CLIMATE AND DISASTER RISK FINANCE: A MOSAIC OF INSTRUMENTS

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Introduction

INTRODUCTION

Climate and Disaster Risk Finance and Insurance (CDRFI) is a long-term agenda requiring political will, technical expertise and collaboration between the public and private sector.

CDRFI aims to curtail the cost of climate-change mitigation and adaptation and of managing disaster events. Reaching way beyond just raising funds in a timely manner to meet post-disaster funding needs, CDRFI is geared towards minimising the overall impact of climate change and natural hazards through financing risk reduction and readiness strategies. Therefore, CDRFI is an elemental part of climate- and disaster-risk management that promotes comprehensive protection measures across five phases: risk reduction, risk retention and transfer, preparedness, emergency response and recovery. The effectiveness of CDRFI is maximised when it is fully aligned with the climate- and disaster-risk management activities that it finances, also with respect to their implementation timeline and the availability of funds at a specific time of need. This explains why it is essential to consider climate- and disaster-risk management and finance holistically and in an integrated manner.

This perspective also extends to the CDRFI strategy itself: it is multi-dimensional (in terms of type of financing, time of availability, investors, beneficiary group, etc.) ***and based on an amalgamation process*** – combining and weaving together a range of financing instruments, insurance structures and financial-management solutions – that is tailor-made and adapted to the specific circumstances and needs of a country, for example. In addition, risk-layering techniques are applied to separate specific risk tiers or components according to their risk profile and increase the efficiency and impact of risk-finance solutions. This is the reason why we chose to call this compendium a 'mosaic of instruments' and its 2019 predecessor a 'toolkit'. Any country-specific CDRFI strategy, for instance, will most likely consist of a range of financial instruments across public finance, insurance and capital markets.

Governments are in the driving seat when it comes to creating a conducive framework for CDRFI and, indeed, the finance and investment sector as a whole. Governments develop public-finance regulations and task public authorities with implementing financing activities. They set the rules for financing and investment activities of the private sector and pension funds. They define legal and regulatory standards, yet are also called upon to set the stage to attract national and international investors to climate- and disaster-risk finance opportunities.

Governments' policy-setting role extends to the international stage, where they come together in distinct global forums, alongside international organisations such as UN bodies or development-finance institutions like the World Bank. There they co-ordinate policies and guidelines and set targets, such as for greenhouse-gas emission reductions. The private sector and civil society play a subordinate role in these forums, if they are involved at all rather than just represented. They only become part of the process when internationally agreed targets are cast into national law and efforts. As it is first and foremost a political process, this translation exercise of breaking international goals down to national targets is challenging for all countries; yet it is specifically so for developing countries, since they often lack the technical expertise to reflect such commitments in public finance management, to arrange for or attract the requisite funding and/or to make mitigation or adaptation projects investment-ready.

The international debate on climate change centres on the United Nations Framework Convention on Climate Change (UNFCC) and the Paris Agreement of 2015 covering climate-change mitigation, adaptation and finance. The agreement established the Global Stocktake, which in 2023 for the first time started to evaluate progress made, not only in mitigation and adaptation, but also in climate finance and technology.

According to the Climate Policy Initiative (CPI), global climate finance excluding risk transfer/insurance almost doubled between 2019/2020 and 2021/2022. However, this was predominantly due to renewable/clean-energy mitigation finance from private investments in advanced markets. Explicit adaptation-finance flows only made up about 5% of total climate finance in 2021–2022 (private investment in adaptation being difficult to assess), and climate finance to least developed countries was just short of 3%. The CPI in collaboration with the Global Center on Adaptation estimate that during this period developing countries only had access to about a fourth of the public funds needed on the adaptation side. Private-sector investments need to generate a return, and this is more challenging for adaptation than for mitigation activities. The OECD estimates that up to

86% of private climate investments during the period 2016-2020 targeted mitigation projects, while only 9% financed adaptation (with some 6% cross-cutting).

