

THE TRIPLE DIVIDEND OF RESILIENCE

*Background Paper***Disaster Risk Management and Fiscal Policy****Narratives, Tools, and Evidence Associated with Assessing
Fiscal Risk and Building Resilience***Reinhard Mechler**Junko Mochizuki**Stefan Hochrainer-Stigler***WORLD BANK GROUP**

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Abstract

This paper addresses the question whether and how co-benefits, through disaster resilience building, can be further promoted. Co-benefits are defined as positive externalities that arise deliberately as a result of a joint strategy that pursues several objectives synergistically at the same time, such as disaster risk management and development goals, or disaster risk management and climate change adaptation. Of particular interest is the question of how the economic and broader benefits of disaster risk management can be recognized and realized by those in charge of fiscal policy decisions. The paper considers the interplay between public disaster risk management investment and fiscal policy, and provides an overview of the current debate as well as assessment methods, tools, and policy options. In fiscal budgeting,

it has been standard practice to focus on direct liabilities and recurrent spending. Costs of disasters are often dealt with after the fact only, rather than being considered as contingent liabilities. As a consequence, the full costs of disasters have often not been budgeted for, and, with a price signal missing, there is lack of clear incentives for investing in disaster risk management. Overall, the paper identifies four steps and three dividends to be harnessed: (i) understanding fiscal risk; (ii) protecting public finance through risk financing instruments, the *first dividend*; (iii) managing disaster risk comprehensively, the *second dividend*; and (iv) pursuing a synergistic, co-benefits strategy of concurrently managing disaster risks and promoting development, the *third dividend*.

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Disaster Risk Management and Fiscal Policy: Narratives, Tools, and Evidence Associated with Assessing Fiscal Risk and Building Resilience

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1 Introduction: From understanding risk to building fiscal resilience

Overview

Disaster risk has seen strongly increasing recognition by research, policy and implementation over the last few years. Substantial investments into disaster risk management (DRM) have been made and, according to some accounts, the balance between *wait-and see* (ex-post relief and reconstruction funding) and *proaction* (ex-ante investments into DRM) has been shifted from 95% vs. 5% a decade back to about 87% vs. 13% (Kellet and Caravani, 2012). Economic decision-support tools have helped to understand the benefits of DRM and shown substantial dividends from DRM (see UK Government Office for Science, 2012).

Yet, more effort is needed to further shift this balance. The recent UNISDR Global Assessment reports (UNISDR 2013&2015a) issue a stark warning that economic losses linked to disasters are “out of control” and will continue to escalate unless DRM becomes a core part of business investment strategies. The World Bank’s World Development Report 2014 (World Bank, 2013) emphasizes the need to further switch from unplanned and ad hoc responses to proactive and systematic risk management. As well, recent IPCC assessment reports (IPCC 2012, 2014) emphasize the need for risk based assessment and careful management planning before disasters strike. Finally, the last Global Risk Report published by the World Economic Forum (WEF, 2015) concludes that stronger efforts are needed to understand, measure and foresee the evolution of interdependencies of risk.

Governments at different scales are important actors in DRM. In addition to providing DRM, regulating private sector activity, promoters and coordinators of collective action on DRM (Wilkinson, 2012), they are risk-takers, as a large part of disaster risk ends up with the fiscal position (Mechler, 2004). Over the last few years, there has been increasing recognition and understanding of the need to deliberately consider this in public and fiscal risk planning for disasters and implement disaster risk reduction (DRM) to the extent possible.

Approach

This paper provides reflection on the benefits of DRM in the context of fiscal policy and public investment, addressing the question whether and how co-benefits through disaster resilience building can be further promoted. In line with the literature, we define co-benefits as positive externalities that arise deliberately as a result of a joint strategy that pursues several objectives

synergistically at the same time, such as DRM and development goals, or DRM and climate change adaptation (see Hourcade et al, 2001).¹

Of particular interest for the following debate is the question of how economic and broader benefits of DRM can be recognized and realized by those in charge of fiscal policy decisions. The discussion considers the interplay between public DRM investment and fiscal policy and provides an overview of current debate as well as assessment methods, tools and policy options. Currently, in fiscal budgeting practice it is mostly standard to focus on direct liabilities and recurrent spending, such as foreign and domestic sovereign borrowing, expenditures by budget law, future recurrent costs of public investment projects, and pension and health care expenditure. Costs of disasters are often dealt with after the fact only rather than being considered as contingent liabilities. As a consequence, the full costs of disasters are not budgeted for and with a price signal missing there is lack of clear incentives for investing in DRM.

Charting out progress

The following discussion traces progress in the debate on fiscal disaster risk management by focussing strongly on analytics and current practice (see figure 1). We overall identify four steps, which are being pursued deliberately, as well as three dividends, which are being harnessed (see also ODI & World Bank, 2015).

- (i) Understanding fiscal risk- identifying and assessing the relevance of disaster risk for public finance;
- (ii) Protecting public finance through risk financing instruments – identifying and examining insurance-related instruments that support protection of the fiscal position - the *1st dividend*;
- (iii) Comprehensively managing disaster risk including risk reduction and risk preparedness as they affect development – the *2nd dividend*;
- (iv) Pursuing a synergistic, co-benefits based, strategy of concurrently managing disaster risks and promoting development – the *3rd dividend*.

¹ In contrast, ancillary benefits are additional benefits that arise without deliberate planning. Similarly, there may also be co-costs from projects and policies. This is not the topic of this chapter, but will need attention further on.

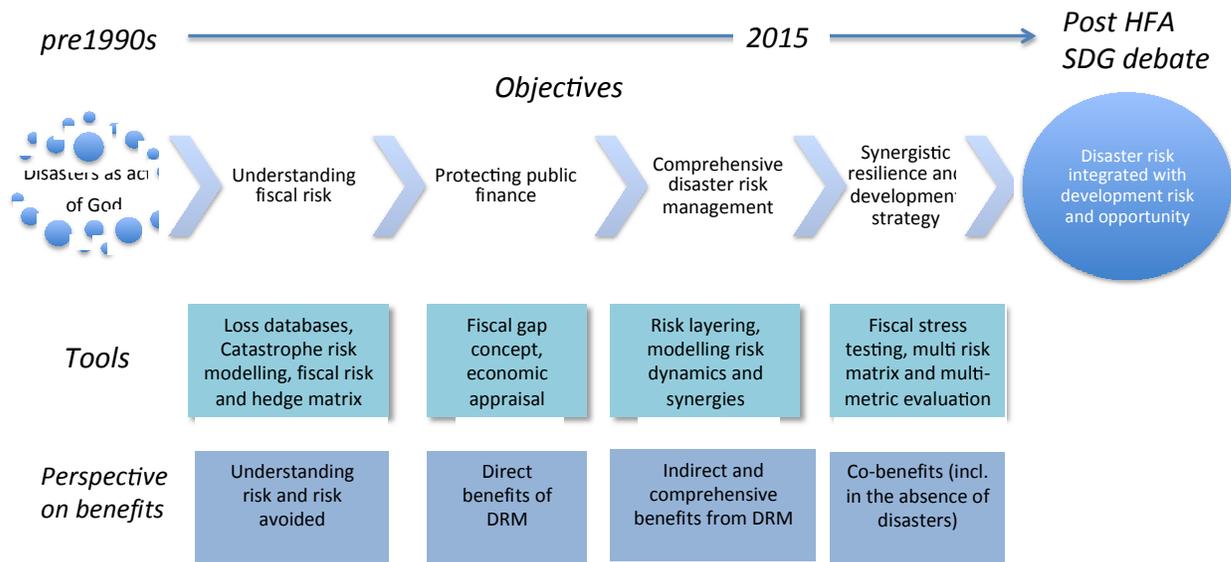


Figure 1 Tracing progress in debate and practice: From acts of god to DRM as part of fiscal risk management

Specifically, the paper aims at providing an analytical assessment with a ‘user focus’ based on the following broad guiding question: How can the findings support government’s DRM investment decisions as a public good? We provide empirical evidence, seek to identify good/bad practices in fiscal policy design and contextualize the discussion with relevant country-level and regional examples, such as from Mexico, the Caribbean states and OECD countries. Overall, we seek to distill entry points for more strongly recognizing and realizing the economic and broader benefits of DRM by those in charge of fiscal policy. Specifically, we identify current guiding principles and aims for fiscal policy, then discuss if and how those can be amended to support DRM. The ensuing discussion is organized according to the four steps and dividends and finally leads into a short conclusions section, which provides final commentary regarding the ongoing transition, which increasingly positions disaster risk as part and parcel of resilience strategies to harness co-benefits from managing disaster risk and stimulating development.

2 Understanding fiscal risk

A first logical step for managing (fiscal) risk, which is commonly pursued, is to properly understand and put risk in the proper context of fiscal operations, for which considerable effort has been expanded over the last few years.

Natural disasters lead to loss of life and assets and have large impacts on people, businesses and governments. Governments at different scales are decisive to assessing, reducing and financing disaster risk. From an economic perspective, governments are exposed to natural disaster risk and potential losses due to three functions: (i) the allocation of goods and services (security, education, clean environment), (ii) the provision of support to private households and business in the case of market failure, (iii) and the distribution of income (Mechler, 2004; see Musgrave, 1959). From a budgeting perspective, sovereign disaster risk arises as a contingent public sector liability, which is associated with government's functions to provide relief, support to recovery, undertake reconstruction and raise tax revenue. Once a disaster hits, these contingent liabilities can lead to large costs accruing to governments for providing relief, recovery and reconstruction assistance (see Box 1).

Box 1: Government operations and costs post disaster

Relief operations include emergency assistance provided to the affected population to meet basic needs, such as shelter, food and medical attention.

Early recovery operations following the initial relief efforts are crucial to limit secondary losses and ensure that reconstruction can start promptly. They include the emergency restoration of lifeline infrastructure (e.g., water, electricity and transportation lines), the removal of debris, and the like.

