contrast to catastrophe bonds, the transaction costs of insurance are relatively low, approximately 1% of the cover amount (Lane 2004). Still, providing insurance for a single government can involve higher transaction costs because of the need to tailor the product to one large customer.

An additional factor not shown in Figure 2 that can contribute to the costs of catastrophe cover is imperfect competition in insurance and reinsurance markets, which can lead to excessive profits (Froot and O'Connel, 1999). Other contributing factors include ambiguity or uncertainty aversion by the insurer, adverse selection and moral hazard. Due to the extreme nature of the losses and the substantial costs involved in such transactions, disaster insurance and other risk financing instruments generally absorb only specified layers of risk, defined by an attachment and exit point (with the lower and upper limits based on the recurrence period of the events). Low layers of risk, for which the government is able to raise sufficient funds for financing the losses, will typically be retained.

Risks of adverse selection and moral hazard facing conventional insurance systems are absent in the case of index-based programs, such as those in Ethiopia and the Caribbean mentioned previously. Basis risk may be one of the most difficult challenges facing these programs. Will governments of Caribbean states continue supporting such a system if a major loss occurs for which they are not compensated?

Besides the premium cost, an important consideration for governments selecting among reinsurance companies is their credit risk, which reflects the capability of a company to honor its acquired obligations. Premiums differ according to credit rating, i.e., insurers with high ratings are able to demand a higher premium in the market. There is no publicly available information on the premium differentials associated with credit rating, but it is known that less than 10% of reinsurers hold the best credit rating of AAA (Cardenas et al. 2007).

2.4.2 Catastrophe bonds

Although it may appear that reinsurance and catastrophe bonds provide the same product to the client, there are important differences. As noted above catastrophe bonds have negligible credit risk, but in contradiction to expectations, the Mexican bond cost the authorities more than commercial reinsurance for the same cover (Cardenas et al. 2007). The premium paid for a catastrophe bond has two components: The main component is the pure risk premium, or the pecuniary value of the risk born by the investors in the SPV. Under competitive markets this represents the probability of losing resources invested in the transfer vehicle. The second component is the fixed costs of the transfer process, including fees for:

- legal services,
- setting up an SPV,
- the financial entity (structuring and placement fees),
- the rating agency,
- the catastrophe modeling agency,
- the verifying agency, and
- the indenture trustee.

Despite some technical support from the World Bank, the costs of the Mexican cat bond amounted to about 2% of the cover amount, which substantially exceeds the usually around 1% cost for traditional reinsurance (Lane 2004). It should be kept in mind, however, that the Mexican finance ministry pioneered this new instrument. With more experience, better data collection and improved local expertise (the Mexican's relied heavily on outside consultants), the transaction costs might be substantially lowered.

2.4.3 Contingent credit

A contingent credit arrangement can potentially provide a government with lower cost capital relative to either insurance or catastrophe bonds. As an example, the World Bank Cat DDO is priced at the prevailing interest rate for loans offered by the International Bank for Reconstruction and Development (IBRD) at the time of withdrawal or drawdown. The IBRD offers loans at near-market rates but generally with more time to repay. The price is comprised of the contractual spread, funding cost, maturity premium and market risk premium. The DDO is also subject to a one time front-end fee of 0.50 percent and a renewal fee of 0.25 percent.

While this fee is typically less than insurance, the capital received after a disaster must be repaid. The major disadvantage already noted is that post-disaster credit can exacerbate the country's debt burden. According to Cardenas, et al. (2007), the Mexican authorities were concerned that contingent credit schemes would put pressure on the national budget and jeopardize Mexico's favorable credit rating, and for this reason they chose insurance and the issuance of a catastrophe bond. In addition, there remains credit risk if the issuing commercial entity cannot honor the contingent contract. The desirability of this product thus depends on the country's post-disaster financial profile, and more specifically on its post disaster fiscal situation (Cummins and Mahul, 2008).

2.5. Under what circumstances should governments engage in risk-transfer instruments?

2.5.1 The theory

Given the costs and risks of market-based instruments, it is important to ask whether and under what circumstances governments should engage in pre-disaster risk financing. Governments, like individuals, purchase insurance because of their concern about the volatility of possible outcomes, referred to as risk aversion. Agents are risk averse if they are willing to pay more than their expected losses to avoid the risk of incurring very large losses at one time. Poor households and farms are particularly risk averse because a large loss (e.g., the loss of crops from a drought) can threaten livelihoods and lives if victims do not have reliable sources of post-disaster assistance.

In contrast to individuals, governments of wealthy countries are not, in theory, risk averse, and thus in most circumstances should not purchase insurance. This is the result of a well-known theorem by Arrow and Lind (1970), who give two reasons for the risk neutrality of the public sector: If the government spreads its risk over its citizens (most usually by means of taxation), the expected and actual loss to each individual taxpayer is minimal due to the sheer size of the population. Moreover, a government's relative losses from disasters in comparison with its assets may be small if the government possesses a large and diversified portfolio of assets. The Arrow-Lind theorem is largely accepted as the theoretical underpinning for governments dealing efficiently with risk (Little and Mirrlees 1974), and leads to the conclusion that governments should not purchase catastrophe insurance or other risk-transfer instruments. It is also validated in practice since most governments assume catastrophic risks themselves (Guy Carpenter 2001: 39-40), thus implicitly or explicitly they behave as risk-neutral agents. Because of their ability to spread and diversify risks over a large population, Priest refers to governments as "the most effective insurance instrument of society" (Priest 1996, 225).

This theorem does not, however, apply to highly exposed, small, or low-income countries that have over-stretched tax bases and highly correlated infrastructure risks (Hochrainer and Pflug 2009; Mechler, et al, 2006). If local, state or national governments do not carry a large portfolio of independent assets and/or they cannot spread the losses of the disaster over a large population, then they might justifiably consider purchasing risk-transfer instruments. The conditions that

might lead countries to consider transferring public sector risk through insurance and other instruments are thus (Mechler 2004):

- high natural hazard exposure
- low tax revenues and domestic savings and shallow financial markets
- high indebtedness with little access to external finance
- few large infrastructural assets and high geographical correlation between those assets
- concentrated economic activity (e.g. large urban agglomerations) exposed to natural hazards.

Even under these conditions, a government will not necessarily find it advisable to purchase risk-transfer instruments. In the words of a leading World Bank expert, any ex ante risk financing strategy should be based on "an in-depth understanding of a country's risk exposure, a thorough analysis of the potential benefits of mitigation efforts, and cost trade-offs between different types of risk financing instruments, and last but not least, on assessing the country's internal financial capacity to retain the risk" (Gurenko 2004, xxii). In considering the case for or against financial instruments, government authorities should thus take account of their changing financial needs following disasters. As illustrated in Figure 3: , Ghesquiere and Mahul (2010) distinguish three phases of post-disaster activity: relief, recovery and reconstruction. These analysts point out that the most important financial criterion for funding *relief* is that the funds be available immediately. The second installment of the needed funds will only be required months later for the *recovery* phase, and the major funds will be needed several months or even years later to finance *reconstruction* programs. The design of an efficient financing strategy should take account of this temporal dimension to ensure that funding requirements are matched with disbursement capacity.

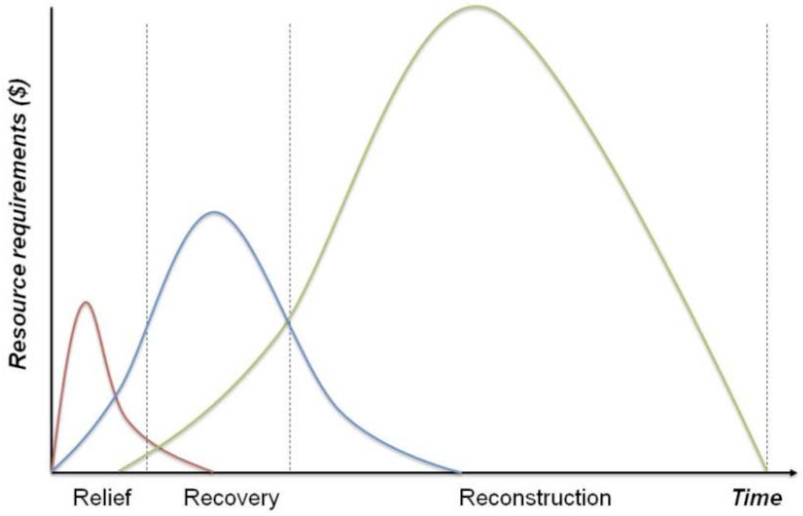

Figure 3: The three phases of the post-disaster funding process (Ghesquiere and Mahul 2010)

Keeping in mind the rationale and timing requirements for post-disaster funds, what follows will examine the alternatives to market-based instruments, and then turn to comparing their costs and the time required for disbursement.

2.5.2 Alternatives to market-based risk financing instruments

For the most part, alternatives to market instruments involve tapping available resources once a disaster has struck, or as witnessed in Haiti after the 2010 earthquake, reneging on responsibilities for relief and recovery. Public authorities have access to a variety of ex post financing mechanisms. Wealthy countries rely heavily on reserve funds, issuing bonds on the domestic and international markets, diverting funds from other budget items and sometimes imposing or raising

taxes. Typically, low-income country governments have less access to these sources because disasters significantly increase fiscal deficits and worsen trade balances. They become reliant on bi- and multi-lateral assistance, credit from the central bank (which either prints money or depletes its foreign currency reserves) and from international financial institutions such as the World Bank.

2.5.2.1 Credit

Post-disaster bonds (in contrast to pre-disaster catastrophe bonds) and other debt instruments that transfer the burden to future periods and even future generations are the most common sovereign post-disaster financing mechanism. Issuing bonds after a disaster is rarely a problem for wealthy countries where the hazard impact does not significantly affect the economy or the ability of the government to service its debt. The credit ratings of Japan and the U.S. were not affected by the Kobe earthquake in 1995 and Hurricane Katrina in 2005, respectively. This is not typically the case for low-income countries since domestic financial institutions may not be willing to lend on pre-disaster terms.

