DISASTER RISK FINANCE – A TOOLKIT

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EXECUTIVE SUMMARY

The impacts of climate-related disaster risks are growing. The Intergovernmental Panel on Climate Change identifies that the frequency and severity of climate-related hazards are already increasing due to climate change, and that this will worsen in the future. The damage that events cause is also growing, as people and assets continue to concentrate in vulnerable locations and inadequate measures are taken to reduce the vulnerability of people and assets to these risks.

These risks disproportionately affect developing countries. This is driven both by their greater exposure to risks and their greater vulnerability once risks materialize. 90 per cent of those who have been killed by disasters since the 1990s live in either Africa or Asia, while the direct economic losses from disasters are 14 times higher in low–income countries than high–income countries.

There is an imperative to reduce and better manage these risks. A key element to achieving this is the development of disaster risk management plans. These plans, developed ahead of a specific disaster arising, can specify what actions to undertake to reduce risks and also who will do what, taking account of what evidence, after a disaster. To be effective, these plans need to be developed in an inclusive way, with particular focus on the needs of the poor and vulnerable. They require the participation of a large number of stakeholders through processes that can often be facilitated by development and humanitarian partners.

However, disaster risk management plans only work when accompanied by finance. This finance facilitates and incentivizes activities that reduce risk. It also means that sufficient and reliable resources are available to respond when remaining risks materialize. Ensuring this finance is available in a timely fashion after a disaster is crucial for reducing the human cost of disasters.

Much uncertainty surrounds the different financial instruments for disaster risk that are available to governments, municipalities, communities and households – as well as the development and humanitarian partners who support them. Different instruments can play different roles, providing different amounts of resources to different actors at different speeds. This means that different instruments are more or less appropriate to use in different circumstances. It also means that, in most cases, a combination of instruments will be required to efficiently and comprehensively manage disaster risk.

The purpose of this disaster risk toolkit is to provide practical guidance on how to choose which disaster risk finance instruments for which circumstance. The main audience is policymakers in developing countries who are responsible for disaster risk management, at national, regional and local levels. It is also intended to assist the development and humanitarian community who support developing country policymakers in disaster risk management and who, sometimes, either implicitly or explicitly, also hold some of the risks associated with disasters in these countries. It is structured as a series of steps that those actors who hold risk, and the partners who support them in this role, can follow to better understand, reduce and manage these risks, and finance activities accordingly.

Step 1: Risk Audit. This involves developing a sound understanding of the underlying risk in order to shape the subsequent financing strategy. This consists of four phases (i) defining the exposure at risk – both in terms of people and assets - to understand what needs to be managed; (ii) identifying what perils and hazards can impact that exposure, (iii) quantifying the expected frequency and severity of impact from those perils, ideally using a probabilistic risk analysis, and; (iv) setting a resilience target to identify the extent to which risks will be explicitly managed.

Step 2: Determining disaster risk management actions. This requires identifying actions that can be taken to cost effectively reduce the risks that are faced. This will be determined based on specific circumstances and requires both sound economic analysis and engaged, participatory processes. In relation to the remaining risks, a decision needs to be taken as to which will be retained (the financial consequences of the risk materializing are borne by those who face the risk) and which will be transferred (the financial consequences of the risk materializing are passed to a third party, usually in return for a premium payment).

Step 3: Understanding the dimensions of the financing need. Risk reduction, retention and transfer can be achieved by using a range of financial instruments. However, before these instruments can be selected, a basic situational analysis should be undertaken to understand the financial needs associated with these activities in more detail. This can be structured around answering four key questions:

– *What is the capacity and need of the risk holder?* The risks of disasters fall on a wide range of actors, from individuals to communities, municipalities and sovereign governments. There may also be cases where the humanitarian and development community choose to hold risks, in order to reduce the human suffering that events will otherwise cause. Different risk holders will have different capacities and financial ability to make use of different financial instruments.

– *What will the funds be spent on?* The ultimate purpose of disaster risk finance instruments is to fund or facilitate resource flows towards a diverse range of activities that make disasters less damaging for people. This can be further disaggregated between funding directed towards protecting and managing the impacts of risk on lives and livelihoods; funding directed at reducing the damage that events cause on assets and facilitating the reconstruction of assets,
and the services they provide, after a destructive event; and funding covering the immediate operational and humanitarian needs after a disaster strikes.

– *When is funding needed?* Funding for risk reduction is required in advance of disaster impact, and can be independent of any particular event, or based on long or near-term event forecasts. After an event strikes, funding needs spike and there is an urgent need for additional resources, followed by a longer term, typically larger, but less urgent, need for funding to support reconstruction. Different financial instruments are more or less valuable in meeting funding needs at different timescales.

– *What level of risk is being addressed?* Some risks manifest themselves on a frequent basis, even annually. Other risks are much less frequent but, when they do arise, cause more severe levels of impact. The profile of risk has an important bearing on which financial instruments might be desirable.

Step 4: Selecting disaster risk financing instruments. This involves understanding the range of financial instruments available, their strengths and weaknesses and applicability to different dimensions of financing needs. To support risk reduction activities, the key instruments and incentives that can be considered are loans; micro-credit; bonds; grants, subsidies and tax breaks; crediting and impact bonds. The key financing instruments for risk retention are budget contingencies, reserve funds and lines of contingent credit. Risk transfer instruments include insurance – and its different forms including mutual insurance, Takaful, microinsurance, agriculture insurances and risk pools – as well as catastrophe bonds. Many of these instruments have a range of variants that alter their suitability in different circumstances. In particular, risk retention and risk transfer instruments where different ‘trigger’ mechanisms can be used to determine whether and how much funding is released following a disaster. Figure 1 illustrates how these different instruments map on to the dimensions of financing need identified in step 3.

Figure 1. Taxonomy of DRF instruments

		Risk Holder				Purpose			Timing			Risk Level			
		What is the capacity and need of the risk holder?				What will funds be spent on?			When is funding needed?			What level of risk is being addressed? (return period)			
Action	Instrument	Individual	Community	Municipality	Sovereign	Life & Livelihood	Operational	Physical Assets	Preparation	Response	Recovery	Annual	1-10 year	10-50 year	50+ year
Risk Reduction	Loan	•	•	•	•	•		•	•		•	•	•		
Risk Reduction	Micro-credit	•	•			•		•	•		•	•	•		
Risk Reduction	Bonds			•	•			•	•		•	•	•	•	•
Risk Reduction	Grants, subsidies, & tax breaks	•	•	•	•	•		•	•	•	•	•	•		
Risk Reduction	Crediting	•	•	•		•		•	•		•	•	•	•	•
Risk Reduction	Impact Bonds	•	•	•	•	•	•	•	•		•	•	•	•	•
Risk Retention	Budget Contingency			•	•		•			•		•	•		
Risk Retention	Reserve Funds	•	•	•	•	•	•	•		•	•	•	•		
Risk Retention	Contingent Loans				•		•			•	•		•	•	
Risk Transfer	Micro-insurance	•	•			•		•		•	•		•	•	•
Risk Transfer	Agriculture Insurance	•	•			•				•	•		•	•	•
Risk Transfer	Takaful & Mutual Insurance	•	•	•	•	•	•	•		•	•		•	•	•
Risk Transfer	Insurance & Reinsurance	•	•	•	•	•	•	•		•	•		•	•	•
Risk Transfer	Catastrophe Bonds			•	•	•	•	•		•	•			•	•
Risk Transfer	Risk Pools			•	•		•	•		•	•		•	•	•

Step 5: Combining disaster risk financing instruments to create a disaster risk finance strategy. A coherent disaster risk financing strategy will involve more than one instrument. The possibility of combining instruments opens up a range of further issues that risk holders and their partners need to consider. Risk reduction activities reduce the residual risk, and therefore the expected costs associated with risk retention and risk transfer. Focus is growing on how to capture this risk reduction in a way that increases the incentive to reduce risks. As regards risk retention and risk transfer instruments, a risk-layering strategy can reduce costs and improve the reliability of funding. This involves combining risk retention instruments for high-probability, low impact events with risk transfer instruments for the lower probability, higher impact events.

To practically illustrate these steps, the final section of the paper presents a hypothetical use case of an urban environment in South East Asia and shows how these steps might be followed and the possible implications that may result.

Introduction

INTRODUCTION

Why we need disaster risk management

Natural systems contain extremes, whether in the motions of the atmosphere, the concentration of precipitation, or the accumulation and release of strain along faults. The gradients of temperature in the atmosphere can generate vortex storms. The runoff from extreme rainfall can overflow river systems. The absence of rain over many months itself causes drought and can exacerbate wildfire. The continents are being pushed and pulled by the convective currents within the earth.

Human induced climate change threatens to make many of these extreme events more likely. The Intergovernmental Panel on Climate Change[1] identifies that the frequency and severity of climate-related hazards are already increasing due to climate change, and that this will worsen in the future. In particular it warns that we can expect an increased frequency and intensity of heatwaves; an increased frequency of heavy precipitation events, resulting in greater risk of flooding at the regional scale; and an increased frequency and intensity of extreme sea level events, such as those caused by storm surges.

The impact of these extreme events depends critically on both the exposure and vulnerability of potentially affected people and assets. Exposure relates to the extent to which people, communities and assets are located in areas that are prone to hazards. For example, exposure increases when decisions are taken that lead to people living in flood prone areas (or, alternatively, when decisions that might prevent people from living in flood prone areas fail to be taken). Vulnerability relates to the social, economic and environmental factors which increase the susceptibility of people, communities or assets to the impact of a hazard. For example, people who lack the knowledge or resources to undertake preventative actions ahead of a disaster arising are more vulnerable to the impacts of that disaster. Unsurprisingly, the poor and socially disadvantaged are typically also the most vulnerable to disasters, lacking access to public services and with restricted availability or affordability of water, food and other consumption items.

Both exposure and vulnerability help to explain why the impact of disasters is far more damaging in developing countries than in developed ones. According to the INFORM Index for Risk Management[2], 9 out of the 10 countries most exposed to natural hazards are developing countries – while developing countries account for all of the top 70 positions in the same organization's vulnerability index. Correspondingly, 90 per cent of those who have been killed by disasters between 1990 and 2013 lived in low or middle income countries[3], while the direct economic losses from disasters, when expressed as a percentage of GDP, are 14 times higher in low–income countries than high–income countries[4].

Policymakers and humanitarian actors increasingly recognize the need to respond to these growing risks, especially in developing countries. As the Box A below explains, the Sendai Framework[5] and the Warsaw International Mechanism for Loss and Damage[6] are multilateral initiatives that reflect the urgency that the international community attaches to reducing and managing disaster risks while the Agenda for Humanity[7] also places a strong focus on managing disaster risks in developing countries.

Responding to these risks requires information, planning and financial resources, along with an appropriate enabling environment. There is little that can be done to control how hard the wind blows, but it is possible to assess how much damage it might cause in which locations. Similarly, it is possible to understand how the design of the built environment will influence the damage caused by wind, flood, fire, and ground shaking. This information allows the development of disaster risk management plans to better reduce and manage these risks. These plans can identify risk-informed actions to reduce risks – both a long time in advance of a disaster, and through anticipatory actions taken immediately before a disaster strikes – and how these actions will be financed. They can also identify what will happen after a disaster strikes, who will undertake what actions to respond and recover from an event and where the associated financial resources will come from. By making plans ahead of time, identifying and clarifying roles and responsibilities (both financial and otherwise), the devastating impacts of disasters can be reduced[8]. These plans are easier to develop and implement when there is political consensus on their value – so that they can be developed through a technocratic, apolitical process – and when backed by an enabling legal framework.

The success of disaster risk management plans depend critically on the involvement of all key stakeholders: policymakers, international actors, humanitarian agencies, non-governmental actors and community groups. It is particularly important for plans to be developed in active consultation with those who are most vulnerable to disasters – such as disabled, elderly, women, slum dwellers and indigenous groups. Typically these groups bear the brunt of any disaster impact but can be too easily excluded from decisions over what should be done and where. Only with the full and active participation of these groups can the devastating impact of disasters on lives, livelihoods and economic development potential be reduced and managed effectively.

The Integrated Climate Risk Management (ICRM) approach from GIZ's ACRI+ project provides a framework for the development and execution of disaster risk management plans. It emphasizes both the traditional role of disaster risk management in responding to growing climate risks, as well as the important role of risk retention and risk transfer mechanisms. It explains how the latter could be particularly important as the adverse effects of climate change pose new forms of risks that are currently difficult to predict. Figure 2 illustrates the framework.

Figure 2. Integrated Climate Risk Management (ICRM) Approach.

The development of disaster risk management plans according to this framework is a substantial exercise – this Toolkit focuses on the financial instruments that can facilitate their implementation. The development of disaster risk management plans requires consideration of a wide number of factors including what activities to undertake and when, and how to ensure active participation of all key stakeholders. This report does not seek to discuss all of these issues. Rather, recognizing the emphasis that the ICRM framework places on risk retention and transfer, which typically require dedicated financial instruments, it has a more focused purpose: to examine the financial instruments that allow the delivery of disaster risk management plans[i]. Often this is seen as a technical, somewhat impenetrable, issue. But, it has a crucial role: the delivery of finance through appropriate instruments is indispensable for the cost-effective implementation of any plan. This report aims to provide a practical disaster risk finance toolkit for policymakers, humanitarian actors and practitioners to understand the wide range of financial instruments that are available; their characteristics, strengths and weaknesses; and how they can be combined within a disaster risk management plan to develop a coherent, cost-effective approach.

Box A. Multilateral initiatives to address disaster risk

The **Sendai Framework** is a 15-year (from the year of its adoption in 2015), voluntary, non-binding agreement which recognizes that the State has the primary role to reduce disaster risk but that this responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders. It aims for: 'The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries'. This objective is encapsulated in seven targets – relating to, for example, global disaster mortality and direct disaster loss – to be delivered through four priorities for action. These priority areas are:

- Understanding disaster risk
- Strengthening disaster risk governance
- Public and private investment in disaster risk reduction; and
- Enhancing disaster preparedness for effective response and to Build Back Better

The **Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts** has been mandated with promoting implementation of approaches to address loss and damage associated with the adverse effects of climate change. It has three main functions:

- To enhance knowledge and understanding of comprehensive risk management approaches to address loss and damage
- To strengthen dialogue, coordination, coherence and synergies among relevant stakeholders
- To enhance action and support, including finance, technology and capacity-building, to address loss and damage associated with the adverse effects of climate change

The **Agenda for Humanity**, arising from the World Humanitarian Summit sets out five major areas to address and reduce humanitarian need, risk and vulnerability, and 24 key transformations that will help achieve these five major areas. It places a strong emphasis on managing disaster risk with one of the key transformations being to anticipate crises, using data and risk analysis to take early action and thereby prevent and mitigate crises.

It also calls for, among other things, international frameworks and regional cooperation to ensure that countries in disaster-prone regions are prepared to receive and protect those displaced across borders; greater support for Small Island Developing States to prevent, reduce and address disasters resulting from climate change; increasing domestic resources for risk management, including by expanding tax coverage, increasing expenditure efficiency, setting aside emergency reserve funds, dedicating budget lines for risk-reduction activities and taking out risk insurance; and for developed countries to dedicate at least 1 per cent of official development assistance (ODA) to disaster risk reduction and preparedness activities by 2020.

i While this is partly motivated by the specialised financial instruments associated with risk retention and transfer, it also considers financial instruments that can be used for all elements of a disaster risk management plan.

A Toolkit for Disaster Risk Finance: Report Structure

The below schematic provides an overview of the structure of the Toolkit. Disaster risk financing (DRF) instruments exist to fund the various costs of managing disaster risk and set incentives for a behavioral change. However, instruments differ significantly in their cost, how much finance they provide and how quickly they can mobilise resources.

This implies, critically, that disaster risk financing instruments should not be chosen without an understanding of the underlying disaster risk. This can be achieved through a risk audit, as explained in section 1. Once the risk is understood, there are a range of different actions that can be undertaken to manage that risk: the risk can be reduced, the risk can be retained with resources set aside to manage it, or the risk can be transferred to others. Section 2 describes these options in more detail, recognizing that the appropriate mix will depend on the specific circumstances. Once the actions have been chosen, they often require a range of different financial instruments and/or policy mechanisms. But these financial instruments and policy mechanisms vary across a number of important dimensions. Section 3 explains the criteria that can be used to choose between different instruments. Section 4 sets out the different financial instruments and evaluates them against the criteria identified in section 3. Section 5 then explains how instruments do not work in isolation and how a disaster risk management strategy needs to combine various instruments, and sets out the key interdependencies between different types of instruments and the action they facilitate.

Figure 3. A toolkit for disaster risk finance.