Reconstruction operations generally center on the rehabilitation or replacement of assets damaged by a disaster. These include public facilities and infrastructure, which are the direct responsibility of the state, but national or municipal authorities usually face obligations that go beyond their own assets. Governments often are called on to subsidize the reconstruction of private assets, in particular housing for low-income families who could not otherwise afford to rebuild their homes.

Loss of tax revenue arises as the economy is depressed and needs time to recover.

Source: World Bank, 2010a

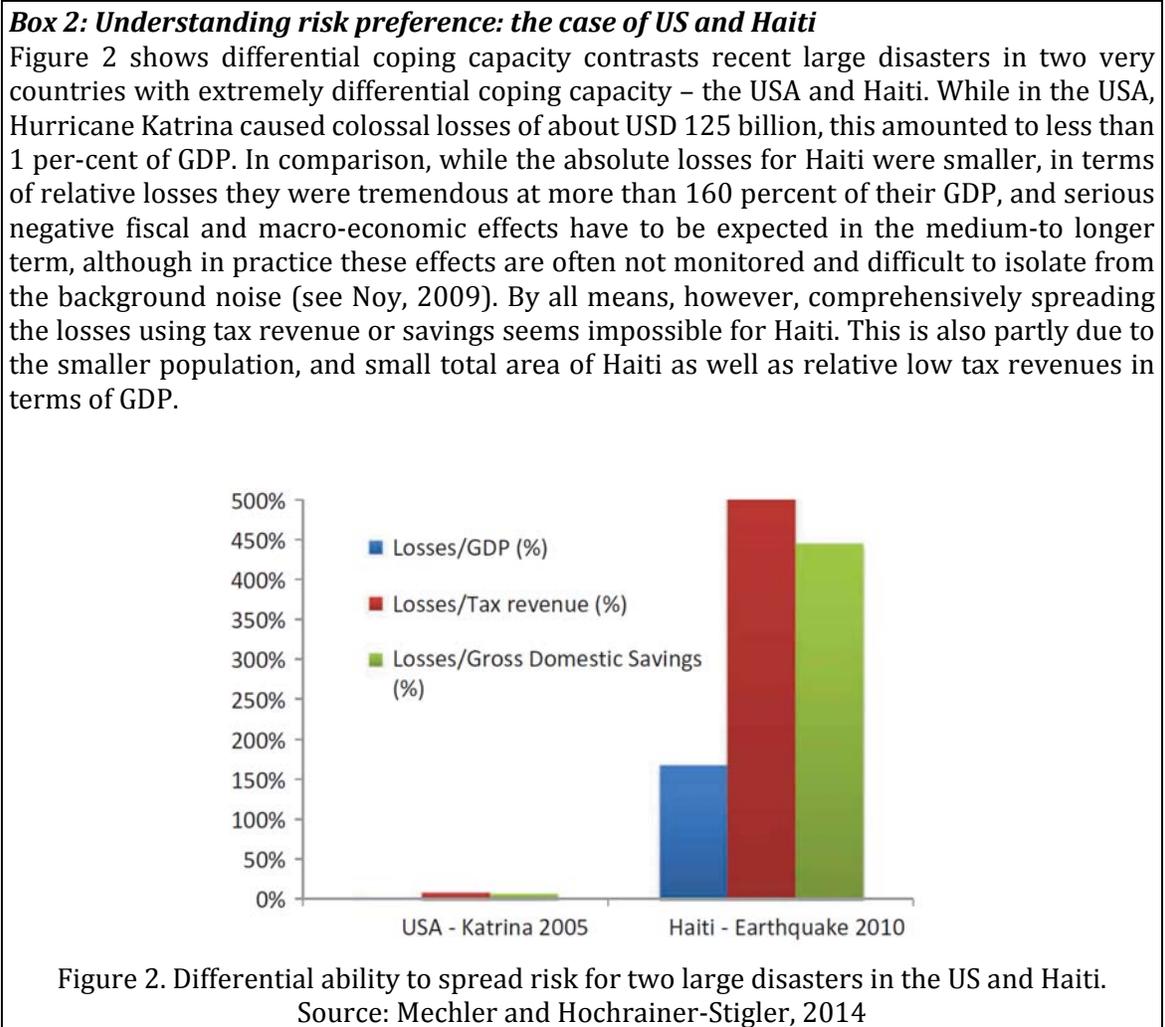
2.1 Coping with risk: Understanding risk tolerance and the need to plan

As disaster risk is a liability, the question arises whether governments should take disaster risk into account explicitly or can they afford a responsive mode of operations? A seminal paper by Arrow and Lind (1970) on the role of sovereign risk preference proposed that governments should behave (disaster) risk-neutrally, as they are considered the entity best suited to deal with risk via efficiently pooling and spreading potential losses. More precisely, the argument did not favor neglecting risk; rather Arrow and Lind suggested a fiscal management approach based on expected values only: "[...] the government should behave as an expected-value decision maker" (Arrow and Lind 1970). This means governments, as they can afford to refinance quickly,

should only plan for and reserve for average costs incurred over longer time horizon, and thus would not need to pay close attention to variability in costs which is arises due to the fact that disasters are high-impact-low frequency events (thus are defined by strong volatility around the mean).

Challenging Arrow-Lind

Over the last few years, it has been recognized that variability matters and that countries exhibit differential coping capacity for dealing with risk (see box 2).



Practically, the Arrow-Lind theorem has been challenged on theoretical grounds and the case for risk aversion has been understood (Priest, 2003; Mechler 2004; Hochrainer, 2006; Ghesquiere and Mahul, 2007; Anginer et al. 2013; Mechler and Hochrainer-Stigler, 2014). However, only a few of these analyses (Mechler 2004; Hochrainer, 2006; Ghesquiere and Mahul, 2007; Mechler and Hochrainer-Stigler, 2014) explicitly studied and criticized the details of the

theorem for the disaster dimension. Broadly, the Arrow-Lind theorem does not apply to governments of countries that exhibit some of the following characteristics (see Mechler, 2004; Mechler and Hochrainer, 2014), and in these cases governments should justifiably act as risk-averse agents.

- High natural hazard exposure;
- Economic activity clustered in a limited number of areas with key public infrastructure exposed to natural hazards; and
- Constraints on resources to finance disaster losses and associated requirements. Such sources are determined by the ability to reallocate the budget, domestic savings, access to financial markets, and level of external indebtedness.

While income is not the sole defining variable for risk coping and risk preference, it is informative to compare income to losses in large event to understand where to look and where to prioritize action. As figure 3 suggests, while absolute damages (losses) have been concentrated in higher income countries, in lower income and particularly in small island states (SIDS), the relative burdens have been found to be much larger (e.g. more than 300% of GDP in SIDS (World Bank, 2013).

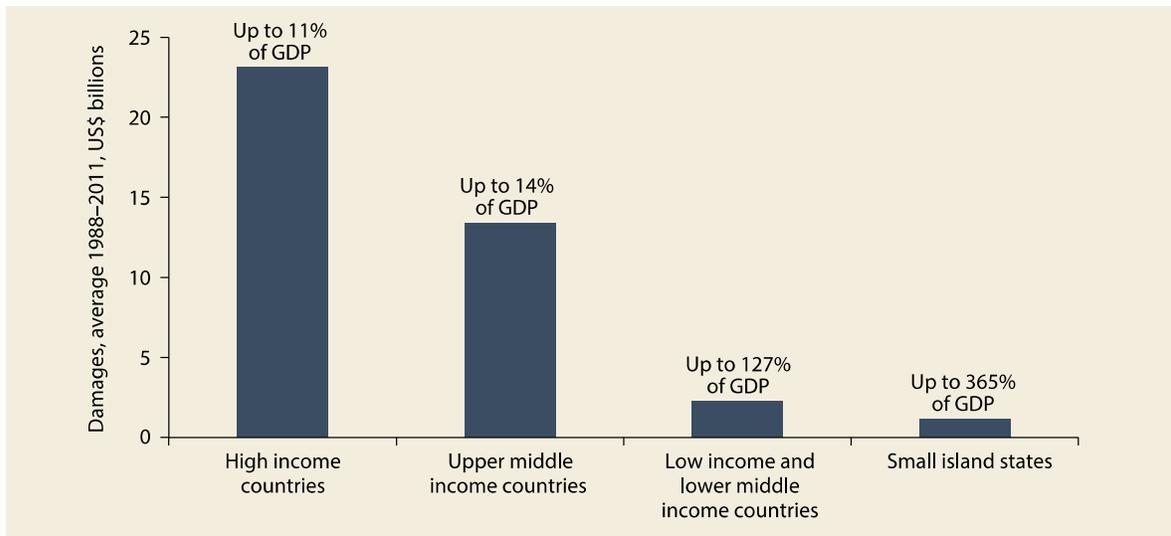


Figure 3 Country income groups and disaster losses. Source: World Bank, 2013

If risk aversion is identified as the proper risk preference, this implies that risk has to be taken into account explicitly (and beyond average values) in budget and fiscal planning. A government then should go beyond being an 'expected value' decision-maker, and consider variability and risk properly.

2.2 Tools and concepts: The fiscal risk and hedge matrices

Budget and resource planning for disasters is not an easy proposition. Applying the so-called *fiscal risk matrix* is a step forward. Governments commonly plan and budget for *direct* liabilities, that is, liabilities that manifest themselves through certain and annually recurrent expenditure. Those liabilities are termed *explicit* (as recognized by law or contract), or *implicit* (moral obligations). In contrast, disaster risk enters the balance sheet as *contingent* liabilities (marked in red in table 1), i.e. obligations that arise randomly when a particular event occurs. Explicit, contingent liabilities deal with the reconstruction of infrastructure destroyed by events, whereas implicit obligations are associated with providing relief – commonly considered as a moral liability for governments (Polackova Brixi and Mody, 2002).