To address the post-disaster needs of vulnerable countries, the World Bank and other IFIs issue loans with favorable conditions. Since the early 1980s, the World Bank alone has initiated over 500 loans for disaster recovery and reconstruction purposes for a total disbursement of more than US$40 billion (World Bank 2006), and the Asian Development Bank also reports large loans for this purpose (Arriens and Benson 1999). IFIs and donor organizations, however, are greatly concerned about the dependence of developing countries on post-disaster capital grants and loans, which discourage governments from engaging in risk reduction activities (Gurenko 2004). Recipient countries, in turn, are concerned that international donations and loans for post-disaster reconstruction will continue to take an increasing portion of declining official development assistance (Mechler 2004). A major limitation is the growing discrepancy between the amount of reconstruction funds available from the international community and the growing funding needs of disaster-prone countries.

2.5.2.2 International assistance

In addition to low-cost credit, resource-strapped governments confronting major relief and reconstruction expenditures generally rely on international assistance. International donations, especially for highly publicized humanitarian crises, are an important source for bolstering a government's relief and reconstruction budget, although donor aid is relatively small and declining (Linnerooth-Bayer and Amendola 2000). In reality, pledges from the international community chronically fall short.

Even wealthy governments rely on international solidarity instruments. The European Union Solidarity Fund (EUSF), as an example, was created in 2002 in response to massive flooding throughout Central and Eastern Europe. The purpose was to show solidarity with Member States by granting post-disaster financial aid if losses exceed the capacity of governments to respond (Commission Report 2005). Hochrainer et al. (2010) argue, however, that this fund does not meet its stated purpose, and suggest that it re-orient to provide backup capital for national and regional insurance pools.

2.5.2.3 Taxes

Governments can collect special catastrophe taxes or increase taxes. For example in Germany a tax reduction planned prior to the Elbe flooding in 2002 was postponed, and the extra revenue was used for private sector compensation and public sector reconstruction. Alternatively, if a new tax year is approaching, government officials can raise the tax rate, as was the case in Austria after the 2002 floods. A new tax has the disadvantage of large transaction costs for its implementation, and the funds will not be immediately available.

2.5.2.4 Budget diversions

After disasters, governments facing a capital deficit frequently divert funds from other budgeted projects. In the developing world, these diversions are often from international loans for infrastructure projects. Based on anecdotal evidence, Lester (1999) cites a figure of 30% of infrastructure loans from the World Bank diverted for this purpose worldwide. Whereas this response may be the least costly one for a government from a short-term perspective, it can be disruptive both economically and politically. Most countries require that budget reallocations have parliamentary approval, which can delay appropriation of funding.

2.5.2.5 Reserve funds

Recognizing the economic and political costs of budget diversions, many countries (particularly in Latin America) have instituted a catastrophe reserve fund (Mexico's FONDEN being just one example) (Charvériat 2000). A catastrophe reserve fund has a cost equal to the foregone return from maintaining liquid capital and a benefit in having the resources immediately available with less transaction costs. A major problem with a fund, however, is that it may be insufficiently capitalized, especially if the disaster occurs shortly after its creation. Another serious problem with a catastrophe fund is the political risk of diversion for other purposes in years with no disasters. Ideally, the fund accumulates in years without catastrophes; however, experience shows there is considerable political risk of fund diversions to other pressing government needs, especially after long periods without serious disaster incidence.

2.5.3 The resource gap

Due to the lack of insurance or other risk-transfer instruments, combined with exhausted tax bases, high levels of indebtedness and limited donor assistance, many highly exposed developing countries cannot raise sufficient capital to replace or repair damaged assets and restore livelihoods following major disasters, exacerbating the impacts of disaster shocks on poverty and development (Gurenko 2004). This lack of sufficient post-disaster capital constitutes a financing or resource gap.

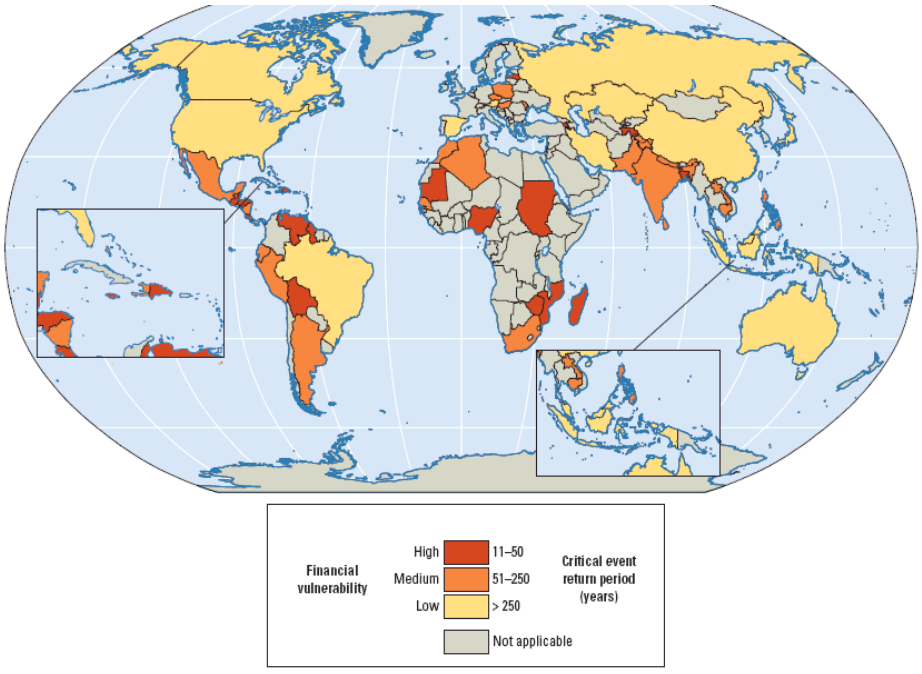

Figure 4: Countries at risk to a financing gap from floods, storms and droughts (Mechler et al 2009).

Current or historical resource gaps can be determined, for example in Pakistan following the 2010 flooding and Haiti following the 2009 earthquake, and also anticipated for the future. This is possible by modeling the public risk exposure of a country and assessing the government's capacity to respond to potential losses of different magnitudes. Mechler et al. (2009) carried out this exercise for floods, storms and droughts across 74 most disaster-prone countries (those that have experienced direct losses of at least 1 percent of GDP). The map in Figure 4: shows the degree to which countries are, today, financially vulnerable to floods and storms.

The important message is that whole countries and regions - despite international assistance, reserves, credit and diverting resources – face a high risk of insolvency and impoverishment after disasters. As this map shows, the most at-risk countries of a post-disaster capital or resource gap include the Small Island Developing States (SIDS), such as the Caribbean and Pacific Island groups, and highly indebted and hazard prone countries, such as in Central America (e.g., Honduras, Nicaragua, El Salvador), Africa (e.g., Madagascar, Mozambique) and in Asia (e.g., Pakistan, Nepal). For the most at-risk countries, some combination of ex ante and ex post financing instruments may be essential for aiding recovery to future flood and storm disasters.

2.5.4 Comparing instruments

In choosing among ex ante market-based instruments and the ex post alternatives, governments can make use of information on their respective costs, the time it will take for disbursement, and the amounts of funds likely to be accessible. Ghesquire and Mahul (2010) have examined a range of instruments across these three criteria. According to these authors, and as shown in Table 2, for relief operations governments can turn to easily disbursable and relatively inexpensive sources, like reserves and budget reallocations, but the size of these sources is usually limited. If larger sums of capital are needed in the recovery stage, governments might turn to a combination of sources, including donor assistance and ex ante risk financing instruments, such as contingent credit. If large sums of money are foreseen as potentially needed, governments that anticipate a resource gap would be advised to consider ex ante market based instruments, including conventional and index-based insurance and cat bonds. The cost of these instruments, however, can greatly exceed that of more conventional ex post instruments.

Table 2: Ex ante and ex post financing instruments (Adapted from Ghesquiere and Mahul 2010)

Instruments	**Approximate cost (multiple of expected loss)**	**Disbursement (months)**	**Amount of funds available**
Ex ante market instruments			
Insurance	2+	2-6 (1-2 for index based)	Large
Cat bonds	2+	1-2	Large
Contingent credit	1-2	0-1	Medium
Ex post instruments			
External credit	1-2	3-6	Large
Donor assistance	0-2	1-9	Uncertain
Budget diversion	1-2	0-1	Small
Reserves	1-2	0-1	Small

2.6. Conclusion: towards a balanced risk financing and management portfolio

Investing in insurance and other financial instruments inevitably and importantly raises the question: Is it not better to invest in reducing risks rather than in sharing or transferring them? Risk reduction, if cost effective, will - up to a point - be preferable to insurance, prompting most analysts to recommend that priority be placed on risk mitigation measures. This means that only after cost-effective investments have been made in preventing losses should governments consider investing in risk transfer instruments for the residual risk. This conclusion, however, assumes that insurance is a measure for sharing losses and not reducing them. The view that insurance is an alternative to risk reduction (and climate adaptation) overlooks the fact that post-disaster liquidity enables recovery operations that can save lives and livelihoods that would otherwise have been lost in the disaster repercussions. This view also overlooks the propensity of well-designed insurance programs to provide incentives for physical interventions and lifestyle changes that ultimately reduce disaster risks. Governments facing high premiums on infrastructure insurance will have an incentive to invest in safer projects, thus lowering premiums. Although the potential for behavioural changes induced by insurance is well documented, there is little empirical evidence to support these claims, and for this reason more attention needs to be given to the role of insurance in promoting loss-reducing behaviour.

Poorly-designed insurance contracts, on the other hand, can discourage investments in loss prevention or even encourage negligent behaviour - what is referred to in this paper as moral hazard or maladaptation. Insurers guard against moral hazard by requiring deductibles or co-insurance, such that the insured incur a portion of their losses. A major advantage of index-based insurance schemes is the avoidance of moral hazard. Mexican authorities taking measures to protect their infrastructure against hazards can only gain since the indexed catastrophe bond is triggered regardless of losses. Moreover, if governments can reassure outside investors that disasters will only temporarily disrupt critical infrastructure, this will create a more secure environment for attracting international capital. Well-designed insurance thus reduces disaster losses in two ways: by providing early liquidity, it prevents long-term loss of livelihood and lives; and by pricing risk, it provides strong incentives for pre-disaster preventive and adaptive behaviour. Because of the absence of moral hazard, index-based systems are particularly promising as instruments for adaptation to climate change.