Based on its analysis of the format of public funds going to developing countries over the period from 2016 to 2020, the OECD reported that around 82% of mitigation funds and a steadily growing 62% of adaptation funds were provided in the form of loans, with approx. 14% and 37% respectively as grants. While public guarantees were excluded from these numbers, public equity investments were negligeable in mitigation finance and non-existent in adaptation finance. Funds flowed through multi- and bilateral channels inside and outside the UNFCC and Paris Agreement mechanism. External financing continues to be dominated by international development-finance institutions and supported by regional risk-transfer pooling structures, such as the Caribbean Catastrophe Risk Insurance Facility, the African Risk Capacity and others.

A new disaster-risk finance mechanism, initiated in 2022 and so far predominantly funded by Germany and a G7/V20 partnership with V20 countries in the driving, the *Global Shield against Climate Risks* (Global Shield) aims to close protection gaps in countries heavily exposed to climate and disaster risks, based on systematic evidence-based risk assessments, technical assistance and grant funding for country-led programmes. Beneficiaries may include not only governments, but also local communities and businesses as well as humanitarian agencies. With a propensity for risk-transfer and contingency instruments, the Global Shield intends to promote pre-arranged funding and rapid-response schemes providing ad-hoc support where it is most needed when adverse events occur. As such, it represents an exemplary adaptation-oriented model of CDRFI.

Also structurally independent, yet conceptionally aligned with the UNFCC, are efforts in climate finance to compensate developing countries for damage associated with climate change and climate-change-induced disasters that cannot be averted anymore by mitigation and adaptation efforts. ***This Loss and Damage debate has resulted in an agreement*** by developed countries to support capacity building and the transfer of know-how and, at COP28 in 2023, to establish a dedicated fund with initial financial pledges from a number of countries and the EU. Although full operationalisation and sustainable funding have yet to be worked out, the first beneficiaries in Malawi, displaced after a cyclone, have received cash payments based on the Scottish pledge matched with the help of a private funding platform.

Countries most vulnerable to climate change, such as small island countries, consider financial assistance for climate-related ***damage and losses a matter of holding developed countries accountable***. Developing countries heavily exposed to climate change tend to have limited financial and technical resources and poor capacities for adaptation, yet need to grapple with costly and devastating disasters, which are moreover increasing both in severity and frequency. However, these countries have historically contributed comparatively little to the cause of these disasters, such as by emitting greenhouse gas.