Table 1 Government liabilities: the fiscal risk matrix

Liabilities	Direct Obligation in any event	Contingent Obligation if a particular event occurs
Explicit Government liability recognized by law or contract	<ul style="list-style-type: none"> • Foreign and domestic sovereign borrowing, • Expenditures by budget law and budget expenditures 	<ul style="list-style-type: none"> • State guarantees for non-sovereign borrowing and public and private sector entities • Reconstruction of public assets
Implicit A “moral” obligation of the government	<ul style="list-style-type: none"> • Pension and health care expenditure • Future recurrent costs of public investment projects 	<ul style="list-style-type: none"> • Default of subnational government or public or private entities, • Banking failure • Disaster relief and recovery assistance

Source: Modified after Polackova Brixi and Modi, 2002. Note: DRM relevant items in red.

Similarly to the fiscal risk matrix, a fiscal hedge matrix can be established, which would identify the sources governments have available to generate resources generally and in future (contingent) events (table 2). Risk financing would thus fall under the explicit contingent sources for coping with disaster losses.

Table 2 Government sources: the fiscal hedge matrix

Liabilities	Direct Sources in any event	Contingent Sources if a particular event occurs
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Explicit Direct control by Government	<ul style="list-style-type: none"> • Tax revenues (less tax expenditures) • Government-owned assets for possible sale or lease 	<ul style="list-style-type: none"> • Transfer income from the central government • Recovery of loans made by government (on-lending) • Legal claims against the state • Reserve funds • Contingent credit lines and financing commitments from official creditors • Sovereign insurance
Implicit Not directly controlled by Government	Existing funds that are under indirect government control (social security funds)	<ul style="list-style-type: none"> • Future profits of state-owned enterprises and agencies

Source: Modified after Polackova Brixi and Modi, 2002. Note: DRM-relevant sources in red.

Three key types of government risk financing are worth noting in relation to disasters (and will be discussed further below): reserve funds, contingent credit lines, and sovereign insurance (traditional or alternative).

2.3 Evidence of planning for contingent liabilities

Historically, countries have generally not planned for contingent liabilities, and using ex-post sources such as budget reallocations, aid and emergency loans have financed disaster losses. Large, developed countries have relied on their national reserve funds, the reallocation of the budget (existing tax revenue) or new tax revenue to fund the aftermath of disaster event, and those countries have done less fiscal planning for disaster risk (see e.g., UNESCAP 2013). OECD and larger countries can generally absorb the impact of adverse natural events since revenues from unaffected regions can subsidize the affected region.

Among others, the fiscal risk matrix has seen application in Mexico, Colombia, Thailand and Indonesia with reference to disaster risk. Colombia has been one of the pioneers in this regard (see box 3).

Box 3: Assessing the Contingent liability of Disasters Using Catastrophe Risk Models in Colombia

Colombia is a leader in assessing contingent liabilities. In 2010, the government for the first time undertook a comprehensive assessment of all such liabilities. Natural disaster risk was found to be the second most important liability (after legal claims on the state, which ranked on top) with annual expected losses of estimated at close to half a billion USD or 0.7% of the

2010 budget. While averages are informative, variability is key and 100 and - 500-year return period were considered to potentially lead to more than 4% and 8% per-cent of budget, respectively

Table 3 Contingent liabilities' assessment for Colombia

Contingent Liability	US\$ Million	% GDP *	% Budget *
Legal Actions	18,642	7.5	27.7
Natural Disasters	490	0.2	0.7
Public Credit Operations	56	0.02	0.1
Infrastructure Projects	26	0.01	0.0
Probable Maximum Loss from Natural Disasters			
	US\$ Million	% GDP *	% Budget *
100 year PML	2,976	1.2	4.4
250 year PML	4,417	1.8	6.6
500 year PML	5,655	2.3	8.4

Source: Ministry of Finance and Public Credit, Colombia 2011 as reported in GFDRR, 2012b

2.4 Fiscal stress testing

Improved understanding of risk has been the basis for fiscal stress testing, for which decision-supporting tools have been developed. As an indicator of financial vulnerability, Mechler (2004) suggests to measure sovereign financial vulnerability in terms of the *resource gap* concept, which is defined as *the lack of sufficient funding for relief and reconstruction*. Governments would thus be fiscally risk averse if they cannot access sufficient funding after a disaster to cover their liabilities with regard to reconstructing public infrastructure and providing assistance to households and businesses. The repercussions of large resource gaps can be substantial. The inability of a government to repair infrastructure in a timely manner and provide adequate support to low-income households can result in adverse long-term socioeconomic impacts. As a case in point, despite substantial inflows of donor aid, but given limited domestic resources, Honduras only received about 50% of the funds necessary for relief and reconstruction, and experienced extreme difficulties in repairing public infrastructure and assisting the recovery of the private sector following Hurricane Mitch in 1998. Five years after Mitch's devastation the GDP of Honduras was 6% below pre-disaster projections.

A report by the World Bank (Cummins and Mahul, 2009) added another dimension to this framing and assessment in terms of the timing of resource flows. While enough funding may be available over time, there may be a sporadic resource gap, as generally in the aftermath of a disaster event, urgent

expenditure needs are high, but the immediately available financial resources are often very limited. The timing of financial inflows for financing the losses is important and can differ for different ex-ante and ex-post instruments.

Empirical information on fiscal gaps

Although there has been a considerable amount of discussion, there is very little reported evidence on the scope and scale of liquidity gaps. The case of Grenada is a notable exception highlighting various repercussions of fiscal crisis (see box 4).

Box 4: Grenada and the financing gap post Hurricane Ivan

Hurricane Ivan struck Grenada on September 7, 2004 and left tremendous devastation in its wake with damages estimated at over USD800 million - or twice Grenada's Gross Domestic Product (GDP). Just as it required additional resources to finance relief, clean-up and emergency rehabilitation, Grenada experienced a dramatic decline in revenues. The revenue reduction was an estimated 5 percent of GDP between September and December 2004. The government, which had only limited reserves, faced serious problems financing the public service bill, including salaries and the continuation of key services. It also became evident that the country would not be able to meet its debt obligations as they fell due. In an effort to secure the necessary resources to continuing functioning, the government sought donor assistance in the reconstruction of the island and in helping it meet its expense liabilities (imports and civil servant salaries). Despite over USD150 million in pledges, only USD12 million was available to address immediate liquidity needs. The remainder of the funds pledged was earmarked for reconstruction projects that were implemented over the following two years. In addition to the requested donor assistance, the government also sought the cooperation of its creditors by developing a proposal to restructure over 85 percent of its commercial debt. The final effort of the government to address its revenue short-fall was to pass revenue-enhancing measures yielding over 2 percent of GDP in April 2005, about 7 months after the event. These measures included: (i) an increase of about 45 percent in the retail price of fuel; (ii) an increase in excise taxes on alcohol and tobacco; (iii) a special levy on incomes over USD375 per month for a five year period; and (iv) improved tax administration. Despite all these efforts, Grenada's fiscal situation remained challenging and the country still faced a financing gap of 4.5 percent of GDP for 2005 with total debt projected to increase to 150 percent of GDP. Furthermore, instead of focusing on recovery and reconstruction, the government was distracted by the need to finance the emerging resource gap. This led to delays in the recovery and reconstruction periods. To make matters worse, Hurricane Emily followed in 2005, which caused about USD 50 million in additional economic losses. The Grenada experience and lessons learnt have been considered an important impetus for the discussion regarding the creation of the Caribbean Catastrophe Reinsurance Facility (CCRIF) in 2007 (see World Bank, 2010b).

Yet, the detailed information available on Grenada, including a reported instance of a liquidity gap, is rather the exception than the rule, and at best the information available is often fragmentary.

2.5 Analytical tools to assess fiscal risk and gaps

Given the lack of robustness of empirical information on risks, interested parties may want to resort to analytical tools to derive relevant information. Modeling and decision support based on work by IIASA (see Mechler, 2004; Hochrainer, 2006; Hochrainer-Stigler et al., 2014 and IDB, 2008) over the last

few years is available regarding countries' financial vulnerability and questions relating to how much and what to insure. CATSIM has addressed this question in some detail for many countries and regions. The Catastrophe Simulation (CATSIM) model, developed by IIASA, is a risk-based economic framework for evaluating economic disaster impacts, and the costs and benefits of measures for reducing those impacts. CATSIM uses stochastic simulation of disaster risks by randomly and repeatedly generating disaster events in a specified region and examines the ability of the government and private sector to finance relief and recovery. The model compares asset loss distribution with fiscal resilience, defined as the total of ex-post and ex-ante risk financing (see Figure 4 below).