Finally, insurance and other financial instruments can reduce losses through innovative designs to enable early capital for preventive measures. Most weather events, although uncertain in terms of their exact timing and magnitude, are predictable. The current system for responding to these natural disasters however is not as timely or equitable as it could be. Funding is secured on a largely *ad hoc* basis after disaster strikes and only then can relief be mobilised towards the people who need it most. In the meantime, lives are lost, assets are depleted, and development gains experience significant setbacks. Financial preparedness through contingency funds, as offered by the World Food Programme's *Africa Risk Capacity* (ARC, see Box 2.11.), promises a more efficient system of response to weather shocks. Evidence from Ethiopia (Wiseman and Hess 2005) suggests protecting the lives and livelihoods of the most vulnerable lowers the total cost of assistance and protects development gains: findings indicate securing US$1 in contingency financing now for timely and predictable disbursement to emergencies can save US$5 by averting the destruction of livelihoods and coping mechanisms. ARC combines several of the ideas discussed earlier in this paper, including risk pooling to reduce costs of holding capital, the use of newly available computational tools and approaches to quantify risk, and preparedness measures explicitly linked to the financial instrument in order to avert losses.

Box 2.11. Africa Risk Capacity (ARC)

Africa Risk Capacity (ARC) is an innovative project aiming to provide participating African governments with effective financial weather risk management tools and funds to manage extreme climate events and to incentivise improved disaster risk reduction, planning and response. The project sets out to do this by developing a regional contingency funding mechanism for planned responses to extreme weather emergencies through the establishment of an African-owned risk pooling entity for weather risk. The working model for the risk pool is a stand-alone entity able to provide participating AU member states timely and rapid access to pre-defined funds in the event of severe weather disaster in their country to implement response plans, and assist the most vulnerable affected populations in their country, as part of a comprehensive national disaster risk management and food security strategy.

The World Food Programme's Climate and Disaster Risk Solutions (CDRS) team have developed a software application[3] called *Africa RiskView* that combines leading existing operational rainfall-based early warning models on agricultural drought in Africa with data on vulnerable populations to form a standardized approach for estimating drought-related food insecurity response *costs* across the continent – information critical to financial preparedness for drought and providing the basic infrastructure needed to establish and manage a parametric risk pool and trigger disbursements. To date the project has focused on drought risk – the greatest systemic weather risk to food security across the continent – but other risks are being considered.

If established, key benefits would be to speed the early flow of funds to a *country* following a disaster, enabling government response actions that reduce the dislocation caused by such events and the dependence on international appeals for assistance. Action examples include: securing food commodity imports early, to lock-in prices and grain flows to a country in a managed way (Syroka and Nucifora 2010); scaling up social safety net systems in a predictable manner to cope with the eventual increase in people needing cash or food assistance (Hess, Wiseman and Robertson 2006); other early mitigation or DRR responses that are appropriate; or supporting the distribution of farming inputs for subsequent seasons.

While each country could use this information to build a national risk profile and contingency financing strategy, initial WFP analysis indicates that there is a financial incentive to pool different types of weather risk across countries and regions; within the atmospheric-ocean system, it is unlikely that extreme weather events will happen simultaneously or in the same year in every country. This diversification means risks do not accrue in an additive fashion, lowering the probable maximum costs that a group of countries may incur together to a more manageable amount than the sum of each country's individual probable maximum cost. Preliminary findings indicate a 50% savings from diversification of drought-related losses across Africa – making ARC an attractive financing mechanism in support of African food security. Creating a vehicle for aggregating sovereign-level risk across the continent, a risk pool provides a mechanism for all actors in the development and humanitarian arena to offer their services and build country-level capacity to prepare for and manage climate related disasters. The quantification of risk and cost of contingency funding also create incentives and benchmarks for investment in a disaster risk reduction, aligning the interests of governments, international organizations and donor countries.

Under the leadership of the African Union Commission and together with its technical partners, including the World Bank and UN ISDR, WFP is about to embark on the thorough feasibility and design process, including the support to development of national contingency plans, national capacity building and stakeholder engagement, to work towards the creation of a risk pool.

In sum, smart insurance products can contribute to reducing direct and (longer term) indirect losses from disasters, a potential benefit that should be considered in addressing the question of whether to invest in risk-reduction projects or in risk transfer. It will thus be important to assess the costs and benefits of both preventive investments and risk-transfer instruments in terms of risk reduction and the benefits of timely capital following disasters. For highly vulnerable countries that cannot otherwise finance their post-disaster liabilities, a balanced portfolio will likely contain both types of investments.

[3] The development of this software was funded by the Rockefeller Foundation.

3. MICRONSURANCE: AN INSTRUMENT FOR DISASTER RISK REDUCTION?

3.1 Introduction

Most households, farmers and small business owners in the developing world cope with the aftermath of disasters by relying on a diverse combination of informal and non-market options, including their own savings and assets, as well as solidarity from their family, remittances and government assistance. They also turn to the market by borrowing from micro-credit institutions and money lenders. While non-insurance mechanisms appear to work reasonably well for low-loss events, they are often unreliable and inadequate for catastrophic events (Cohen and Sebstad, 2003). Faced with large losses, households may be forced to sell productive assets at very low prices; post-disaster inflation may greatly reduce the value of savings; money lenders may exploit their clients; entire families, even if geographically diverse, may be affected; and donor assistance rarely covers more than a small percentage of losses (Mechler, 2004). The resulting liquidity deficit can greatly aggravate poverty and reduce capacity for adapting to climate change.

This chapter focuses mainly, but not exclusively, on micro-insurance instruments, and how they can be linked to the reduction of human and economic losses. It also discusses some innovative ideas on linking insurance in high-income countries with disaster risk reduction. Throughout it should be kept in mind that many non-insurance mechanisms may actually be preferred as a risk management or climate adaptation strategy, especially for frequent and less-catastrophic events. In the anticipation of a liquidity deficit, however, insurance becomes an option for risk-averse households and businesses; yet, typically it is neither available nor affordable to the most vulnerable. As shown in Figure 5: , catastrophe insurance density drops from around a third in wealthy countries to less than a tenth in higher-middle income countries, and it is almost negligible (1-2%) in lower-middle and low income countries (Munich Re 2005a).

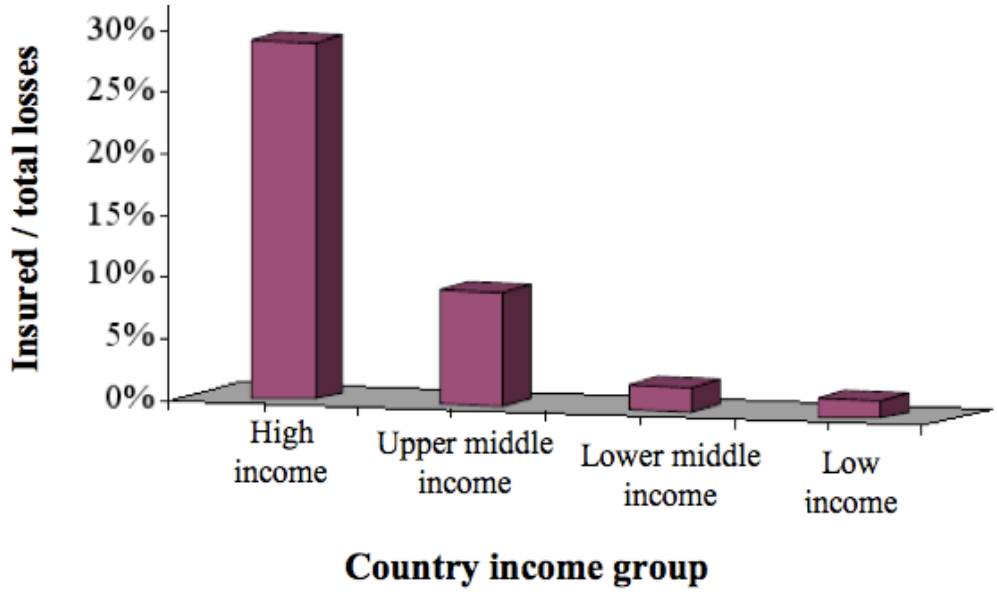

Figure 5: Insurance density during the period 1985-1999 according to country income groups. Data source: Munich Re (2005b)

Two examples can illustrate the stark difference in global insurance coverage. At the time of the 2010 earthquake in Haiti, insurance policies represented only about 0.28% of the country's GNP. Payouts to private Haitians by the largest insurers are expected to total below $40 million (Carney 2010). This stands in contrast to Hurricane Katrina in 2005, which led to more than $40 billion of insurance claims, making it the industry's most costly geological or hydro-meteorological disaster to date (OpenCRS 2008). In Ethiopia, a country with a population of almost 80 million people (mostly subsistence farmers), insurers count fewer than an estimated 300,000 clients - almost exclusively serving large or urban clients (Chamberlain and Smith, forthcoming). But with more pilot microinsurance projects and often more clients per pilot, that number is growing, including among smallholder farmers and other clients that used to be thought of as "too small to insure".

As mentioned in section 1, one of the forces behind the growth in micro-insurance is the ability to set "index-based" or "parametric" contracts, written against a physical trigger (usually a weather variable) instead of the expensive approach of conventional indemnity-based insurance (written against *actual* losses). Although there is optimism about the potential of index-based micro-insurance in the developing world, it is important to keep in mind that most recent programs are still in the pilot stage, and none have experienced a major and widespread catastrophic event. It is too early thus to fully assess their effectiveness in reducing economic insecurity, providing incentives to reduce risks, and promoting adaptation and development. Importantly, without exception they have received technical and/or financial support from international development and donor organizations. Yet, most observers agree that they could radically change the way individuals, governments and development organizations manage disaster risks.