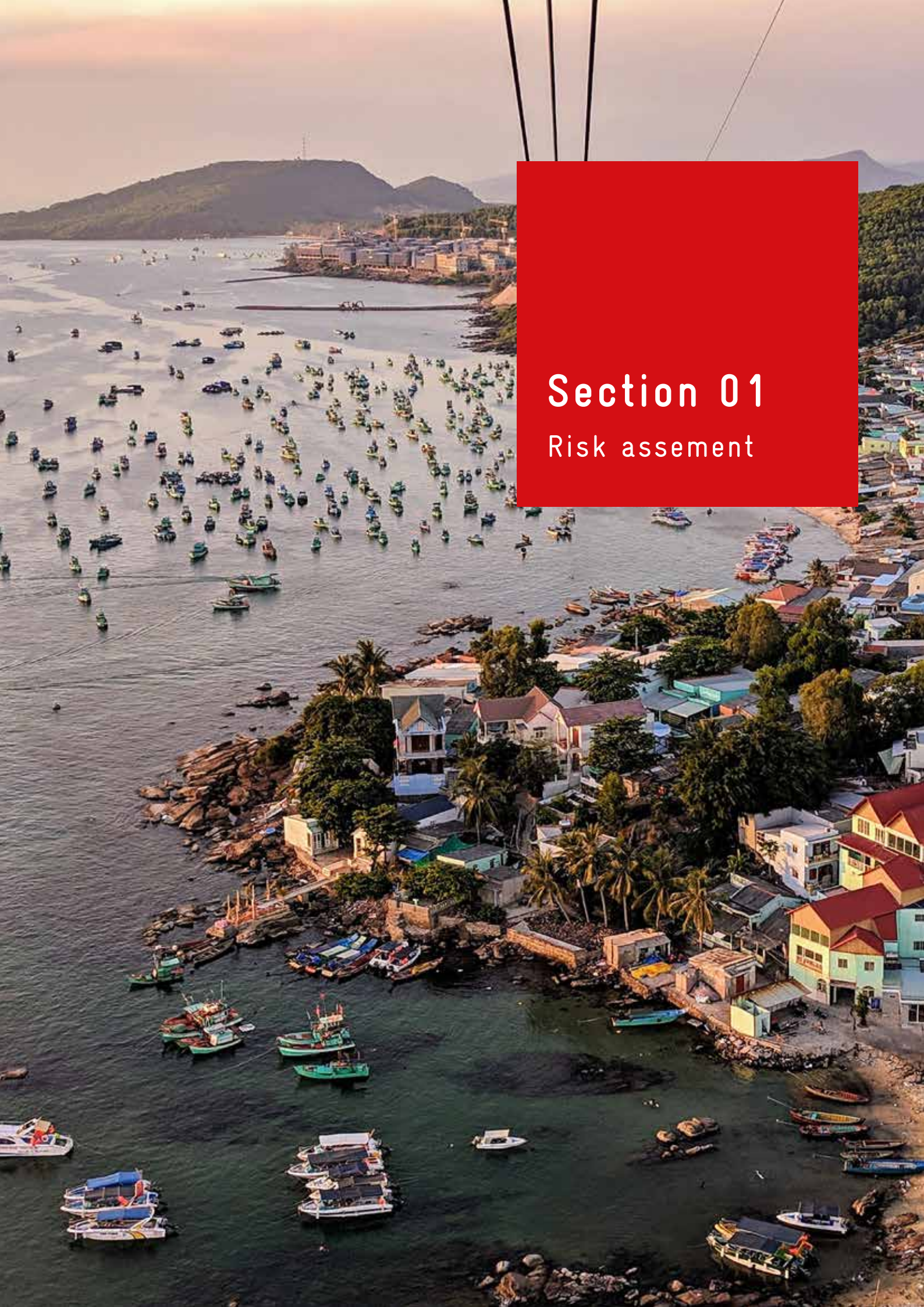
While such agreements and mechanisms each have a different starting point and impetus, they have one concept in common: ***they follow the polluter-pays principle***, a widely accepted practice in the environmental sector that those who cause pollution should bear the costs both of managing it and of dealing with its consequences. The principle is key to achieving progress in mitigating the effects of climate change on a global scale in a fair and effective way. It was one of the guiding principles of sustainable development in the United Nations Declaration on Environment and Development (Rio Declaration) back in 1992.

The Paris Agreement has framed fairness as an imperative: ***the transition to a low-carbon economy and net zero is to be 'just' and equitable*** by equally tackling social issues, promoting decent work and addressing economic risks (Just Transition). As both climate action and climate finance have social and economic dimensions, they need to be factored in when pursuing the Paris Agreement's climate goal. Trying to achieve net zero at the expense of socio-economic aspects would be myopic and run the risk of potentially increasing exclusion and social inequality as well as hampering economic development and prosperity.

There is a growing consensus that the impact of ***climate change is not gender neutral*** and is harshest on the most vulnerable. Women are disproportionately affected as they generally have less or no control over financial assets and access to finance is therefore challenging for them. For many women, economic dependency, after marriage for example, often translates into poverty and increased vulnerability. When climate or disaster risks materialise, women in developing countries thus tend

to be first in line in bearing the consequences. Gender equality and women empowerment are vital in the endeavour of achieving increased climate resilience and regarding the associated effectiveness of climate finance.

