Chapter 5
Investing today for a safer tomorrow

The Mount Elgon Labour-based Training Centre builds a new building in Mbale, Uganda.
Photo: Mikkel Ostergaard/Panos Pictures
Both individuals and governments tend to discount low-probability future losses and seem reluctant to invest in disaster risk management (DRM). Governments often cite a lack of financial resources as a constraint, but the allocation of available public resources reflects political priorities. The imperative to invest in DRM is likely to be greater in countries with effective institutions, and where a strong civil society can hold governments and other stakeholders to account for poor decisions. Despite the magnitude of disaster costs, reducing disaster risks is often perceived as less of a priority than fiscal stability, unemployment or inflation.

Evidence from Colombia, Mexico and Nepal indicates that this judgement is short-sighted. Country risk profiling and stratification can provide the basis for unexpected development and growth dividends. The data highlights that disasters and their downstream impacts represent major losses for governments, who are responsible not just for public assets, but implicitly at least, also for the uninsured assets of low-income households and communities. As the HFA Progress Review highlighted, few countries systematically account for their disaster losses, and invisible impacts do not generate incentives to invest.

Conducting a comprehensive risk assessment and systematically accounting for disaster losses do not guarantee that governments will invest more. They can, however, encourage governments to take ownership over their stock of risk and identify strategic trade-offs when making policy decisions for or against investing in DRM. Although economic costs and benefits are never the only criteria for investment, making the trade-offs transparent offers two significant advantages for governments. They would then be able to assess the liabilities implicit in the full spectrum of risk in their country, important for fiscal and fiduciary planning, and make more informed decisions concerning the most cost-effective portfolio of risk management and financing strategies.
5.1 The opportunity cost of DRM

The decision to invest in DRM is clearly not technical or administrative – it is fundamentally political. However, it is far less clear how governments identify the political and economic incentives to invest.

Japan has more people and GDP exposed to earthquakes and tropical cyclones than any other country in the world (UNISDR, 2009). Its risk-aware population has experience dealing with disasters, but even in Japan it is difficult to persuade citizens to invest in risk reduction. As Box 5.1 highlights, only a small minority of risk-prone households have participated in a government-sponsored earthquake retrofitting programme despite government cost-sharing, subsidized loans and tax breaks (Okazaki, 2010).

Difficulties persuading people to make rational choices have been observed in California (Stallings, 1995) and Romania, confirming that even in high-risk contexts, individuals heavily discount future risks and are reluctant to invest today for a safer tomorrow (Kahneman and Tversky, 1979; Loewenstein and Prelec, 1992; Kunreuther and Useem, 2010). Despite evidence that DRM investments are cost-effective, politically expedient and socially sustainable (ECA, 2009; UNISDR, 2009; World Bank, 2010b; Campos and Narváez, 2011), given short political time horizons, governments are likely to overly discount future risks. As the HFA Progress Review highlighted, few governments have a dedicated budget line for DRM, and many are unable to quantify their investments.

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The decision to invest in DRM is clearly not technical or administrative – it is fundamentally political. However, it is far less clear how governments identify the political and economic incentives to invest. During financial crises, governments often act quickly to provide public resources to save banking systems and protect wealth. During the 1995 financial crisis in Mexico, for example, the public resources used to protect private assets amounted to approximately 20 percent of the country’s

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Box 5.1 Incentives for safer building: lessons from Japan

In Japan, traditional wooden houses are vulnerable to earthquakes. During the 1995 Great Hanshin-Awaji Earthquake which claimed more than 6,000 lives, 80 percent of the mortality occurred in collapsed houses. While new buildings are earthquake resistant, about 25 percent of Japan’s total housing stock was still vulnerable (Japan, 2008), representing a significant risk to household budgets and public finances.

In 2003, a major retrofitting initiative was launched to reduce the vulnerability of the housing stock to 10 percent by 2013. Two thirds of the cost of evaluating houses and 23 percent of the cost of retrofitting houses constructed before 1981 has been subsidized by the government. Those who retrofit their houses are eligible for a 10 percent income tax deduction and low-interest loans from the Housing Finance Corporation.

Despite these subsidies, only 31,000 homes and 15,000 other buildings had been retrofitted by 2009, far less than the 50-60,000 homes which were being renovated annually before the programme began. A 2005 poll showed that although two thirds of households believed their homes could be hit by a strong earthquake within the next 10 years, only a tenth of those polled had evaluated vulnerability and invested in retrofitting. So despite a well-targeted and generous set of policy measures and subsidies, and a high awareness of disaster risk, persuading households to invest in DRR remains a challenge.

(Source: Okazaki, 2010)
GDP. By comparison, between 1997 and 2009, accumulated allocations to Mexico’s disaster management fund added up to only 2.3 percent of the GDP in 1995. In Mexico, annual DRM investment has been decreasing since 1999, and in 2007 it was equivalent to only 0.01 percent of the government’s income and 0.04 percent of total public investment (Moreno and Cardona, 2011). In Colombia, DRM investment has been increasing, but it was still only 0.08 percent of government income and 0.07 percent of public spending in 2009.