A main focus of this section is how these emerging instruments can be integrated in risk management strategies that emphasize the reduction of immediate and long-term disaster losses. This can take many different forms, including:

- The provision of incentives for reducing risk and vulnerability by pricing contracts to reward pre-disaster cautionary behaviour;
- The use of insurance to enable more productive (and sometimes riskier) household and business strategies, which by reducing poverty and vulnerability contribute to the lessening of diseases and other longer-term ramifications of disasters;
- Tying these instruments directly to preventive strategies, for example, by designing contracts such that the insured can pay the premium by providing labor for risk-reducing projects; and
- Designing index-based insurance contracts based on a forecast, which means that claims are paid before the hazard strikes, thus providing necessary liquidity for loss-reducing activities.

Any discussion of micro-insurance and how it is linked to the reduction of disaster losses must confront issues concerning the potential benefits, costs, risks and viability of this emerging new instrument. A number of recent publications, including several listed in Box 1.1: , deal in depth with these issues. For the most part, but with important exceptions (notably Hellmuth et al 2009), the microinsurance literature and practice has been detached from the discipline and practice of disaster risk reduction. The intent of this chapter is to begin filling that gap by providing an overview of microinsurance instruments, their use and their viability as well as a systematic examination of how they can be used to advance the goals of DRR practitioners.

We begin in section 3.2 with a discussion of the US and French national insurance systems and how they have been linked to risk reduction investments and activities. We turn then to microinsurance, discussing indemnity-based (section 3.3), index-based (section 3.4), bundled systems with loans (section 3.5), forecast-based index products (section 3.6), and the participatory approach in Ethiopia that explicitly seeks vulnerability reduction through microinsurance (section 3.7). We conclude in section 3.8 by discussing crucial factors influencing the scalability and sustainability of microinsurance initiatives, including insights from a "Bottom of the Pyramid" conceptual framework.

3.2 Linking insurance with DRR in wealthy countries

Even in industrialized countries, private insurers have been reluctant to offer region- or nation-wide policies covering flood and other hazards with large loss potential because of the systemic (co-variant) nature of the risks, as well as problems of moral hazard and adverse selection. Because private insurers are often not prepared to fully underwrite the risks, many countries, including Japan, France, the US, Norway and New Zealand, have legislated public-private national insurance systems for natural perils with mandatory or voluntary participation of the insured as well as single hazard and comprehensive insurance. The US and French systems are briefly described in Box 3.1: .

Box 3.1: ***The US and French national insurance systems***

The US National Flood Insurance Program (NFIP), created in 1968, is unique in that the federal government serves as the primary insurer, offering voluntary policies to residential and commercial buildings (mandatory in the case of a mortgage). Because the flood peril was considered uninsurable, the NFIP was designed to increase the role of the insurance industry in writing flood insurance policies (where the government bears all the risks) and ultimately to have the industry take over a risk-bearing role.

The aftermath of Hurricanes Katrina, Wilma and Rita in 2005 revealed large debts in the NFIP and its continuing dependence on taxpayer support. A government study in 2005 claimed that the program does not collect sufficient premium income to build reserves to meet long-term expected future flood losses, partly because the US Congress authorized subsidized insurance rates for some properties (US Government Accounting Office, 2005). The Katrina disaster revealed a great deal of discontent of NFIP and private insurer procedures, especially the delineation between cover for flood and wind damages. Because the NFIP does not reimburse wind damage, many argue that the US should institute a national all-perils policy. According to Mills (2005) the restriction of insurance is often criticized, yet, in some cases, it can also be viewed as a recognition of society's limited ability to pay the increasing costs of natural disasters.

Whereas the NFIP only covers flood losses, private insurers in France are required to offer catastrophe insurance in an all-hazards policy that is bundled with property insurance. Policies are not risk based, and there are large cross subsidies inherent in the system. The program is reinsured through a public administered fund, the Caisse Centrale de Réassurance (CCR). If this fund proves insufficient, taxpayers will be called upon to contribute. The French have rejected risk-based premiums in favor of a flat rate as a percentage of the property value.

3.2.1 Links to risk reduction

A notable feature of the NFIP is that communities must take prescribed loss-reduction measures if their residents are to be eligible for cover. Flood insurance is only available in those communities that adopt and enforce a floodplain management ordinance that meets or exceeds the minimum NFIP standards. With the intent of reducing subsidies and moving toward risk-based premiums, the philosophy of the NFIP (and also the earthquake insurance program in California) is that persons living in exposed areas should eventually bear their full risks. This is the case for new buildings for which premiums are based on flood risk determined by the elevation of the lowest floor of the structure relative to the elevation of the national base flood (100-year flood) standard. The NFIP has a pilot program requiring owners of repetitive-loss properties to elevate, relocate or demolish houses, with NFIP bearing some of the costs.

The French system takes a different view on risk reduction. Because of the value French society places on solidarity, the government is reluctant to move to full risk-based pricing and is thus confronted with disincentives from the cross subsidies. To counter this disincentive for risk reduction, a recent decree sets a deductible that increases with the number of disasters in the same area. This means that the compensation a household or business receives will continually decrease in high-risk areas, leading to incentives to take loss-reduction measures (e.g. relocation).

3.3 Indemnity-based microinsurance

In 2001, the global annual agricultural and forestry insurance premiums amounted to some US$6.5 billion compared with the estimated total value of agricultural production of US$1,400 billion, or 0.5% global cover. This cover is concentrated in developed countries, with only a minor percentage of global premiums paid in the developing world (Roberts, 2005). Still, crop insurance programs exist throughout Asia (e.g., in India, Malaysia and the Philippines), Latin America (e.g., in Argentina and Brazil) and Africa (e.g. Mauritius). For the most part, these programs pay claims based on losses (indemnity-based insurance), as illustrated by the crop insurance program in the Philippines (Box 3.2:), where farmers are at high risk to cyclones, droughts and pests.

Box 3.2: The Philippines crop insurance program

A nation-wide crop insurance program in the Philippines grew out of an agricultural guarantee fund, which was operated by a government bank servicing the agricultural sector. The insurance is operated by a para-governmental entity, the Philippines Crop Insurance Corporation (PCIC), which began business in 1981. Designed initially to provide risk management to borrowing farmers and their lenders, the PCIC now offers policies to self-financed farmers. Participation is compulsory for farmers in the high-potential agricultural areas for two crops, maize and rice. Claims are based on crop losses reported by claim adjusters. Premiums paid to PCIC are heavily subsidized by the government and by institutional lenders. (Roberts, 2005)

Indemnity-based crop insurance has major disadvantages. It requires extensive networks of claims adjusters who assess individual losses following an event. Moreover, insurers in low-income countries have far less access to global crop reinsurance markets than do those in developed countries. The low volume of business and large fixed transactions costs means that insurers can service these markets only at high cost. Traditional indemnity-based crop insurance programs are thus costly, which is a reason why many such programs have failed in developing countries (World Bank 2005).

3.3.1 Links to risk reduction

Subsidies are a concern for agricultural insurance programs in developing countries, not only because many governments cannot afford to facilitate income transfers given the large segments of the population often engaged in farming but also because they encourage farmers to invest in crops or locations that would be considered too risky if farmers paid the full risk-based premium. In other words, premiums can dis-incentivize risk reduction activities. Moreover, indemnity-based insurance is plagued by moral hazard since insured farmers have less incentive to control for pests or plant drought-resistant crops.

Nonetheless, indemnity-based programs, even those heavily subsidized, can be linked to risk reduction. Oxfam UK has been providing financial and technical support for a micro-insurance program that protects against natural disasters and targets low-income women in Andhra Pradesh, India. In the first year, Oxfam paid 50% of the insurance premium, but guarded against the ensuing disincentives for risk reduction by deliberately integrating micro-insurance services within a disaster risk management program. In other words, it is only part of a program that also offers housing, health awareness, drinking water, and sanitation, as well as capacity building for communities, government, civil society, and media organizations.

3.4 Index-based microinsurance

To avoid the high transaction costs of indemnity-based insurance systems, index-based or parametric schemes (discussed in sections 1. and 2.) circumvent expensive claims settling. In the case of weather derivatives, farmers collect an insurance payment if the index reaches a

certain measure or "trigger" regardless of actual losses. These schemes may offer a less costly and thus more viable alternative to traditional indemnity-based crop insurance.
This was the motivation for a rural microfinance organization in the Indian state of Andhra Pradesh to launch an index-based drought insurance program known as BASIX. As described in Box 3.3: , this scheme provides post-drought cash payouts to middle-income farmers who insure their cash crops (Hess and Syroka, 2005a; Mechler, et al., 2006).

Box 3.3: BASIX index-based crop insurance

The BASIX insurance program covers non-irrigated farmers in Andra Pradesh against the risk of insufficient rainfall during key parts of the cropping season. The policies are offered by a commercial firm, ICICI Lombard General Insurance, and are marketed to growers through micro-finance banks, which are linked to the APEX micro-finance entity known as BASIX (Bhartiya Samruddhi Finance Ltd.). Claims are based on an index of precipitation, which is closely correlated with crop yield. The BASIX scheme owes its existence to international technical assistance provided by World Bank. The BASIX system remarkably increased its penetration from 230 farmers to over 250,000 over the first three-year period, and in 2008 claimed over a half million clients (Gunaranjan, 2008). In 2009, uptake rates in Andhra Pradesh and Gujarat had risen to about 5-10 percent (Giné et al. 2009) Similar schemes are implemented or underway in Mongolia, Ukraine, Peru, Thailand and Ethiopia (Mechler, et al., 2006).

The potential for index-based microinsurance systems is large. Over 40 per cent of farmers in the developing world face weather-related threats to their livelihood (World Bank, 2005), which will predictably increase with climate change, and yet only a small percentage benefit directly from micro-insurance systems. The obstacles for scaling up these systems to provide cover across the developing world will be discussed in section 3.8 .