This publication focuses on financial instruments and financial-management approaches used in CDRFI across the public and private sector. It assigns them to the five phases of CDRFI, while acknowledging that such attributions are not always clear-cut. The same applies to the instruments and approaches, the distinctions between which are not explored in detail for the sake of simplicity and their applicability in CDRFI. The latter phases – preparedness and emergency response – are less focused on raising finance and also incorporate funding channels (money out). With a few exceptions, we do not cover financial instruments specifically used in mitigation finance, the reason being that, so far, this field is dominated by well-established instruments in energy finance, albeit applied to renewables, and an active international private-sector investor base with a proven track record in this space. Mitigation operates within a triangle consisting of this investor universe (albeit with a focus on developed and emerging markets), research and development (in the form of climate modelling and the analysis of interdependencies between climate parameters) and emission-reduction targets (set by governments on the international level and implemented nationally). Based on a similar justification, we do not include within the scope of this publication instruments for the recovery/reconstruction phase, as these largely serve to rebuild conventional infrastructure, albeit based on the 'building-back-better' principle, using common debt and equity instruments either directly or through fund structures. Where we do see major gaps, however, is in financing adaptation and disaster risk. Consequently, this publication aims to map out suitable instruments and approaches with the ultimate aspiration to unlock more financing from a wider range of sources.



Section 01

Risk assement

RISK ASSESSMENT

UNDRR[1] defines risk assessment as 'a qualitative or quantitative approach to determine the nature and extent of […] risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods and the environment on which they depend.'

Process

A thorough understanding of underlying risks is fundamental to effectively managing climate-related risk. Over the past years, the focus has been shifting from coping with disasters to managing the risk of climate-induced events in advance. The aim of risk management is to increase the resilience of vulnerable population groups by enabling them to take precautionary measures to prevent extreme events from becoming disasters. To gain a deep and comprehensive understanding of climate-related risk, various multi-disciplinary methodologies have been developed and are now being used.

Notwithstanding the adopted methodology, risk information, derived from analysing risk-related data and any interdependence between them using a variety of innovative tools, has become the central component of successful climate- and disaster-risk management, finance and investment decisions. Data collection and modelling should thus aim to provide fit-for-purpose information – at the appropriate level of granularity and quality – to facilitate decision-making.

The risk-assessment process that provides the basis for effective risk-informed decisions[2] can be divided into four phases:

(i) Define the risk exposure (of vulnerable areas) to determine the main risk drivers
(ii) Identify extreme weather-related or geological hazards associated with this risk profile
(iii) Model and quantify the expected frequency and severity of impact from those hazards, ideally using a probabilistic risk analysis
(iv) Set a resilience target[3] to understand the extent, to which risks will explicitly be managed

Risk assessment process

Exposure definition	Define risk exposure in terms of its key characteristics: · Location · Vulnerability · Value Value can be quantified in various 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, salinisation) · **Systemic events:** events that occur as a result of multiple factors (e.g. landslides, conflict, migration)

1 United Nations Office for Disaster Risk Reduction; https://www.undrr.org/terminology/disaster-risk-assessment

2 In the development context, a risk-based decision process aims to ensure that governments or communities at risk reduce risks and build resilience by systematically assessing '…threats, risk perceptions, tolerances, opportunities, options and uncertainties…', thereby making development more sustainable (Risk-informed Development (RID); https://media.odi.org/documents/12711.pdf)

3 Defined as the threshold, at which a country or society is in a position to withstand adversity or absorb a shock and bounce back

	**Vulnerability and risk analysis**	Conduct a comprehensive vulnerability and risk analysis to develop a tailor-made risk-management strategy. For a given set of exposure and hazard types, risk models allow a quantified understanding of the probability and severity of factors such as disaster impact, to guide decision-making.
	**Resilience targeting**	Set a resilience target as the threshold between actively managed risk and unmanaged 'residual' risk. Some events are so infrequent yet severe that it would be prohibitively expensive to endeavour to manage the entirety of their impact in advance. As the resilience target involves a residual risk ultimately being retained by the risk holder, the objective of a risk-management strategy is to reduce such risk to a 'tolerable' level. The resilience target varies between risk holders and depends on risk capacity, individual risk-management strategy, cost-benefit ratio and affordability considerations.