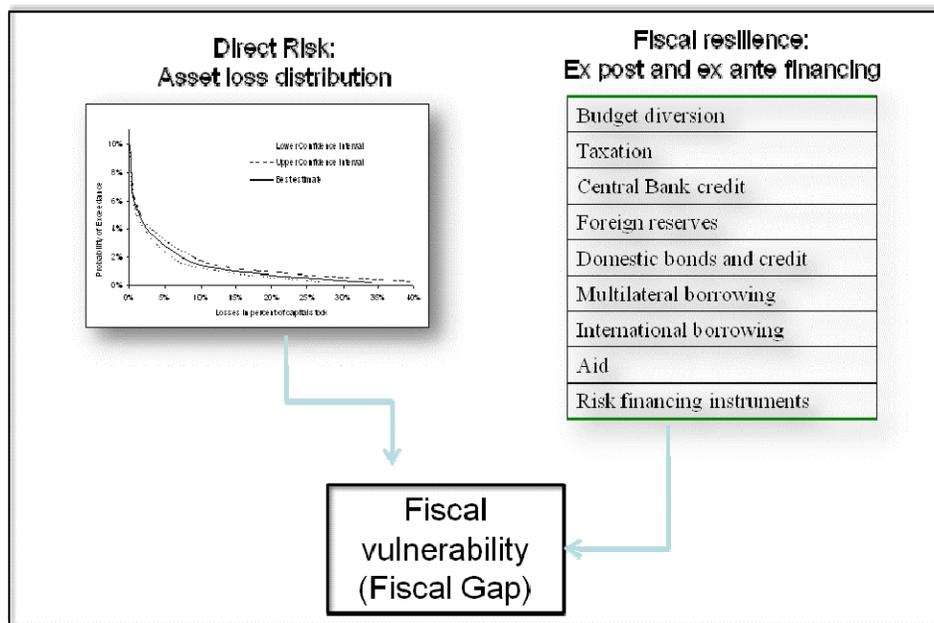


Figure 4 Modelling fiscal vulnerability and resilience to natural hazards
Source: Hochrainer et al., 2014

For the World Bank World Development Report 2010, and recently published Hochrainer-Stigler et al. (2014), CATSIM was used to conduct global analysis on fiscal vulnerability and risk. The global analysis highlighted the following countries to be particularly fiscally vulnerable: (i) various small island developing states in the Caribbean and Pacific, (ii) countries in Latin America (Honduras, Nicaragua, El Salvador and Bolivia), Africa (Madagascar, Mozambique, Zimbabwe, Sudan, Nigeria and Mauritania) and Asia (Nepal, Cambodia, Laos, the Philippines, Indonesia, Papua New Guinea). These countries are prime candidates for stepping up activities to plan, reduce and manage risks in order to reduce serious human and financial loss burden to exposed populations, business and wider macroeconomic health. Figure 5

shows a global map of fiscal gap return periods, i.e. the estimated return period for which countries would incur a fiscal shortfall.

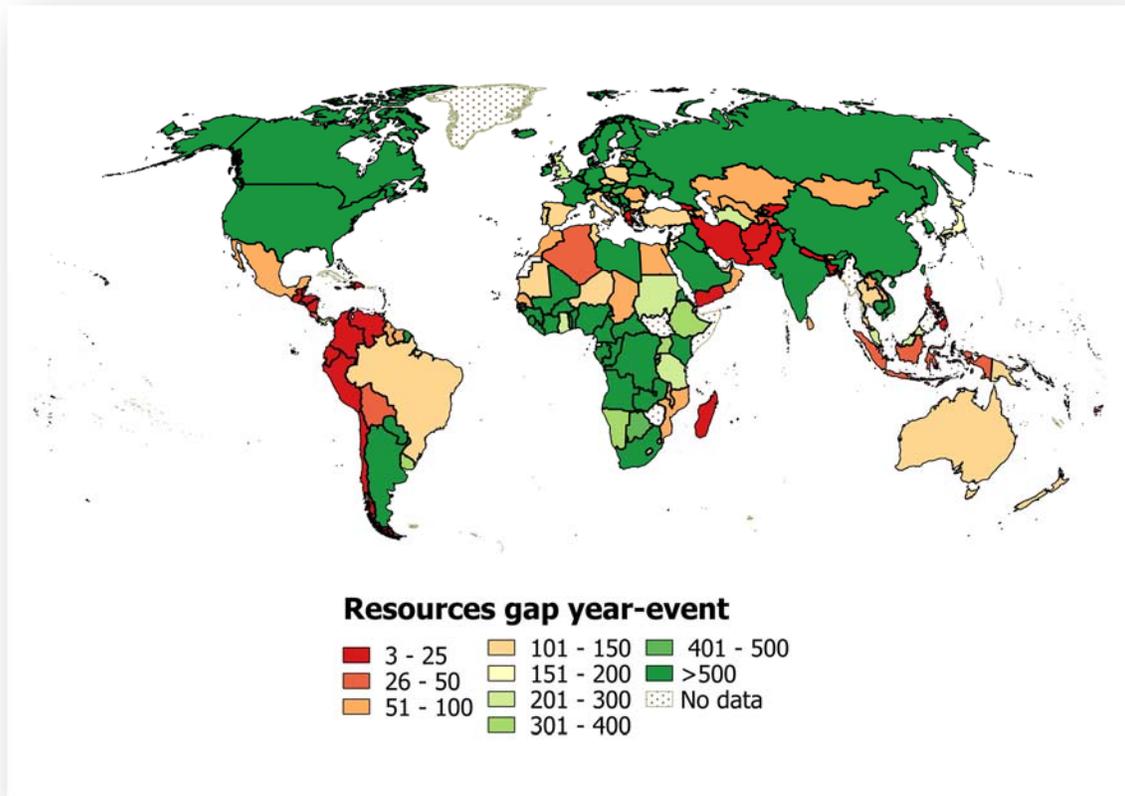


Figure 5 Global map exhibiting calculations of the fiscal gap year
Source: Data based on Williges et al., 2015

The disaster deficit index (DDI) developed by IDB (2008) is based on the CATSIM methodology and can be derived by dividing the loss by the financing available. For example, in figure 6, the DDI of about 4.3 for a 50 year return period event in Honduras means that the losses would amount to more than four times the finance available to rebuild lost assets.

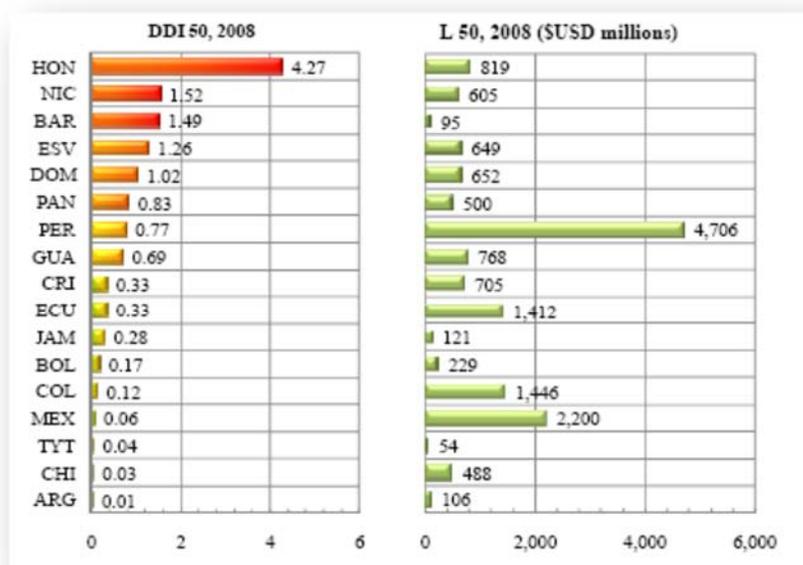


Figure 6 Calculating the disaster deficit index for the Latin American and the Caribbean region: Disaster Deficit Index and Probable Maximum Loss in 50 years.
Source: IDB, 2008

3 Protecting public finance

As mentioned, governments throughout the world have used to rely on ex post resources to fund the costs of disasters. In terms of ex ante risk financing instruments, government reserve funds have been used, and only recently other ex-ante instruments, such as sovereign insurance and contingent credit have started to be employed. Increasingly, attention has been turning to the use of such ex ante instruments, because of the delays and uncertain timing of ex post instruments (Mechler, 2004; Gurenko, 2004; Linnerooth-Bayer et al., 2005; Cummins and Mahul, 2009; OECD, 2012). Over the years, given identified risk aversion, fiscal gaps, their size and timing ex ante risk financing instruments, such as insurance, reserve funds and contingent credit, have been considered to complement the commonly employed ex post instruments.

3.1 Risk financing and planning practice

A number of countries highly susceptible to disaster risk have begun to consider disaster and budget planning and move more strongly from reactive to proactive perspective (see table 4), incl. Colombia, Mexico, Caribbean countries and Pacific SIDS. In Asia, also there is momentum, as shown in table 4 in terms of a movement from ex-post to ex-ante risk financing. As an example,

most ASEAN countries are currently involved in or actively considering contingent risk financing or sovereign insurance.

Table 4 Summary of fiscal risk management arrangements in ASEAN Member States

	Ex post						Ex ante				
	Annual budget allocations	In-year reallocations	Medium-term capital budget realignment	Tax increases	Deficit financing	International assistance	Contingent credit	Insurance of public assets	Risk transfer		
									Public support of private policy holder insurance	Parametric sovereign insurance	Catastrophe bonds
Brunei Darussalam											
Cambodia											
Indonesia											
Lao PDR											
Malaysia											
Myanmar											
Philippines											
Singapore											
Thailand											
Vietnam											

Source: GFDRR, 2012a

Yet, while processes and procedures are being implemented, the budgeted amounts remain rather small and inadequate for tackling the increasing burden from disaster risk (GFDRR, 2012a).

3.2 Implementing innovative risk financing measures

Risk financing through insurance and other hedging instruments spreads and pools risks, thus lessening the variability of losses, but does not directly reduce risk. By providing indemnification in exchange for a premium payment, insured victims benefit from the contributions of the many others that are not affected, and thus in the case of a disaster they receive a contribution greater than their premium payment. However, over the long run, insured persons or governments can expect to pay significantly more than their (expected) losses. This is due to the costs of insurance transactions and the capital reserved by insurance companies for potential losses (or reinsurance), as well as the financial return required for absorbing the risks. The “load” can be significant, or as much as 500% of the pure risk (expected losses) (Froot, 2001). Still, people buy insurance, and justifiably so, because of their aversion to (large) losses, i.e., their concern about the volatility of the possible outcomes. Insurance and other risk-transfer instruments are thus justified by the concept

of risk aversion and it is because of aversion to large risks that people are willing to pay for insurance.

Insurance. Traditional or parametric/index-based insurance provides indemnification against losses in exchange for a premium payment. It is the most common form of risk transfer, and there are well-established markets. The disadvantage is that the premium can be significant, and is a definite cost against the budget.