Not only farmers, but also herders, are benefiting from index-based insurance. In Mongolia, where domestic animals provide sustenance, income, and wealth to protect nearly half the residents, a harsh winter (dzud) can have devastating effects even for experienced herders. To protect herders against livelihood losses from extreme weather, an innovative livestock insurance program has recently been developed by the World Bank (see Box 3.4:). It stands in contrast to Mongolia's traditional indemnity-based livestock insurance, which was ineffective for several reasons: the high costs of settling claims across vast areas, the disincentives to reduce losses and the incentives to falsely report animal deaths. The goal of the new public-private system according to its founders (see Mahul and Skees, 2006) is to (i) offer insurance coverage that is attractive to herders, (ii) involve the domestic insurance market while protecting it against catastrophic losses, and (iii) limit the fiscal exposure of the government.

Box 3.4: Mongolian index-based livestock insurance

In 2006, an index-based livestock insurance (IBLI) program was introduced on a pilot basis in three Mongolian provinces. Because of lack of weather stations and the complexity of dzud events, the index is not based on weather, but rather on the overall mortality rate of adult animals in a given county determined by a (long-standing) yearly census.

The insurance system is made affordable to herders and viable to insurers by a layered system of responsibility and payment. Herders retain small losses that do not affect the viability of their business. The next layer of losses is transferred to the private insurance industry through risk-based premium payments on the part of herders. A third layer of risk is absorbed by taxpayers, in what Mahul and Skees (2006) refer to as the "social product". Herders who purchase the first layer of protection are automatically registered for the social layer at no additional cost. The financing of the government's potential losses during the pilot phase relies on a combination of reserves and – as a fourth layer - a contingent credit provided by the World Bank (see Box 2.9:).

Even with the social product covering extreme local losses, there are significant risks associated with the commercial product as mortality rates are highly correlated across regions in. In another innovation, the pilot design involves a syndicate pooling arrangement for insurance companies, which protects the under-developed insurance industry as well as the clients. If the pilot is scaled up, it is hoped that the pool can find reinsurance partners or investors for its securitization (e.g., with catastrophe bonds). Finally, the design offers the opportunity to transition the system to the market if and when herders can pay the full risk premium. (Mahul and Skees, 2006)

Both the BASIX and Mongolia systems, as well as most micro-insurance pilots serving the poor, receive subsidies from the state to render them affordable to their low-income clients. Some observers suggest that eventually the market will provide this coverage, and they point to systems operating without donor support, for example, the Proshika program providing catastrophe property insurance to 20,000 villages and 2,000 slums in Bangladesh (Mechler et al. 2006). While the Proshika program targets the poorest of the poor, it pays only twice the amount of the savings deposit in the case of property damage due to disasters and thus falls short of providing a comprehensive safety net.

The unaffordability of microinsurance offering cover for catastrophic events contradicts experience with other types of micro-insurance, including coverage for life, health and funeral expenses, where unsubsidized policies are widespread throughout many countries. The reason is that catastrophic cover is fundamentally different with far higher transaction costs. Because disasters can affect whole communities or regions (co-variant risks), insurers must be prepared for meeting large claims all at once. Their cost of requisite backup capital, diversification or re-insurance to cover co-variant claims can add greatly to the business expenses and raise the premium far above the client's expected losses (see Figure 2 in previous chapter). Moreover, insurers that operate in developing countries have high start-up and other transaction expenses, which can greatly limit affordability and constrain insurance penetration.

3.4.1 Links to risk reduction

The index-based insurance systems described above can be linked to the reduction of immediate and long-term drought and winter weather losses in several ways: First, because of the physical trigger, there is no moral hazard; to the contrary, farmers and herders will have an incentive to reduce potential losses, for instance, by diversifying their crops or by protecting herds against the weather. There is no need for expensive individual claims settling, and expedient payments will reduce the need for farmers and herders to sell their assets and livestock at lowered market prices to survive. Finally, by providing safety nets to farmers and herders, these schemes will allow them to take "productive risks" or those with a high payoff. This should eventually reduce their vulnerability to disasters. How indexed systems can be more directly linked to risk reduction will be discussed in the next sections.

3.5 Bundled microinsurance-loan packages that enable productive investments

Whereas insurance is generally viewed as a mechanism to provide much needed cash after a disaster, a recent example in Malawi shows that insurance can also have benefits even in the absence of a disaster. Groundnut farmers in this country, where the economy and livelihoods are severely affected by rainfall risk resulting in drought and food insecurity, have in the past had extreme difficulty in receiving loans that enable them to purchase more productive seed and other agricultural inputs. The reason is that banks are reluctant to make loans in the face of drought-related default risk. Thanks to a creative micro-insurance pilot project, participating farmers can now receive loans that are insured against default with an index-based weather derivative (Hess and Syroka, 2005b).

Box 3.5: Malawi index-based crop insurance

Food insecurity in the southern African country of Malawi is chronic and greatly worsened by drought, although 20% of the country's area is covered by water, including Lake Malawi. Most farmers have small holdings, from 0.5 to 3 hectares. In 2005 nearly 1000 smallholder farmers in Malawi participated in a pilot weather insurance project that allowed them to access an input loan package for better groundnut seed. This packaged loan and micro-insurance product was offered by Opportunity International Bank of Malawi (OIBM) and Malawi Rural Finance Corporation (MRFC) to groups of farmers organized by the National Smallholder Farmers (NASFAM). Accordingly, the farmer enters into a loan agreement with a higher interest rate that includes the weather insurance premium, which the bank pays to the insurer, the Insurance Association of Malawi. The insurance payments are index-based depending on precipitation measured at one of three weather stations within the region of the pilot program.

Depending on location premiums amounted to 6-10% of the insured cost-of-seed values, an amount easily repayable from the increased productivity of the seeds (estimated at about 500%). The index triggering payment was calibrated with the rainfall needed for germination of the seeds and different phases of the plant growth. In the event of a severe drought, the borrower pays a fraction of the loan, the rest is paid by the insurer directly to the bank. The farmer is less likely to default, which has a stabilizing effect on the bank's portfolio and risk profile. Without this assurance, banks rarely loan to high-risk, low-income farmers. The advantage for the farmers is that they obtain needed credit to invest in the seeds and other inputs necessary for higher-yield crops. The World Bank together with Opportunity International (OI) played the catalyst in developing this weather insurance product by providing technical assistance and training. In the words of one of the project founders, the Malawi microinsurance scheme "takes the big rocks out of the way – drought risks – and clears the path for development" (Hess 2005).

(Osgood and Warren 2007, Suarez, et al. 2008)

Figure 6: (a) Malawian farmer showing a groundnut plant affected by water stress; (b) Groundnut field in the Kasungu district of central Malawi. The Chalimbana 2000 hybrid variety often yields twice as much output as the traditional variety (photos: P. Suarez)

3.5.1 Links with risk reduction

As an index-based system, the Malawi experience enjoys all the benefits in terms of reduced moral hazard and transaction costs. As in the case of the BASIX and Monglian cases, there is no need for expensive individual claims settling, and expedient payments will reduce the need for farmers to sell their assets and livestock to pay back outstanding loans. (Keep in mind, however, that the Malawi program provides only very limited coverage for the loan repayment. Providing higher coverage to reduce food insecurity would likely render the system unaffordable to the subsistence farmers). Perhaps most importantly, the insurance-loan makes it possible for farmers to plant higher yield and higher risk seeds, which will enhance their ability to cope with droughts.

Productive farmers can accumulate savings that will protect them and their families during unproductive seasons.

The incentive effects of index insurance can be made more powerful if premiums are tailored to reflect, not the average historical risk, but the risk facing the upcoming planting season. Continuing with the Malawi example, seasonal forecasts differ from the historical average mainly because of the ENSO phenomenon. An El Niño – Southern Oscillation (ENSO) event can be described as an anomaly in sea surface temperature and atmospheric pressure in the tropical Pacific Ocean that occurs roughly every four to seven years, changing circulation patterns across the planet. ENSO is the major single source of climate variability on seasonal-to-inter-annual scales. Droughts are strongly related to ENSO in parts of Africa, the Americas and the Asia/Pacific region, and may become more frequent and intense under a changing climate (IPCC 2007, Hewitson and Crane 2006).

If a seasonal precipitation forecast indicates that a drought is likely or unlikely to strike a certain area, this information can help farmers choose a drought-resistant crop variety or engage in high-yield (and high-risk) farming practices, respectively. There have been attempts to communicate climate predictions to farmers through agricultural extension services, but the communication infrastructure is not adequate in communal rural areas, and few farmers have incorporated the forecasts into decision making (Patt and Gwata 2002, Patt et al 2005). Observers suggest that if forecasts are widely disseminated and adopted in the future, appropriate market or policy interventions may need to accompany the information to optimize societal benefit of climate forecasts (Phillips et al 2002). One market intervention is to price insurance such that it reflects seasonal forecasts. Ideally, premiums are adjusted upwards in El Niño years when bad rains are expected and adjusted downwards in La Niña years to reflect the reduced risk of drought.

Notwithstanding a significant relationship between the ENSO phenomenon and seasonal rainfall in Malawi, the pilot insurance scheme (Box 3.5:) did not take ENSO-based predictions into consideration. Seeds and other agricultural inputs made affordable to farmers through credit did not reflect expected seasonal rainfall, even though they are distributed to farmers at a time when the seasonal forecast was already available. Subsequently, researchers have shown through simulation models that integrating seasonal rainfall forecasts in the pricing of the Malawi product could have led to substantial increases in gross revenues for farmers during La Niña years (by a factor of up to seven), and substantially reduce losses during El Nino years (Osgood et al 2008). The main message is that micro-insurance schemes that use skillful seasonal forecasts to adjust the bundled loan-insurance contract according to expected rains can substantially benefit participating farmers, furthering both DRR and the accumulation of wealth (Suarez and Linnerooth-Bayer 2010).

The Malawi experience illustrates the indirect implications of a bundled insurance/loan package for increasing resilience to disasters and, in so doing, reducing long-term losses, and the potential for increasing the DRR effect with the skillful use of climate forecasts. Another example shows a more direct path for DRR. Instead of bundling the insurance product with loans for productive activities, a program in St. Lucia bundles the insurance with loans for disaster risk reduction. This program is described in Box 3.6: .