Governments indicate that a lack of financial resources constrains investment in DRM, but how available public resources are invested tends to reflect other political priorities. Figure 5.1 shows that government investment in DRM in Colombia and Mexico is significantly less than the amount of money the governments give out in the form of tax exemptions. In Mexico, for example, tax exemptions represented 6 percent of GDP and 50 percent of potential tax income in 2007, while cumulative DRM investment over eight years (1999–2007) amounted to less than 0.2 percent of GDP in 2007. These governments do not lack the resources to invest in DRM – they have not identified it as a priority.

In contrast, there is usually a strong political imperative for disaster relief. Leaders have always understood the power of symbolic and real responses to disasters. Saving lives and assisting disaster victims is a moral, humanitarian and political paradigm that few would contest. As such, disaster relief can be a powerful tool for leaders, enhancing their political profile and facilitating patronage. As Box 5.2 highlights, electoral considerations certainly influence disaster responses (Sen, 1981; Bueno de Mesquita et al., 2004).

In contrast, the incentives for DRM, a public good, are far less obvious. If governments patronize the powerful private interests often internalized in sectors such as urban development, construction, agribusiness and tourism, there may be a disincentive to invest in DRM. As discussed in Chapter 3, the privatization of water resources by the agribusiness sector may increase agricultural productivity and generate foreign exchange but simultaneously transfer agricultural drought risk to subsistence farmers. Seriously addressing underlying risk drivers involves trade-offs which may represent an important political opportunity cost for governments.

5.1.1 Can disasters provide a political and economic incentive for DRM investment?

Major disasters can sometimes provide a political imperative, given a real or perceived social demand for improvements in DRM. The evidence, however, is mixed. In some
countries the window of opportunity for DRM opens wider than in others. Unfortunately, the mechanisms through which large disasters can provide a political incentive, and under what conditions, have not been systematically studied. Despite huge investments, post-disaster recovery programmes are rarely assessed from the perspective of DRM improvement. The post-tsunami TRIAMS process represents one effort to address that gap, marking an important breakthrough by proposing a framework of core indicators to monitor DRR progress and assess impact across different countries, at different scales, and for a number of key sectors.

There are further examples of real change. In Iran (Islamic Republic of), the 7.2 magnitude earthquake in Bueen Zahra in 1962, which resulted in the death of 12,000 people (EM-DAT, 2011b), enabled a national consensus on building codes that had long been debated (Aon Benfield, 2010). In Colombia, the 1983 Popayán earthquake and the 1985 eruption of the Nevado del Ruiz volcano led to the establishment of a comprehensive DRM system. The 1999 Orissa super-cyclone and the 2001 Gujarat earthquake in India, the 2001 floods in Mozambique and the 2004 tsunami in Indonesia are other examples of large disasters that highlighted DRM capacity gaps and led to institutional and legislative changes. Following the 2004 tsunami, Indonesia also enacted comprehensive legislation and established a National Disaster Management Agency (BNPB) tasked with coordinating risk reduction (Llosa and Zodrow, 2011; Scott and Tarazona, 2011). In many of these cases, including in Colombia and Mozambique, the emergence of individual champions also played a decisive role (Llosa and Zodrow, 2011; Williams, 2011).

For each success story, there are others where the social demand was either weak or ignored, the strengthening of DRM was cosmetic, or the initial impetus was difficult to sustain. Rarely does the recognized need for a revision of land use planning after disasters lead to a full reform of land use and tenure systems (Barnes and Riverstone, 2009). In the HFA Progress Review, less than half of the countries reported that they had DRM provisions in their recovery and reconstruction budgets.

Countries with stronger governance are better placed to use the political window of opportunity following a major disaster, building on existing institutions, risk assessments, expertise and professional networks (Ievers and Bhatia, 2011). Weak governance linked with low institutional, financial and human capacities, and a lack of information on the costs and benefits of risk reduction, mean that governments are often unable to measure the opportunity costs of investing in DRM (Karayalcin and Thompson, 2010).

In general, countries that experience more frequent major disasters are more likely to invest in risk reduction due to lower opportunity costs (Keefer et al., 2010). Predictable disasters, such as recurring tropical cyclones, stimulate more social demand for DRM, because a failure to reduce foreseeable risks will expose government negligence. In contrast, when confronted with low-probability events, governments are more able to discharge their responsibilities and blame external forces such as God, nature and, more recently, climate change.

In addition, disasters that affect marginal groups with little voice in national politics are less likely to catalyse investment than those that affect strategic economic or political sectors (Maskrey, 1996; Smith and Quiroz Flores, 2010). Extensive disasters, for example, rarely create the concentrated citizen pressure necessary to stimulate a national political and economic imperative (Williams, 2011).