1 Risk Audit	Exposure Definition	Quantify risk and define resilience target to enable risk-informed action.
	Peril Identification	
	Risk Quantification	
	Resilience Targeting	
2 Disaster Risk Management Actions	Risk Reduction	Design a DRM plan, consisting of risk reduction, risk retention, and risk transfer actions.
	Risk Retention	
	Risk Transfer	
3 Dimensions of Instrument Design	Risk Holder	Use situational analysis to define underlying need and inform instrument requirements.
	Purpose	
	Timing	
	Risk Level	
4 Disaster Risk Finance Instruments	Taxonomy	Select appropriate DRF instruments.
5 Risk Management Strategy	Complementarity	Combine DRF instruments to create an efficient DRM strategy using a risk layering approach.
	Risk Layering	

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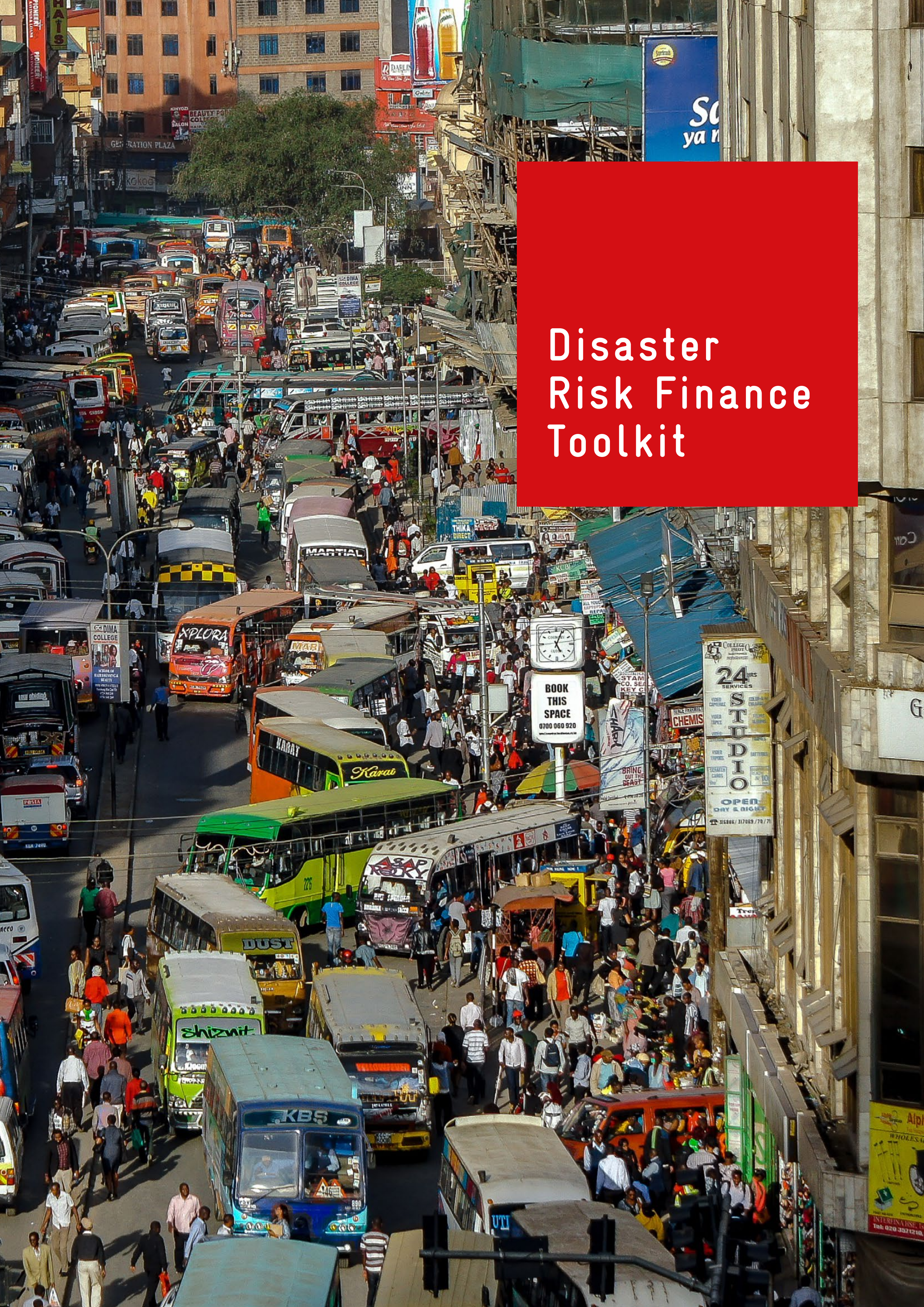
Disaster Risk Finance Toolkit



1. RISK AUDIT

A sound understanding of the underlying risk is fundamental to effective risk management. Risk managers – those people who implicitly or explicitly bear the consequences if a risk materialises, and which can include individuals, governments, and humanitarian actors – should collectively undertake a risk auditing process as the first step towards developing an effective risk management strategy.

Risk auditing consists of four phases; (i) define the exposure at risk to understand what needs to be managed; (ii) identify what perils and hazards can impact that exposure, (iii) quantify the expected frequency and severity of impact from those perils, ideally using a probabilistic risk analysis, and; (iv) set a resilience target to identify the extent to which risks will be explicitly managed.

This risk auditing process provides the foundation to make effective risk-informed decisions. The phases are summarised in Figure 4.

Figure 4. Risk auditing process.

Exposure Definition	Define the exposure to risk in terms of its key characteristics: • Location • Vulnerability • Value Value can be quantified in a range of ways, for example in terms of number of people or asset replacement cost, but also in terms of value to society, or criticality for dependent systems.
Hazard Identification	Identify the range of possible event types (perils), and the associated hazards. Peril types may include: • **Shock events:** rapid-onset events (e.g. tropical cyclone, flood, earthquake) • **Strain events:** slow-onset events (e.g. drought, pandemic) • **Systemic events:** events that occur as a result of multiple factors (e.g. conflict, migration)
Risk Quantification	Risk analysis is fundamental for developing a targeted risk management strategy. For a given set of exposure and hazard types – risk models allow a quantified understanding of the probability and severity of disaster impact to guide decision-making.
Resilience Targeting	Some events are so infrequent and severe that it would be prohibitively expensive to aim to manage, in advance, the entirety of the impact. The resilience target describes the threshold between actively managed risk, and unmanaged ‚residual' risk. As residual risk is ultimately retained by the risk holder, the objective of a risk management strategy is to reduce the residual risk to a 'tolerable' level. The resilience target can be measured in terms of 'return-period' impact, for example a resilience target may be to actively manage risk up to the 1 in 250-year return period impact.

The process of risk auditing should be approached in an outcome-oriented manner. The data collection and modeling exercises should therefore aim to provide fit-for-purpose information to support decision making.

This consideration is particularly important in regions where there is an apparent lack of reliable exposure and hazard data, and limited catastrophe risk model coverage. In these cases, simple assumptions can greatly support risk management, utilising lessons learned in analogous regions to enhance the risk auditing process.

Furthermore, while risk modelling has relied on extracting useful insights from large amounts of historical data for a long time, new 'big data' and artificial intelligence techniques opens up the opportunity of utilising more data sources and processing that information more quickly and at lower cost[9].

Importantly, risk management is an iterative process – the difference between no risk-information and some simple risk-information generated using basic assumptions can be significant. As a first step, an order of magnitude level risk audit, combined with an appreciation of assumptions and limitations, still allows risk managers to make substantially more informed decisions. Simple assumptions might include local estimates of population, property construction types and values, and historical or scenario-based impact assessments. These simpler analyses can provide good initial insight, and pave the way for more advanced data collection and risk modeling exercises.

An illustrative scenario is provided in → Box B to show how risk auditing can be applied in practice.

Box B. Illustrative Risk Audit

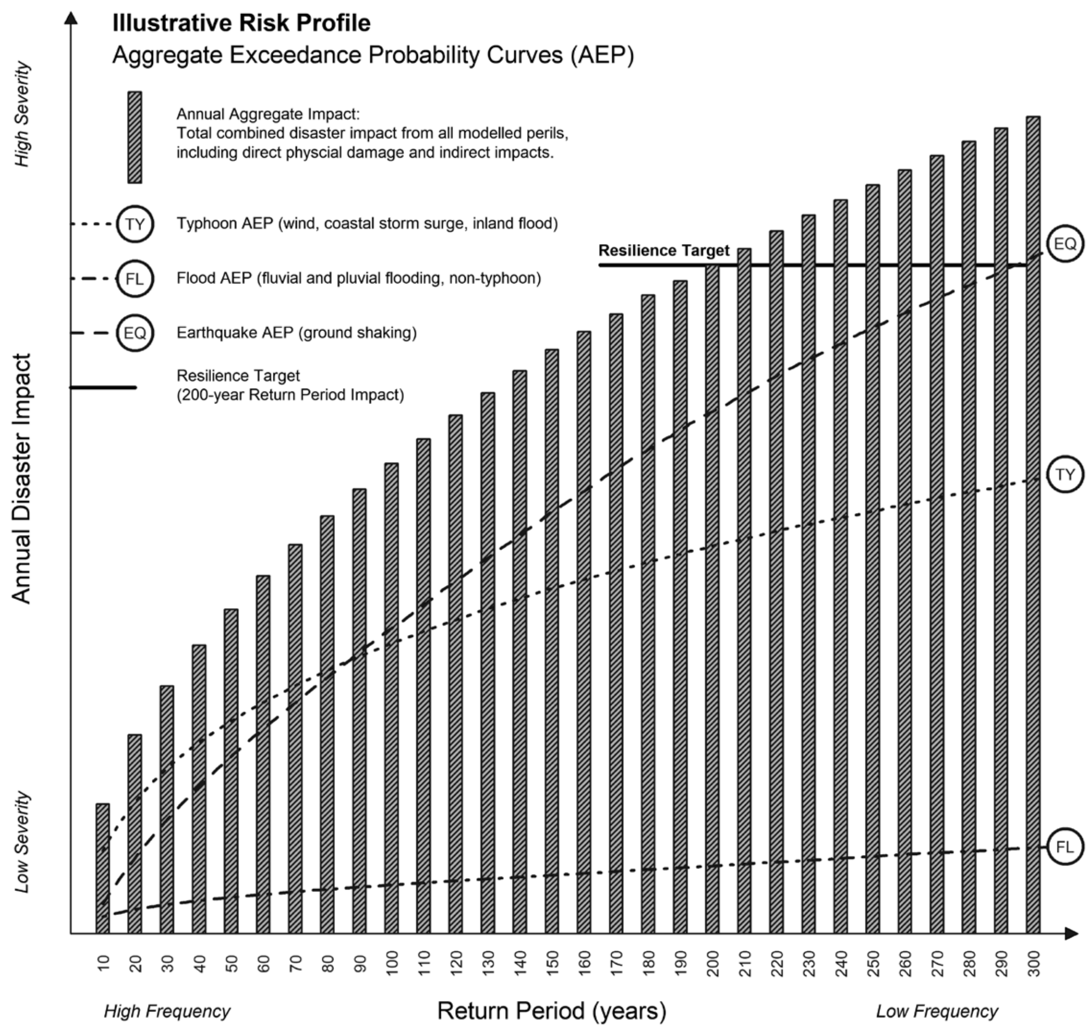
Scientific research and observations from previous disaster impacts provide the data necessary to build catastrophe risk models, which estimate the probability and severity of potential disaster impact. Catastrophe models provide a framework in which it is possible to quantify and compare the risk from a range of perils, enabling greater insight into the drivers of risk.

The below table outlines the application of a risk auditing process of definition, identification, quantification, and targeting, using a state-of-the-art catastrophe risk model to create an illustrative risk analysis.

The modelled risk analysis results for a set of assets are shown in Figure 5 using an 'exceedance probability' (EP) curve.

EXPOSURE DEFINITION **What is at risk?**	**The analysis covers commercial-type properties in a Southeast Asian country.** **The data includes information about:** • The location of people • The location of assets (including residential property, business and commercial properties and infrastructure) • Key determinants of the vulnerability of people – including: – Gender – Age – Proportion affected by disabilities – Other vulnerable groups • Key asset characteristics, which inform their vulnerability – including: • Construction (dominant material used in constructing the building frame/structure) • Occupancy (typical use of the building) • Year built (captures building practices/regulation and deterioration) • Number of stories • Replacement value – in relation to assets, describes the cost to rebuild, including both the structure and value of contents.
PERIL IDENTIFICATION **What can cause impact?**	The analysis focuses on two climate-related peril (typhoon, and inland flood) and one seismic peril (earthquake). The secondary hazards associated with these perils include: • Typhoon: wind, coastal flooding from storm surge, typhoon-induced coastal and inland flooding • Inland food: non-typhoon pluvial and fluvial flooding from excess rainfall • Earthquake: ground shaking
RISK QUANTIFICATION **What is the frequency and severity of impact?**	Catastrophe risk models can quantify the risk of direct damage and loss to assets. The risk analysis results are presented in an exceedance probability curve (→ Figure 5). Of course, direct physical damage is only one component of a disaster impact with loss of lives and livelihoods and downstream impacts also of crucial importance. Physical damage is, however, often a good indicator for the total potential impact from all sources, including direct and downstream impacts. 'Disaster Impact' is used to describe all potential impacts.
RESILIENCE TARGETING **What is the risk tolerance level?**	Resilience targeting sets the threshold between the risk which will be actively managed using a DRM strategy, and the level of 'residual risk', which falls beyond active risk management. The level of the resilience target depends on the risk tolerance of the risk holder, and other practical considerations including available budget and regulatory requirements. An example resilience target is shown at the 200-year return period impact.

Figure 5. Aggregate Exceedance Probability (AEP) curve for illustrative scenario (source: RMS).



Exceedance Probability Explainer

The exceedance probability curve is an analytical tool used to describe the frequency-severity distribution of disaster impact. There is typically an inverse relationship between disaster severity and frequency of occurrence, i.e. the more severe an event, the less frequently it is expected to occur.

- **Frequency (x-axis):** 'Return Period' thresholds are used to describe the frequency of occurrence. The Return Period (year) is equivalent to $^{1}/_{(\text{Exceedance Probability (year}^{-1}))}$.
- **Severity (y-axis):** 'Disaster Impact' is used to describe the total annual aggregate disaster impact. Direct physical damage and loss is used here as an indicator for total disaster impact (including indirect impacts). Severity is often measured in financial terms ($ loss), though other metrics can also be used as appropriate (e.g. number of casualties, storm category, flood extent).

Any point along the exceedance probability curve can be read as "there is a 1 in X-year annual probability of exceeding a disaster impact of Y". Note that while the combined exceedance probability curve consists of the risk from all three perils, is not equivalent to the sum of the independent peril exceedance probability curves. This is expected due to the methods used to calculate AEPs.

2. DISASTER RISK MANAGEMENT ACTIONS

Once the risks are understood, it is possible to develop a risk management strategy around three core categories of actions: (1) risk reduction; (2) risk retention, and; (3) risk transfer. Figure 6 describes these actions in more detail.

Figure 6. Risk management actions.

Risk Reduction	Any ex-ante action that reduces the severity of disaster impact. Risk reduction activities include physical interventions such as building flood defences and retrofitting property, but also planning activities such as risk-based site selection for new developments, and evacuation and response plans. It can also include activities taken immediately before an event impacts such as the distribution of hygiene kits and water purification tablets, or preparatory actions taken based on near or long-term forecasts. The decisions about which risk reduction activities to undertake, in which localities and to the benefit of which groups should be taken following a combination of economic feasibility assessments and participatory processes that allow opportunity for all voices to be heard. Risk reduction has benefits for all severities of disaster – however the relative size of the benefit in terms of reduced impact can vary depending on event severity.
Risk Retention	After an event has occurred, some costs can be financed directly by the risk holder using funds that are readily available. Risk retention mechanism are a relatively reliable source of funds, and they are therefore most appropriate to support more frequent disaster costs, such as those that are expected to occur every 10 years or less. In order for funds to flow quickly, the rules concerning how the resources associated with risk retention mechanisms are allocated should be determined prior to the event, and, as far as possible, be informed by data. The rules should be determined in an open, consultative manner. Risk retention mechanism have longer term cost implications, in that the costs are held and repaid by the risk holder, potentially for years after an event has occurred.
Risk Transfer	For lower-frequency higher-severity disasters, it is relatively more uneconomical to use risk retention mechanisms. Risk transfer mechanisms remove a portion of disaster risk in return for an annual premium payment. As such, they redistribute the infrequent and unmanageable total cost of disaster, into an equivalent manageable annual cost (premium). After an event, if the payment terms of the instrument are met, funds are paid by the risk transfer provider to the risk holder. As with risk retention, decisions as to how the resources associated with the use of risk transfer instruments (after they are triggered) should ideally be taken in advance (as far as possible) and following an open, participatory consultation process.

Risk reduction is core to disaster risk management, as it directly reduces the severity of potential disaster impacts, saving lives and reducing the destruction of homes and critical infrastructure. However, in reality risk reduction activities alone are unlikely to be able to reduce residual risk to meet resilience targets.

Risk retention and risk transfer tools provide additional options to manage any residual disaster risk. In all three cases, the decisions as to who should benefit from these different actions, and how the actions should be implemented, need to be taken in a participatory fashion that provides full representation for those most exposed and vulnerable to the risks.

These three actions should be applied in combination in order to meet defined resilience targets. The specific combination of actions this requires will be context specific, and informed by both cost benefit analysis as well as through participatory engagement processes with local communities, especially the most vulnerable. → Section 5 discusses how to combine DRM actions and DRF instruments efficiently and effectively.

These three types of action are also part of the ACRI+ and International Red Cross and Red Crescent Movement (ICRM) disaster risk management 'cycle'. However, this toolkit separates risk retention and risk transfer whereas the ACRI+ cycle combines these two elements. In addition, the framework in this paper distinguishes how the risk is managed, from the time at which actions are taken (which is discussed in section → 3.2) whereas the ACRI+ cycle combines these elements. This distinction between which actions are taken and when they are taken is powerful when explaining the differences between different financial instruments. However, both frameworks essentially incorporate the same elements.

3. DIMENSIONS OF INSTRUMENT DESIGN

Disaster Risk Financing (DRF) instruments exist to support the various funding needs associated with disaster risk management. In practical terms, these instruments fund or facilitate risk reduction, risk retention, or risk transfer actions. Different instruments are more or less suited to these different actions.

However, DRF instruments also vary according to a range of other criteria. These include; (i) the needs and capacity of the risk-holder (individuals, sovereigns or somewhere in-between, as well as development and humanitarian actors); (ii) the ultimate purpose for the funds, (iii) the required timing of support relative to a disaster; and; (iv) the level of risk that they help support.
A basic situational analysis can be performed by asking the following questions.

Figure 7. Instrument design dimensions.

	Risk Holder	What is the capacity and need of the risk holder?
	Purpose	What will funds be spent on?
	Timing	When is funding needed?
	Risk Level	What level of risk is being addressed?

The answers to these questions can help to inform the risk holder about which DRF instruments are most appropriate for the underlying need. They can also help articulate the design requirements for individual DRF instruments. However, the factors which influence DRF instrument design are complex and often interlinked and, as a result, the criteria share some intersecting themes. The following sections discuss each of these dimensions in more detail.

3.1. Risk Holder

Disasters impact people and organisations at all scales, from the farmer to the finance minister.

The needs of the risk holder vary across this range of scales, as does the financial and technical capacity to purchase and maintain DRF instruments as outlined below:

Figure 8. overview of needs and typical technical and financial capacity of risk holders.

Risk Holder	Overview
INDIVIDUAL (personal, household, smallholder, SME)	At an individual level people are responsible for the wellbeing of themselves and their families, property including homes and possessions, and their livelihoods. This might include individual households, smallholders and small and medium-sized enterprises (SME). This risk holder has a limited budget, and less need to access sophisticated DRF instruments. The types of DRF suitable at an individual level are typically standard consumer products, including property & life insurance, and loans. Micro-finance has been developed to address those with limited capacity to pay, especially in developing countries.
COMMUNITY (groups of individuals or businesses, towns, villages)	The pooling of individual risk and resource increases the range of DRF instruments that are available to fund DRM at a local level. Coordinated groups of individuals and businesses, and local authorities have greater purchasing power and can carry out resilience actions on a greater scale. The range of responsibilities also increases to include restoration of services, in order to minimise impacts on population or employees. Community level DRM initiatives may be supported by external entities, who can provide greater technical support, more funding, and access to a wider range of DRF instruments.
MUNICIPALITY (cities, sub-national government)	Municipalities are often responsible for supporting large urban populations. This includes the provision of critical and essential services such as power, water and waste management, transport, education, emergency, social and healthcare services. Municipalities can receive income through taxation, and often have independent risk management capacity, and additional technical and financial support from national governments. Municipalities have capacity to purchase a broad range of DRF instruments, across a range of markets. They can also coordinate and incentivise DRM activities at the individual and community level, as well as influence national DRM practices.
SOVEREIGN (state, supra-national entity, international body)	Sovereign entities are ultimately responsible for the welfare of their populations, development outcomes, and for near and long-term economic productivity. The financing needs at a sovereign level are significant, but so are the available DRM activities and DRF instruments. Sovereign entities can employ budgeting mechanisms and issue debt, build disaster reserves, and implement risk management policy and regulation among other activities. Sovereigns can benefit from international financial, technical and operational support from supra-national agencies, development banks, as well as international aid.