Box 3.6: Hurricane-Resistant Home Improvement Program in St. Lucia (HRHIP)

In 1996 the St. Lucia charity, National Research and Development Foundation (NRDF), with assistance from USAID/OAS and CARITAS, established a home improvement program offering loans for affordable new or improved existing housing to low-income homeowners, while providing for physical and financial protection against natural disasters. Within this Hurricane- Resistant Home Improvement Program, minimum building standards were developed for reference by homeowners, and builders and local builders

were trained in safer construction. The services of a trained building inspector were also offered to approve materials for use in retrofitting and to check whether minimum standards were being observed.

Furthermore, a group insurance plan, underwritten by a Caribbean subsidiary of a United Kingdom–based insurance company, was established through a St. Lucia broker. The insurance plan covered major natural disasters such as windstorms, earthquake, floods and sea surge, and volcanic eruptions. ***Membership of the insurance scheme was mandatory for recipients of the home improvement loans.*** Full coverage with a deductible of 2% was specified in the policies. Premium rates ranged from 0.60% for concrete block homes to 1.05% for homes made of timber. The insurer trained NRDF project officers in property valuation and accepted these exposure estimates.

Between 1996 and November 2002, 345 loans were disbursed within this program, with an average loan size of EC$11,000 (approximately US$4,100 in 2002). The majority of these loans (68%) were either for extensions to existing structures or for new structures. The remainder of the loans was for repairs and renovations, purchase, or relocation of homes. No claim was reported by the scheme, as no major event with substantial losses hit the country. The program was discontinued in 2002 when the insurance broker went into liquidation; it was revealed that the insurance premiums had not been passed on to the insurer, causing the contracts to lapse. (OAS, 2003a; OAS, 2003b). This highlights the need to set up rigorous mechanisms for regulation and oversight – as financial schemes with inadequate scrutiny and enforcement will always be vulnerable.

The St. Lucia case is based on the premise that homeowners are eager or at least willing to invest in cost-effective home improvements that decrease their risk from hazards. Empirical evidence in developed countries suggest that this premise is far from reality. Many homeowners exhibit myopic behavior in the sense that they are not concerned with low-probability events that may occur far in the future (Kunreuther, 2006). To counter this problem, Kunreuther and his colleagues have proposed long-term insurance contracts that are tied to the property. An example is given in Box 3.7: . The interesting feature of long-term insurance bundled with a loan for home improvement is that the gains are realized in the present, making it attractive even for the most myopic.

Box 3.7: Long-term insurance: an example

Consider a lower-middle-income family, whose house is exposed to cyclones. This family could invest $150 to strengthen the roof of their house so as to reduce the damage by $3,000 from a future cyclone with an annual probability of 1 in 100. An insurer would be willing to reduce the annual charge by $30 (1/100 $3,000) to reflect the lower expected losses that would occur if a cyclone hit the area in which the family was residing. If the house was expected to last for ten or more years, the net present value of the expected benefit of investing in this measure would exceed the up-front cost at an annual discount rate as high as 15 percent.

Under current annual insurance contracts, many property owners would be reluctant to incur the $150 expenditure, because they would get only $30 back next year and are likely to consider only the benefits over the next two or three years when making their decisions. If they underweight the future, the expected discounted benefits would likely be less than the $150 up-front costs. In addition, budget constraints could discourage them from investing in the mitigation measure.

Suppose a twenty-year required (micro)-insurance policy were tied to the property rather than to the individual. If the family were able to secure a $150 loan for 20 years at an annual interest rate of 10 percent, its annual payments would be $15. If the insurance premium was reduced by $30, the savings to the family each year would be $15.

These mitigation loans would constitute a new financial product. A financial institution such as the Grameen bank, would have a financial incentive to provide this type of loan, the insurer knows that its potential loss from a major disaster is reduced. Moreover, the general public will now be less likely to have large amounts of their tax dollars going for disaster relief—a win-win-win situation for all! (Adapted from Kunreuther, 2006).

3.6 Forecast index insurance

Previous examples have illustrated the index-based approach, whereby the insurance payout is triggered by a measurable physical variable reaching a certain threshold linked to the *event that actually causes loss*. This approach can be taken one step closer to disaster risk reduction by establishing the payout threshold not based on the actual event, but on observable parameters that can be used to predict the likely future occurrence of the event. For example, the trigger for an insurance payout could be the forecast of a flood based on upstream river levels instead of the flood itself. This was the idea behind a novel insurance program recently operating in Peru, where claims are based on forecasts of an ENSO event. This is described in Box 3.8: .

Box 3.8: El Niño forecasts as trigger of insurance against business interruption in Peru

Rainfall intensity in the region of Piura (northern Peru) is strongly correlated to the *El Niño* phenomenon - an unusual warming of the Pacific waters that can be observed weeks to months before the occurrence of extreme precipitation events.

In collaboration with the national banking and insurance regulator, microfinance institutions and various other stakeholders, GlobalAgRisk Inc. has helped establish an El Niño contingent insurance product: essentially a business interruption insurance policy designed to compensate for lost profits or extra costs likely to occur as a result of the catastrophic floods as predicted by a specific indicator of El Niño (known as "ENSO 1.2"): indemnities are based on sea surface temperatures measured in November and December, which are taken as a forecast of flood losses that would occur a few months into the future (February to April).

The insured entity chooses the amount to insure (which must not be larger than a maximum amount determined by an estimation of the largest plausible flood losses). This El Niño insurance is currently not available directly to households, but in principle the product could be sold to households. Designers of this instrument specifically targeted risk aggregators: firms that provide services to numerous households or businesses exposed to El Niño and related floods, such as loan providers and the fertilizer sector. This is likely the first "forecast index insurance" product to receive regulatory approval. (GlobalAgRisk Inc. 2010b).

3.6.1. Links with risk reduction

The clients of this insurance product in Peru can take preventive measures to reduce losses from ENSO-related flooding - if they can afford to invest in the right measures ahead of peak rains. For example:

- irrigation boards could purchase machinery that accelerates cleaning of canals
- agricultural producers could improve flood-prone portions of main road links to ensure their production can reach markets,
- despite likely losses in revenue, all players in the agricultural value chain could adjust financial flows to sustain payment of necessary services involving fixed costs.

By activating financial flows well ahead of the extreme event, this approach allows the disbursed funds to be used for implementing disaster preparedness and risk reduction measures that, if the event actually occurs, would curb disaster losses (through reducing exposure to the forecasted hazard or reducing the vulnerability of populations, assets and productive or financial processes). This ex-ante mechanism for reliable and timely disbursement of financial resources could fund ideas like the one that emerged from a participatory video process in the village of Mphunga in Malawi (see Baumhardt et al. 2009). Subsistence farming households located in floodplain currently store their harvest in open granaries: distribution of empty grain bags before the floods

would allow families to quickly put their grains in bags and store their food in elevated sites to avoid losses – therefore avoiding future dependence on food aid. Indeed, this forecast-based approach could even turn crisis into opportunity, for example by purchasing and prepositioning bean seeds that can grow in the floodplain without much rain, simply by tapping on the moisture left in the soil after the peak flood has passed.

3.7 Participatory micro-insurance as part of a risk reduction package

An innovative donor supported project in Ethiopia distinguishes itself from many index pilot programs in that it has involved very low-income farmers directly in the design. The project described in ***Box 3.9*** aims to promote climate change resiliency, food security, and livelihoods building by addressing the needs of smallholder producers through an unusual mix of risk reduction, drought insurance, and increased market access (primarily through credit-led investments).

Box 3.9: The Horn of Africa Risk Transfer for Adaptation (HARITA) project

The HARITA project is an ongoing initiative involving, among other partners, Oxfam America (OA), Swiss Re, The Rockefeller Foundation, the Relief Society of Tigray (REST), the International Research Institute for Climate and Society (IRI), Nyala Insurance, and Ethiopian MFI called Dedebit and Credit Savings Institution (DECSI). Starting at the concept stage in late November 2007, the HARITA partners designed an agricultural risk management package for farmers in Ethiopia's northernmost state of Tigray.

The initiative builds on an existing, donor-supported, government run program, namely Ethiopia's Productive Safety Net Program (PSNP), that provides transfers to chronically food-insecure subsistence farmers (who need food aid for several months per year), and through a microinsurance mechanism adds a layer of predictable transfers for unpredictable needs that emerge as a result of the additional food scarcity caused by inadequate rains. By integrating insurance with a food security program, farmers' immediate concerns begin to be addressed, allowing them the luxury of thinking about longer-term issues that insurance is designed to cover.

Farmers in the first pilot village of Adi Ha were central participants in the design of the rainfall index insurance package. The community itself identified farmers' vulnerabilities to specific hazards and their capacity to adapt, and elected community members to join the pilot design team, which made use of focus groups and other participatory procedures. In addition, farmers helped collect rainfall data in their fields and were involved in defining research questions on DRR that were investigated by the local agricultural university. This process of deep engagement resulted in what many view as an attractive insurance package as well as substantially increased ability to educate farmers about the product effectively.

Adjusted for landholding, farmers (paying in cash or labor) paid an average of approximately US$12 in premiums (Ethiopia's nominal, annual GDP per capita is US$324). *Wahisna*'s *percentage* premium price was 22% plus a 2% administrative fee. Based on historical rainfall records, expected payout is just over 1 in 5 years. The farmers could opt either to pay an unsubsidized premium, or, alternatively, they could participate in an insurance-for-work plan, whereby cash-constrained farmers can pay the premium through labor that directly contributes to reducing their own vulnerability to future extreme events. DRR-oriented activities include:

- Tree, grass, and bush planting (provides fodder for livestock; reduces runoff and erosion from hillsides)
- Creation of stone bunds (terracing) for soil and water conservation
- Soil fertility management through compost making
- Spate irrigation (diversion of floodwaters, supplementing irrigation during shortage of rain in August).

Remarkedly, in the pilot's first year in 2009, the village take-up rate was 34 percent, which greatly exceeds most other micro-insurance products and compares favorably with the uptake of mobile phones and micro-credit in developing countries (Dinku, et al. 2009).