It has remained difficult to justify DRM investments based on estimates of their avoided impacts on medium- and long-term economic growth. The conflicting evidence provided by macro-economic studies (Kahn, 2005; Jaramillo, 2009; Noy, 2009; Cavallo et al., 2010; Keefer et al., 2010) may be due to the different econometric methods used and countries analysed. In Colombia, for example, most large disaster events did not produce lasting effects on economic growth but did affect inflation, per capita income, unemployment rates and inequality in the short term (Moreno and Cardona, 2011). Such effects, however, were heavily conditioned by how each individual disaster was managed. For example, the 1994
Tierradentro earthquake devastated a remote indigenous region in southern Colombia. After the disaster, unemployment increased and stabilized at a higher rate, and inequality also increased to rates that persist today. In contrast, the major investments in reconstruction after a 1999 earthquake devastated Colombia’s central and economically important coffee-growing region actually led to reduced inequality.

5.2. Revealing risk and identifying development trade-offs

If governments were to account for recurrent disaster losses and for their future liabilities, they may begin to make more considered decisions based on an assessment of the costs, benefits and trade-offs internalized in risk-sensitive public investment.

In nationally reported disasters in the 21 countries in Africa, Asia and Latin America analysed in Chapter 2, there were 63,667 schools and 4,873 health facilities damaged or destroyed since 1989. During this period, 73,000 kilometres of roads were also damaged, and 3,605 municipal water systems, 4,400 sewer systems and 6,980 power installations were reported damaged and destroyed. Of these total losses, 46 percent of the schools, 54 percent of the health facilities, 80 percent of the roads and more than 90 percent of the water, sewer and power installations were damaged or destroyed in frequently occurring extensive disasters rather than in occasional and intensive catastrophes.

These losses are massive, and they indicate how public investments in social and economic development are in practice often investments in risk construction and contingent liability (Cardona, 2009). This large loss of publicly owned assets remains largely invisible and unaccounted for (Gall et al., 2009), and impacts are transferred to affected low-income households and communities. This invisibility represents a major political barrier to investing in DRM. Revealing these impacts will not automatically lead to greater investment, but if governments were to account for these recurrent losses and for their future liabilities, they may begin to make more considered decisions based on assessments of the costs, benefits and trade-offs internalized in public investment.

As explained in Chapter 1, a country’s stock of risk comprises a combination of high-severity, low-frequency intensive risks, and low-severity, high-frequency extensive risks. Normally, neither conventional catastrophe risk models nor risk models based on historical disaster-loss data are able to comprehensively estimate both of these risk strata. Fortunately, national disaster loss reporting (see Box 2.5 in Chapter 2) and the growing availability of open-source probabilistic models, such as CAPRA, have facilitated the development of innovative hybrid models that can estimate both extensive and intensive risks. One such hybrid model (Box 5.3), which combines historical disaster loss data and probabilistic catastrophe risk modelling, has been piloted in Colombia, Mexico and Nepal (ERN-AL, 2011). By integrating assessments of both extensive and intensive risks, the real scale of recurrent loss and future risk begins to emerge.

Estimates of disaster impacts are normally made only after large events, meaning that recurrent disaster loss is often unaccounted for. The evidence produced by applying the hybrid model in Colombia, Mexico and Nepal indicates that the scale of recurrent losses may be far higher than most governments realize (Figure 5.3). Estimated average annual disaster losses reach US$2.24 billion in Mexico, US$490 million in Colombia and US$253 million in Nepal.

Analysis based on the hybrid loss exceedance calculation for Colombia shows that the government may have to address losses in publicly owned assets as well as the uninsured private assets of low-income groups, ranging from US$100,000 (100 times per year) to US$1 billion (at least once every 30 years). In Mexico, and excluding impacts from drought and in the agriculture sector, the government
Box 5.3 The hybrid risk model

Loss exceedance curves are normally used to express the probable maximum losses (PML) that can occur in a given period, or the probability of exceeding a given level of loss in a given period. For example, an exceedance rate of 0.1 means there is a 10 percent probability of a given loss occurring in a year, formally representing a return period of 10 years for that loss. An exceedence rate of 10 means that it is probable that the loss is exceeded 10 times in a year. The curves can also be used to estimate annual average loss, being the expected annual loss over the long term.

The hybrid risk model is built by constructing two loss exceedance curves: one derived empirically from recorded disaster losses for all the hazards to which the country is exposed, and the other derived analytically for major hazards, such as earthquakes and tropical cyclones.

The empirical loss exceedance curve is constructed by assigning monetary values to recorded disaster losses for all weather-related and geological hazards in national disaster databases, applying parameters widely used in disaster impact assessments. The resulting curve models probable maximum losses up to a return period of approximately 40–50 years, accounting for most extensive risk.