In a *Reserve Fund* amounts are laid aside on an annual basis, so that capital can accumulate. The fund accumulates in years without catastrophes and can be used in the case of an event to finance the losses. However, for a vulnerable country facing events, which might cost more than the entire annual GDP, this is not practical. Even for larger economies, the fund may not be able to accumulate sufficiently before the first disaster occurs, and it always needs to be replenished after it has been used. There is also a real danger that the fund will be 'raided' for other purposes if a period without disasters creates a sense of false security.

Contingent credit arrangements do not transfer risk, but spread it inter-temporally. In exchange for an annual fee, the right is obtained to take out a specific loan amount post-event that has fixed conditions. Contingent credit options are commonly grouped under alternative risk transfer instruments. The World Bank has recently developed such an instrument, which is now labeled a "deferred drawdown option" (CAT DDO). The disadvantage is that the exercise of the right creates a new debt, which can constrain future development.

Also, important innovations have been implemented with respect to implementation disaster risk financing in different regions.

The Ethiopian weather derivative

To supplement and partly replace the traditional food-aid response to famine of the Ethiopian government as aided by the World Food Programme (WFP), the WFP 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) (Wiseman and Hess, 2007).

Mexico: FONDEN and the catastrophe bond

In 1996 the Mexican government created a budgetary program called FONDEN (Fund for Natural Disasters) to enhance their country's financial preparedness

for natural disasters. FONDEN's objective is to prevent imbalances in the federal government finances as a result of natural catastrophes. In 2006, the Mexican government chose to insure FONDEN against major earthquakes with a mix of reinsurance and a catastrophe bond, thus accessing both reinsurance and financial markets (Cardenas et al., 2007).

The Caribbean Catastrophe Risk Insurance Facility (CCRIF)

The Caribbean Island States in 2007 formed the world's first multi-country catastrophe insurance pool, reinsured in the capital markets, to provide governments with short-term liquidity in the aftermath of hurricanes or earthquakes. 16 Caribbean countries contribute resources ranging from US\$ 0.2 to US\$ 4 million depending on the exposure of their specific country to earthquakes and hurricanes. CCRIF has created a viable insurance instrument, and is helping with improving the region's capacity to deal with disasters. Also, country risk profiles via a *Multi-Peril Risk Evaluation System (MPRES)* catastrophe risk modelling platform are under way providing a systematic basis and entry point for more detailed information (GFDRR, 2011).

4 Toward comprehensive DRM

Approaches organized around the protection of the balance sheet using risk financing instruments have seen a lot of emphasis in disaster-prone countries. Yet, can those lead into broadly supporting DRM? We discuss entry points and evidence.

4.1 Integrating risk financing with risk reduction and reconstruction

Figure 7 exhibits the different phases of disaster management suggesting the various links from risk financing to risk reduction as well as to preparedness and response and finally to dealing with 'surprise.' Today, still DRM is strongly focused on ex-post response, and the uptake of ex-ante risk management today dwarfed by spending on post-disaster recovery and reconstruction. The globally information provided by Kellet and Caravani (2012) of a ratio of 87% to 13% in favor of ex-post response over ex-ante risk reduction is mirrored by case study information for this report for Mexico with a balance of ex-post to ex-ante interventions of 90% vs. 10%.

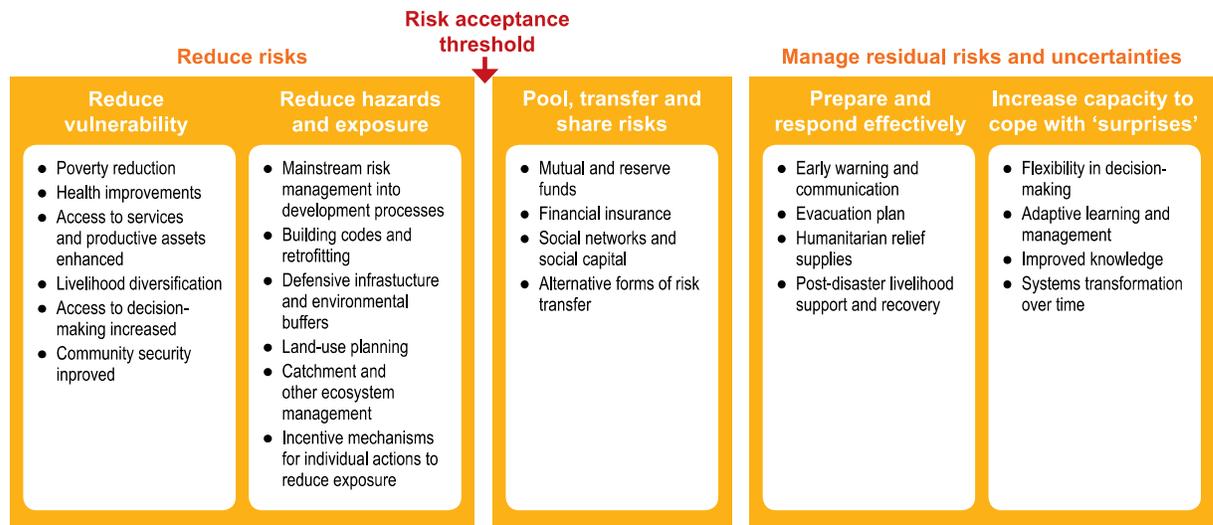


Figure 7 Comprehensive DRM approach. Source. Lal et al., 2012

Determining how much should be invested in risk reduction and how much in risk financing as well finding a proper balance between ex-post and ex-ante disaster management is not straightforward. It ultimately depends on the wider costs and benefits of both types of activities on their interaction (e.g. financial instruments through incentives, can influence prevention activities, see Linnerooth-Bayer et al., 2011) and their acceptability. Cost and benefits, in turn, depend on the nature of the hazard and risk. One way to think about the balance is illustrated by the risk-layering approach as shown in Figure 8.

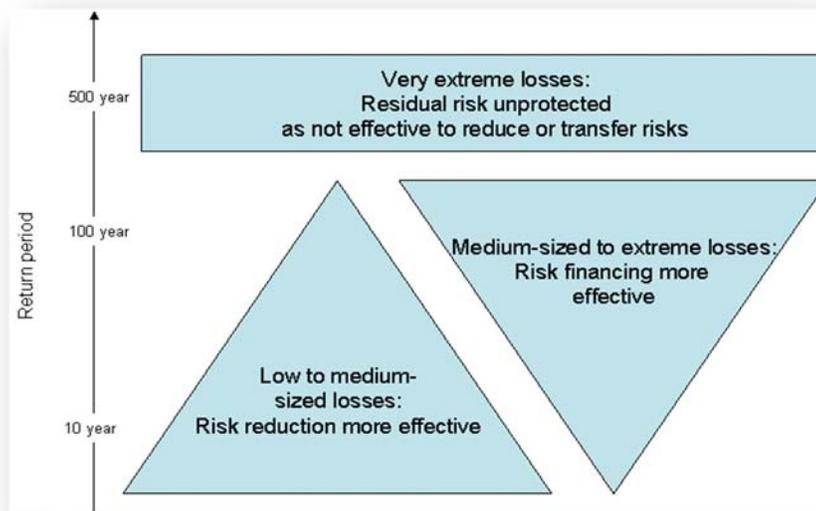


Figure 8 The layering approach for risk reduction and risk financing. Source: after Mechler et al., 2014a

For the low- to medium-loss events that happen relatively frequently, risk reduction is likely to be cost effective in reducing burdens. The reason is that the costs of risk reduction often increase disproportionately with the severity of the consequences. Moreover, individuals and governments are generally better able to finance lower consequence events (disasters) from their own means, for instance, savings or calamity reserve funds, and including international assistance. The opposite is generally the case for risk financing instruments, including reserve funds, catastrophe bonds and contingent credit arrangements. For this reason, it is generally advisable to use those instruments mainly for lower probability hazards that have debilitating consequences (catastrophes). Finally, as shown in the uppermost layer of Figure 8, individuals and governments will generally find it too costly to use risk-financing instruments against very extreme risks occurring less frequently than, say, every 500 years.

Budgetary policies and risk financing options can in principle also lead to incentives for giving stronger emphasis to risk reduction. Implementing a structured process for risk detection in the balance sheet has potential for providing a “price signal.” In turn, a strong focus on ex post disaster management (the still somewhat dominant approach as discussed before) offers little in the way of risk awareness and stimulating the reduction of risk (Phaup&Kirschner, 2010).

While there is no detailed information on these linkages and incentives, in the literature there is some evidence in Mexico, which, as one of the prime actors for fiscal risk management, provides for important learning.

Mexico: Linking risk financing to comprehensive DRM

As a prime example, Mexico is aiming at better linking risk reduction and risk financing. The primary interest in Mexico on DRM in the late 1990s has been within the finance ministry in order to identify sovereign insurance for increasing fiscal stability. In 1996 the Mexican government created a budgetary program to enhance the country’s financial preparedness for natural disasters, The Fund for Natural Disasters (FONDEN). FONDEN’s objective is to prevent imbalances in the federal government finances as a result of natural catastrophes. Over the years FONDEN has led to innovative risk financing arrangements, such as using catastrophe bonds to protect the balance sheet. As an ancillary benefit of the risk financing strategy, which also required detailed information from risk assessments, risk reduction has been incentivized. Fonden is currently promoting DRM in reconstruction activities, and about 25 percent of FONDEN resources are earmarked to (post-event) building back better of damaged assets against future disasters. As another

measure to increase risk and cost awareness FONDEN is also deliberating and encouraging relocation of housing in high-risk areas. Yet, FONDEN's reach for encouraging DRM is limited by the fact that it is not a government agency, but a financial instrument (personal communication; World Bank, 2013).

4.2 Informing the transition to holistic DRM integrated with development: A need for broader-based decision-making tools

Moving from risk detection to risk financing, there is stronger emphasis on comprehensive DRM. Where is the transition in thinking and implementation leading to and what tools can help to support this shift in mind-set?