A discussion of different potential risk-holders raises important questions about the role of humanitarian actors. This is discussed further in Box C.

Box C. Stakeholders

Humanitarian actors receive funds from public donors and private sources, to enhance, support or substitute for in-country responses to a population in crisis. They include local and international non-governmental organizations, UN humanitarian agencies, the International Red Cross and Red Crescent Movement, host government agencies and authorities, and donor agencies. Humanitarian actors work according to four key principles:

- **HUMANITY:** human suffering must be addressed wherever it is found. The purpose of humanitarian action is to protect life and health and ensure respect for human beings.
- **NEUTRALITY:** humanitarian actors must not take sides in hostilities or engage in controversies of a political, racial, religious or ideological nature.
- **IMPARTIALITY:** humanitarian action must be carried out based on need alone, giving priority to the most urgent cases of distress and making no distinctions on the basis of nationality, race, gender, religious belief, class or political opinions.
- **INDEPENDENCE:** humanitarian action must be autonomous from the political, economic, military or other objectives that any actor may hold regarding areas where humanitarian action is being implemented.

Historically, the role of humanitarian actors has been to step in following a crisis, when a risk holder has not been identified, or when the magnitude of the risks overwhelm the ability of a purported risk holder to respond to the realisation of that risk. In these cases, humanitarian actors provide indispensable services and support to minimise the human cost of the event.

While this still represents a core role for humanitarian actors, in recent years, there has been a deliberate attempt to move beyond this role. At least three additional roles can be identified:

- To support national actors to better understand the risks that they face and develop disaster risk management plans, and associated financing strategies. The Agenda for Humanity[7] encourages humanitarian actors to work alongside development partners, national governments and other partners with the aim of 'strengthening local and national response in risk-prone countries outside of crises' It recognises that 'Investment in data and risk analysis should be increased and action taken early to prevent and mitigate crises.' This is a key area in which humanitarian and development actors have sought to work more closely.
- To explicitly become one of the actors within the plans developed ahead of crises – in other words to become an explicitly identified risk-holder that ex ante commits to provide resources when risks materialise, and/or as important actors in implementing risk reduction, response and recovery activities. This is broadly similar to the 'traditional' role played by these actors, but in a way that is explicitly incorporated within a broader disaster risk management plan. This has been associated with a shift towards anticipatory finance, as discussed below.
- To encourage greater societal participation in decisions about disaster risk management strategies, recognising that humanitarian actors can often play a crucial role in ensuring that otherwise marginalised and vulnerable people can have their needs taken into account[10].

Red Cross Red Crescent and its role in anticipatory finance

The Red Cross Red Crescent Climate Centre (RCCC) has applied lessons learned from pilot projects to inform the development of a model of providing humanitarian finance in anticipation of an extreme event[11]. This involves identifying triggers, Early Action Protocols (EAPs) and an associated financing mechanism.

1 TRIGGERS

Region-specific "impact levels" are identified based on the detailed risk analysis of relevant natural hazards, impact assessments of past disaster events, and vulnerability data. A trigger model then determines priority areas where the impact of an extreme weather event is anticipated to be most severe. Box D in section 4 explores the use of this sort of trigger mechanism, compared to those conventionally used for disaster risk finance in more detail.

2 EARLY ACTIONS

Once a forecast exceeds the trigger, a pre-agreed set of early actions, specified in an Early Action Protocol, are undertaken. These actions are aimed at reducing the impact of the predicted event on human lives, by providing assistance to people at risk and helping them to protect their families and livelihoods. This can include, for instance, providing veterinary kits, tying down house roofs, providing food and clean water, as well as transferring cash.

3 FINANCING MECHANISM

A Forecast-based Action Fund automatically allocates funding once a forecast reaches a pre-agreed danger level to enables the implementation of the Early Action Protocol.

3.2 Purpose

The ultimate purpose of DRF is to fund or facilitate resource flows towards activities that make disasters less impactful for people.

This can be achieved by minimising the risks to populations through reduction in vulnerability and volume of exposure; reduction frequency and severity of hazard; strengthening of disaster preparedness and response plans; and increasing the speed and effectiveness of recovery, among other activities.

Disaster risk finance provides the funds which enable these disaster risk management activities. The specific purpose for the funds has implications for which DRF instruments are appropriate, and further for the design of individual instruments (instrument mechanics).

It can be challenging to clearly segment and define purpose, given that disaster management costs are diverse and interconnected. In reality funds from individual DRF instruments are often used for a mix of activities, and instruments can be designed to accommodate multiple purposes.

Nevertheless, the exercise of 'purpose mapping' can help to guide both DRF selection and design processes. The following three categories are selected to capture the main purpose groups.

Figure 9. DRF Purpose groups.

Purpose	Overview
Life and Livelihood	Injury, death, and disruption resulting from disaster are the most immediate and pressing impacts of a disaster. There are immediate impacts for those directly affected, but also for municipalities and sovereigns who have responsibilities for the wellbeing of their populations. The costs required to fund life and livelihood impacts are diverse, and relatively challenging to quantify ahead of an event. DRF instruments designed to support this purpose should be flexible enough to reflect impact and needs assessments.
Operations	Disaster management activities have a range of implementation costs, including costs of personnel and resources required both before and after a disaster. Ensuring that these are met is crucial both to reducing the impact of a disaster and to ensuring that any negative impacts from a disaster are quickly dealt with, and helping to avoid detrimental impacts for longer-term economic and developmental outcomes. Funding to support operations must be readily available at the point of need. Prior to an event funding for operations can be directed towards disaster response and contingency planning. In the time-critical phase leading up to, during, and immediately following a disaster, rapid access to sufficient levels of funding for operations can significantly mitigate the overall severity of impact. Capital liquidity and certainty of payout are key considerations when designing DRF for operational costs.
Physical Assets	Physical assets are exposures that can be directly damaged. This damage can have drastic impacts on the ability of people to meet their basic needs and access essential services such as water and sanitation, education, or health services. The costs associated with physical assets include the costs of development, maintenance, repair, replacement of property such as buildings and infrastructure, property, machinery, and environmental assets. The costs and risk associated with physical assets are typically most easily quantified. Catastrophe models are designed to capture direct physical damage, and the downstream impacts from damage such as business interruption and casualty losses. DRF to fund physical assets should aim to closely match the total financial needs of the DRM action, be it the cost of construction or retrofit, or rebuild/ replacement costs following damage.

3.3 Timing

Different instruments facilitate access to funds at different speeds, and to varying levels of funding. This means that they are more or less appropriate for use at different times relative to a disaster event.

This analysis distinguishes between three phases[ii]:

- A preparatory phase where it is not urgent to access funding immediately but where relatively small amounts of funding can significantly reduce the direct and downstream impacts of a disaster, both in terms of the lives that will be affected, and the asset damage that may be realised.
- A response phase where funding needs are urgent in order to reduce the overall impact of the event, especially the impact on lives and livelihoods. During this time critical period it is important that risk management activities are not dependent on DRF instruments which take a long time to release funds.
- A recovery phase during which funding needs can be substantial, especially if there has been significant damage to physical assets and infrastructure, but the urgency of accessing that funding is not so great.

Figure 10 provides a stylised representation of the scale and timing of these needs. Figure 11 outlines the types of activities that occur within each phase.

Figure 10. Schematic of Illustrative timing and volumes of funding associated with each phase.

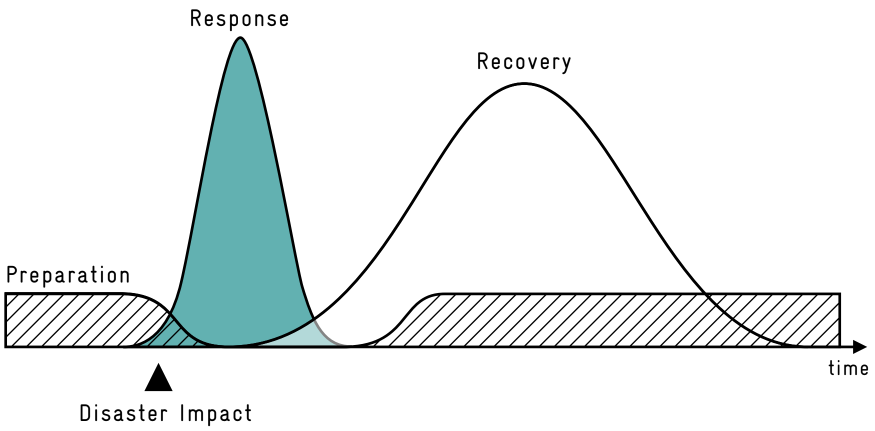


Figure 11. example activities associated with preparation, response, and recovery phases.

Timing	Activities
Preparation	– Continuous costs of disaster reduction – Preceding a forecast event impact (using near or long-term forecast data) • Evacuation • Deploying defences • Initiating disaster response plans
Response	– Immediately following disaster impact • Search and rescue • Humanitarian services • Restoration of essential services
Recovery	– Longer-term post-disaster • Reconstruction • Social support

3.4 Risk Level

The relative cost effectiveness of DRM actions and DRF instruments vary according to the frequency-severity profile of the underlying risk.

The following risk level bands are indicative only – a comprehensive risk audit and expert guidance is ideally used to provide context-specific guidance for selecting risk-appropriate DRF solutions.

FIGURE 12. Indicitive risk levels.

Risk Level	Overview
Annual	Risk holders who are responsible for large volumes of risk from multiple sources, such as municipalities and sovereigns, can expect to incur at least some level of disaster impact on an annual basis. This type of yearly ('attritional') risk can be measured based on previous experience, and so should be accounted for using established annually recurring DRF instruments. Budgeting mechanisms and allocated disaster funds are an efficient and effective means of managing yearly costs. Risk reduction actions (including maintenance, simple retrofit, and planning, as well as early actions immediately prior to an event such as preparation of emergency shelters), can also be very effective in managing attritional disaster impacts.
HIGH-FREQUENCY LOW-SEVERITY **(1 to 10-year return period)**	For less frequent events which cause impacts in excess of the yearly expected level, annual budgeting may not be the most cost-effective option for managing risk. Disasters which occur on a return period of up to 10 years are still relatively frequent. In isolation, and depending on the country context, the levels of loss they cause might fall within a 'manageable' level relative to the risk holder's capacity to pay using ex-post mechanisms. However, the uncertainty associated with disaster occurrence can easily make potentially manageable losses very unmanageable if events occur in succession.
MODERATE-FREQUENCY MODERATE-SEVERITY **(10 to 50-year return period)**	Moderate severity event impacts typically fall beyond a risk holder's capacity to pay using available capital reserves. For less-frequent events more sophisticated DRF is required to manage the potentially significant levels of impact. Funding may have to be sourced from external providers, including international lenders. Risk reduction activities must also be more robust to significantly reduce the risk for more severe impacts.
LOW-FREQUENCY HIGH-SEVERITY **(50+ year return period)**	Low-frequency high-severity events can cause catastrophic impacts which generate significant funding needs for large risk holders. This level of impact is likely to far exceed a risk holder's ability to build sufficient disaster reserves. Risk transfer offers an effective means of moving risk off the risk holder's balance sheet. Depending on the local context, the international reinsurance and capital markets may offer the most affordable risk transfer options. The bundling of risk in sovereign-level risk pools can also be effective.

4. DISASTER RISK FINANCE INSTRUMENTS

This section explores a range of financial instruments and policy mechanisms that can be used within a disaster risk management strategy.
Building on the discussion above, it categorises these instruments and policy mechanisms into those that can fund or facilitate risk reduction (in relation to climate-change related risks, this represents 'adaptation' to climate change); those used for risk retention; and risk transfer instruments.
The taxonomy also characterises appropriate risk holders, timing, purpose, and risk levels that each DRF instrument or policy is tailored to support. In doing this, it recognises that the instruments often have a range of structural options, which will vary depending on the specific needs and circumstances of the user. Different options mean that some instruments or policy mechanisms can be used across a range of scales and purposes and can be structured to respond to different requirements associated with timing and risk level.
Finally, it also provides examples of how the instruments have been used in practice, drawing, in particular, on examples from developing countries.
The taxonomy presented in Figure 13 summarises the appropriate range of application for each of the DRF instruments.

Figure 13. Taxonomy of disaster risk finance instruments, categorized by risk management action and design criteria

		Risk Holder				Risk Level			Timing			Purpose			
		What is the capacity and need of the risk holder?				What level of risk is being addressed? (return period)			When is funding needed?			What will funds be spent on?			
Action	Instrument	Individual	Community	Municipality	Sovereign	Life & Livelihood	Operational	Physical Assets	Preparation	Response	Recovery	Annual	1-10 year	10-50 year	50+ year
Risk Reduction	Loan	●	●	●	●	●		●	●		●	●	●		
	Micro-credit	●	●			●		●	●		●	●	●		
	Bonds			●	●			●	●		●	●	●	●	●
	Grants, subsidies, & tax breaks.	●	●	●	●	●		●	●	●	●	●	●		
	Crediting	●	●	●		●		●	●		●	●	●	●	●
	Impact Bonds	●	●	●	●	●	●	●	●		●	●	●	●	●
Risk Retention	Budget Contingency			●	●		●			●		●	●		
	Reserve Funds	●	●	●	●	●	●	●		●	●	●	●		
	Contingent Loans				●		●			●	●		●	●	
Risk Transfer	Micro-insurance	●	●			●		●		●	●		●	●	●
	Agriculture Insurance	●	●			●				●	●		●	●	●
	Takaful & Mutual Insurance	●	●	●	●	●	●	●		●	●		●	●	●
	Insurance & Reinsurance	●	●	●	●	●	●	●		●	●		●	●	●
	Catastrophe Bonds			●	●	●	●	●		●	●			●	●
	Risk Pools			●	●		●	●		●	●		●	●	●

4.1. Risk Reduction

This section consists of two components: first it considers a range of financial instruments that are commonly used to structure the flow of capital into investments that will reduce the risks that disasters cause; then it explores a range of policy mechanisms that governments or development partners can use to make it more economically attractive to undertake such investments, using various types of financial instrument.

Risk Reduction: Financial Instruments

Loans

Individual to sovereign	Primarily to reduce risks to physical assets but can also be used to reduce risks to lives and livelihoods	Preparedness activities plus recovery	Most effective at reducing risks from frequent (annual or up to 1 in 10-year events)

OVERVIEW

Bank loans are one of the most common instruments for channelling capital into risk-reduction, and other types of, investments. They can be made by either public or private financial institutions (FI) and provided to companies, households or other institutions. They are primarily used to finance investments that reduce risk in preparation of a disaster event but can also be used to finance reconstruction after a disaster event (where risk reduction is achieved by a commitment to 'build back better'). Loans supporting investments that reduce risks are likely to be proportionally more effective at reducing risks from high-probability, low-severity events; more extreme events are typically so devastating that risk-reduction investment is less effective[12].

Regardless of use, the borrower is expected to repay the loan, plus make interest payments on the balance of the loan that has not been repaid. On some occasions, the FI advancing the loan will receive the capital to make the loan through a credit-line provided by an International Financial Institution (IFI). This credit line will provide resources to the FI on more favourable terms than it could otherwise access, on condition that loans are advanced for a particular purpose.

DESIGN OPTIONS

The key design characteristics influencing the nature of the loan are the amount advanced; the duration (tenor) of the loan; the repayment schedule; whether the loan is secured on the asset that it finances (or other collateral) such that the FI can claim the asset in the event that the borrower defaults; and the interest rate, and other pricing, charged on the loan. In cases where loans are supported by IFI credit lines, the IFI may require that the loans offered to the final borrower are priced on more favourable terms than would otherwise be available in the market.

CHALLENGES

Loans are a very well-known financial instrument used to finance a wide range of capital investments. As such, the potential challenges in using the instrument are well known. Most importantly, if the borrower is unable to repay the loan, either because the asset does not perform or otherwise, then this can cause problems of indebtedness for the borrower and reduces the profitability of the financial institution, making it more reluctant to lend in the future. Some households and businesses can also find it difficult to access loans, either because the FI finds it difficult to judge the likelihood of repayment, or because the distribution channel of the FI does not reach those who would like a loan.

REQUIRE-MENTS

FIs need to be licensed by, and are subject to supervision from, the national bank authorities in the countries in which they make loans, influenced by international bodies such as the Bank for International Settlements' Basel Committee on Banking Supervision.

EBRD CLIMADAPT

The European Bank for Reconstruction and Development's (EBRD) ClimAdapt programme in Tajikistan provides a good example of how loans, supported by an IFI credit line, can support risk reduction investment[13]. In this initiative, the EBRD, with the support of various donors, has advanced a $10m credit line to a selection of banks, who then provide loans to local businesses and households to invest in projects that reduce climate-related risks.

At the time of writing, more than 3500 projects had been supported, with investments in water efficient technologies, energy efficiency and sustainable land management practices.

MICRO-CREDIT

Individual and community	Lives and livelihoods, and small scale physical assets	Preparedness activities plus recovery	Most effective at reducing risks from frequent (annual or up to 1 in 10-year events)

OVERVIEW

Micro-credit involves the provision of relatively low value, frequent repayment loans to individuals, households, SMEs and communities. The product arose as a reaction to the difficulty that conventional FIs are unable or unwilling to provide loans to this target customer group. Micro-credit is typically provided by dedicated micro-finance institutions (MFIs) who are financed by commercial lenders and for-profit investors, multilateral and bilateral development banks, and donors. Donors and IFIs may also provide additional support to specific microfinance programs to reduce costs or risks.

A typical characteristic of microfinance is the engagement of the community within the loan appraisal and monitoring process through, for example, joint liability or peer monitoring. Microfinance also often specifically targets women. On many occasions, loans are one of a series of financial products the MFI offers, others include micro-insurance (see discussion on microinsurance below).

MFIs are beginning to consider the use of some of the risk transfer instruments described below, or alternatively donor support, so that they are in a better position to extend loans quickly after a climate shock – so called recovery lending. Early results suggest promise[14].