The analytical loss exceedance curve is constructed by measuring the quantity and value of a proxy of the exposed assets to hazards of different intensities in each sector (e.g., housing, energy, health, transportation). These are assigned to vulnerability functions in order to estimate probable losses, e.g. different earthquake vulnerability curves are used for buildings with different construction systems. The analytical loss curve represents the fiscal or sovereign risk associated with major hazards, such as earthquakes in Colombia and Nepal, and both earthquakes and tropical cyclones in Mexico.

When the two curves are integrated as presented in Figure 5.2 for the case of Colombia, the empirical curve estimates higher probable maximum losses than the analytical curve for the strata of extensive risks, with direct losses of up to US$30 million occurring once a year. This confirms that the analytical loss curve does not accurately capture extensive risks. However, the analytical curve estimates higher probable maximum losses for longer return periods, confirming that the empirical loss curve underestimates intensive risks, particularly those with very long return periods. By combining both, the hybrid loss exceedance curve enables governments to estimate the full spectrum of disaster risks they face.

A loss exceedance rate of 10 means it is likely that the associated loss will be exceeded 10 times a year in events with a return period of 0.1 years (1.2 months).

(Source: ERN-AL, 2011)
is likely to incur weather-related disaster losses of over US$1 million at least 50 times a year, of more than US$15 million at least 10 times a year, more than US$300 million at least once a year, and more than US$1 billion at least once every 6 years. In Nepal, the government is implicitly liable for losses amounting to US$1 million almost 10 times each year, and of US$100 million almost every second year.

This is the real scale of disaster loss in these countries. It gives an idea of the magnitude of the public funds required if a government were to compensate for and replace public assets, and support the recovery of low-income households and communities. Also, it is not just recurrent losses that governments are ill prepared to deal with. With some notable exceptions, governments are rarely adequately prepared, by either contingent financing or insurance, to cover the probable maximum losses from a low-probability intensive event. Taken by surprise by liabilities that they have never assessed, governments are then forced to rely on slow and often unreliable international assistance for recovery and reconstruction.

To put these losses into a political perspective, Figure 5.4 shows the value of nationally recorded losses for five successive presidential periods in Mexico from 1982 to 2009. All Mexican governments since 1982 have had to absorb disaster losses of over US$10 billion during their period in power, rising to almost US$20 billion in the new millennium. This is the scale of loss any incoming government is likely to have to deal with unless serious investments are made in DRM.

From an economic perspective, the losses are significant in all three countries studied. In Colombia, for example, as Figure 5.5 shows, the estimated annual loss from disasters represents approximately 1 percent of GDP. Although this
is less than the cost of cyclical unemployment, disaster losses are higher than the cost of 5 percent inflation, and are comparable to the cost of armed conflict, which was estimated at 1.1 percent of GDP for the period of 1991 to 1996. Furthermore, the maximum probable disaster loss with return periods of 500 and 1,000 years, represent costs of 2.3 percent and 2.9 percent of GDP, respectively, equivalent to the losses caused by the financial crises of the 1980s and 1990s (Moreno and Cardona, 2011).

These figures indicate that if decision-making were based on a realistic assessment of the social and economic costs and benefits, DRM should have a similar public policy importance as controlling inflation or resolving armed conflict. In other words, a larger share of the national budget should be allocated to reducing disaster risks. Making these costs visible is also a key step towards identifying the trade-offs in DRM investment.

These figures on disaster loss do not include the cost of indirect disaster impacts documented in the 2009 Global Assessment Report (de la Fuente and Dercon, 2008; UNISDR, 2009), for example increasing poverty and declines in human development. Moreover, disasters reduce the savings level in society and thus the amount of capital and product per person. As a result, recurrent disasters, even though they may be small-scale, affect per capita income rates in the long term (IDEA, 2005; Cavallo et al., 2010; Moreno and Cardona, 2011).

5.3 Tailoring DRM strategies

Governments will need a range of different DRM strategies to address the different risk strata. It may be more cost-effective to reduce the more extensive risks using a mix of prospective and corrective risk management strategies. For some of the more intensive risks, corrective disaster risk management will not be cost-effective, although compensatory risk management could address them through insurance, reinsurance, transfer to capital markets, and contingent financing.

5.3.1 Identifying risk strata

Governments typically have three strategic DRM instruments at their disposal: prospective, corrective and compensatory.9 The portfolio of resources and their financial costs are very different for each. By assessing the full spectrum of risks they face, governments will be able to identify the most appropriate and cost-effective DRM strategies for each risk strata. Applying probabilistic risk modelling and cost–benefit analysis to develop a composite profile for each
country can assist in defining a pragmatic mix of instruments depending on the economic and development status of a country.

From a risk-financing perspective, there are three possible strategies that a government can adopt to manage disaster risk: retaining the risk, insuring the risk and transferring the risk to capital markets. The decision how much risk to retain and how much to transfer is ultimately a government policy decision, based on considerations such as the value of the annual average and probable maximum loss, the fiscal space or capacity to invest in risk reduction, social and political acceptance of risk, and access to risk financing.