Debate regarding public sector disaster risk management has largely focused on the use of economic efficiency-oriented approaches, which can be analyzed using cost-benefit analysis (CBA). Over the years, appraisals of public investment decisions building on this logic have mushroomed and improved in terms of methodology. Recent analysis (Mechler et al., 2014b) highlights the fact that CBA and associated processes can be very useful in supporting risk-reduction decision-making, if key challenges are properly tackled. These challenges include: complexities in estimating risk; data-dependency of results; negative effects of interventions; inclusion of stakeholders, and distributional aspects. How this information is used will qualify the acceptability and robustness of the studies.

Key challenges remain, which need attention including the consideration of intangibles, including multiple objectives such as equity and distributional issues, as well as taking a stronger systems perspective on the benefits, which means understanding how broad-based interventions into health, education and infrastructure can create cross-sectorial benefits. As figure 9 building on cost-benefit information on the returns of public interventions in various sectors suggests, this is needed. The chart suggests that investments *within* sectors such as health, nutrition, water and DRM all reap good returns well beyond the necessary condition of exceeding the benefit-cost threshold of 1. The decision-maker, particularly in the finance ministry, ever faced with limited resources is however left wondering how to create returns synergistically *across* sectors, which involves enhance thinking about mainstreaming DRM into development and resilience-based strategies that can lead to co-benefits.

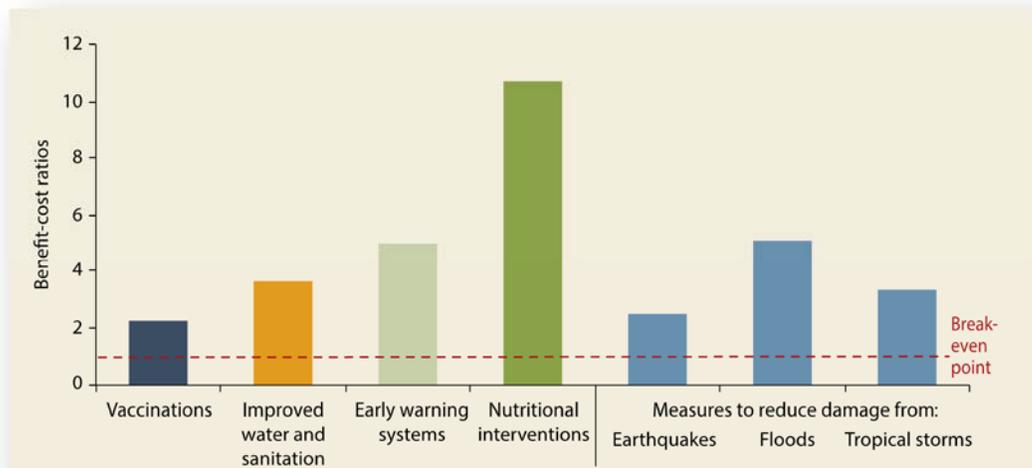


Figure 9 BC ratios of measures in various sectors. Source: World Bank, 2013

The need for further integration and mainstreaming of DRM into broader development agendas requires rethinking of strategy and decision-tools used to inform the strategy. For this, the use of single ‘efficiency’ criterion (as used by CBA) is becoming increasingly obsolete, and more integrative decision-making frameworks that incorporate additional criteria such as ‘co-benefits’ ‘robustness’ and ‘public acceptability’ is increasingly needed. Such broader framing may colloquially be understood as a shift from ‘risk’ to ‘resilience’ thinking: policy makers, practitioners and researchers are increasingly called to look beyond ‘direct risk’ and to find critical linkages to the development-risk nexus. The IPCC recently identified on-going shift in thinking with references to climate change adaptation (where DRM figures prominently): economic analysis is moving away from a unique emphasis on efficiency, market solutions, and cost-benefit analysis of adaptation to include consideration of non-monetary and non-market measures, risks, inequities and behavioral biases, and barriers and limits and consideration of ancillary benefits and costs (Chambwera et al., 2014).

This implies also looking beyond CBA to other tools available that can help public-sector decision makers to make decision on DRM, such as cost-effectiveness analysis (CEA), which does not require the monetization of intangibles, and multi-criteria analysis (MCA), which allows for multiple objectives to be assessed concurrently (table 5).

Table 5 Characteristics and applicability of different decision-support tools for assessing DRM

	Opportunities	Challenges	Typical Application
CBA	Quantitative framework based on comparing costs with benefits under a single-objective economic efficiency criterion	Need to monetize all benefits, difficulty in representing intangible impacts, such as value of life, value judgments of analyses not always fully transparent	Well-specified <i>hard-resilience</i> projects with economic benefits
CEA	Ambition level fixed, and only costs to be compared. Intangible benefits, particularly loss of life, do not need to be monetized	Ambition level needs to be fixed and agreed upon	Well-specified interventions with important intangible impacts, which should not be exceeded (loss of life, etc.)
MCA	Consideration of multiple objectives and plural values	Multiple criteria require weighting involving multiple value judgments, which can make replication complex	Multiple and systemic interventions involving plural values (e.g., investing in infrastructure and education)

Source: Mechler et al., 2014a; Surminski, 2014.

Note: CBA-Cost Benefit Analysis; CEA-Cost-Effectiveness Analysis; MCA-Multi-Criteria Analysis

Particularly, MCA appears a useful decision-technique for the changing perspective on decision-making for DRM. While MCA thinking has not been applied significantly beyond frameworks and pilot studies,² it holds good potential (see Scrieciu et al., 2014 for a recent overview).

5 Toward fiscal resilience and creating co-benefits

Bridging gaps in integrating government risk financing with risk reduction and with economic and development planning processes holds potential for

² MCA has been applied to DRM in the UNEP project “Multi-criteria analysis for Climate Change (MCA4C),” which was commissioned to provide practical assistance to governments in preparing climate change mitigation and adaptation strategies. The objective was to assist government decision-makers, particularly in developing countries to identify and examine policy options and measures for climate change that are low cost, environmentally effective and in line with national development priorities (<http://www.mca4climate.info>).

putting a cost on risk and incentivizing investments into risk reduction (Mitchell et al., 2014). However, stepping beyond a focus on DRM only, how can fiscal co-benefits be considered and created by following a synergistic strategy that focuses on both DRM and development? We discuss recent discourse on risk and resilience, then turn to entry points with relevance for the fiscal perspective.

5.1 A broadening discourse on risk and resilience

The DRM discourse is broadening framed around a resilience perspective. There is wide debate as to what such resilience framing would entail, but Keating et al. (2014) suggest that there is an emerging, if tacit, consensus that sees resilience as essentially *forward looking (bouncing forward)* in terms of: “the ability of a system, community, or society to pursue its social, ecological, and economic development and growth objectives, while managing its disaster risk over time in a mutually reinforcing way.” (Keating et al., 2014). This perspective is also stated in a recent report by UNESCAP (2013). In the future, it is clear that many countries will need to build their resilience to adapt and thrive in an unpredictable and shock-prone environment. To achieve this they will need to make policy in a different way. Rather than dealing with problems in the economy, environment and society separately, they will have to be addressed as parts of an overall system.

Similarly, in the climate change domain, IPCC’s Fifth Assessment Report (AR5) Working Group II contributed to the reframing of climate change adaptation with regard to extreme climate events by emphasizing risk management as fundamental to the policy response. The report suggest as the basis for policy action a shift towards the essentiality of managing extreme event risks holistically (to which climate change is contributing in addition to other factors), rather than keeping a climate lens with a focus on climate adaptation policy only (IPCC, 2014).

Impact of a co-benefits approach

Synergistic policy and pursuing co-benefits in program and project planning may lead to impact in terms of increased investment in DRM. A recent evaluation by ADB’s Independent Evaluation Department (IED) reports a significant number³ of loans and grants disbursed by ADB for supporting DRM versus supporting disaster recovery over the time period 1995 to 2011 (ADB, 2012). The breakdown reported between spending on disaster risk reduction projects vs. disaster recovery has been 57% to 43% in favor of financial

³ Projects including dedicated DRM projects as well as other projects that incorporate and support building resilience.

support for pre-disaster activities, and 21% predominantly allocated to risk management. What explains this surprisingly large share of DRM in disaster management shown in figure 10?

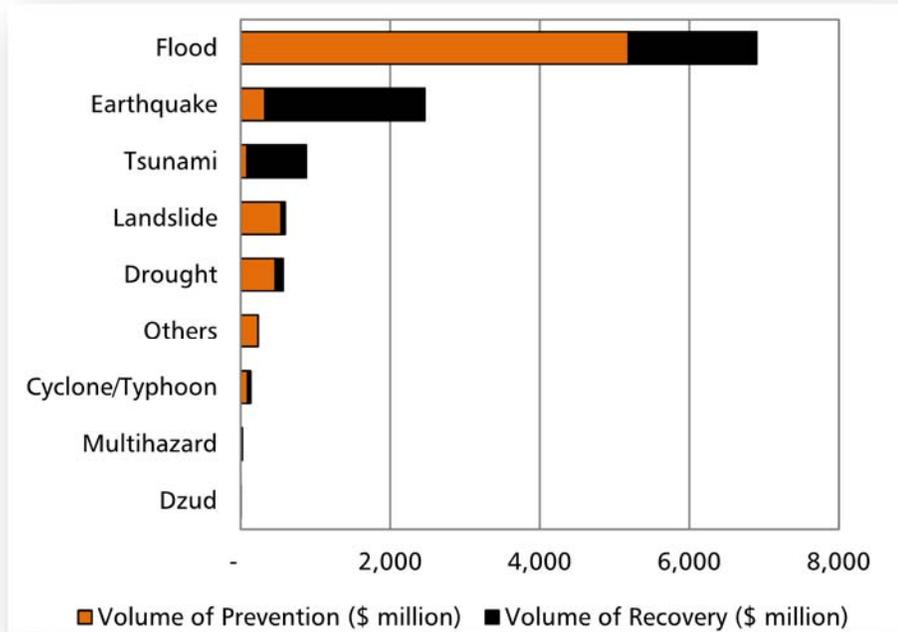


Figure 10 Breakdown of ADB's DRM and recovery projects according to hazard-type.
Source: ADB, 2012

An important factor has been that of the DRM related projects, the majority of lending has been undertaken to partially or predominantly support flood risk management as part of water resource management, irrigation and drainage efforts. This integration seems to explain why the share of prevention vs. recovery is a magnitude higher as compared to the global evidence on disaster spending. While lending occurred at substantially lower levels, landslide and drought DRM projects seemingly profited from a similar integrative strategy, while for seismic and Tsunami risk co-benefits were perceived small or less visible, and lending shows a strong reactive bias.