An exciting outcome of this participatory insurance model is that it has proved capable of effectively reaching very vulnerable families, most of whom many industry observers have considered "uninsurable" (Allianz 2009). In both years, approximately 40 percent of purchasers were female-headed households (considered the most vulnerable in an already very vulnerable community) and 65 percent were officially registered as chronically food-insecure. The pilot thus demonstrates that micro-insurance, if designed with the client in mind, can indeed reach those at the "bottom of the pyramid" (BoP).

3.7.1 Links with risk reduction

Another remarkable feature of this experiment is that it dramatically increases the affordability of the risk transfer product through creative payment options. The "Insurance-for-Work" (IFW) plan involves working on labor-intensive risk-reduction, climate change adaptation, and poverty reduction projects in their own communities. Participating farmers learned to make and use compost, which is critical for rebuilding soil nutrients and improving soil moisture retention. In addition, they constructed small scale water harvesting structures on farmland, as well as planted nitrogen-fixing trees and grasses to promote soil regeneration and water conservation, and reduce the risk of flooding. Finally, farmers cleaned teff seeds as a way to boost productivity and control weeds. These risk reducing interventions are keys to reducing losses from natural hazards, boosting income and promoting quicker recovery from disasters. Many of the benefits of clean seeds are expected to accrue to women who are usually saddled with the labor-intensive task of weeding. Seed cleaning also boosts productivity but requires relatively little time to conduct and can be completed close to the home while minding children.

During the pilot phase, farmers' labor on DRR, adaptation and poverty reduction projects was paid for by Oxfam with support from its donors which are increasingly considering switching from post-disaster aid to pre-disaster financial support since investments in prevention can greatly reduce the need for donor assistance (Linnerooth-Bayer et al. 2005). In the future, this labor will likely be compensated through donor organizations, or by a climate adaptation fund.

3.8 Towards an enabling environment for microinsurance

Problems of affordability and capacity dampen aspirations for scaling up micro-level financial risk management schemes to comprehensively cover the billions of poor subsistence farmers or slum dwellers facing weather risks. During a consultation process organized by the United Nations Development Programme (UNDP) Environment Finance Group, over thirty practitioners with substantial expertise in the field of micro-finance, cautioned strongly against expecting significant short-term development returns by investing in micro-level risk-transfer programs. It takes substantial time, perseverance, expertise and even "good luck" to build solid foundations for these initiatives. The barriers to scaling up index-based microinsurance and other schemes targeting the most vulnerable include, inter alia:

- financial illiteracy among the poorest of the poor
- lack of trust in unfamiliar financial instruments
- insufficient financial experience and institutional maturity among relevant organizations
- lack of sufficient historical data
- changing climate conditions
- basis risk

Nonetheless, many of these barriers are likely to become surmountable over the next decade. Participatory simulation games, video-enabled approaches and other innovative educational tools are allowing illiterate farmers to understand and engage in the design of complex instruments (see Box 3.10: and Box 3.11:). Satellite-based index insurance triggers (Hellmuth et al. 2009), web-based tools to design tailored financial products, mobile phone banking to collect premiums or

transfer payouts (Medhi et al. 2009) and other technological advances are expanding the range of what is possible.

Box 3.10: Games that simulate insurance markets: a tool for education and design

Helping participants understand how microinsurance operates constitutes a crucial challenge: there is evidence that farmers with a poor understanding of insurance are less likely to use it. Game-based activities can help communicate complex financial ideas by setting up a set of simple rules that simulate an insurance market. The IFAD-WFP Weather Risk Management Facility supported the design of a game involving index-based microinsurance bundled with credit for agricultural inputs, whereby Ethiopian and Malawian farmers (many illiterate and even innumerate) played using coupons, a die and real money - allowing participants to can gain first-hand experience of the consequences of a range of plausible decisions. This activity investigated farmers' understanding and the effectiveness of a role-playing game at improving that understanding. The survey analysis indicates that the game was at least as good as a conventional lecture approach in conveying most of the key insurance concepts – and better at one key dimension related to trust (Patt et al 2009). This approach was taken one step further by Oxfam America, IRI and partners in the HARITA project: game-based tools were used to facilitate the dialogue about product design with vulnerable farmers.

Figure 7: Games that simulate financial markets can accelerate learning and facilitate the process of participatory design, helping tailor new microinsurance products to farmers' preferences (Photos: J. Mendler de Suarez)

It may be that some people or places will be forever unable to benefit from new risk transfer instruments, but given the likelihood of continued progress in various relevant fields, it is desirable to embrace a long-term view for envisioning and nurturing new ways to reduce disaster risk through innovative market-based approaches.

Box 3.11: Video-enabled approaches to participatory learning and dissemination

There is a need to facilitate the creation and dissemination of information and ideas that can accelerate community-based DRR. Increasingly affordable technologies may allow for extending the benefits of available knowledge to those who most need it. Short films, animation[4] and other audiovisual media, when combined with participatory processes for DRR, offer potentially effective ways to raise awareness, scale up capacity building, support product design, and develop innovative approaches to advocacy and partnerships. Video tools can help give vision and voice to the most vulnerable members of communities engaged in market-based risk sharing initiatives, reducing the risk of asymmetries in information.

A large body of literature explores, reports and rigorously analyzes the use of video tools for health risk management. Over a decade ago, Eiser and Eiser (1996) systematically reviewed 175 studies of video-based projects with the aim of assessing the value of video as a tool for health promotion and education, and concluded that audiovisual tools can produce changes in attitudes and knowledge – outlining key elements for successful initiatives. With regard to climate risk management, video tools are in their infancy, but some recent initiatives are showing promise (Suarez et al 2008), as shown by the successful pilot led by the Malawi Red Cross and the Malawi Meteorological Services (see Figure 8, also Baumhardt et al 2009).

Communication strategies are essential for bringing the advantages of index-based insurance and other risk-sharing tools to the most vulnerable, particularly given the complex, place-specific nature of risks and markets. By charting the interface between audiovisual media and pro-poor instruments, audiovisual innovation can assist those seeking to accelerate pro-poor financial innovation.

Figure 8: Subsistence farmers became filmmakers using participatory video methods. Their short film,[5] aimed at peer-to-peer learning, explained how climate risks are changing and shared options to improve resilience, including replacing chickens with ducks to secure survival of poultry during floods. The video was screened in neighboring villages, accelerating the dissemination of adaptation measures. Similar approaches could support financial innovations for the poor (Photos: F. Baumhardt)

[4] For a superb example of how animation can concisely explain complex financial issues both elegantly and understandable, see www.crisisofcredit.com (Jarvis 2009), a 10-minute piece on the recent global crisis.
[5] A 7-minute version of the farmers' film can be seen at http://www.youtube.com/watch?v=2PcVn4oy3NI

Accepting the argument that the private sector has a role to play in the promotion of micro-level DRR through financial mechanisms (thus positioning profit-seeking enterprises engaged in processes involving government, donors, vulnerable communities or development and humanitarian organizations), it is useful to turn to the field of corporate social responsibility (CSR) for guidance on how market-based initiatives can best advance the DRR agenda at the micro level. A growing focus of CSR is on the so-called Bottom of the Pyramid (BoP), which can be thought of as a business strategy that focuses on products, services, and enterprises to serve people throughout the base of the world's income pyramid (Prahalad 2006).

A study by Karamchandani (2009) found that the most successful BoP initiatives were self-funding; operated at sufficient scale to make a difference to a large swathe of poor communities; and featured a business model "tailored to the special circumstances of markets at the base of the income pyramid." The authors drew a number of lessons about BoP initiatives that are relevant to microinsurance and DRR, which we summarize below:

a) Tailor products to "wants"

Compared to other microinsurance products, index insurance for weather risk has experienced some of the lowest adoption rates around the world. In absolute terms, the number of impoverished agricultural insurance clients has surpassed the million mark (Hess and Hazel, 2009). However, this impressive figure pales when the uptake rate is measured against the number of households offered insurance and the number of villages in which it is sold. For example, the Basix uptake rate in 2006 was approximately 7.6 percent (Gine et al 2010).

This can be attributed to a number of factors, including

- In contrast to microcredit, microinsurance typically requires very cash-strapped clients to give up funds ex ante to hedge against misfortunes that may or may not come to pass.
- Many clients have a variety of coping mechanisms that are better known and more trusted.
- Most people are myopic;
- Difficulties in understanding products;

It might be tempting to conclude that agricultural microinsurance is a hopeless proposition, but consider the findings of Karamchandani et al. (2009):

> The most common mistake among unsuccessful market-based solutions is to confuse what low-income customers or suppliers ostensibly need with what they actually want. Many enterprises have pushed offerings into the market only to see them fail. People living at the base of the economic pyramid should be seen as customers and not beneficiaries; they will spend money, or switch livelihoods, or invest valuable time, only if they calculate the transaction will be worth their while.

Low uptake rates may suggest that many of the agricultural insurance products that have been offered are simply not desirable to clients. As Michael McCord of the Microinsurance Centre so aptly put it: "microinsurance is not just the same old products with reduced premiums and coverage levels. It requires a dramatic refocus in every aspect of product development and delivery" (McCord 2006).

b) Consider customer cash flows as a key parameter for pricing

Related to the last point, products must be priced in a way that matches customer cash flows. Opportunity International, one of the world's leaders in microinsurance provision, found that a risk transfer scheme in Albania failed not because prospective clients objected to product pricing or terms, but because the premiums had to be paid upfront, and not as cash becomes available (Churchill 2006 p.40). The Yeshasvini milk cooperative partner in India has enjoyed much success by giving farmers an opportunity to pay for insurance in creative currency; in their case, milk delivery on an installment plan (Churchill 2006).

c) Be wary of building proprietary distribution channels

In general, a distribution or delivery channel is the entity that sells a product or service directly to the client, although the manufacturer (or risk holder) is often another entity. Karamchandani et al. (2009) find that many BoP entrepreneurs make the mistake of creating a proprietary distribution network, which can result in uncompetitive product prices and non-scalable business models.