Data collection and modelling exercises, usually involving analysis at different temporal[4] and spatial[5] scales, should be multi-hazard, are ideally open-source and comprise compound, cascading and/or systemic risks *(> see section 8, Compounding & Layering, pp. 61)* including a climate-change layer. First and foremost, however, they should aim to provide practical 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 consequently limited catastrophe-risk modelling coverage. Even in these cases, simple assumptions and the utilisation of lessons learned from similar regions can support risk management in informing risk reduction, risk transfer and adaptation policies and actions.

Ultimately, risk management is an iterative process: the difference between no risk information and simplified risk information generated by using basic assumptions, may be significant. A first step in an order-of-magnitude-level risk analysis might include simple assumptions comprising local estimates of population size, 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-modelling exercises. As experience increases, such new risk-assessment iterations will lead to better results and thus, to more effective measures.

For a long time, risk modelling has relied on extracting insights from large amounts of historical data.[6] However, climate-change-induced effects increasingly manifest themselves in events (and consequently data), thereby rendering purely statistical time-series analytics less effective, which constitutes a challenge for risk managers. At the same time, Artificial-Intelligence techniques based on machine learning and big-data analytics make it possible to draw on large quantities of (diverse yet granular) data points[7] as well as time- and cost-efficient processing methods.

Methods

A broad range of risk-assessment methods have been developed to screen, analyse and measure risk, and they generally follow or build on the risk-assessment process outlined above. Each approach or tool emphasises different features, some are more holistic or more focused in their nature, more complex or more simplistic, and they are categorised as qualitative, semi-quantitative (risk matrix, scorecard or based on indicators) and quantitative (deterministic or probabilistic).

Some of these methods directly support decision-making by delivering actionable recommendations as output of the assessment process, while others rank possible activities based on cost-benefit analyses, and again others

4 Historical data, current patterns, projections
5 Country-wide down to individual administrative units
6 Sourced from statistical time-series analytics
7 For example, as a result of exponentially increasing volumes of sensor data

simply serve as guidelines or help to frame informed discussions among stakeholders.

It is therefore up to the risk manager to select the most suitable method depending on the exact purpose and context, in which a risk-assessment tool is used. As a guiding principle, the following three dimensions must be considered when selecting an analysis methodology:

(i) Characteristics and quality of the method
(ii) Operational requirements (time, cost, technical requirements such as data, expertise)
(iii) Significance and complexity of the risk

As risk data is available in varying quantity and quality, different assessment methods may be combined to provide a more holistic picture, although it can be difficult to ensure the comparability of risks and simulated impacts derived from different analyses. Regardless of this, it is essential that each assessment's outcome can be integrated into a common format for comparing the relevance of the risks, evaluating appropriate actions and communicating results.

Irrespective of the methods used, it is important to understand that risk assessments are of fundamental importance in developing a suitable risk-management and subsequently a risk-financing strategy.

Example of how risk assessment can be applied in practice:

Example of risk assessment in practice

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 that stems from a range of hazards, enabling greater insight into the drivers of risk.

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

Exposure definition **What is at risk?**	**The analysis covers commercial-type properties in a South-East 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 that 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	**Featured tool: CLIMADA**[8] Open-source, probabilistic natural-catastrophe damage model for conducting risk assessments. As a special feature, it also calculates damage averted thanks to adaptation measures. CLIMADA is based on four elements: **1.** People and assets (people, housing, public infrastructure and ecosystems, among others, which can be clustered by sectors)

8 CLIMADA allows the estimation of expected economic damage as a measure of risk today, the incremental increase from economic growth and the further incremental increase due to climate change. The Economics of Climate Adaptation (ECA) methodology provides decision-makers with a fact base to understand the impact of weather and climate on their economies, including cost-benefit perspectives on specific risk-reduction measures.