DESIGN OPTIONS

There are a number of design elements that influence the microfinance loan. These include whether the loans must be used for specific activities, the duration (tenor) of the loan, the interest rate charged and the distribution channel. There is an increasing interest in using mobile banking solutions to improve access to microcredit by lowering distribution costs.

CHALLENGES

Researchers have extensively analysed the impact of microfinance with conflicting results. Various studies find no significant impact on poverty or other development indicators; while there are also concerns about the potential indebtedness of consumers. On the other hand, microfinance (including microcredit) has been associated with an enhanced ability of poor people to deal with shocks, but this is not universal[15].

Microfinance programs specifically targeted at reducing climate risks are in their early stages. They offer significant potential, although there are challenges in enhancing awareness regarding the value of risk reduction investments across all stakeholders, finding distribution models that reach the most climate vulnerable and, when programs are supported by public funds, ensuring loan repayments.

REQUIRE-MENTS

Most countries have introduced regulation to license and supervise microfinance institutions, especially in cases where the MFIs take deposits as well as advance credit.

JAMAICA PPCR AND OTHER EXAMPLES

In Jamaica, the Pilot Program for Climate Resilience (PPCR), working through the Inter-American Development Bank, has underwritten microfinance loans extended to farmers and small enterprises in the tourism and agricultural sector[16]. These loans have, among other things, supported farmers in installing dams and grass and live vegetation barriers.

However, even in cases where micro-credit is not explicitly targeted at investments that reduce climate risks, they can be an important tool to build livelihoods and assets that enhance broader adaptive capacity to climate risks[15].

The investments supported by micro-credit are most likely to be effective at reducing frequent, relatively low-intensity events.

BONDS

Municipality and sovereign (plus large corporates)	Physical assets	Preparedness activities plus recovery	Can be used to fund more significant infrastructure projects (all risk levels)

OVERVIEW

Bonds are issued by national and local governments, and other quasi-public organisations, as well as large companies, to finance investment. In exchange for the payment of the bond by the purchaser, the issuer agrees to pay the purchaser interest payments on a set schedule, and repay the principal at maturity. As such, they are a form of debt instrument. They are attractive to investors as low-risk securities, depending on the sponsor, that can be easily traded. Due to their expense (see below), bonds are typically used for financing large scale capital infrastructure, either supporting preparedness by reducing risks prior to an event, or for less time-sensitive reconstruction of assets.

Bonds can be classified according to who issues the bond (government, municipal, corporate) as well as according to the use of proceeds from the bond sale. In recent years, there has been a significant growth in green bonds: bonds that are explicitly issued in order to finance projects that are environmentally sustainable or support the mitigation of or resilience to climate change. Climate Bonds Initiative reports that, as of 2018, there were around $1.45 trillion of bonds that claim links to addressing climate change, although less than 0.1% have an explicit focus on reducing risks to climate change[17].

DESIGN OPTIONS

A number of features define the specific characteristics of the bond. These include: size; the use of proceeds; whether repayment will come from general sources (either corporate cashflow or tax revenues) or from the specific revenues generated by the financed asset(s); the duration of the bond; and the interest rate (coupon) that will be paid to investors.

For green bonds, the Green Bond Principles (GBP) provide voluntary process guidelines to issuers for launching a credible Green Bond. The Principles cover defining criteria for a green project, defining the processes for selecting green projects, the systems used to trace the green bond proceeds, and reporting guidelines. The principles also identify that issuers have the option to ask third parties to certify their green bond, using organisation such as the Climate Bonds Initiative. These organisations will assess the bonds against pre-agreed criteria, especially related to how the proceeds will be used. This increases the green credentials of a bond among investors, but also increases transaction costs[18].

CHALLENGES

Bonds are expensive to structure, with transaction costs typically of 1% or more of the principal raised. They take several months to structure. These costs and time increase further if the bond is certified. This tends to mean that it is only somewhat richer developing countries that issue sovereign bonds, although the IMF reports that in the 10 years to 2013, Rwanda, Tanzania, Senegal and Cote d'Ivoire all issued sovereign bonds19 while Nigeria and Fiji have recently issued sovereign green bonds.

REQUIRE-MENTS

Bond issuance is typically regulated by the capital market authorities in the country where the bond is issued. The economic aspects of this regulation might, for instance, place nationality restrictions on who is allowed to issue or purchase bonds within a jurisdiction, whether or not a prospective bond issuer meets necessary standards; and taxation rules. Prudential regulation focuses on investor protection and avoiding systemic risks, by identifying principles for, for example, issuance standards or trading norms.

GROWING GREEN BOND MARKET

Despite constituting a very small proportion of the overall bond market, there are a number of important examples of institutions issuing bonds to reduce climate risks. For example, the Government of Fiji issued a $50m green bond which will primarily be used for investments that build resilience against the impacts of climate change[20] (as well as renewable energy projects) while the City of Cape Town issued a $76m green bond in July 2017 to refinance a number of assets, including the rehabilitation and protection of coastal structures[21, 22].

Risk Reduction: Policy Mechanisms

GRANTS, SUBSIDIES, & TAX-BREAKS

Individual to sovereign	Physical assets and lives and livelihoods	Preparedness activities plus recovery and possibly response	Most effective at reducing risks from frequent (annual or up to 1 in 10-year events)

OVERVIEW

A key way to increase the attractiveness of risk reduction activities is through grants to reduce their capital costs, subsidies to reduce their ongoing operating costs, or tax breaks. These can be used to support investments that reduce the exposure of both infrastructure and lives and livelihoods to extreme weather events, and at all scales from individuals through to sovereigns. They are best suited for preparedness activities or to support asset reconstruction, although quickly arranged grants may also help with response activities.

DESIGN OPTIONS

Most grants, subsidies or other incentives take a relatively simple form whereby the payment is made concurrently, or in advance of, when costs are incurred. Large grant payments may be disbursed in separate tranches and made conditional on evidence that the previous tranche has been used as intended.

There also is growing interest in making 'results-based' grants or incentive payments, whereby payments are only made when the outputs expected from undertaking a set of activities have been delivered. This mechanism can help strengthen the incentives of the recipient (they only get the additional resource if they deliver results) but it can be challenging in contexts where the recipient faces challenges in accessing upfront finance. A further challenge is identifying metrics that can be used to demonstrate that the activities have successfully reduced risks.

CHALLENGES

By improving the economics of undertaking risk reduction investments, they can be powerful mechanisms to encourage such activity. However, activities may become reliant on the incentives that, over time, can threaten the financial sustainability of the mechanism.

In terms of international climate finance, almost all developing countries have in place the institutional architecture to engage with relevant multilateral funds. However, there are frequent criticisms that the requirements to access resources from these funds are too burdensome for many countries.

REQUIRE-MENTS

The regulatory requirements for the domestic use of grants, subsidies or tax breaks are relatively light and will generally already be in place to provide incentives for other activities. Results-based incentive payments typically require more onerous regulatory regimes, in order to generate assurance that the result that warrants the incentives has been delivered.

GRANT & SUBSIDIES

Canada has established a 10-year $2 billion Disaster Mitigation and Adaptation Fund that aims to increase community resilience to natural hazards and extreme weather events[23]. It provides grants of between 25% and 75% of the eligible costs of infrastructure projects costing more than C$20m that serve to reduce risks. For developing countries, international climate finance is an important source of grants to make risk resilience investments more attractive to both public and private sectors. For example, the Adaptation Fund provides grants of up to $10m to country governments for adaptation investments, including those that reduce the risks from extreme weather events[24]. For example, a $5m grant is helping to enhance resilience and reduce the risk of flooding in Ulaanbaatar City in Mongolia, primarily through the construction of various community level flood protection assets[24]. Similarly, the Green Climate Fund (GCF) provides grants to support adaptation investment, potentially of a larger scale[25]. For example, the GCF will provide a grant of $27.1m to support a $70.3m project to scale up Georgia's Multi-Hazard Early Warning System to provide reliable information on climate-induced hazards, vulnerability and risks.

In addition, both the funding received by humanitarian and the way that this funding is passed on to support governments, municipalities, communities and individuals manage and reduce disaster risk is also typically provided in the form of grants/subsidies. Box D describes the growing trend for some of this support to be provided in advance of disasters striking, through anticipatory finance mechanisms such as forecast-based financing.

CREDITING (MITIGATION BANKING)

Municipality & community – with spillovers to individuals	Physical assets and lives and livelihoods	Preparedness activities plus recovery	Can be used to fund more significant projects (all risk levels)

OVERVIEW

This approach incentivises risk reduction investment by allowing the benefits from these projects to be recognised in a 'credit', that can then be sold to (typically) companies. Companies choose to purchase the credits either for regulatory compliance purposes or corporate social responsibility reasons. The sale of the credit boosts the revenue from undertaking the investment, making it more economically attractive. Indeed, in some cases, the credit sales may be the only revenue source for the risk reduction project.

The investments incentivised by this type of mechanism can help to reduce the damage that disasters pose to physical infrastructure and to lives and livelihoods. The time taken to set up a crediting mechanism means that they are most well-suited for preparatory activities while the relative sophistication of the instrument means that they are most likely to be effective at encouraging investment by companies in a way that supports the local community, but this can have spillover benefits at the personal level. As with all risk-reduction activities, they are most likely to be cost-effective in reducing the risks associated with relatively high-frequency events, though crediting mechanisms can be incorporated in more significant risk reduction projects.

DESIGN OPTIONS

Some of the key issues to determine in this mechanism are whether credit purchases will be voluntary or mandated by regulation, the extent to which credits are just bilaterally exchanged or whether they can be traded between third parties (the latter potentially allowing for the formation of a more liquid commodity market but also being likely to introduce additional price volatility) and the type of investments that are allowed to generate credits.

CHALLENGES

The attraction of crediting mechanisms is that they can create an additional economic incentive for risk reduction investments without the use of (scarce) public resources. However, to be effective, there needs to be a sustainable source of demand for the credits. In the case of mitigation banking (see below), this is achieved through regulatory requirements on developers to make good the negative biodiversity impact of their developments.

It may be difficult to generate a parallel source of regulatory demand for risk reduction investments, while CSR demand may not be consistently high.

A further, critical challenge is in quantifying, on a comparable basis, the risk reduction benefits that a wide range of varying investments deliver.

REQUIRE-MENTS

The regulatory requirements for this approach are relatively light in cases where any credits are purchased on a voluntary basis i.e. for CSR purposes. However, if demand for credits stems from a compliance obligation placed on purchasers by regulation then an associated regulatory architecture will be needed to ensure that the risk reduction investments, and the associate credits they generate, are consistent with the objectives of the regulation.

MITIGATION BANKING

One of the most mature examples of this approach is known as 'mitigation banking'[26]. Developed in the US, with a focus on the restoration or enhancement of wetland or other aquatic resource areas, purchasing credits from such projects provides a flexible way for developers to fulfil mandates to compensate for the impact of other developments. While this mechanism is primarily intended as a mechanism for preventing biodiversity loss/ achieving net gain, there are many cases where ecosystem restoration can also reduce the damages from disasters

There are also similar examples in developing country contexts. For example, the African Development Bank is piloting the concept of an Adaptation Benefits Mechanism[27]. This will create credits (or Adaptation Benefit Units (ABUs)) that reflect the value of the social, economic and environmental benefits of adaptation activities. ABUs could then be sold to interested parties who want to demonstrate their commitment to support adaptation activities in Africa. The pilot, to run between 2019 and 2023, is set to include projects that enhance coastal protection through afforestation with mangrove trees.

IMPACT BONDS

	Can be used to fund more significant projects (all risk levels)	Lives and livelihoods, operations, and physical assets	Preparedness activities plus recovery	Can be used to fund more significant projects (all risk levels)
OVERVIEW	Impact bonds encourage risk reduction investment by offering a pay for performance contract between an 'outcome based funder' – typically a government, donor agency or philanthropy – and private sector investors in relation to a project that has social or development objectives. Under an impact bond structure, investors will provide capital (either/both debt and equity) to a project with the outcomes-based funder committing to make repayments to investors depending on the extent to which independently verified performance targets are met. These targets place a strong incentive on the overall outcomes expected from the project, rather than just immediate project outputs. Investors will normally appoint a 'managing agent' to implement the project. The structure could be used to incentivise investments that reduce the risk that disasters pose to infrastructure, although by boosting the adaptive capacity of individuals and communities e.g. improving health or education outcomes, the mechanism could also reduce the risks to lives and livelihoods that disasters cause. The long timescales and substantial transaction costs involved in structuring impact bonds (see below) mean that they are most appropriate for preparedness activities and typically at the community, municipal and/or sovereign level. As with all risk-reduction activities, they are most likely to be effective in reducing the risks associated with relatively high-frequency, low-impact events. The structure can be attractive to outcome based funders as they allow the risk of successful delivery of outcomes to be transferred to investors (if no outcomes are met, less or no money is paid to investors). They also require that the capital for a project comes from private sources. At the same time, they are also attractive to private investors as a way of marrying financial return[iii] while delivering social impact.			
DESIGN OPTIONS	Key design questions include which outcomes to target, how much return investors should earn if outcomes are delivered and how much they should lose if the outcomes are not delivered.			
CHALLENGES	Impact bonds can be complicated to design, often taking 6 months to 3 years to structure[28]. Moreover a recent report by Lloyds and DFID explores how impact bond could be used to incentivise risk reduction/resilience investments. The report notes that the structure may be challenging to adopt for resilience/risk reduction due to difficulties in quantifying outcomes related to risk reduction and because of questions over who should bear the risk of a disaster striking during the lifetime of the bond.			
REQUIRE-MENTS	Specific regulation for impact bonds is unlikely to be needed but the ability to structure deals in the context of existing procurement regulations can sometimes be complicated[29].			

DEVELOPMENT IMPACT BONDS

There are no examples of development impact bonds explicitly targeting risk-reduction investments. However, humanitarian actors have developed this model in other contexts. For example, so-called Humanitarian Impact Bond, designed by the International Committee for the Red Cross, involves a selection of governments have committed to make payments to consortium of investors depending on whether, after 5 years, new physical rehabilitation centres financed by the investors deliver a level of outcome – in terms of the number of people receiving mobility devices per physical rehabilitation professional – that is higher than the average in Africa. If the benchmark is exceeded the investors will receive a return on their investment; if it is below benchmark, then the investors will lose a certain amount of their initial investment30.

iii A Blavatnik School of Government briefing reports 2 case studies suggesting investor returns of between 15% and 70% for two impact bonds targeting development outcomes[57].

4.2. Risk Retention

Risk retention instruments are pre-arranged mechanisms that provide risk holders access to capital, where funds are sourced either from their own reserves or external capital that they are responsible for repaying. The resources provided through these instruments come from those affected by the disaster. In other words, those affected by the disaster are those who retain the responsibility for covering the costs that arise following the event. The section explores three main risk retention instruments: budget contingencies, reserve funds and contingent loans. In relation to all risk reduction mechanisms, and the risk transfer instruments discussed in section 4.3, there are important considerations relating to how resources are released from the instrument – this consideration is described as the 'trigger mechanism'.

Box D. Trigger Mechanisms

For risk retention and transfer – a key design option is the mechanism by which the funds are accessed and distributed. The 'trigger mechanism' determines whether, and the volume of funds that are released from a DRF instrument for a given event.

Trigger options range in complexity from subjective processes, to pre-defined objective processes that are based on the measured parameters of an event (parametric triggers).

Parametric-based triggers use observed event parameters as a basis for estimating total disaster impact. In order to design parametric triggers, catastrophe risk models can be used to quantify the relationship between event parameters and the associated disaster impact. This understanding is then used to define parametric trigger thresholds. With careful design, parametric triggers offer a rapid and transparent alternative to subjective or indemnity-based triggers. Parametric triggers create derivative products, which can cause payouts that over- or under- estimate the actual need, this challenge is discussed later in → Box E.

The main categories of trigger are summarized below:

Trigger Mechanism	Measurement	Description
Subjective	Informed Judgement	Informed judgement is often sufficient to access risk retention mechanisms, where the capital 'belongs' to the decision maker. Totally or partially subjective triggers are useful for accessing time-critical funds, as it implies no need for (independent) assessment. Subjectivity can raise issues of transparency. To deal with this, these triggers should be associated with clear decision-making processes and a requirement that funds are distributed according to pre-arranged disaster plans.
Indemnity	Reported Claims	Traditional risk transfer instruments are often triggered based on the reported level of loss following an event. The majority of insurance and reinsurance policies, and insurance-lined securities (ILS) trigger on an indemnity basis. The advantage of indemnity-triggers is that the payout closely matches the underlying need. A challenge with indemnity-triggers is that they require regulated claims handling processes, and claims can take a long time to settle as they are reviewed.
Simple Parametric	Macro-event parameters	Where local observation data is limited, remote observations of an event's main characteristics can be used to trigger funds. For example, a simple 'cat-in-a-box' structure uses hurricane category and track location with respect to a pre-defined area ('box') as the basis for a trigger mechanism. This simple structure is a useful first step towards developing more sophisticated trigger mechanisms. And may be the most fit-for-purpose solution in some contexts.

Pure Parametric	Local Hazard Measurement	Where there are robust local observation networks, location-based hazard measurements (wind speed, flood depth, temperature) can be used in parametric trigger mechanisms. Local hazard measurements are more highly correlated to local damage than macro-event parameters, and so can give a more accurate estimate of total event impact.
Modeled Loss	Modeled Footprint	For large spatially distributed sets of exposure, local observation networks may not provide enough coverage to create an accurate estimate of total disaster impact. Available observation data (from local observations and remote sensing) can be used to create a modeled event hazard footprint. This can then be used in catastrophe models with exposure and vulnerability datasets to create a 'modeled loss estimate' which is used to trigger the funds.

Innovations in Trigger Design: Forecast-based Finance

Conventionally, trigger mechanisms developed in the private markets have been responsive – they measure what has happened and make an appropriate payout. However, in a humanitarian context, the potential value of delivering funds prior to impact has spurred innovation in trigger design.

The need for rapid funding has led rise to an innovative form of DRF called Forecast-based Finance (FbF), which broadly describes financing instruments which are triggered by forecast data. There are a range of current initiatives to develop anticipatory trigger mechanisms, which use forecast data and other available information to anticipate the potential severity of disaster impact – this information is then combined with pre-arranged response plans, to deliver funds for particular activities prior to the main impact. The attraction of these mechanisms is that relatively small injections of capital received before an event, if placed in the hands of local responders, can support preparation and response activities that significantly reduce the eventual severity of impact.