In general, it is more cost effective for governments to retain rather than insure extensive risks below the level of retention (Figure 5.6). From an insurance perspective, this stratum would normally be considered as a deductible, which governments would have to cover from their own resources.

It is more cost effective for a government to transfer intensive risks, between the deductible amount and the risk transfer limit, through insurance, reinsurance and through contingent credit and similar instruments, rather than to retain them. Beyond the risk transfer limit, risks cannot be insured, and can only be transferred to capital markets through instruments such as Cat Bonds, or are residual. Beyond this point, countries are likely to face the range of very low-probability emerging risks as described in Chapter 2.

In Colombia, for example, national insurance regulators have established that all insurers should have reserves, including reinsurance, to cover the probable maximum loss associated with a return period of 1500 years. This would be the risk transfer limit if the insurer decides to establish an excess loss threshold at that level, above which losses are not insured: a probable maximum loss of US$7.6 billion in the case of Colombia (Figure 5.7). If the deductible was established at 1 percent, the government would have to retain probable maximum losses of up to US$1.5 billion and cover annual average losses of approximately US$200 million with its own resources, below the level of retention.

Similar findings are seen in cost–benefit analyses of different climate adaptation options (ECA, 2009). Studies in 15 diverse countries including China, India, Mali, the United Kingdom, the United States of America and seven Caribbean countries showed that countries with a balanced portfolio of prospective, corrective and compensatory risk management measures were best positioned to proactively manage the total spectrum of climate risk.
5.3.2 Compensatory DRM

Many low- and middle-income countries are vulnerable to post-disaster resource deficits. In such circumstances governments have to divert funds from already tight budgets, re-allocate development loans to relief, and/or take on new loans from other states and the international community. Unless special conditions are granted, these sources of post-disaster finance are often slow and too expensive. When governments are unable to mobilize timely resources for recovery and reconstruction, the direct costs and impacts of the disaster can cascade into a range of other negative social and economic outcomes (Suarez and Linnerooth-Bayer, 2011). For example, Honduras experienced a severe delay in economic growth due to difficulties repairing public infrastructure and assisting private sector recovery after the devastation of Hurricane Mitch in 1998. Five years after Mitch, its GDP was still 6 percent below pre-disaster projections (Mechler, 2004).

Following intensive disasters, a lack of financial liquidity often leads to serious delays in recovery. In Haiti, of the almost US$6 billion pledged for the first two years after the January 2010 earthquake, only about US$0.5 billion or less than 10 percent had been transferred as of August 2010 (Ferris, 2010). This financing gap occurs after most major disasters and severely affects not only recovery itself, but also future investments in DRM.

Figure 5.8 shows the relative costs of relief, recovery and reconstruction, the three phases of post-disaster funding in the case of intensive disasters. Whereas the humanitarian community and the media tend to focus on relief, most post-disaster funding requirements are normally for reconstruction. In the case of extensive disasters, the amplitude of the curves may be inverted. Although governments may spend on relief (and to a lesser extent on recovery), the large initial costs of relief, and even of subsequent reconstruction, are usually absorbed by low-income households and communities.

The cost of financial instruments that could address the needs of each of the funding phases varies considerably (Ghesquiere and Mahul,
A government’s own contingency funds and grant financing from donors will always be the cheapest source of funding, but they have limitations in terms of quantity, predictability, speed of disbursement, and hidden costs, for example when funds are diverted from previously allocated development budgets and grants (Mahul and Skees, 2006; Ghesquiere and Mahul, 2010). As highlighted by Box 5.4, contingency funds rarely provide more than a fraction of the funds required, and they may be exhausted by the cost of extensive disasters. The implication is that countries have to divert development resources to cover recovery and reconstruction costs, or transfer losses and impacts to affected households and communities. In both cases, the development deficit increases.

Insurance and risk-sharing approaches can enable governments to complement other risk management strategies. They do this by ensuring or accelerating financing for relief, recovery and reconstruction, while at the same time guiding investment decisions that also contribute to reduce risks (Suarez and Linnerooth-Bayer, 2011).

Two factors contribute to the cost of risk transfer: the entry level of risk transfer where the deductible amount is fixed, and the value of risk to be transferred between the deductible amount and the risk transfer limit. The cost of risk transfer can be significantly reduced if governments decide to retain and reduce part of their risk. For example, the cost of risk transfer with a deductible of 1 percent could be only a tenth of the cost of the transfer were no deductible established (ERN-AL, 2011). In the example of Colombia, using the hybrid curve, the cost of insuring the catastrophic risk between a level of retention of US$1.5 billion and a limit of risk transfer of US$7.6 billion would be calculated at approximately US$30–40 million per year.