Hazard identification **What can cause impact?**	The analysis focuses on two weather-related perils (tropical cyclone and inland flood) and one seismic peril (earthquake). The secondary hazards associated with these perils include: · Tropical cyclone: wind, coastal flooding from storm surge, inland flooding · Inland flood: pluvial and fluvial flooding from excess rainfall · Earthquake: ground shaking	**2.** Hazards (multi-hazard), both today and under future projections (projections and simulations of hazards, incorporating historical damage and losses and remote-sensing data to produce hazard maps)
Risk quantification **What is the frequency and severity of impact?**	Catastrophe-risk models can quantify the risk of direct damage and loss to assets. Direct physical damage is only one component of a disaster impact, considering that loss of lives and livelihoods and downstream impacts are also of crucial importance. However, physical damage is 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.	**3.** Damage functions (focus: economic consequences, but also other metrics such as people affected) **4.** Value-add: Damage-aversion potential and cost-benefit ratio of adaptation measures (such as improved building codes, sea-wall, sandbags, reefs, mangroves)
Resilience targeting **What is the risk tolerance level?**	Resilience targeting sets the threshold between the risk, which will be actively managed using a disaster-risk management strategy, and the level of 'residual risk' 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 the 200-year return period impact.	* Note: a depository of open-source risk models can be found on the Oasis catastrophe-modelling platform (Oasis Loss Modelling Framework, https://oasislmf.org/), which is predominantly supported by the (re-) insurance industry for the benefit of any public or private risk managers. Models are packaged in a standard format. It also offers a toolkit for developing, testing and deploying new catastrophe-risk models.

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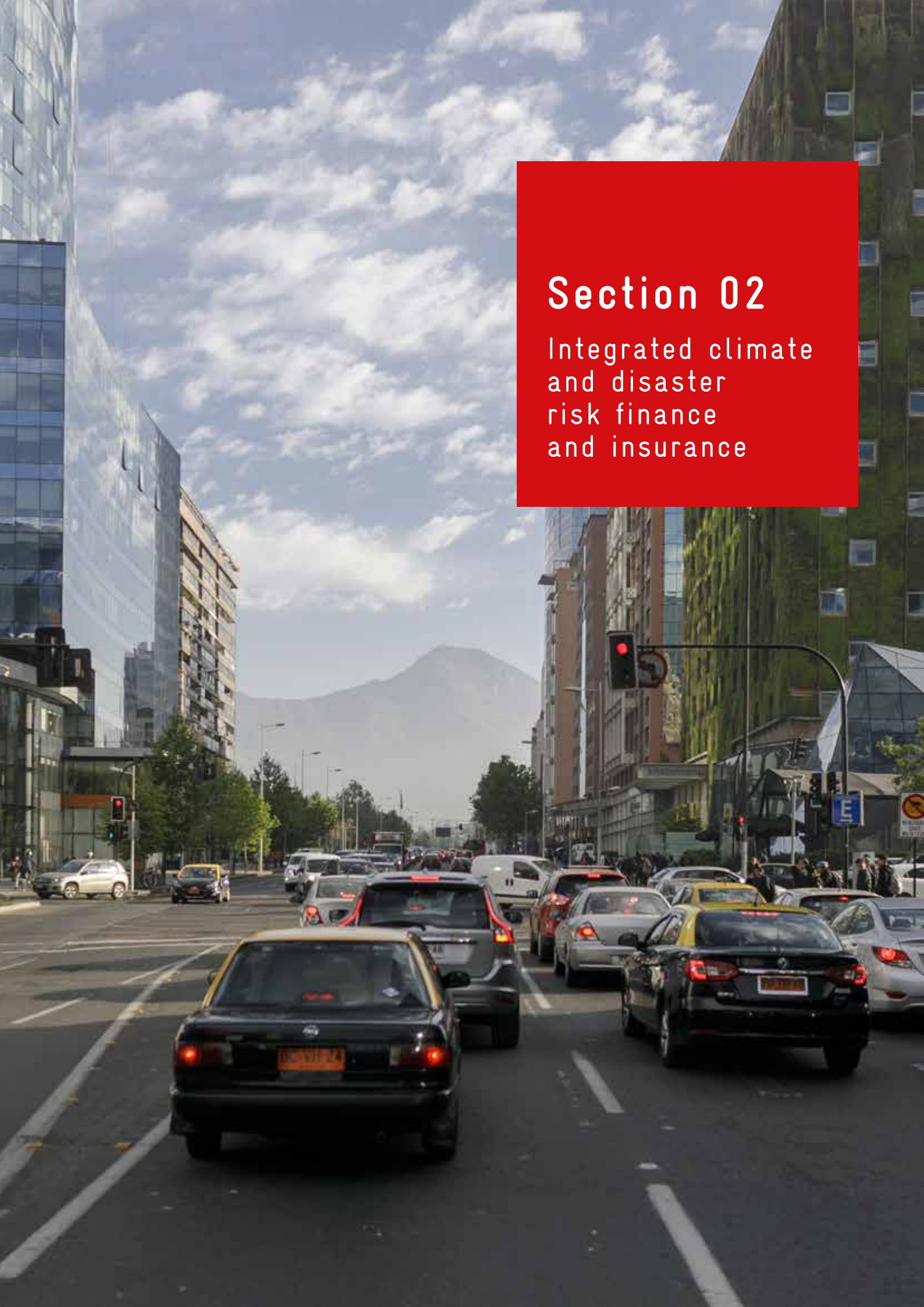