This observation is particularly relevant to the distribution of insurance in rural markets with low population density and few insurance companies (typically located in urban areas. Many successful BoP initiatives have adopted a shared distribution channel strategy of piggybacking on pre-existing delivery networks set up for altogether different purposes. Shared channels also allow scaling much more easily because multiple insurers can share the costs of a channel that would otherwise be too expensive for any one company. Plantations, clothing retailers, churches, post offices, transport providers, microfinance institutions (MFIs), community-based organizations, cooperatives, mutuals and international NGOs are serving as sales networks, and in some cases also as direct insurers (McCord 2008; Compendium 2008).

Among the most common shared channels are MFIs and agricultural co-ops. MFIs are attractive because "most rely on a proprietary direct sales force and offer the appealing synergy of distribution along with access to credit—in effect, goods plus financing." However, Karamanchandani et al. (2009) found that numerous prominent attempts to distribute socially beneficial products via MFIs have been notable disappointments. In general, the MFI channel can handle additional capacity but needs managing to avoid overstretching its capabilities. As described in Box 3.9 HARITA employs an untraditional shared channel, namely Ethiopia's Productive Safety Net Program (PSNP).

d) Aggregate consumers or suppliers

Due to the fixed costs of delivering insurance products, aggregation of small policyholders into large purchasing groups can be helpful in transforming low income markets into economically attractive targets. Aggregation is also important in insurance, but only if the risks are not co-variant. As risk pools grow and become better balanced and more commercially attractive, premiums can decrease substantially, as was the case of the Caribbean Catastrophe Insurance Facility (see Box 2.5:).

Similarly, on the supply side, insurance companies in Latin America formed the Latin American Reinsurance Group (LARG). The association's goal is to overcome challenges in placing reinsurance treaties individually. By aggregating their business, LARG members attract more interest from competing insurers, and in so doing they lower costs.

Sometimes, aggregation can take creative routes. Researchers at IIASA and IRI, for instance, have analyzed the potential of creating pools based on the El Nino Southern Oscillation (ENSO) (Vicarelli 2009). ENSO causes extreme weather such as floods, droughts and other disturbances in many developing countries that depend upon agriculture and fishing, but because these effects are countercyclical across regions, poor countries could potentially help each other by pooling their risks.

e) Recognize that implementation takes time

Why has it been so difficult to implement and scale microinsurance programs? Certainly part of the explanation lies in demand- and supply-side constraints discussed earlier. Moreover, Korten (1987) argues convincingly in favor of a "learning approach" that allows development programs to evolve and grow organically, to embrace error, plan with the people, and link knowledge building with action. The Harita project is a good example of this approach.

Many policymakers, insurers, academics, think tanks, poor communities and donors appear enthusiastic about the prospect of microinsuance serving the poor. At the same time, given low adoption rates, many industry watchers have fallen into disillusionment. As Karachandani et al point out, “no demand-led model targeted at low-income markets is likely to scale in less than ten years...We would count any time span short of a decade as remarkable, and anything with the 10- to 15-year range as aggressive but realistic.” The microfinance sector may need to muster greater patience and a more flexible approach to microinsurance development, whereas the DRR sector may need to examine the potential growth of the microfinance sector in ways that can support community-level resilience.

4. CONCLUSIONS: THE WAY FORWARD

Market-based risk-transfer instruments are increasingly contributing to the efforts of governments and individuals to reduce the immediate and long-term losses from extreme events. They not only make funds available for post-disaster relief and reconstruction, which itself contributes to reducing long-term human losses, but can also be designed to support ex ante reductions in vulnerability. In this way, financial risk management offers opportunities for advancing the Hyogo Framework of Action.

In this paper we have shown through examples ways in which market-based instruments can increase disaster resilience, not only as a complement to DRR but as an integral part of it. After discussing the context in which risk management takes place (development, climate change, markets and technological progress), we have described the most topical financial instruments for managing risk at the macro and micro levels.

At the macro level, sovereign states have a number of options for assuring the availability of post-disaster capital for funding relief, recovery and reconstruction - while protecting their long-term fiscal balances. If designed appropriately, these market-based instruments can be linked effectively to reducing disaster losses:

- *Insurance instruments* can help governments, donors that support governments, or pools of small sovereign states to distribute disaster losses across space and time. Case studies, like the forecast-based contingent insurance project in Peru and the World Food Programme's pilot project in Ethiopia, illustrate how insurance can help reduce risks, by releasing funds in the time window between observed or predicted extreme events and actual materialization of losses.
- *Catastrophe bonds* enable governments to transfer their risks to willing investors in the international financial markets (as in the case of the Mexican catastrophe bond), and in theory can be designed to support DRR measures in the same way that insurance instruments can.
- *Contingent credit* ensures access to loans in times of crisis. Governments that provide backup for insurance schemes, as in the case of the Mongolian livestock insurance program, can benefit from the security offered by a contingent credit arrangement. Importantly, contingent credit can be linked to risk reduction requirements, as illustrated by the World Bank's CAT Deferred Drawdown Option, which requires eligible countries to make progress on disaster risk reduction.

Despite the significant benefits of these instruments, and their potential for promoting risk reduction and climate adaptation, we have emphasized the need to evaluate the benefits in light of the costs, which can be significant due to the expenses of insuring correlated risks. Governments typically have lower-cost alternatives (i.e. reserves, budget diversions donor assistance, or loans). An analysis of financial vulnerability to natural hazards (i.e. the "resource gap") reveals, however, that even considering the alternatives, many countries and regions face a high risk of insolvency and impoverishment after disasters – with potentially catastrophic results for the most vulnerable. In these cases, a balanced portfolio is recommended, combining DRR investments with risk transfer instruments. Because the most vulnerable countries are also the least able to afford these instruments, donor organizations and international financial institutions are increasingly supporting risk-financing strategies.

At the micro level, households and businesses in developing countries are increasingly gaining access to new ways to manage disaster risks, particularly with the emergence of index-based financial instruments that link the payout not with the actual loss but with a measurable *event* that causes loss. Microinsurance can support DRR in a variety of ways as described below:

- Loan packages bundled to microinsurance can enable (i) productive investments that reduce long-term vulnerability - as in the Malawi pilot for groundnut farmers; or (ii) investments in risk reduction measures – like the hurricane scheme in Saint Lucia for home improvement.
- Index insurance can be linked not to an observed event but to the *forecast* of an event likely to cause catastrophic damage (such as the business interruption insurance product tied to the seasonal rainfall forecasts for Peru based on El Niño), which can provide timely funds for pre-disaster risk reduction activities.
- Participatory risk management initiatives can explicitly link risk transfer with risk reduction, as does the Ethiopia pilot that offers cash-constrained farmers the possibility to pay the microinsurance premium with DRR-oriented labor, thus mobilizing the community in activities that reduce the likely losses caused by future extremes.

It should be noted that, outside of the realm of natural hazards, many of the best-known methods to link risk reduction with conventional insurance products address reduction of the hazard (e.g., car insurance premium can be made less expensive for owners that install theft alarms in their vehicles, thus discouraging thieves). In contrast, approaches that link risk reduction with risk-transfer instruments typically address vulnerability (i.e. guiding investments so that if the hazard materializes, the unit being protected is less susceptible to being damaged), although measures could be taken to reduce the hazard, e.g., sand bagging against the rise of the river.

Insurance instruments can also be structured to enhance preparedness. Similar to mortgage loans that are made available only for homes with a smoke detection system (accelerating the response of fire fighters), index-based insurance instruments, for example, can improve preparedness in two ways:

- By linking insurance to *observation and* detection of the hazard before it causes losses (as in the Ethiopian WFP pilot that disbursed aid after the detection of insufficient rains but before there was scarcity of food)
- By paying claims based on the *forecast* of likely extreme events associated with avoidable losses (like the contingent insurance arrangement in Peru, which enables retrofitting investments with weeks anticipation in order to minimize damages that would be likely to occur after an El Niño seasonal rainfall forecast).

The HARITA pilot project that was designed with Ethiopian subsistence farmers is the first risk transfer scheme designed specifically with the goal of reducing the direct losses likely to be caused by future natural hazards, a particularly relevant goal in the context of climate change (where the beneficiary community has contributed little to greenhouse gas emissions). The forecast-based insurance scheme in Peru opens a window of opportunity for designing contingent financing instruments aimed at accelerating preparedness measures when, as predicted, climate change worsens ENSO-related extreme events. Given the failure of negotiations addressing the causes of global warming, the humanitarian sector can only stand to benefit from the design of scalable and sustainable mechanisms to reduce vulnerability to climate risks – and microinsurance can help.

As promising as these developments appear for contributing to disaster risk reduction strategies, it must be kept in mind that microinsurance today only reaches a very small population of low-income farmers, herders, households and their intermediaries. Lessons drawn from reviews of microinsurance pilots show very substantial obstacles to scaling up systems targeting the most vulnerable under current conditions. Some of the obstacles include weak regulatory systems, the temptations for corruption among all relevant stakeholders, the lack of trust in suppliers, the insufficient understanding of the instruments, and the difficulties of estimating risks (particularly in light of climate change). Possible negative outcomes include the rapid growth complicated schemes that do little to actually improve the resilience of the most vulnerable while transferring wealth to the already wealthy, or badly designed financial instruments that actually encourage

investments in places or endeavors that are too risky. Much can be learned from the "bottom of the pyramid" approach, which puts people's *wants* (not needs) at the center of the design and implementation process. At the very least, scaling up financing systems to reach the world's most vulnerable will require dedicated support from the international development and climate adaptation communities.

On an optimistic note, the remarkable progress in linking science, technology and risk transfer instruments over recent decades has enabled DRR practitioners to better anticipate future conditions, reduce vulnerabilities and take early action to avoid losses. DRR can be enhanced if forecasters, risk managers and financial experts build common ground, and design smart DRR-oriented market instruments. The disaster risk reduction community can greatly benefit from collaboration with the disaster risk financing community, to jointly and creatively find new linked financial/DRR solutions, and to overcome the obstacles in scaling up existing ones.

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