Forecast-based trigger mechanisms could be incorporated in risk retention or risk transfer instruments, e.g. a forecast-based trigger could be used to access a reserve fund, or to trigger a payout from a catastrophe bond. Their potential to reduce the severity of impact also means that they act to reduce risk.

Forecast-based finance is an evolving topic – and early lessons learned will continue to refine approaches. As described in Box C, the Red Cross Red Crescent Societies have been key proponents of FbF and have implemented a range of FbF projects[31]. The Start Network Crisis Anticipation Window[32] has similarly used forecasting to inform disbursement of funds.

Conceptually FbF is a very powerful tool – however, it will not be appropriate in all situations, some considerations are explored below. Note that some of these considerations also apply to parametric triggers more broadly.

Considerations for FbF	
Given the innovative nature of forecast-based triggers, care should be taken when applying this trigger mechanism to DRF instruments. The following table provides guidance on some considerations for FbF.	
Uncertainty & Flexibility	There are inherent uncertainties in the approach of using forecasts to trigger funding. Disaster events are a function of many complex inter-related factors, any one of which can make the difference between the event unfolding into a minor or major catastrophe. However, given that relatively small capital injections can have a profound impact on mitigating the overall severity of disaster, the risks of this approach can be measured against the potential benefit. Advances in forecasting and risk modelling techniques will continue to reduce the uncertainty associated with anticipatory triggers. In addition, uncertainty in forecasts can be accommodated with flexibility in the trigger design and instrument mechanics. For example, it is possible to design 'soft' parametric triggers which make a small initial payout based on early information, with the option to make a subsequent larger payout when there is more certainty in the event outcome. Softness can also be designed into the trigger mechanism by allowing for a combination of both objective and subjective elements. For example, an objective parametric measurement may 'flag' an event, which can then be referred to an expert panel to assess if a payout should be made.
Delivery	Forecast-based finance is most impactful when it can be spent effectively on the ground, by local actors who can use the funds to implement pre-arranged response plans. The speed of forecast-based payouts should therefore be matched by the capacity of the recipient to use the funding efficiently and effectively. Clear disbarment mechanisms and spending plans are therefore fundamental to supporting forecast-based payouts in particular. The humanitarian system is well placed to support forecast-based initiatives. Local, regional, and international networks can act as the distribution mechanism for funds. Given the uncertainty in the actual costs required to support action, the combined experience can also guide decisions about how much funding is required, and how best to allocate and distribute funds to local responders. It should also be noted that the speed of payout may also be constrained by the DRF instrument itself – for example special purpose vehicles (SPVs) which hold collateral funds for catastrophe bonds, may only be able to provide cash payouts days after they are triggered. This is due to the constraints on liquidity of the underlying funds. This delay can be accommodated provided that the recipient is able to cover costs based on the promise of repayment.
Shock, Strain, & Systemic Events	The speed of onset and complexity of the peril type are important factors when considering the applicability of forecast-based trigger mechanisms. For rapid-onset weather events including typhoons, floods, and convective storms, climate variability means that forecasts may only provide actionable guidance shortly before impact (hours-days). In addition, forecasts for very local hazards (e.g. hail, lightning, tornado) can be highly uncertain. For slower onset events including drought or El Niño events, forecast-based payouts can be made as the event is unfolding (similarly to the World Bank Pandemic Bond issued in 2017)[33]. An important design consideration for slow-onset events is to carefully identify payout thresholds. This decision process is strongly informed by risk modeling – care should be taken to consider model and measurement uncertainty, as well as forecast skill. To some extent, all disasters are systemic in nature. However, for complex disasters that result from multiple upstream causes (e.g. mass migration resulting from climatic and geopolitical factors), it can be challenging to accurately model the complexity in the system to the extent that it is necessary to develop forecast-based parametric triggers. For complex systemic disasters, where possible triggers should be deigned to be flexible (e.g. both objective and subjective) in order to avoid issues when events do occur.

BUDGET CONTINGENCY

Municipal and sovereign (plus smaller-scale bodies if they set their own budgets)	Operational	Response	Most cost effective when used to respond to high frequency low-intensity events e.g. up to 1 in 10-year events

OVERVIEW

A budget contingency is a risk retention mechanism whereby a certain proportion of revenues within a budget are set aside for dealing with contingencies. These contingencies may be either explicitly defined but, more commonly, are simply left available to be used for undefined 'exceptional events'. The instrument is most typically used by, national or municipal governments but, in principle, could be used by any organisation or household that face significant risks. In the case of governments, budget contingencies typically amount to 2-5% of the annual government budget34.

The attraction of budget contingencies is that, compared to other risk retention or risk transfer mechanism, they are a relatively low cost, flexible instrument for risk holders to manage their risks. Funds can be accessed almost as soon as they are needed[iv], and the main cost is the opportunity cost of the activities that are not supported because the money is being held as a contingency. A previous analysis estimates the cost of the instrument as just 1–2 times the expected pay-out of the instrument, making it among the lowest cost instruments explored in that study[34].

This flexibility, combined with the fact that they are unlikely to be able to provide large sums of capital (see below), means that they are best placed for dealing with the immediate, response costs during and following a disaster event, and for high-frequency, low damage events (i.e. events that, on average, happen every 2 or 3 years).

DESIGN OPTIONS

The key design options relate to how much funding is placed in the contingency and whether there are any formal rules determining whether the funding can be accessed or how it can be spent.

CHALLENGES

The flexibility of the instrument is both its biggest advantage, but also its biggest disadvantage. As the arrangement is voluntary, it can be politically difficult for large sums of money to be placed in a contingency budget, and it can be politically tempting for governments to use whatever funding is placed in a contingency for other, non-disaster related reasons.

REQUIRE-MENTS

There are typically no substantial regulatory barriers to using this instrument among any organisation that has budget setting powers.

NATIONAL BUDGETS

A number of governments have budget contingencies in place including Japan, Vietnam, Indonesia and Colombia. For example, in Vietnam, under the State Budget Law of 2002, Central and Local governments are required to allocate between 2 percent and 5 percent from their total planned budget for capital and recurrent expenditures to contingency budgets[35]. However, these contingencies are not explicitly linked to disasters. This has led to situations where the country has experienced a major cyclone hit the country in November, but when the contingency budget had already been fully exhausted[34].

iv Although this depends somewhat on the budget and spending rules of a jurisdiction; if these are cumbersome it may take longer before budget contingency can be released. Ghesquierre and Mahul (2012) suggest that it can take between 0 and 9 months after an event to access resources from a budget contingency.

RESERVE FUNDS

Municipal and sovereign (plus smaller scale risk holders using informal reserving)	Life and livelihood, operational, and physical asset costs	Response and recovery	Most cost effective when used to respond to high frequency, low-intensity events e.g. up to 1 in 10-year events

OVERVIEW

Reserve funds involve the same basic idea as budget contingencies – money that could be spent now is instead saved to cover future costs after a disaster – but aim to provide more formality concerning how the money can be accessed and what it can be spent on. Specifically, money is transferred into a reserve account that sits outside the budget and the transfer of resources to the fund recognised as a spending line in the budget. In addition, funds are typically not then transferred back to the budget if unspent in that year. Reserve funds can be set up by national, city or local governments. Informal reserving mechanisms can also support smaller scale risk holders, at the individual and community levels.

The attraction of reserve funds is similar to that for contingency funds: they offer a means of quickly accessing funding for the immediate response costs associated with a disaster event, at relatively low cost. Previous studies suggest resources can be made available 0-1 month after a disaster event and that costs are only 1-2 times the expected pay-out[34]. They are therefore typically used for covering immediate response costs, although the Philippines example below shows how the basic model can be adapted to cover other costs as well. Moreover, the rules-based nature of the transfer of resources into the reserve fund and out of the reserve fund to cover costs means that they are a more predictable source of post disaster financing than, for example, budget contingencies.

DESIGN OPTIONS

The examples in the box below illustrate some of the most important design issues to consider in relation to a reserve fund: who should place how much money in the fund (and with what level of discretion); what determines whether the money can be accessed; and the rules governing what the money in the reserve fund can be spent on.

CHALLENGES

While reserve funds may provide more predictable funding than budget contingencies, it still remains politically challenging to allocate substantial funds to a reserve fund. They therefore remain better suited for providing capital to deal with relatively frequent, low-intensity events.

REQUIRE-MENTS

There are not normally substantial regulatory challenges associated with setting up a reserve fund, although in some countries there may be reluctance from the Finance Ministry or Treasury regarding the extent to which funds can be established that operate beyond its immediate purview.

DISASTER RESERVES

In the Philippines, cities are required under legislation to set up Local Disaster Risk Reduction and Management Funds (LDRRMF), which are the principal source of funding for all disaster risk events[36]. Cities are required to allocate at least 5% of their budget to these funds. 30% of the collected resources are allocated to a Quick Response Fund for past disaster financial liquidity, which is made available upon the declaration of a state of calamity at a local (city or higher) or national level by the relevant body. The remaining 70% is placed into a Mitigation Fund for prevention, response and recovery activities. Any unspent balances at the end of the year transfer to a Special Trust Fund for the sole purpose of funding disaster risk reduction.

Mexico's disaster fund, FONDEN, provides a further example of a reserve fund operating at a national level: this receives annual budget appropriations of around $800m per annum and covers 50% of the costs of reconstruction after disaster events[8].

While reserve funds are most commonly set up by local or national governments, they can also be set up by communities.

For example, the FAO has supported the establishment of Community Contingency Funds whereby communities pay into a fund which then help vulnerable households following an unexpected event such as drought, hurricanes, floods, earthquakes or other extreme events[37]. Funds can be accessed, typically in the form of low-interest loans, for households to, for example, purchase supplies for the new agricultural season in the event of crop losses. In these cases, donors and international organisations might also support the set up or capitalisation of such funds.

CONTINGENT LOANS

	Sovereigns	Operational costs	Response	Most cost effective when used to respond to high frequency, low-intensity events e.g. up to 1 in 10-year events

OVERVIEW

Contingent loans are loans that, in advance of a disaster, it is agreed will be made available on specified terms following a disaster, if the disaster's severity meets or exceeds a certain threshold (trigger). In other words, they are made available contingent on a particular event or level of damage being incurred. They are typically provided by International Finance Institutions (IFIs) to sovereign governments. IFIs often only allowing sovereigns to sign up for a contingent loan if they have a disaster risk management plan.

The main attraction of a contingent loan is that the resources can be accessed quickly following a disaster. This makes the instrument well suited to dealing with the immediate increases in costs, and liquidity challenges this can pose, during the response phase of a disaster. A further attraction is that, especially at rates offered by IFIs, they are a relatively cheap way of accessing capital to deal with the impact of disaster. Reflecting this, analytical work suggests that they are typically well suited for 'medium' risks, in other words, risks with a relatively low impact but which happen quite frequently, perhaps once every five years or so.

DESIGN OPTIONS

There are two main variants of contingent loans: soft trigger and hard trigger loans. A soft trigger is a subjective trigger mechanism whereby the sovereign government can determine whether or not an event in sufficiently severe to justify the loan being accessed – practically this is achieved by making the trigger the declaration of a state of emergency. A hard trigger is a parametric trigger, for example, relating to wind speed of a tropical cyclone. Other design features include how much capital should be available to each country; the interest rate and other pricing conditions at which the loan will be made available; and the drawdown period (the period of time over which the loan can be drawn down).

CHALLENGES

There can also be challenges in using contingent loans. An evaluation of the contingent loan offering by the IDB found that they were not always supported within the organisation as they used up scarce lending capacity that might never be used. Similarly, potential borrowers were sometime reluctant to take out contingent loan products because of a fear that this would indicate they were vulnerable to the impacts of a disaster (especially compared to peer countries). The evaluation found this problem was exacerbated for products that had standby fees included and in cases where there was some uncertainty about whether the loan will actually be made available[38].

REQUIRE-MENTS

The product is typically provided through a contract between an IFI and a sovereign government. As such, the regulation that needs to be in place for the product is relatively light. However, the IFI will typically require that the sovereign has both an adequate macroeconomic policy framework; and be preparing, or already have, a satisfactory disaster risk management program,

CAT DDO

An established example of a contingent loan product is the World Bank's Development Policy Loan with a Catastrophe Deferred Drawdown Option (CAT DDO) product. This product allows countries to borrow up to the lower of US$250 million or 0.5 percent of GDP (IDA countries39) or US$500 million or 0.25 percent of GDP (IBRD countries[40]) in the event of a state of emergency being declared by the country. The drawdown period for the loan is 3 years, renewable up to 4 times.

The interest rate on the loan is the same as for regular IDA/IBRD loans, with no front end fees or renewal fees (IDA countries)/0.5% front end fee and no renewal fees (IBRD countries). The product is only available to countries that have, or are preparing, a satisfactory disaster risk management plan, which the World Bank monitors on a periodic basis.

Between 2008 and 2017, 15 such loans were approved worth US$2.345 billion across countries[41].

4.3. Risk Transfer Instruments

In contrast to risk retention instruments, risk transfer instruments place the obligation for providing (a certain amount of) capital in the event of a disaster onto third parties. The capital provider will receive a payment in exchange for accepting this risk. This section includes an overview of insurance as the key risk transfer tool, as well as exploring a number of different forms on insurance examples – focusing on those of greatest relevance to developing countries – before considering catastrophe bonds.

A key issue associated with all of these instruments is that of basis risk, this is discussed in Box E.

Box E. Quantifying Basis Risk

When disaster strikes, it is not unusual for an insurance payout to differ from the policyholder's expectation. The possibility of such a discrepancy is referred to as basis risk. Basis risk can be defined simply as the 'difference between expectation and outcome'.

Parametric insurance is most commonly associated with basis risk. For example, in the case of a modeled loss trigger, basis risk will emerge when there is a difference between modeled loss and measured loss after an event; while for a pure parametric trigger, basis risk refers to the difference between the index loss calculated from a wind speed measurement and the total actual loss. However, when defined as above, it becomes clear that basis risk exists within all DRF instruments which contain a trigger mechanism. For example, in indemnity-based insurance, basis risk could stem from the possibility that a contract fails to pay because of a legal miswording.

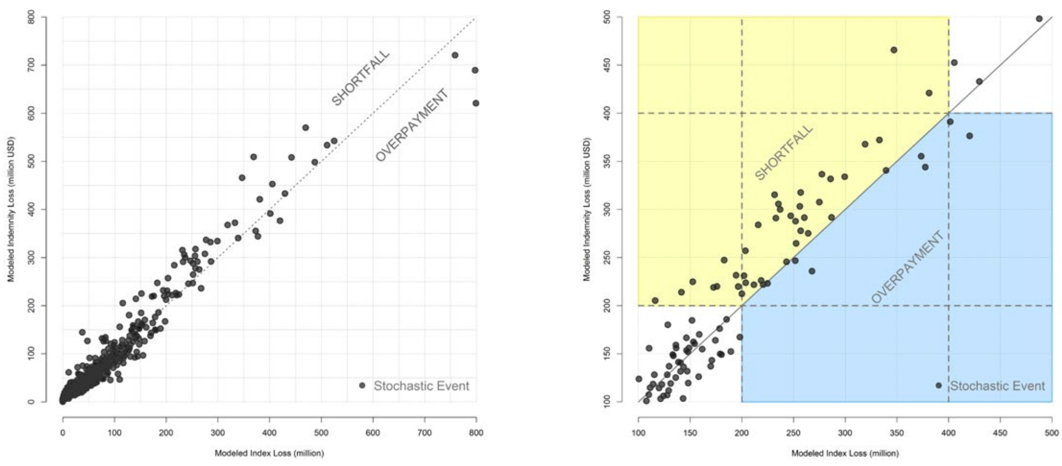
The primary drivers of basis risk vary between structures. To quantify basis risk, it is first necessary to identify the primary sources of uncertainty with respect to each structure. Once identified, basis risk can often be quantified, and communicated to the purchaser. With the basis risk appropriately understood, the structure can then be tailored to modify the expectation as appropriate.

A range of methods have been developed to assess basis risk in parametric structures, these can also be applied in modelled loss and indemnity cover. Catastrophe models provide a useful tool for the assessment of basis risk. A simple assessment of the correlation between the modeled parametric index and indemnity loss can uncover if a trigger mechanism tends towards shortfall (no payout when expected) or overpayment (payout when not expected). Calculation of shortfall and overpayment with respect to a target covered layer can be done using the following equations – the process of basis risk calculation and trigger refinement is fundamental to the design of appropriate parametric instruments.

$$Overpayment = \left(\frac{Loss_{index} - Loss_{indemnity}}{Exhaustion - Attachment}, 0\%, 100\%\right)$$

$$Shortfall = \left(\frac{Loss_{indemnity} - Loss_{index}}{Exhaustion - Attachment}, 0\%, 100\%\right)$$

Figure 14. Basis risk plots. left: parametric index against modeled loss. Right: shortfall and overpayment for an illustrative risk layer (Source: RMS).



MICRO-INSURANCE

Individual and community	Lives and livelihoods and physical assets	Response (especially parametric) and recovery (especially indemnity)	Most cost effective when used to respond to low frequency, high-intensity events e.g. beyond 1 in 10 year events but sometimes used for more frequent events.

OVERVIEW

Microinsurance is the provision of insurance to transfer risks associated with disasters from poor and vulnerable households who would otherwise not have access to insurance. Coverage and premium payments are, by design, low, with insurance payments intended to pay out for losses of life and property.[v] A review by Climatewise in 2011 identifies 14 Disaster Micro-insurance schemes in developing countries, one of which was at a proposed stage, and another had been discontinued.

The speed of pay out and appropriateness for different forms of risk are similar to those for agricultural insurance as discussed above.

DESIGN OPTIONS

As the examples below demonstrate, the schemes can be designed with either parametric or indemnity triggers. There are also choices over the channel to market; as the Swayamkrushi example below suggests, it is increasingly common to bundle the provision of microinsurance with microcredit. Other design features across which schemes may vary include which perils to cover, trigger design (especially for parametric), premia amount and options for payment.

CHALLENGES

The same challenges regarding affordability as discussed for agricultural insurance also apply to disaster microinsurance.

REQUIRE-MENTS

The same regulatory issues as discussed for agricultural insurance also apply to disaster microinsurance.

MICROINSURANCE

'Mithapukur Sonirvor Mohila Somobay Somity' has developed a microinsurance product for residents in the Mithapukur Upazilla District of Bangladesh that also complies with the principles of Takaful insurance (as discussed above).

Self-help groups make a contribution of 100 taka per year (approximately US$1.15) to manage the scheme. In addition, individual members each pay 100 taka annually. This entitles them to access pre-defined benefits in the event of hazards such as death, disability, hospitalisation and business loss, including those caused by weather-related events. As of 2016, 90% of SHG members (more than 3,300 people) had taken up the scheme, with the 50 payouts made in that year, and surplus income of 180,000 taka.