Section 02

Integrated climate and disaster risk finance and insurance

2. INTEGRATED CLIMATE AND DISASTER RISK FINANCE AND INSURANCE

Once climate and disaster risks are better understood, measured and a resilience threshold determined, it will be possible to assess how these risks can be managed most effectively. Although there is some overlap, it may be helpful to split the risk-management strategy into three phases: (1) risk reduction, (2) risk retention and (3) risk transfer.

	**RISK REDUCTION**	Any ex-ante action that reduces the likelihood of disasters striking or the severity of disaster impact or climate-change effects. Risk-reduction activities include physical interventions such as building flood defences and retrofitting property, but also ecosystem-based adaptation such as planting mangroves or restoring wetlands. Besides grey and green infrastructure it includes planning activities such as risk-based zoning and building codes for new developments. Another aspect of critical importance is disaster preparedness, a set of tools and measures (built into plans and standard operating procedures) undertaken by governments, organisations and communities, to be able to prepare for, respond to or cope with the immediate effects of a disaster event, thereby not necessarily reducing risk, but mitigating disaster impact. Examples are the stockpiling and subsequent distribution of supplies, early-warning systems, evacuation plans, search and rescue operations, etc.
	**RISK RETENTION**	Retaining responsibility for certain risks or risk components and for the consequences associated with their occurrence. Risk retention should be based on a conscious decision and not be 'by default'. Risk holders, such as governments, retain risk based on a planned assumption of responsibility and selection of risk components. When the effects of climate change materialise or a disaster event occurs, they subsequently deal with the consequences by paying for the associated losses. The financial capacity of the risk holders must be taken into account and a combination of funding sources created so that they are available when they are needed. Such arrangements have longer-term implications, possibly extending many years after the occurrence of an event. Commonly, it is governments that act as risk holders in the last resort. Sovereign risk financing is provided through national budgets, typically in the form of earmarked funds or reserves. Governments' capacity to pre-arrange or mobilise emergency financing is restricted by the need to protect the fiscal sustainability of their countries.
	**RISK TRANSFER**	Transferring risks from one party to another or sharing the consequences with other parties through a mutual mechanism. When risks or risk components exceed the anticipated coping capacity of risk holders, consequences of such risks may be shared with like-minded parties also carrying risks. For risk reduction purposes, this may be through diversification (e.g. risk pooling) or they may be transferred to specialised risk carriers (e.g. from the insurance market) that excel at managing such risks and exposures, again with the help of diversification in their portfolios. Risk-transfer mechanisms are often based on co-operation between the public and private sector, use pooling or a sovereign scheme for catastrophic levels and are mandatory for individual policyholders to avoid adverse-selection problems. Risk-based premiums in turn create incentives for risk reduction measures.