If a broader perspective is to be operationalized, what are the entry points for deliberative strategies for creating fiscal co-benefits? Based on the review of fiscal risk management approaches, two, not mutually exclusive, entry points emerge: fiscal disaster risk assessment leading to the mainstreaming of DRM; and broad-based contingency planning. Both, albeit with limited evidence, have potential to lead to a broader co-benefit approach for dealing with disaster risk.

5.2 Disaster risk as the entry point: Fiscal disaster risk assessment and mainstreaming

Mainstreaming DRM (and CCA) into development planning and policy has become the imperative and features also in the Sendai Framework for Action (UN, 2015).⁴ Figure 11 identifies the rationale and process of mainstreaming risk in terms of factoring risk, if estimated to be important, into development-relevant planning at different levels, such as national programming, sectorial and budgetary planning. The budget process holds high appeal as it provides for links between national development and sectorial planning, and policies, regulations, programs and ultimately projects.



Figure 11 Incorporating disaster risk assessments into strategies and plans. Bettencourt et al., 2006

We discuss approaches on mainstreaming that have foundations in fiscal disaster risk assessments.

⁴ E.g., page 15: “Promote the mainstreaming of disaster risk assessments into land-use policy development and implementation, including urban planning, land degradation assessments and informal and non-permanent housing, and the use of guidelines and follow-up tools informed by anticipated demographic and environmental changes.”

Mexico: From sovereign insurance towards holistic DRM and mainstreaming

Starting from a focus in insurance solutions, Mexico has since taken its efforts forward. A new comprehensive programmatic approach put in place in 2012 has three pillars (World Bank, 2014): In addition to (i) strengthening Mexico's existing disaster risk management systems, it (ii) supports joint disaster and climate resilience-building activities across key sectors, and (iii) fosters collaboration and partnership-building with many actors domestically and within the region. Among others, engagement occurs between the Ministry of Agriculture, Territorial and Urban Development and CENAPRED (National Disaster Prevention Center) on mainstreaming risk reduction policies into territorial and urban planning; with education authorities around strengthening safe school approaches; and on fostering partnerships that assess and tackle poverty with improved catastrophe risk management. A tool for information provision is a risk-modeling platform that aims at systematic integration of disaster risk information into the formulation and evaluation of federal investments.

Madagascar: Mainstreaming DRM across sectors

Having experienced severe shocks from cyclones over the recent past, and as part of work towards setting up a regional disaster risk management platform for the Indian Ocean islands, Madagascar over the last few years has been strongly focusing on fiscal disaster risk assessment. The intention has not been to work towards risk financing tools, but to understand the budgetary implications of disaster risk and identify options for managing those broadly. Given the importance of risk, the country has further mainstreamed risk in different sectors. Officially, the authority for DRM sits with the prime minister office, which with the finance ministry has been closely engaged on the budgetary risk analysis. Building on increasing risk awareness, DRM has increasingly become a crosscutting concern and investment in DRM is being pursued by public authorities, such as the ministry of agriculture (key risk is the loss of revenue following the physical loss of the export crop vanilla), domestic affairs, public works and transport (see figure 12).

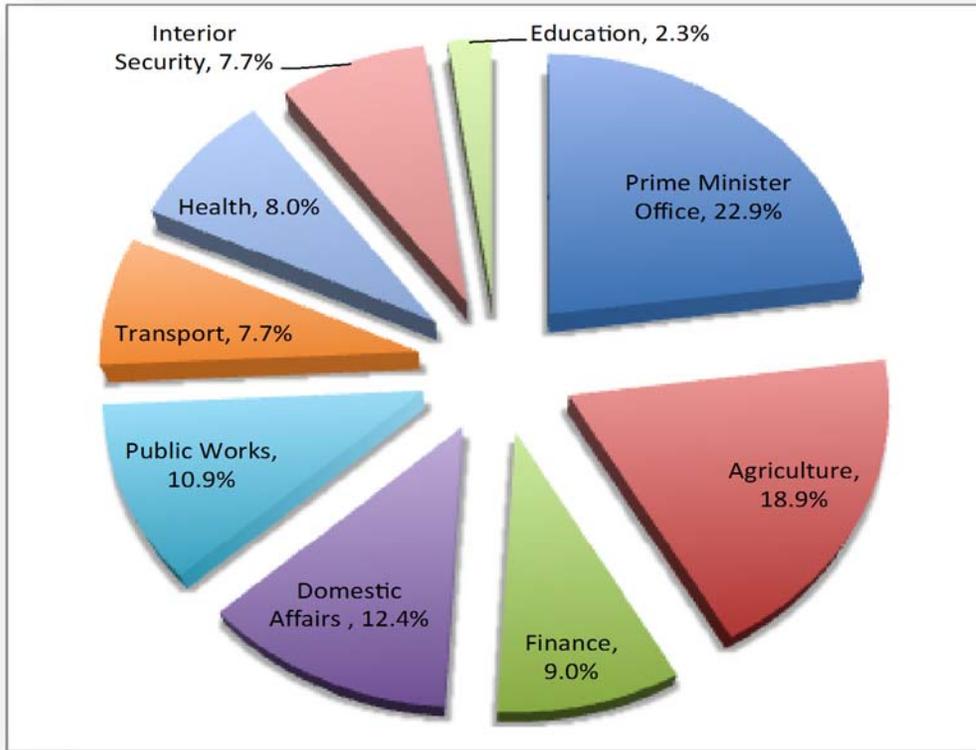


Figure 12 DRM spending per ministry budgets (average 2010-14). Source: UNISDR 2015b

5.3 Holistic fiscal stress testing and national risk assessments as entry points

Another, related, approach pursued with substantial effort is working towards a co-benefits approach via the fiscal risk matrix by considering many contingent risks and their interaction with disaster risk at the same time. Such push has come from insights gained during the recent and ongoing financial and fiscal crises. In the aftermaths, fiscal risks are being more systematically assessed, through sensitivity tests on baseline macro and fiscal indicators, which is commonly referred to as stress testing. Also, there has been increasing understanding of a need for taking a systemic perspective for understanding the potential for complex and interrelated shocks, essentially leading to a multi-risk approach (WEF, 2015). Disaster risk has become to be considered a key threat, and in a recent survey regarding relevant fiscal risks in OECD countries, disasters came out as an important concern (table 6).

Table 6 Relevance of disaster risk for fiscal management in OECD countries

Category	Relevance			
	High	Medium	Low	None
	(In per cent of each category)			
Pension funds	6	37	31	25
PPPs and other risk sharing	6	16	44	34
Financial sector	31	22	25	22
Legal claims	3	9	53	34
Other liabilities and guarantees	9	19	63	9
Natural disasters, health-care risks	9	13	53	25

Source: Kopits, 2014

Colombia and the UK are examples for countries that have started to pursue broader multi-risk strategies in fiscal and public risk management.

Colombia: towards broad-based fiscal risk management

Fiscal risk assessment has become an important consideration for working towards a more sustainable and equitable development strategy. Fiscal risk assessment has become mandatory in Colombia and disaster risk, ranked as the second most relevant risk, is seen as a critical component of a broader fiscal risk management strategy, which looks at the various risks that are interlinked and options for mutually managing risk across issues of concern. As one example, the Government of Colombia is intent on upgrading catastrophe insurance requirements for concessions. This would help reducing its contingent liabilities that arise from public-private partnership arrangements undertaken for infrastructure construction and operation (World Bank, 2011).

UK: National risk assessments as broad based planning tools for multi-risk strategies

The United Kingdom since 2008 (and similarly the Netherlands since 2007) has taken a broad-based perspective on risks throughout. National risk assessments (NRAs) to improve policy related to preventing and planning for key risks (such as health-related or terrorist focused) are being undertaken bi-annually by the UK cabinet office since 2008 and are being published as National Risk Registers (UK Cabinet Office, 2015). These assessments identify and measure main risks bearing upon the country: natural, technological, terrorist, and other types of risk following a systematic methodology of risk identification, scenario building, and determination of impacts. The

quantitative part is finally summarized by a national risk matrix (see figure 13), which organizes main risks according to probability of occurrence and impact. The synoptic representation of risks provides for a level-playing field, which allows for planning policy measures and, in theory, linking of agendas, such as with the national climate change risk assessment (UKCCRA), which have to be undertaken every 5 years as decreed by the Climate Change Act (see DEFRA, 2012). However, it is currently not clear whether this analysis has truly led to the implementation of options (also, financial risks are not considered).