New and innovative market-based instruments that promote DRM (Cardona, 2009; Hess and Hazell, 2009) are now being developed and piloted throughout the world. In Peru for example, new contingent insurance policies are being developed that ensure payouts a month ahead of forecasted floods resulting from an El Niño event (Box 5.5). These instruments have been developed for individual micro-insurance schemes, but this is one of the first attempts to apply them to a government client. In Manizales, Colombia, an innovative collective insurance policy protects both public and private assets by cross-subsidising coverage for low-income groups from voluntary payments. Using the kind of sophisticated catastrophic risk models presented above enabled the municipal government to design a collective risk transfer instrument and promote an insurance culture in the city (Marulanda et al., 2010).

By ‘pricing’ not only risk, but also the benefits of risk reduction, insurance instruments provide incentives for DRM. With such contingent insurance policies, a government could, for example, calculate the expected costs of risk reduction for a specific hazard, estimate unavoidable losses and then decide on the premium it can pay.

Other market-based instruments provide built-in incentives and an appropriate pricing of premiums according to previous risk reducing investments (Box 5.6). Whereas these are mostly designed for individual and business customers, the incentive and pricing principles can also be adopted for macro-level schemes.

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**Box 5.4 Mexico’s disaster contingency fund**

In 2010, Mexico’s disaster contingency fund (FONDEN) ran out of money. With an annual budget of 7 billion pesos, FONDEN had already spent 12 billion pesos by September and it estimated that it needed 25 billion by the end of the year due to non-assessed losses. FONDEN should have been in a better position given that Mexico issued a catastrophe bond for earthquakes and hurricanes, but extensive disasters, such as recurring floods and mudslides, led to FONDEN’s multi-billion pesos bill (rather than high-intensity hurricanes which could trigger the bond’s payouts). To make up the shortfall other government revenues had to be diverted.
The prohibitive cost of some insurance and risk financing instruments means that a conservative fiscal policy and the use of contingency funds and contingent lines of credit from development banks may be the most efficient way to deal with intensive risks (Ghesquiere and Mahul, 2010). Insuring a large part of the potential loss is equivalent to multiplying the loss, considering that insurance always costs more than potential loss. The fact that in 2011, only 5 out of 82 countries reporting to HFA on disaster financing mechanisms have issued catastrophe bonds (whereas 41 rely on national contingency funds) is reflective of this.

Unlike insurance and catastrophe bonds, contingent 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 where, by accessing contingent credit, the government secured liquidity in the aftermath of severe winter storms to provide relief and as a re-insurer to its livestock insurance programme (Box 5.7). Importantly, contingent credit can be linked to DRM as shown by the World Bank’s CAT Deferred Drawdown Option, which requires eligible countries to have a DRM programme in place. The loan may be ‘drawn down’ after a disaster, unless the government has received prior notification that their DRM programme is not being implemented in accordance with the agreement. The fact that the lines of credit are contingent on the development of DRM strategies means that Ministries of Finance get directly involved in a dialogue on risk reduction.

Different country contexts create different distributions of risk strata, and correspondingly, different ‘optimal’ portfolios of prospective, corrective and compensatory risk management. For example, in countries with high levels of drought risk and large agricultural economies, such as China, India or Mali, prospective and corrective risk management measures such as irrigation control, improved soil management and improved fertilizer use are less expensive.
**Box 5.6 Incentives for disaster risk reduction through new risk financing instruments**

Examples of new approaches and instruments in the insurance sector reflect a growing concern for creating incentives to reduce disaster risk. 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 threats to food security in ways that prevent the depletion of farmers’ productive assets. This reduces future demand for humanitarian aid by enabling households to produce more food during subsequent seasons.

Governments that join regional risk pools can negotiate lower-cost insurance contracts, as they require the implementation of risk reduction measures for pool eligibility. The African Risk Capacity (ARC), for example, aims to provide African governments with financial weather risk management tools and funds to manage extreme events, while creating incentives for disaster risk reduction, planning and response. It intends to do this through a regional contingency funding mechanism for planned responses to weather emergencies and the establishment of an Africa-owned risk pooling entity.

With small economies and high debt levels, Caribbean states are highly dependent on unpredictable donor support to finance post-disaster needs. The Caribbean Catastrophe Risk Insurance Facility (CCRIF), set up in 2007, is a parametric risk transfer scheme owned by 16 countries, which provides short-term liquidity in the event of hurricanes and earthquakes. After the magnitude 7.4 earthquake that shook the eastern Caribbean in late 2007, the Saint Lucian and Dominican governments received CCRIF’s first payouts; a total of US$0.9 billion to finance urgent post-earthquake recovery efforts. In early 2010 when Haiti was struck by a massive earthquake, the government received the full policy amount of only US$8 million, highlighting both the advantages as well as the inherent limitations of the instrument when governments are severely underinsured.