The pilot also identified some of the challenges associated with microinsurance, including a lack of understanding of the product leading to scepticism among potential beneficiaries as to the benefits they would receive, difficulties associated with pricing due to the lack of weather data, affordability constraints, and the potential fragility of the scheme to large events that might wipe-out any reserves.[42]

v Some definitions of microinsurance also include agriculture insurance for smallholders. However, this is treated separately in this taxonomy.

AGRICULTURE INSURANCE

Individuals	Lives and livelihoods	Response and recovery e.g. new seeds	Most cost effective when used to respond to low frequency, high-intensity events e.g. beyond 1 in 10 year events but sometimes used for more frequent events.

OVERVIEW

Agricultural insurance is an insurance product specifically designed to transfer risks associated with agricultural losses caused by weather related hazards. A 2011 Climatewise report identifies 84 agricultural insurance schemes in developing countries[43].

Agricultural insurance can be an effective tool. For example, one study found that following a drought in the Horn of Africa, households benefiting from an index-based livestock micro-insurance scheme were 25 per cent less likely to reduce meals than their uninsured counterparts and 36 per cent less likely to engage in distress sales of livestock[44].

Ideally, agriculture insurance would be best placed to transfer risks associated with infrequent, large events. However, the individuals benefiting from the schemes may not be in a position to substantially retain risks without resorting to negative coping strategies, implying that insurance may also be used to transfer the risk of more frequent events.

DESIGN OPTIONS

A key distinction is between products that have an indemnity trigger and those with a parametric trigger. Parametric triggers have become popular in many developing world contexts as they avoid costly assessments of losses. Indemnity triggers may be based on either yield or revenue losses.

As with other forms of insurance, the type of trigger determines the speed of payout and hence the disaster risk financing phase to which they are best suited. Parametric triggers can pay out in less than 2 months making them suitable to covering the response phase of a disaster; whereas indemnity schemes may take around 6 months to pay out but may be better for longer term asset acquisition. Other design features include which hazards are covered and the level of cover provided.

CHALLENGES

A key challenge is whether premia are affordable for those targeted by the scheme as, relative to the ability to pay of typical customers, scheme set up and operation costs can be high. To address this challenge, donor and/or public funding may be made available. In addition, or alternatively, schemes may use innovative approaches for premia payment as explored in box below.

While parametric triggers are better suited to many developing world contexts, trigger design can be complicated, and basis risk substantial, if granular meteorological information is not available.

REQUIRE-MENTS

The issues and challenges surrounding regulation for agricultural insurance are broadly the same as those described more generally for insurance above. Given the prevalence of index based insurance in developing countries, there can be a particular challenge when regulatory frameworks do not recognise index based insurance, as has been the case in West Africa. This has held back the development of the market in this region compared to East or Southern Africa[45].

‘R4 RURAL RESILIENCE INITIATIVE

The R4 Rural Resilience Initiative[46], supported by Oxfam and the World Food Programme, as of early 2018, has reached around 57,000 farms (300,000 people) across Ethiopia, Senegal, Malawi, Zambia and Kenya. It offers microcredit to support risk reduction, promotes savings so as to allow more efficient risk retention, microcredit to support prudent risk taking and offers insurance (risk transfer). An innovative aspect of the scheme is that it allows some premia payments to be made in kind through undertaking risk reduction investments. In 2018, around US$ 1.5 million of insurance payouts were distributed through the initiative in Ethiopia, Kenya, Malawi, Senegal and Zambia.

TAKAFUL & MUTUAL INSURANCE

All scales	Lives and livelihoods, operational and physical assets.	Response and recovery	Most cost effective when used to respond to low frequency, high-intensity events e.g. beyond 1 in 10-year events

OVERVIEW	Mutual insurance offers products that are very similar to standard insurance, but rather than the insurance company being owned by shareholders, it is owned by its policyholders. This means that any surplus income generated by the insurance company is returned to customers or used to reduce future premia. In this sense, strictly speaking, risk is shared among policyholders, rather than transferred to third parties. Takaful insurance is closely linked to the concept of mutual. It responds to an ethical concern with Islamic jurisprudence that conventional insurance provides benefits that are too uncertain or no benefit at all if there is not a risk event) and that insurance company often invest premia in interest-bearing instruments. As such Takaful insurance involves members who, rather than pay premia, make regular 'donations' and receive a pre-defined pay-out in the event of loss, plus a return on the investments made in the insurance fund (which is invested in Sharia compliant instruments).[47]
DESIGN OPTIONS	Mutual insurance companies can offer a wide range of insurance products, with different trigger mechanisms, covering different perils, and with varying designs as to whether insurance is mandated to be compulsory and the premium charged/subsidy offered. As mutual insurance companies do not access external capital, they are sometimes not able to offer as much cover against high impact, low probability events as conventional insurers. Many of these variants are also applicable to Takaful insurance, although takaful principles mean that pay-outs are typically fixed, rather than being based on a detailed assessment of the loss or damage incurred.
CHALLENGES	Mutual and takaful insurance face broadly the same challenges as for insurance products offered by shareholder-owned companies
REQUIRE-MENTS	The regulatory structures for mutual insurance may sometimes be explicitly articulated and different from those for insurance companies owned by shareholders. Countries as diverse as China, Chile, Iran and Indonesia have separate laws for mutual insurance. However, many other countries do not have dedicated laws for mutual insurers, which can impede their market development. As of 2016, it was estimated that 45% of countries, and 63% of low-income countries, did not have a mutual insurance law[48]. Takaful insurance requires monitoring by a Sharia advisory board in order to ensure that Sharia principles are being respected both in relation to operational practices and in how donations are then invested. Further statutory and regulatory provisions may be needed to allow Takaful insurance companies to access external finance in a way that is Sharia compliant.[42]

TAKAFUL INSURANCE EXAMPLE

Takaful Insurance of Africa offers an Index-Based Livestock Insurance (IBLI) product, branded as Index-Based Livestock Takaful (IBLT). This offers protection against prolonged lack of pasture as a result of severe drought and offers protection in the event of limited vegetation for cattle, camel, sheep and goats[49].

In 2014, the company made the first Takaful insurance livestock payment for livestock insurance to 30 women and 71 men in Wajir County in Kenya[50].

INSURANCE & REINSURANCE

All scales	Lives and livelihoods, operational and physical assets.	Response and recovery	Most cost effective when used to respond to lower frequency, high-intensity events e.g. beyond 1 in 10-year events

OVERVIEW

Insurance cedes the risks associated with a disaster to a third party (insurance company), in exchange for premium payments. If a qualifying event takes place, the insurance company is contractually obliged to make payments to cover some or all of the losses. Governments, infrastructure and property owners, to farmers, firms and households can all take out insurance[vi]. Insurance contracts typically last one year, but, on occasion, longer term contracts are available. Insurance companies, in turn, will purchase re-insurance to cover part of their loss exposure.

Both parametric and indemnity products are relatively expensive: previous estimates suggest that they may cost more than 2 times the expected pay out. They are this better suited for less frequent but more damaging events, where the long-term impacts from not otherwise having reliable access to capital would be most damaging.

DESIGN OPTIONS

A critical design feature of any insurance contract is the trigger mechanism, as discussed in the Box D above. Other key factors include the cover provided, which perils are covered, whether payment is compulsory, and the premia amount (including whether the premia is subsidised).

Different types of insurance cover different phases of disaster financing needs. The ability of parametric cover to pay out quickly – in just less than 2 months – makes it a useful instrument for the response phase, supporting debris removal, funding temporary living solutions etc. However, the higher basis risk it less suited for funding longer term reconstruction. In these cases the fact that indemnity products are more likely to pay out what is needed to cover reconstruction costs makes them more desirable, even if the speed of pay-out is much slower (6 months or more)[34].

CHALLENGES

One of the most significant is the cost associated with the products which may make them prohibitive, especially for individuals and households where distribution channels and intense marketing efforts may be required. These costs may be exacerbated by a lack of data, which makes it harder to price risks, and a lack of understanding/mistrust among potential consumers on the role and efficacy of the product. A further challenge, especially for indemnity products, is a concern that their reduce the incentive to undertake risk reduction investments (moral hazard).

Parametric products offer opportunities to both reduce the cost and moral hazard problems, but, in many cases, increase the basis risk embedded in the product.

REQUIRE-MENTS

Insurance regulation varies across countries. In some countries, regulations may restrict the type of cover that can be provided, the extent to which premia can vary between customers or the nationality of the firms that can offer insurance. Greater regulatory harmonisation offers opportunities for growth in insurance markets51.

INSURANCE PENETRATION

Insurance of public assets for disaster losses is compulsory in countries such as Colombia, Peru, the Philippines and for some assets in Vietnam. Indemnity insurance is much more common than parametric insurance. Reserve funds may purchase reinsurance to ensure that they can remain solvent if they face large payouts: for example, since 2011 Mexico's disaster fund, FONDEN, has purchased reinsurance cover on international markets. However, generally insurance levels, especially in developing countries are low. Previous analysis suggests that just 3% of the annual losses of around $30bn from natural catastrophes in low and lower-middle income countries are covered by insurance.[52,53]

v The specific features of insurance for individuals – microinsurance – is explored further below.

CATASTROPHE BONDS

Sovereign (and large corporates and municipalities)	Life and livelihood, operational costs and physical assets	Response and recovery	Most cost effective when used to respond to low frequency, high-intensity events e.g. beyond 1 in 10 year events

OVERVIEW

Catastrophe ('cat') bonds are short term bonds (see → section 3.1 above) (3–5 years) issued by a sponsor to investors in the capital markets. However, in contrast to normal bonds, they are 'triggered' by a catastrophe. Once triggered, the bond sponsor maintains a portion of the principal and consequently investors lose a portion of principal and interest payments. In this way, they transfer natural catastrophe risk to investors. The bond issuer will typically be a state or large infrastructure owner. Insurers, reserve funds or risk pools might also issue catastrophe bonds, as an alternative to purchasing reinsurance, to lessen their risk exposures. They can be attractive instruments to investors as cat bond risks are uncorrelated with other risks investors face.

The cost of catastrophe bonds (see below), plus the fact that bonds can be issued for large amounts, means that they are best suited for low frequency, high impact events; this is also the perspective of investors who would not be interested in bonds that were triggered on a frequent basis.

DESIGN OPTIONS

As with many of the other instruments discussed above, the most important design considerations is whether the trigger mechanism is indemnity-based or parametric. This has the same trade-offs between speed and basis risk identified for other instruments, and accordingly means that cat bonds can either be used to cover near term response costs or longer term reconstruction efforts. Other design questions include the size of the issuance and the coupon on the bond.

One specific- at present, hypothetical - version of a cat bond is a resilience bond. This would work in the same way as a cat bond except that, if risk reduction investments are undertaken, interest rates on the bond would fall to reflect the risk reduction[vii]. 2 This anticipated interest rate reduction could help the financing of the risk-reduction investment. However, this is a complicated instrument – for instance, requiring reliable estimates from modellers of how much the investments reduce risks. As yet, there are no examples of this instrument reaching the market[54].

CHALLENGES

Catastrophe bonds are relatively expensive risk transfer instruments: previous work suggest they may cost more than two times their expected pay out[34]. This reflects both that structuring and issuance cost of these bonds are more expensive than for other bonds and because they tend to require relatively high interest rates to generate investor interest[viii]. This means that they tend to be more appropriate for larger organisations or more developed governments.

REQUIRE-MENTS

As sophisticated instruments, cat bonds are subject to a range of regulatory requirements. Cat bonds are usually set up by Special Purpose Vehicles (SPVs) that will require licensing and having various capital, reserve and solvency requirements. The issuer may also be required to demonstrate that a meaningful transfer of risk has taken place.

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With support from the World Bank, Mexico, Peru, Chile and Colombia all issued cat bonds for earthquake risk in 2018. Collectively, these bonds had a value of around $1360m and with coupons of between 2.5% and 8.25% depending on the risk. They were all designed with tier structures, with the proportion of the principal that investors lost in the event of an earthquake, varying in discrete steps depending on the severity of the earthquake – for example in Peru the payout amounts were set at 30%, 70% or 100% of the bond principal.[55].

vii This would be easier to implement with an indemnity-based trigger mechanism.

viii Artemis report that average coupon returns range from 3% to 6%, but can sometimes be as high as 15% or higher.[58]

RISK POOLS

Municipals and sovereign	Operational costs and physical assets	Response and recovery	Most cost effective when used to respond to low frequency, high-intensity events e.g. beyond 1 in 10 year events

OVERVIEW

Risk pools are structures where a selection of organisations (typically administrative units) come together to purchase insurance. The pool effectively becomes the ‚captive insurer' (bespoke insurance company) for the units in question. The pool retains some of the risks itself and transfers other risks, through reinsurance, or other instruments, to third parties. The pool is able to purchase insurance more cheaply than if its members purchased it individually, as it offers a more diversified risk portfolio, and because of economies of scale and greater buyer power. Pool membership may be conditional on having a disaster response plan.

Risk pools typically use parametric triggers, allowing pay-out within 1–2 weeks, making them suitable instruments for providing liquidity during the response phase of a disaster.

As with other insurance instruments, risk pools are better suited for the less frequent, high impact events where relatively larger amounts of response costs need to be covered (which it will be more difficult for risk retention mechanisms to reliably provide) and where the economic and welfare costs of not having access to these resources will be very damaging.

DESIGN OPTIONS

The parametric trigger needs to be designed carefully to avoid excessive basis risk[ix]. Other key design features include which products the pool might offer and the extent to which the pool retains risks on its balance sheet versus transferring them to reinsurance markets or through purchase of cat bonds (see below).

CHALLENGES

Risk pools face the same types of challenges as other forms of insurance, namely that the premium costs may be too high, and not justifiable (given the risks they are expressed to) for potential members. There are also sometimes concerns expressed regarding whether citizens of jurisdictions within the pool benefit from pay-outs and that such schemes fail to incentivise and change behaviour among those who are at the frontline of facing climate impacts.

REQUIRE-MENTS

As pools typically work with parametric triggers, the regulatory environment needs to allow for the use of parametric products.

SOVEREIGN RISK POOLS

In recent years, sponsors have created a number of risk pools for disasters. One of the most famous is the Caribbean Catastrophic Risk Insurance Facility Segregated Portfolio Company (CCRIF-SPC)[56]. Setup in 2007 with World Bank assistance, this is a risk pool for small Caribbean island nations and, more recently, some Latin American countries. It offers insurance cover for earthquakes and hurricanes. Each country in the pool members pays a premium ranging from $200,000-$4.5 million, depending on the size of the pay-out they consider they require following an event. Possible pay outs range from $1–100 million. The scheme is parametric and pays out within two weeks when triggered. To date, CCRIFF has paid out around $138M to member governments.

Other examples at the national level include the Pacific Catastrophic Risk Assessment and Financing Initiative (PCRAFI) providing coverage against tropical cyclones, earthquakes and tsunamis and the Africa Risk Capacity (ARC) providing coverage against droughts, floods and tropical cyclones across various countries in Africa.

While many risk pool examples operate at the sovereign level, they could also work at a regional or city level. Recent analysis for the ADB has helped to inform the development of a risk pool for different cities in the Philippines[36].

ix For example, Africa Risk Capacity initially failed to make a pay-out to Malawi following droughts in the 2015/16 growing season as the model on which the modelled loss parametric trigger was based assumed that a different model of maize to that which was actually being grown, and out-of-date information on farming practices prevented the model from accurately replicating conditions on the ground[59].

5. RISK MANAGEMENT STRATEGY

This section describes the linkages and interdependencies between the DRF instruments described in section 4 and how they can be combined to create an efficient DRF strategy.

Section 5.1. explores the critical importance of risk reduction in enhancing the effectiveness of a disaster risk finance strategy and how the benefits from risk reduction might be captured.

→ Section 5.2 then explains how to combine different DRF instruments and the cost and coverage benefits that can be achieved when this is done well. It particularly focuses on risk retention and risk transfer mechanisms.

5.1. Complementarity

The benefits from combining instruments increase further when policymakers and other actors take into account risk reduction opportunities and the various policy mechanisms (e.g. subsidies, crediting mechanisms and impact bonds) and financial instruments (loans, microcredit, bonds) that can support these investments.

Examples of risk reduction include investment in coastal barriers (including green infrastructure), upgrading buildings to make them more structurally resilient to wind or flood damage, or altering the design of critical infrastructure like roads and ports, reduce the damage done by disasters (retrofit). Such benefits reduce the damage to physical assets that events cause and, in turn, increase the ability of the people to continue to access the essential services that the assets provide (shelter, health, education).

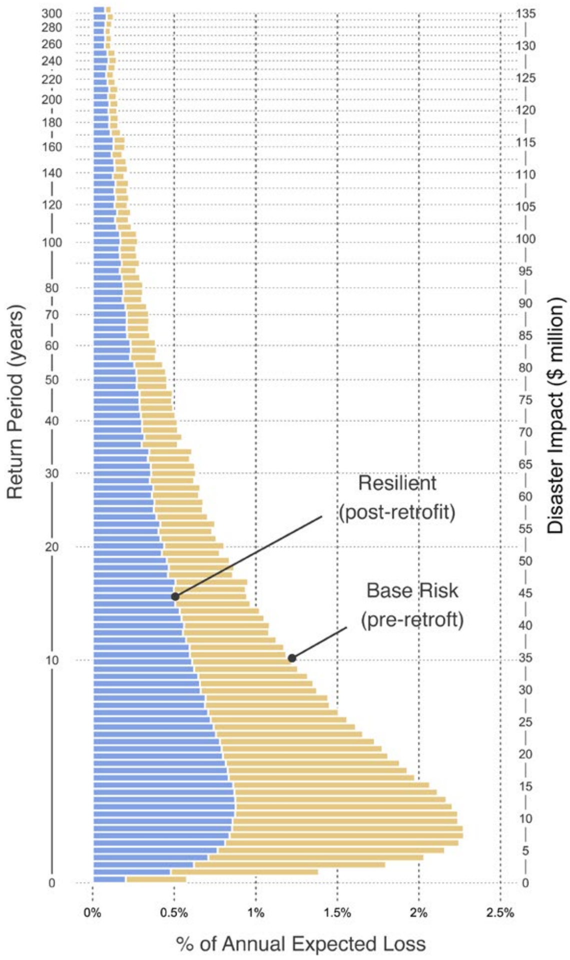
By reducing the damage caused by events, the cost of both risk retention or risk transfer instruments fall. This means, in turn, that the budget needed to reach a given resilience target is lower than before the investment is made, or that a higher level of resilience can be targeted.