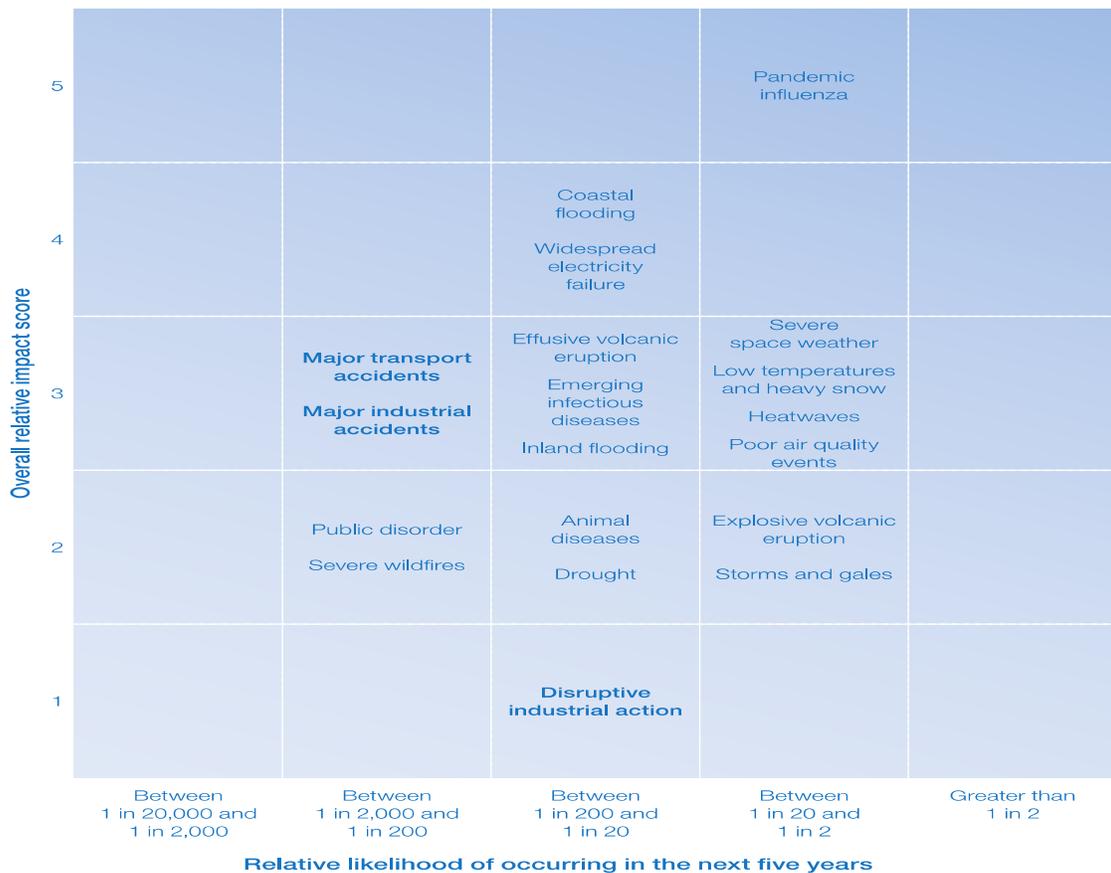


Figure 13 UK’s risk matrix for 2015. Source: UK Cabinet Office, 2015
 Note: terrorist risk is visualized separately in the report.

A key benefit of this comprehensive risk assessment exercise is seen in better allowing to coordinate and cooperate as well as allocate resources across ministries and public sector organizations. Furthermore, such planning helps to provide incentives for managing risk ex-ante better, as it anticipates the ex-post consequences and trade-offs involved in responding to shocks. As a case in point, in the Netherlands, cross-regional competition for resources for emergency management after large floods is concern that has been recognized using the risk assessment. Finally, another important point, particularly for

resilience-based strategies, is that such broad risk assessments allow for identifying new actors, importantly involving the private sector as well, which has been taken part in the assessments as well. Whether and how these comprehensive risk assessments are replicable in other places and regions with more limited capacity and resources, remains an open question. Yet, the government of Morocco with support of the World Bank and the Global Facility for Disaster Reduction and Recovery has started undertaking a multi-risk exercise focused on natural disaster risk, commodity price shocks and agricultural sector risks, which is planned to lead into identifying options and considering relevant institutions for implementing this agenda further (World Bank, 2013).

6 Conclusions: From fiscal risk, to building resilience, to harnessing co-benefits

A large part of disaster risk ends up with the fiscal position, and there has been increasing recognition of the need to deliberately plan for disaster. Yet, fiscal risk management is not an easy proposition, as disaster risk is a contingent liability, i.e. costs accrue only in case of an event. Furthermore, a large part of liabilities are of implicit, unwritten nature (disaster relief and recovery assistance to affected households and business) as compared to direct liabilities (reconstruction of lost infrastructure and assets).

Over the last few years, fiscal policy and public investment on DRM in many countries exposed to disaster risk has seen a step change. Based on experiencing and better understanding the large fiscal and economic burdens from disasters, fiscal and development planning has graduated from a perspective of risk ignorance to one of risk awareness. This effectively means that increasingly risk is explicitly taken into account in fiscal decisions and is being considered as part of contingency liability planning indicating a shift in perspectives from a risk-neutral to risk-averse planning stance.

Progress in fiscal risk planning has been achieved based on the tools available to systematically assess and manage risks in the fiscal balance sheet (fiscal risk and hedge matrices). Better risk planning may lead to improved risk detection across sectors. Countries have started to develop broad risk matrices that chart out probability vs. impact for many diverse risks, which helps to consider measures that broadly enhance fiscal stability. Reduced budgetary uncertainty allows governments to focus less on crisis management and more on longer-term issues.

At the same time, identifying fiscal risks vis-a-vis fiscal hedging instruments helps to develop a level playing field for investments in DRM and other priority investment areas. Such systematic thinking has mostly informed considerations of sovereign insurance across highly exposed developing countries, yet insurance is only one element in the disaster risk management toolbox, and it is widely recognized that in the face of increasing risk, a broad-based perspective is necessary to incentivize risk reduction, avoid risk creation and generate co-benefits that go beyond the direct and indirect gains by creating a third dividend that 'beyond disasters' contributes to providing resilience against shocks more holistically.

This discussion traced the development of fiscal disaster risk management around four steps. These steps and activities may lead to three dividends as framed in the project overall as follows:

- (i) Understanding fiscal risk;
- (ii) Protecting public finance through risk financing instruments (*1st dividend*);
- (iii) Working towards comprehensively managing disaster risk including risk reduction and risk preparedness as they affect development (*2nd dividend*);
- (iv) Pursuing a synergistic strategy of managing disaster risks and promoting development (*3rd dividend*).

As we have shown, all steps and foci are seeing some activity: steps (i) and (ii) have been implemented in a number of countries, and increasingly (iii) is being tackled, while (iv) will need more attention in the future to truly create measureable co-benefits and build resilience throughout. There is increasing recognition that a broad-based perspective is necessary to incentivize risk reduction, avoid risk creation and generate additional co-benefits that go beyond the direct and indirect gains from reducing risk. Co-benefits can be achieved by better integration of disaster risk management with fiscal risk management, public debt management, and development policy and planning, as suggested in figure 14.

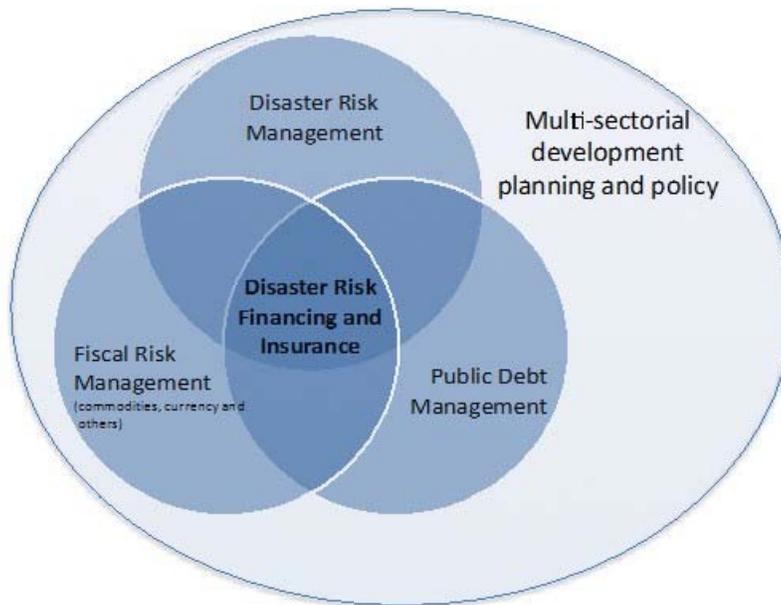


Figure 14 Suggested integration of disaster risk management with fiscal risk management, public debt management and development policy and planning. Adapted from Holm-Nielsen, 2012

Our discussion tentatively suggests that fiscal disaster stress testing and national risk assessment can be entry points for more holistically tackling DRM and development in terms of a co-benefits strategy. These two entry points were found active for a limited number of countries, as summarized in table 7.

Country	Entry point	Strategy
Madagascar	Fiscal disaster risk assessment	Fiscal disaster risk assessment leading to mainstreaming DRM
Colombia	Fiscal disaster risk assessment and sovereign risk financing	From fiscal disaster risk assessment towards a broad fiscal risk management strategy
Mexico	Sovereign disaster risk financing	Sovereign insurance leading into comprehensive DRM and mainstreaming
UK, Netherlands (Morocco)	National risk assessment	Multi-risk planning for synergistic risk-based policies

The potential co-benefits of fiscal DRM overall would comprise, among others,

- Improved planning processes for contingencies providing the grounds for synergistic investments into various sectors at the same time.
- Solid returns from managing multiple stresses and shocks at reduced cost. For example, sorely needed investments into health and infrastructure

often help to build disaster resilience and at the same time, mainstreaming disaster risk reduction into these sectorial investments helps to safeguard any benefits that will accrue despite strong exposure to shocks.

- Risk planning helps with improving risk detection across sectors and identifying key public and private sector actors for managing risks. As one example, the UK has developed a risk matrix that charts out probability vs. impact for many diverse risks, and thus allows taking options that cut across sectors and broadly enhance resilience.

Analytical insight and tools are key to supporting this ongoing transition, and we identified fiscal stress testing, national risk assessments and multi-metric evaluations as important elements of a broad-based toolbox, which, if applied with sufficient stakeholder involvement across local to national to international scales, can help to work towards creating strong dividends that help to better manage disaster risk.

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