Catastrophe bonds, such as the recent issue in Mexico, have not yet been linked directly to disaster risk reduction. Indirectly, however, the Mexican bond will provide immediate and reliable post-disaster payments to the government, though as highlighted in Box 5.4, it has clear limitations. Though it is 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.

(Source: Suarez and Linnerooth-Bayer, 2011)

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5.3.3 Reducing the retained risks

As highlighted in the case of Colombia, even if it had insured its catastrophic risk the government would have to invest approximately US$200 million per year if it were to compensate for the losses for which it is responsible. In general, therefore it is much more cost-effective for governments to invest in reducing the more extensive risk strata (i.e., below the deductible amount) using a mix of prospective and corrective disaster risk management strategies.

To assess the costs, benefits and trade-offs internalized in these different strategies, their cost-effectiveness needs to be compared. Thus for example, using land use planning to reduce hazard exposure or designing according to building codes (prospective) could be compared with the reinforcement of unsafe buildings, relocation of exposed settlements.
Box 5.7 Financing Mongolian index-based livestock insurance through distributing risk layers

In 2006, an index-based livestock insurance (IBLI) programme was introduced on a pilot basis in three Mongolian provinces. The insurance system was 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, and 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 is provided by the World Bank and international reinsurance.

(Source: Suarez and Linnerooth-Bayer, 2011, citing Mahul and Shees, 2006)

to less hazardous locations, or construction of mitigation works (corrective).

In Colombia, as in the other pilot countries, land use planning and improved building standards generate the largest ratio of benefits to costs (approximately 4 to 1). Although corrective risk management produces a positive benefit to cost ratio, it is clear that it is far more cost-effective to anticipate and avoid the build-up of risk than to correct it (Figure 5.9).

Corrective risk management, however, is far more cost-effective when it is concentrated on the most vulnerable part of a portfolio of risk-prone assets. In Mexico, for example, the ratio of benefits to costs when investing in strengthening risk-prone public buildings is far more attractive when it is focused on the most vulnerable 20 percent of the portfolio (Figure 5.10).

This carries a powerful message and opportunity for governments. Corrective risk management investments can be very cost-effective if they concentrate on retrofitting the most vulnerable and critical facilities rather than being spread widely over many risk-prone assets.

These measures can be even more attractive when the political and economic benefits of avoiding loss of life and injury, decreasing poverty and increasing human development, are taken into account. Saving human lives, for example, may be a more powerful incentive for DRM than pure cost-effectiveness. In Colombia, better prospective and corrective investments in risk management would both lead to significant reductions in mortality (Figure 5.11).

Although illustrative, these calculations of costs and benefits are likely to be too conservative.
They do not take into account the cost of downstream outcomes, such as increased poverty, reduced human development, increased unemployment and inequality.

Schools are a politically attractive target for investment in risk reduction. However, if direct economic costs were the only consideration, only four countries in Latin America would opt to retrofit schools for earthquake safety (Box 5.8). Whereas decisions to invest in retrofitting schools should be relatively easy to defend, they are nevertheless made against a backdrop of complex political, social and financial dynamics. Structural reinforcement alone may be costly, and programmes that include both infrastructure and equipment upgrading, and involve the local community, can be more attractive.

When the costs of retrofitting different building types are taken into account, the three countries where retrofitting would be most cost-effective are Costa Rica, El Salvador and Peru. In Bolivia, Honduras and Nicaragua, the estimated retrofitting costs are greater than the costs of replacing the schools. In Argentina, Colombia, Mexico and Venezuela, the expected reduction of average annual loss would not justify the investment.

These calculations of cost-effectiveness did not take into account injury and loss of life, nor did they value education and its loss. When children’s lives are at stake, there may be a strong imperative to retrofit, even when the expected savings in lost educational infrastructure do not match the costs. In addition, given the effects of education on well-being and economic growth, demands for child safety, and the protection of public investments in education, the reduction of seismic vulnerability of educational facilities becomes a matter of priority.

**Box 5.8 The costs and benefits of school retrofitting in Latin America**

Damage and destruction of schools by earthquakes, floods and tropical cyclones leads to an unacceptable loss of children’s and teachers’ lives, wasting valuable public investment in social infrastructure and interrupting the education of those who need it most.15 In the 2010 earthquake in Haiti, it was estimated that 97 percent of the schools in Port-au-Prince collapsed (Fierro and Perry, 2010). In the earthquake in south Sumatra in 2009 more than 90,000 students were left without a school. As highlighted at the beginning of this chapter, although the destruction of schools in major earthquakes tends to attract media coverage, almost as many schools are damaged and destroyed in extensive disasters.