'Annual expected loss' is a metric which is typically used to inform the prices of retention and transfer instruments. This metric describes the annual losses that a risk holder would experience on average.

Figure 15 provides an illustrative example of how a program of residential retrofitting can reduce the annual expected damage and loss from typhoon risk. The horizontal bars represent the contribution to the total annual expected loss across the range of return periods (impact frequency and severity shown along vertical axes).

It shows a key feature of risk reduction – that, in economic terms, risk reduction generates the greatest combined cost savings by reducing the risks associated with lower severity and more frequent events. This also makes sense intuitively – if a risk holder builds a 10 ft. flood barrier, the risk reduction benefit of the lower half of wall is greater than the highest half. This is because the lower half protects against flood waters more frequently, and therefore generates higher expected savings.

Figure 15. the resilience dividend: wind retrofit example, showing resilience benefits in terms of reduction in annual expected loss.



The implication from this result is that risk retention and transfer instruments which cover lower loss levels, will see the greatest benefit in terms of cost savings, and instrument which cover the more remote layers will see a smaller relative benefit.

However, note that the analysis in Figure 15 only demonstrates the benefit of physical risk reduction in terms of annual average savings. It does not fully reflect the fact that risk reduction can also create distinct benefits for higher severity events.

Risk reduction generates benefits that extend well beyond reducing only the economic costs of disaster. In addition, the greater confidence that extreme events will not causes losses encourages risk taking and entrepreneurship; while risk reduction measures can also bring important co-benefits, such as using disaster shelters as schools or community spaces, when not being used as a shelter. Consistent with this, a recent report for Lloyds of London in association with the UK's Centre for Global Disaster Protection found that measures to boost resilience might typically have benefit cost ratios of 4:1, and in some cases this ratio is substantially higher.

An economic analysis such as this can therefore help to quantify the cost-benefit of risk reduction, but it should not be used in isolation.

The possibility that risk reduction investments can reduce the cost of risk retention or risk transfer opens up an important complementarity between these instruments in terms of designing innovative financial instruments, known as resilience-linked financing that is only beginning to be explored. Box F below discusses this concept in more detail.

Box F. Resilience-linked Finance

'Resilience-linked finance' refers to the idea that the business case for risk reduction investments could be made through monetizing the reduction in the cost of risk retention or risk transfer. There are a number of models through which this could be achieved including:

- Insurance-linked loan package. This would involve a loan, most probably provided by an international finance institution to a sovereign or municipality, towards infrastructure programs where resilience is explicitly built into the design. The loan would cover both the construction of the resilient infrastructure program and of a parallel multi-year insurance product. However, the loan amount to cover insurance would be based on the expected insurance premiums without the resilience measures. By contrast, the actual cost of insurance would take account of the resilience measures built into the infrastructure design. The result would be a series of savings on the insurance premiums which could be used to partially pay down the loan.
- Resilience bond. As described in section 4, this is a version of a cat bond where, once risk reduction investments are undertaken, the interest rates on the bond falls to reflect the fact that investors in the bond are now less likely to suffer such large losses in the event of a disaster[x]. This anticipated interest rate reduction could help the financing of the risk-reduction investment[xi].
- Resilience service company (ReSCO) could offer to finance the cost of retrofitting buildings at its own risk. This risk reduction could result in lower insurance premium (assuming these are risk-based). The ReSCo would then realise a return by receiving some proportion of the savings that are realised due to reduced insurance costs. This builds on the concept of energy savings companies (ESCOs) who develop, build, and finance projects that create energy savings. They pay for the project upfront and rely on receiving some proportion of the savings that are realised due to the reduced energy usage to make a return on their initial investment.

These product concepts aim to both promote resilience, but also capitalize on the economic benefits of risk reduction. If effect, capturing the expected savings and using this to part fund the additional investment required to build resilience.

As is demonstrated in Figure 15, the greatest annual expected savings are generated in aggregate from higher-frequency lower-severity events. The absolute savings generated through risk reduction will therefore be greater for DRF instruments which target lower loss levels.

Another challenge is that the annual expected loss for a set of exposures is typically much smaller than the total value of the exposure, so for the savings on expected loss to contribute significantly to the additional cost of resilience, the risk must be high to begin with.

These types of instrument are therefore most appropriate in very high-risk regions, where low-cost resilience measures can significantly reduce the vulnerability. Risk models can help to identify where risk reduction can have greatest impact.

x This would be easier to implement with an indemnity-based trigger mechanism.

xi The expected in interest rate reductions could potentially even be securitised.

5.2. Risk Layering

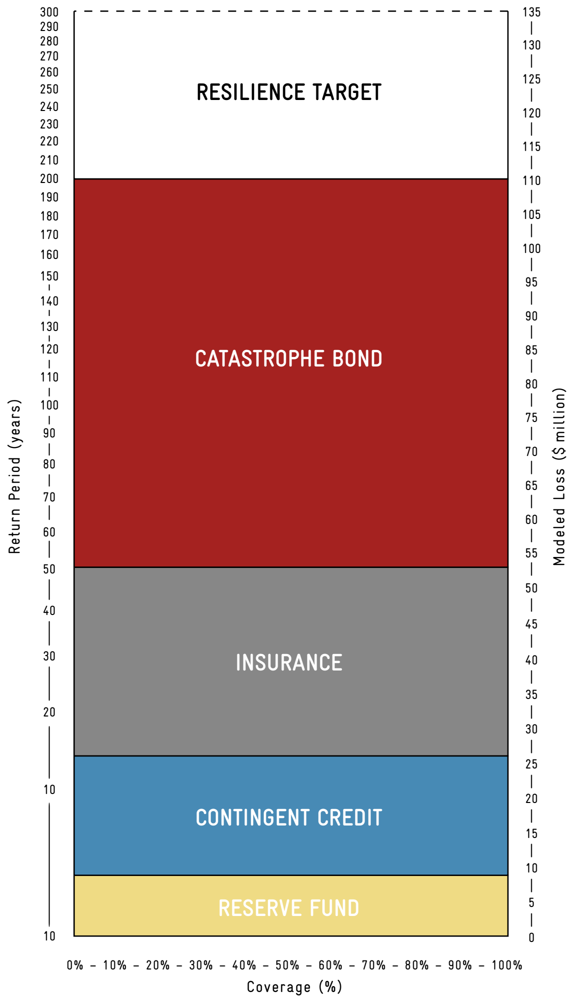
An effective risk management strategy will use risk management actions and appropriately selected DRF instruments in combination. The way in which the instruments are combined has implications for both the cost-efficiency of the DRF, and the overall effectiveness
of the DRM strategy.

As a rule of thumb, an economic and pragmatic approach is to aim to reduce risk first, then to arrange risk retention, followed by risk transfer. This is known as risk layering – Figure 16 provides an illustrative example.

In this example:

- The resilience target is set at set at the 1 in 200-year return period. This defines the level up to which the risk holder will account for risk using risk retention and transfer instruments. Losses that exceed this target will not be actively managed using ex-ante mechanisms.
- For the most frequent risks, with return periods of up to about 1 in 3 years, and estimated to causes losses of up to $9m, risk retention through reserve funds might be most appropriate
- In this strategy, for risks with return periods of between 1 in 3 years and 1 in 12 years, contingent credit can be used
- Insurance then covers losses for events with return periods between 1 in 12 years and 1 in 50 years
- Catastrophe bonds cover the residual risks up to the 1 in 200 year return period.

Figure 16. Risk layering diagram.



The most cited benefit of a risk layering strategy is reducing costs. For risk retention instruments, the most important costs are the opportunity costs associated with not being able to make use of the funds held in reserve and the costs of having to pay back contingent lines of credit. For risk transfer instruments, the key costs are of premia payments and/or of interest rates on the cat bonds. These costs are captured in technical pricing formula. Box G below explains these technical pricing formulae and practically illustrates how a risk layering approach reduces costs.

While technical pricing formula provide useful general guidance on costs, the actual costs of different instruments can vary over time – for example, for risk transfer, insurance markets alternate between phases of 'soft' and 'hard' pricing (phases marked by expansion and contraction of insurance availability, and associated deflation or inflation of insurance premium costs). There is also near-term volatility in instrument prices that might be driven with recent disaster losses, and changes in the underlying perception of risk. Any actual analysis of costs should ideally be carried with context-specific pricing formulae that account for market and pricing dynamics. This assessment should also take account of the costs of setting up the instruments (frictional or transactional costs) as well as practical considerations.

In addition to being cost effective, risk-layering also facilitates reliable access to funds. Reliability relates to the confidence the risk holder can have that they will have access to adequate levels of funds at the point of need. It may be compromised if there is significant basis risk. As is demonstrated in the analysis in Box G, high frequency events (1–10 year return period) tend to drive the majority of the expected losses, implying that reliability of funding is most important for these events. Thereby, by emphasizing the use of reserve funds for these most frequent losses, or other instruments with limited basis risk, risk layering also promotes reliability.

Box G. Optimised Risk Layering

The analysis presented below shows how the risk-based costs of DRF instruments can be quantified, compared, and ultimately used to help structure a layered risk financing strategy. This analysis compares the relative cost efficiency of instruments across a range of risk levels for an illustrative risk profile.

$$\text{Cost Efficiency} = \frac{\text{Risk Premium}}{\text{Expected Loss}}$$

The cost-efficiency ratio is equivalent to the cost multiple, i.e. the risk-based price of the DRF instrument (risk premium) is the cost multiple multiplied by the modelled risk (expected loss). For a DRF instrument, the cost multiple varies according to the underlying risk, such that one instrument may become relatively more cost effective than another for lower frequency losses. An analysis such as this can help to inform the structuring of an 'optimised' risk layering strategy.

Figure 17 illustrates the relative cost efficiency for five DRF instruments. The analysis quantifies the risk premium for each instrument, for a modelled risk profile (high-frequency low-severity to low-frequency-high severity).

The black bars represent the underlying expected loss (risk). The sum of the bars equals the total annual expected loss. Each bar represents a $1 million loss band, i.e. the bottom bar is $0-1m, the second $1-2m. etc. There is a non-linear relationship between loss and return period, which is why the return periods are broader at the lower losses.

The analysis highlights how the majority of annual expected loss is contributed by high-frequency events.

The coloured lines represent the risk-based cost estimates, or risk premium, for each DRF instrument. The risk premiums have been estimated using indicative pricing formula outlined in Table 1.

$$\text{Risk Premium} = a_j + b_j \cdot \text{Expected Loss}$$

The points where the lines intersect highlight the return periods where one instrument becomes relatively more cost-effective than the other. This can guide the development of a layered risk financing strategy. In this example, the most cost-efficient approach is outlined below:

- 1–3 year return period: Reserve Fund
- 3–12 year return period: Contingent Credit
- 12–50 year return period: Insurance
- 50+ year return period: Catastrophe Bond

The 5x and 10x benchmarks are also included for reference.

Figure 17. Comparison of DRF Cost-efficiency (SOURCE: RMS)

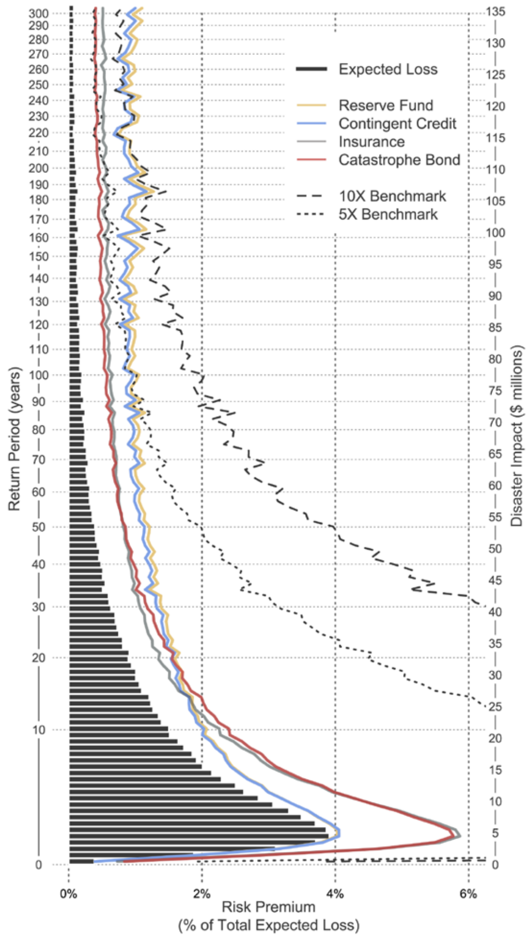


Table 1. Indicative technical pricing formulare for DRF instruments

	DRF Instrument	Overview	a_j	b_j
1	**Reserve Fund**	The pricing formulae for the Reserve Fund and Contingent Credit are replicated from 'Evaluating Sovereign Disaster Risk Finance Strategies: A Framework', D. Clarke (2017).	$\frac{(\delta-r)}{(1+i)}$	$\frac{1+r}{1+i}$
2	**Contingent Credit**		$\kappa+\lambda \cdot \frac{(i-c)}{(1+i))}$	$\frac{1+c}{1+i}$
3	**Insurance**	Prices for insurance and reinsurance policies vary significantly, and are influenced by many factors including the underlying risk, how much capital the (re)insurer needs to hold relative to the risk, desired level of return, how correlated the risk is to the rest of the portfolio. The technical pricing formula used is based on the expected loss, and a function of the standard deviation. The loads on EL and standard deviation will vary according to the specific use case.	$\max(0.5 \cdot EL, 0.15 \cdot \sigma_{EL})$	1
4	**Catastrophe Bond**	The technical pricing formula for catastrophe bonds is empirically derived from historic bond prices and modelled expected losses. Note that cat bond prices vary by peril, region, and trigger type among other factors – these factors have not been isolated in the pricing formulae.	α	β

Table 2. Pricing parameter values.

Description	Parameter	Assumed value
Annual expected loss	EL	Variable, based on simulated loss data from RMS catastrophe risk models.
Marginal interest rate on sovereign debt, assumed to be average borrowing rate on government debt portfolio	$i(=\delta)$	5.5%
Investment return on unspent reserves	r	1%
Arrangement fee for contingent credit	κ	1%
Treatment of outstanding concessionary loans	λ	1
Interest rate on contingent credit	c	2,5%
Standard deviation of losses	σ_{EL}	Variable, based on simulated loss data from RMS catastrophe risk models.
Base cost for indemnity catastrophe bond	α	2,9%
Risk load for indemnity catastrophe bond	β	1.4

6. ILLUSTRATIVE URBAN USE CASE

In order to demonstrate how this toolkit could be applied in practice, the principles outlined in the report have been applied to realistic, but fictional, use case.

The use case provides a simplified illustrative example. In reality, the process of developing a disaster risk management strategy is unlikely to be so clean.

A limitation of the framework presented in this report is that it assumes the ideal situation, in which all risk can be measured and DRF strategies can be developed to completely match the financing to the underlying need. When applying this toolkit in practice it is important to recognize that the reality of risk management is more complex, though this toolkit should help to provide guidance when assessing disaster risk management, and the disaster risk finance tools that can be used to fund it.

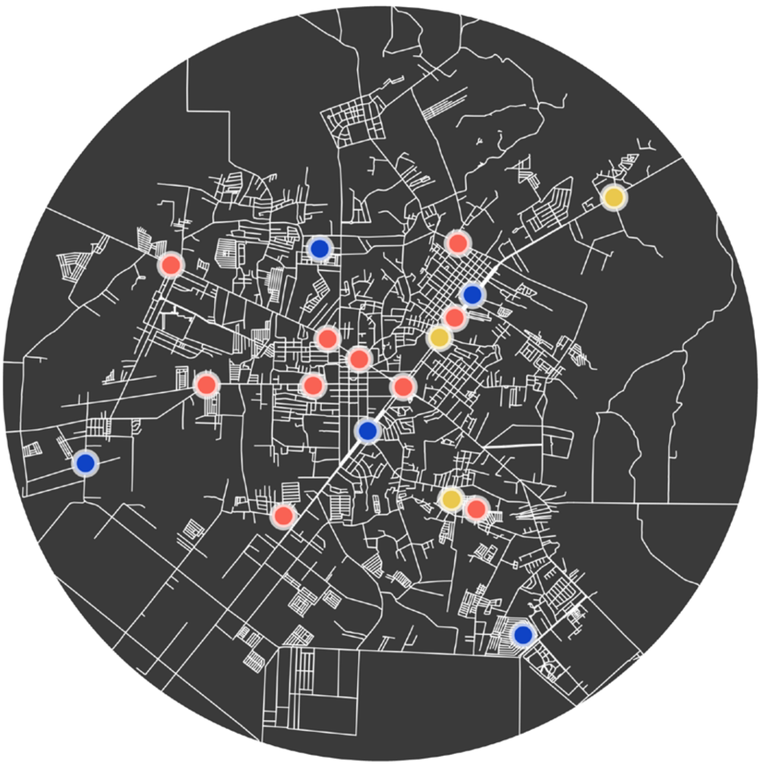
Situational Context

A city in South-east Asia is aiming to develop a disaster risk financing strategy that helps it to manage significant typhoon wind risk, and flooding from excess rainfall.

Their initial focus is on managing the risk to their municipally owned physical assets, including road, water and energy infrastructure, schools and hospitals, and public offices.

The following illustrative example shows how the authority could use the DRF toolkit in order to guide their risk management strategy design, and disaster risk finance selection.

The DRF toolkit has been designed as a guideline to inform how disaster risk financing instruments can be used to support a risk management strategy. In practice, the specific situational context will inform appropriate use of DRF, and this illustrative example does not provide the only possible solution for an urban use case.



Phase		Task	Process
1	RISK AUDIT	**Exposure definition**	The city carries out an exposure data collection exercise – the output from this is a database that contains asset-level information which describes the assets. The database contains exposure information which includes occupancy type (e.g. residential, commercial, highway), the construction method and materials (e.g. masonry, timber-frame), age (year-built), and a value estimate that is based on reconstruction value. The city also collects information on where people with different incomes levels (and other characteristics determining vulnerability) live, work and access essential services. This exposure data forms the input to catastrophe risk models. More detailed exposure information can help to create more accurate results, but may take more time and effort and can cost more to collect. Simple input data can provide good enough results to make initial risk-based decisions. The city decides to err on the side of simplicity, with the aim to enhance the exposure data later if necessary.
		Peril identification	The city had recently experienced a very damaging flood event, which had motivated the city authority to manage its risk more actively. The flood damage from the recent event was fresh in the minds of the local population, and this is the primary focus. However, stakeholder engagement also identifies that severe typhoons are a key concern to residents and businesses. Despite the fact that flood risk is a more frequent issue, the decision is made to also investigate ways to manage the typhoon risk. A multi-peril approach to risk management also allow the city to make most use of the collected exposure data, and potentially 'bundle' more risk to (potentially) be transferred to others.
		Risk quantification	The city approaches the national risk management agency, who has access to risk modeling capabilities. The national risk management agency is supported by development partners in utilizing and interpreting this data. The flooding and typhoon risk are quantified, and the city is provided with a risk analysis which uncovers some new insight into which assets and people are most at risk, as well as an overall risk profile – this provides the foundation for risk-informed decision making.
		Resilience targeting	The city finds out that the recent flood event was approximately equivalent to a 1 in 150-year return period loss. Using this experience as a benchmark, a decision is made to ensure that the risk management strategy is able to manage all disaster losses up to this level. The initial resilience target is therefore set at the 150-year return-period loss. The city therefore looks to develop a strategy of risk reduction, retention, and transfer that ensures they are able to actively manage all losses up to the resilience target.

Phase	Task	Process
2 RISK MANAGEMENT ACTIONS	**Reduction** **Retention** **Transfer**	Based on the risk audit, the city learns that the hospitals contribute the majority to the overall risk for the city. Community engagement also reveals that it is also a risk that particularly affects vulnerable people, who tend to make more use of secondary care facilities. As such, the city prioritizes investment in risk reduction actions for hospitals. It uses risk models to quantify the possible risk reduction benefits for a range of risk reduction options, and uses this to inform a cost-benefit calculation. The analysis indicates that a cost-effective solution is to raise the electrical equipment from the basement to higher floors. The proposed risk reduction activity reduces the 1 in 150-year return period loss by 20%, which leaves 80% of the resilience target loss left to be managed using risk retention and risk transfer instruments. The city now proceeds to better define its capacity and needs, so that it can decide how much risk it wishes to retain, and how much it should transfer.
3 DIMENSIONS OF INSTRUMENT DESIGN	**Risk holder**	The city raises capital through local taxes, and also receives an allocated budget for disaster risk management from the national finance ministry. They have an annual budget that is approximately equivalent to 2x the average annual modeled loss.
	Purpose	Funding is required to support the costs of retrofitting for the hospitals. The city also requires operational funds for restoring essential services immediately following any disaster, and funding for repair and reconstruction of the physical assets.
	Timing	Funds for risk reduction are required immediately. Funds for restoring essential services should be available as soon as possible following impact, if not before. Funds for reconstruction will be required over the longer term, the speed of financing is not so important, but the funding needs to closely match the loss.
	Risk level	The city is aiming to make itself resilient for all risk levels, from the frequent attritional losses, up to the 1 in 150-year return period resilience target.
4 DRF INSTRUMENT OPTIONS		Having identified the risk management actions, and further defined the needs for the funding, the city now assesses the range of DRF options that are available to it. To fund the risk reduction activities, it identifies the following instruments from the DRF taxonomy; loans, bonds and impact bonds. For risk retention, the city identifies budget contingency, and reserve funds as possible options. For risk transfer, the city identifies insurance, catastrophe bonds, and risk pools as appropriate mechanisms. With a range of possible options identified, the city now needs to select from these options.

5	RISK LAYERING	The city has identified that the risk reduction exercise should lower the costs of risk retention and transfer instruments. Selecting an instrument to fund the risk reduction activity is therefore a priority. The city determines that impact bonds would take a long time to arrange, so given the time constraints a bank loan or bond are more attractive. The cost estimate for the hospital retrofits is significant, so the city decides to issue bonds to raise capital for the project. It also commits to exploring in the medium term how impact bonds could improve the efficiency and resilience of its hospitals, building on the experience of the Humanitarian Impact Bond experience in improving health care performance. The hospital retrofit has reduced the overall 1 in 200 year return period loss by 10%. There are also additional benefits in terms of reducing the expected disruption to hospital services. The city carries out a risk layering analysis and determines that the optimal level to start taking insurance is around the 1 in 10 year return period loss. The city already has a budgetary allocation for flood impacts, which was used effectively during the recent events – it is decided to build on this with an additional reserve fund, which is allocated to pay for the costs of clearing the roads immediately following disaster. The regional transportation authority is consulted, and a rapid response plan is designed to make most effective use of the reserve fund. The total risk of the city owned assets is too small to justify the additional costs required to implement a catastrophe bond or risk pool. The city elects to purchase insurance for the remainder of the risk. The insurance premium quoted to cover all of the assets up to the 1 in 200-year resilience target exceeds the funds that the city has available. The city renegotiates for a reduced amount of cover. This completes the disaster risk financing strategy for this year, but the city has now identified where there are protection gaps within its own strategy, and identified a number of additional initiatives which may help to reduce the cost of DRF. The city begins to engage with other cities in neighboring regions to share its DRF experience, and explore options for a city-level risk pool which might help it to achieve its resilience targets in future years.

REFERENCES

1. IPCC. Summary for Policy Makers In Climate Change 2014: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. 2014.
2. INFORM Index for Risk Management [Internet]. [cited 2019 Apr 5]. Available from: http://www.inform-index.org/
3. United Nations. The Sustainable Development Goals Report [Internet]. 2018. Available from: https://unstats.un.org/sdgs/files/report/2018/TheSustainableDevelopmentGoalsReport2018-EN.pdf
4. Ranger N, Surminski S, Mitchell T, Jones L, Lovell E, Comba E. Disaster resilience and post-2015 development goals: the options for economics targets and indicators. Policy Pap Grantham Res Inst Clim Chang Environ London, UK. 2013;
5. United Nations. Sendai Framework for Disaster Risk Reduction 2015 - 2030 [Internet]. 2015. Available from: https://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf
6. UNFCCC. Warsaw International Mechanism for Loss and Damage [Internet]. 2013 [cited 2019 Apr 5]. Available from: https://unfccc.int/topics/adaptation-and-resilience/workstreams/loss-and-damage-ld/warsaw-international-mechanism-for-loss-and-damage
7. United Nations. Agenda for Humanity - Annex to the Report of the Secretary-General for the World Humanitarian Summit [Internet]. 2016. Available from: https://agendaforhumanity.org/sites/default/files/AgendaforHumanity.pdf
8. Clarke DJ, Dercon S. Dull Disasters?: How planning ahead will make a difference. Oxford University Press; 2016.
9. Molinario G. Demystifying machine learning for disaster risk management [Internet]. 2019 [cited 2019 Apr 5]. Available from: https://blogs.worldbank.org/opendata/demystifying-machine-learning-disaster-risk-management
10. Twigg J. Disaster risk reduction: mitigation and preparedness in development and emergency programming. Overseas Development Institute (ODI); 2004.
11. International Federation of Red Cross and Red Crescent Societies. Forecast-based Financing - A new era for the humanitarian system [Internet]. 2019. Available from: https://www.forecast-based-financing.org/wp-content/uploads/2019/03/DRK_Broschuere_2019_new_era.pdf
12. Lloyds's of London, Centre for Global Disaster Protection. Innovative finance for resilient infrastructure [Internet]. 2018. Available from: https://www.lloyds.com/news-and-risk-insight/risk-reports/library/understanding-risk/innovative-finance-for-resilient-infrastructure?utm_source=Lloyds_posts&utm_medium=social&utm_campaign=emergingrisks_innovative-finance-for-resilient-infrastructure
13. European Bank for Reconstruction and Development. The Tajikistan Climate Resilience Financing Facility - CLIMADAPT [Internet]. [cited 2019 Feb 22]. Available from: https://www.climadapt.tj/
14. VisionFund International. Recovery Lending in Africa [Internet]. [cited 2019 Apr 5]. Available from: http://www.visionfund.org/2430/recovery-lending-in-africa/disaster-resilient-microfinance/microfinance/
15. Stewart R, van Rooyen C, Dickson K, Majoro M, de Wet T. What is the impact of microfinance on poor people? A systematic review of evidence from sub-Saharan Africa. London; 2010.
16. Pilot Programme for Climate Resilience. Microfinance for Climate Resilience [Internet]. 2018. Available from: https://ppcrja.org.jm/download/microfinance-in-the-ppcr-jamaica-case-study/?wpdmdl=566
17. Climate Bonds Initiative. Bonds and Climate Change: The State of the Market 2018 [Internet]. 2018. Available from: https://www.climatebonds.net/resources/reports/bonds-and-climate-change-state-market-2018
18. Ernst and Young. Green Bonds: A Fresh Look at Financing Green Bonds [Internet]. 2016. Available from: https://www.ey.com/Publication/vwLUAssets/Green_bonds-a-fresh-look-at-financing-green-projects/$FILE/EY-Green bonds-a-fresh-look-at-financing-green-projects.pdf
19. Mecagni M, Kriljenko JIC, Gueye CA, Mu I, Yabara M, Weber S. Issuing international sovereign bonds: Opportunities and challenges for Sub-Saharan Africa. International Monetary Fund; 2014.
20. The World Bank. Fiji Issues First Developing Country Green Bond, Raising $50 Million for Climate Resilience [Internet]. 2017 [cited 2019 Feb 18]. Available from: https://www.worldbank.org/en/news/press-release/2017/10/17/fiji-issues-first-developing-country-green-bond-raising-50-million-for-climate-resilience
21. City of Cape Town. Green pays: City's R1 billion bond a resounding success in the market [Internet]. 2017 [cited 2019 Apr 5]. Available from: http://www.capetown.gov.za/media-and-news/Green pays City

22. Moody's Investors Service. Green bond market poised to hit $200 billion in 2019 [Internet]. 2019 [cited 2019 Feb 18]. Available from: https://www.moodys.com/research/Moodys-Green-bond-market-poised-to-hit-200-billion-in--PBC_1159526?WT.mc_id=AM~RmluYW56ZW4ubmV0X1JTQl9SYXRpbmdzX05ld3NfTm9fVHJhbnNsYXRpb25z~20190131_PBC_1159526

23. Infrastructure Canada. Disaster Mitigation and Adaptation Fund [Internet]. 2018 [cited 2019 Feb 18]. Available from: https://www.infrastructure.gc.ca/dmaf-faac/index-eng.html

24. Adaptation Fund. Flood Resilience in Ulaanbaatar Ger Areas – Climate Change Adaptation through community-driven small-scale protective and basic-services interventions [Internet]. 2018 [cited 2019 Apr 5]. Available from: https://www.adaptation-fund.org/project/flood-resilience-ulaanbaatar-ger-areas-fruga-climate-change-adaptation-community-driven-small-scale-protective-basic-services-interventions-2/

25. Green Climate Fund. Scaling-up Multi-Hazard Early Warning System and the Use of Climate Information in Georgia [Internet]. 2018 [cited 2019 Feb 18]. Available from: https://www.greenclimate.fund/projects/fp068?inheritRedirect=true&redirect=%2Fwhat-we-do%2Fprojects-programmes%3Fp_p_id%3D122_INSTANCE_VKj2s9qVF7MH%26p_p_lifecycle%3D0%26p_p_state%3Dnormal%26p_p_mode%3Dview%26p_p_col_id%3D_118_INSTANCE_4ZRnUzRWpEqO__column-2%26p_p_col_count%3D2%26p_r_p_564233524_resetCur%3Dtrue%26p_r_p_564233524_categoryId%3D846529

26. United States Environmental Protection Agency. Mitigation Banking Factsheet [Internet]. [cited 2019 Feb 18]. Available from: https://www.epa.gov/cwa-404/mitigation-banking-factsheet

27. African Development Bank Group. Adaptation Benefit Mechanism (ABM) [Internet]. 2018 [cited 2019 Feb 18]. Available from: https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/adaptation-benefit-mechanism-abm/

28. Oroxom R, Glassman A, McDonald L. Structuring and Funding Development Impact Bonds for Health: Nine Lessons from Cameroon and Beyond. 2018; Available from: https://www.cgdev.org/sites/default/files/structuring-funding-development-impact-bonds-for-health-nine-lessons.pdf

29. Gustafsson-Wright E, Gardiner S, Putcha V. The potential and limitations of impact bonds: Lessons from the first five years of experience worldwide [Internet]. 2015. Available from: https://www.brookings.edu/wp-content/uploads/2016/07/Impact-Bondsweb.pdf

30. International Committee of The Red Cross. The world's first "Humanitarian Impact Bond" launched to transform financing of aid in conflict-hit countries [Internet]. 2017 [cited 2019 Feb 18]. Available from: https://www.icrc.org/en/document/worlds-first-humanitarian-impact-bond-launched-transform-financing-aid-conflict-hit

31. International Federation of Red Cross and Red Crescent Societies. Forecast-based Financing [Internet]. [cited 2019 Mar 19]. Available from: https://www.forecast-based-financing.org/

32. Start Network. Start Fund Crisis Anticipation Window Annual Report 2017 [Internet]. 2017. Available from: https://startnetwork.org/resource/start-fund-crisis-anticipation-window-annual-report-2017

33. The World Bank. World Bank Launches First-Ever Pandemic Bonds to Support $500 Million Pandemic Emergency Financing Facility [Internet]. 2017 [cited 2019 Mar 19]. Available from: https://www.worldbank.org/en/news/press-release/2017/06/28/world-bank-launches-first-ever-pandemic-bonds-to-support-500-million-pandemic-emergency-financing-facility

34. Ghesquiere F, Mahul O. Financial protection of the state against natural disasters: a primer. World Bank Policy Res Work Pap. 2010;(5429).

35. Wang X, Mahul O, Stutley C. Weathering the storm: options for disaster risk financing in Vietnam. World Bank, Washingt DC. 2010;

36. Asian Development Bank. Philippine City Disaster Insurance Pool: Rationale and Design [Internet]. 2018. Available from: https://www.adb.org/sites/default/files/publication/479966/philippine-city-disaster-insurance-pool-rationale-design.pdf

37. Food and Aggriculture Organization of the United Nations. Community Contingency Funds: Savings as a means of resilience [Internet]. Available from: http://www.fao.org/3/a-i5623e.pdf

38. Schijman A, Haarsager U, Hernández MJ, Khadr A, Jansson M. Corporate Evaluation: Contingent Lending Instruments. Inter-American Development Bank; 2016.

39. The World Bank. IDA Catastrophe Deferred Drawdown (Cat DDO) [Internet]. 2018. Available from: http://pubdocs.worldbank.org/en/563361507314948638/product-note-cat-ddo-ida-english-2018.pdf

40. The World Bank. IBRD Catastrophe Deferred Drawdown Option (Cat DDO) [Internet]. 2018. Available from: http://pubdocs.worldbank.org/en/526461507314946994/product-note-cat-ddo-ibrd-2018.pdf

41. The World Bank. Disasters, funds, and policy: Creatively meeting urgent needs and long-term policy goals [Internet]. 2017 [cited 2019 Feb 18]. Available from: https://reliefweb.int/report/world/disasters-funds-and-policy-creatively-meeting-urgent-needs-and-long-term-policy-goals

42. Crawford D, Kroessin M, Loeffler K. Mitigating climate change with Takaful insurance [Internet]. 2018. Available from: https://www.gbgfund.org/mitigating-climate-change-takaful-insurance/

43. ClimateWise. ClimateWise Compendium of disaster risk transfer initiatives in the developing world [Internet]. 2011. Available from: https://www.cisl.cam.ac.uk/business-action/sustainable-finance/climatewise/pdfs/overview-of-compendium.pdf/view

44. Jensen ND, Barrett CB, Mude AG. Cash Transfers and Index Insurance: A Comparative Analysis from Northern Kenya. J Dev Econ. 2015;129:14–28.

45. Mahul O, Stutley CJ. Government support to agricultural insurance: challenges and options for developing countries. The World Bank; 2010.

46. World Food Programme. The R4 Rural Resilience Initiative [Internet]. [cited 2019 Mar 29]. Available from: https://www1.wfp.org/r4-rural-resilience-initiative

47. Gönülal SO. Takaful and mutual insurance: alternative approaches to managing risks [Internet]. Washington, DC: The World Bank; 2012. Available from: https://openknowledge.worldbank.org/handle/10986/13087

48. icmif. Access to mutual and cooperative insurance infographic [Internet]. [cited 2019 Mar 29]. Available from: https://www.icmif.org/publications/strategic-research/access-mutual-and-cooperative-insurance-infographic

49. Takaful Insurance of Africa. Index Based Livestock Takaful (IBLT) [Internet]. [cited 2019 Mar 29]. Available from: https://takafulafrica.co.ke/takaful-insurance-products/iblt/

50. Business Daily. Insurer to compensate livestock farmers [Internet]. 2014 [cited 2019 Apr 5]. Available from: https://www.businessdailyafrica.com/Insurer-to-compensate-livestock-farmers/-/539552/2256242/-/gw6ico/-/index.html

51. King P, Rami S. Insurance regulation in Africa: CIMA – the benefits and challenges [Internet]. 2018 [cited 2019 Apr 5]. Available from: https://www.commercialriskonline.com/insurance-regulation-in-africa-cima-the-benefits-and-challenges/

52. OCDE (Organización para la Cooperación y el Desarrollo Económicos). OECD Reviews of Risk Management Policies: Mexico 2013: Review of the Mexican National Civil Protection System. OCDE París; 2013.

53. Risk Management Solutions. Mapping the Role of Insurance in Managing Disaster Losses: A Study of Low and Low-Middle Income Countries [Internet]. 2017. Available from: https://www.preventionweb.net/files/54328_mappingtheroleofinsuranceinmanaging.pdf

54. Re:Focus Partners. A Guide for Public-Sector Resilience Bond Sponsorship [Internet]. 2017. Available from: http://www.refocuspartners.com/wp-content/uploads/pdf/RE.bound-Program-Report-September-2017.pdf

55. Artemis. Artemis Catastrophe Bond & Insurance-Linked Securities Deal Directory [Internet]. [cited 2019 Feb 18]. Available from: http://www.artemis.bm/deal-directory/

56. CCRIF SPC: The Caribbean Catastrophe Risk Insurance Facility [Internet]. [cited 2019 Feb 18]. Available from: https://www.ccrif.org/

57. Government Outcomes Lab. An introduction to development impact bonds (DIBs) [Internet]. [cited 2019 Apr 5]. Available from: https://golab.bsg.ox.ac.uk/knowledge/basics/introduction-development-impact-bonds/

58. Evans S. Cat bond attraction as investment & risk transfer to persist, perhaps intensify [Internet]. 2019 [cited 2019 Apr 5]. Available from: http://www.artemis.bm/news/cat-bond-attraction-as-investment-risk-transfer-to-persist-perhaps-intensify/

59. African Risk Capacity. African Risk Capacity – Response to ActionAid's Flawed Claims [Internet]. 2017 [cited 2019 Apr 5]. Available from: http://www.africanriskcapacity.org/2017/07/10/african-risk-capacity-response-to-actionaids-flawed-claims/

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