School safety has been established as a disaster risk reduction priority,16 but it is simply not cost-effective to retrofit all vulnerable schools. For example, in Bogota, Colombia, an assessment identified 710 schools built before 1960, of which 434 had a high vulnerability to earthquakes. Limited budgets meant that not all schools could be retrofitted and priority was given to the 201 schools that showed a positive cost–benefit ratio (Coca, 2007).
A recent study (ERN-AL, 2010) of earthquake vulnerability of schools in Latin America calculated the probable average annual loss for each country, taking into account earthquake hazard, the number of exposed schools, and their structural vulnerability both with and without retrofitting (Figure 5.12). In Bolivia, Honduras and Nicaragua, the retrofitting costs are greater than the value of exposed schools. In countries like Argentina, Colombia, Mexico and Venezuela, the expected reduction in average annual loss is not significant. Costa Rica, El Salvador and Peru are the countries with higher expected reductions in average annual loss and relatively low costs of retrofitting.

Figure 5.12
The costs and savings associated with retrofitting schools in Latin America

(Source: ERN-AL, 2010; Valcarcel et al., 2011)

Notes
1 Romania national progress report on the implementation of the Hyogo Framework for Action Interim Report, November 2010.
2 The importance of ‘political will’ for DRR both at national and local level is repeatedly cited as a crucial element for national strategies as well as a local enabling environment. This is described in various ways, often as local government commitment to effective DRR (Pelling, 2007; ProVention, 2009). Some resources recognize that political will for DRR has to be created and actively maintained, often via a range of incentive mechanisms (Christopolos, 2008; Trohanis et al., 2009).
3 From 1980 to 2003, the World Bank alone financed US$12.5 billion in post-disaster recovery projects.
4 The Tsunami Recovery Impact Assessment and Monitoring System (TRIAMS) is a common system to monitor recovery progress and long-term impacts in Indonesia, Maldives, Sri Lanka and Thailand.
5 All figures are taken from UNISDR’s Global Assessment Report Data Universe, available at www.preventionweb.net/gar.
6 Comprehensive Approach for Probabilistic Risk Assessment. For more information on CAPRA please see www.ecapra.org.
7 The parameters used are derived from methodology developed by the Economic Commission for Latin America and the Caribbean (ECLAC) for evaluating disaster impacts (ECLAC, 2002). This methodology is widely used following major disasters throughout the world by the World Bank, regional development banks and the United Nations. This, however, does not take account of indirect impacts and costs, for example, in terms of increasing poverty or deteriorating education and health.
8 For example in the post disaster loss and impact assessments produced after the Haiti earthquake in January 2010, the Chile earthquake in February 2010, and the El Salvador tropical storm in November 2009, using methodology developed by ECLAC (2002).
9 See Preface and Chapter 1 for definitions of these strategies.
10 Insurance is a form of risk transfer, but insurance and reinsurance companies, as well as countries, increasingly transfer their risk to capital and derivatives markets to cover major losses through alternative risk transfer (ART) instruments such as Catastrophe Bonds.
11 In insurance terminology, the deductible is the part of the claim that is not covered by the insurance company and that will have to be borne by the insured party.
The value of the deductible depends on several factors; nonetheless, each small event (extensive risk) usually incurs losses lower than the deductible, and therefore, is not covered by the insurance but instead needs to be covered by the government.


13 The costs of transferring risks of a specific layer can be calculated from the expected annual loss, incorporating the expected loss and the probability of occurrence by event (the technical estimation of basic risk premium). This means that the higher the deductible amount (i.e., the more the cost of the risk is retained by the premium holder), the lower the premium or the cost of insurance (see ERN-AL, 2011, Chapter 7, Tables 7.1 and 7.2). This level of retention is established depending on the solvency and financial convenience of the party or government. In addition, investing in DRR (e.g. reducing the level of exposure and vulnerability through retrofitting) has direct implications for the calculation of the premium. If the amount and frequency of expected losses is reduced, this will lower the premium for catastrophe insurance cover or other risk transfer solutions.

14 In fact the losses due to extensive disasters affecting more than 700 municipalities in Colombia during the 2010–2011 rainy season have been estimated in US$5.4 billion (Cardona, 2011) far exceeding available contingency funds and lines of credit. As a result the government has had to consider selling 10 percent of the capital of national energy company ECOPETROL to cover the gap (for more information see www.unperiodico.unal.edu.co/dper/article/anticiparse-al-peligro-no-es-una-opcion-es-una-obligacion).

15 An empirical analysis on a panel of 19 OECD countries observed from 1971 to 1998 has found a robust positive correlation between expenditures on health and education and GDP growth (Beraldo et al., 2009). Evidence also suggests that public expenditures influence GDP growth more than private expenditures. In particular, estimates show that a 1 percent increase in total educational expenditure growth rate would increase the per-capita GDP growth rate by 0.03 percent, with most of this effect coming from public expenditure (Ibid.)

16 Global UN campaigns on safe schools are evidence of this, such as the 2006–2007 ‘Disaster Risk Reduction begins at School’ campaign, or the more recent ‘A million schools and hospitals safe from disaster’ initiative within UNISDR’s ‘Making Cities Resilient’ campaign.