When seeking an optimal balance between risk reduction, risk retention and risk transfer, there is no one-size-fits-all approach. Risk-retention mechanisms tend to be preferred for higher-frequency and lower-severity hazards, while the reverse often applies to risk-transfer solutions, which may be used for extreme events with catastrophic effects given their need for specialist expertise and, as a result, their cost. Risk-reduction approaches, in turn, became part of the risk-management equation when it was realised that they may ultimately excel in terms of their cost-benefit ratio, especially as the effects of climate change seem to lead to higher-frequency and higher-severity hazards. Cost-benefit considerations also play an important role in determining when and for which purpose funding is required, in order to achieve the greatest positive impact on the ground.

The three risk-management phases – risk reduction, retention and transfer – are also standard components in the Integrated Climate and Disaster Risk Management (ICDRM) Cycle[9], which additionally includes financing considerations. Effectively, there are countless variations, yet their core components consist of risk reduction/prevention and preparedness in the pre-disaster phase and response and recovery or rehabilitation and reconstruction in the post-disaster phase.

GIZ and MCII have developed a comprehensive version of a climate- and disaster-risk management cycle, which shows five phases, blends management and financing actions and merges the financing-related risk retention and transfer phases.

Integrated Climate Risk Management (ICRM) Approach.

9 In effect – given its iterative nature – the process depicted as a cycle is better described as a helix.

Integrated risk management is thus a process dedicated to addressing and managing risks in a holistic manner. It starts with identifying and measuring risks, moves on to assessing and evaluating them and subsequently proceeds to taking appropriate measures to reduce risks. It makes arrangements for financing risk pre-emptively, takes emergency measures just before and during a disaster (response), shifts to relief actions, addresses post-disaster financing needs and eventually progresses to the rehabilitation of services and reconstruction. Building-back-better[10] reduces future vulnerabilities and hence, in turn, can be considered as the first step of risk reduction again. This systematic approach ensures that actions in the various phases are complementary and mutually reinforcing.

From a financial perspective, even countries with solid disaster risk-management policies and processes may remain highly vulnerable to the fiscal, economic and financial shocks that climate change and disasters might cause. The international discourse on Climate and Disaster Risk Finance and Insurance (CDRFI) revolves around instruments, strategies, policies and the ecosystem for financing the various components of the risk-management cycle.

CDRFI instruments are designed to support the various funding needs associated with climate- and disaster-risk management. Designing financial protection strategies and instruments for climate-related disasters increasingly aims at securing funding well before disaster events occur so that funds can be deployed for risk-reduction purposes, to prepare in anticipation of an event and, hence, mitigate its impact, instead of merely responding during an event and in its aftermath.

The two basic hypotheses this policy shift builds on are:

- The more funding is secured ahead of extreme-weather events, the quicker it is available (in adequate amounts) for mobilising the required resources for response and recovery.

- The more funding is invested pre-emptively to strengthen resilience, the smaller both the physical and the economic impacts will be when disaster events occur or climate-change effects materialise.

Yet so far, most developing countries still rely heavily on post-disaster financing through budget reallocation, emergency borrowing or, where applicable, tax increases. This also applies to international humanitarian assistance – while some attention has started to shift to funding anticipatory action that is allowing international aid agencies to fund efforts to prepare for an imminent hazard, little consideration is given to more fundamental and longer-term risk reduction[11].

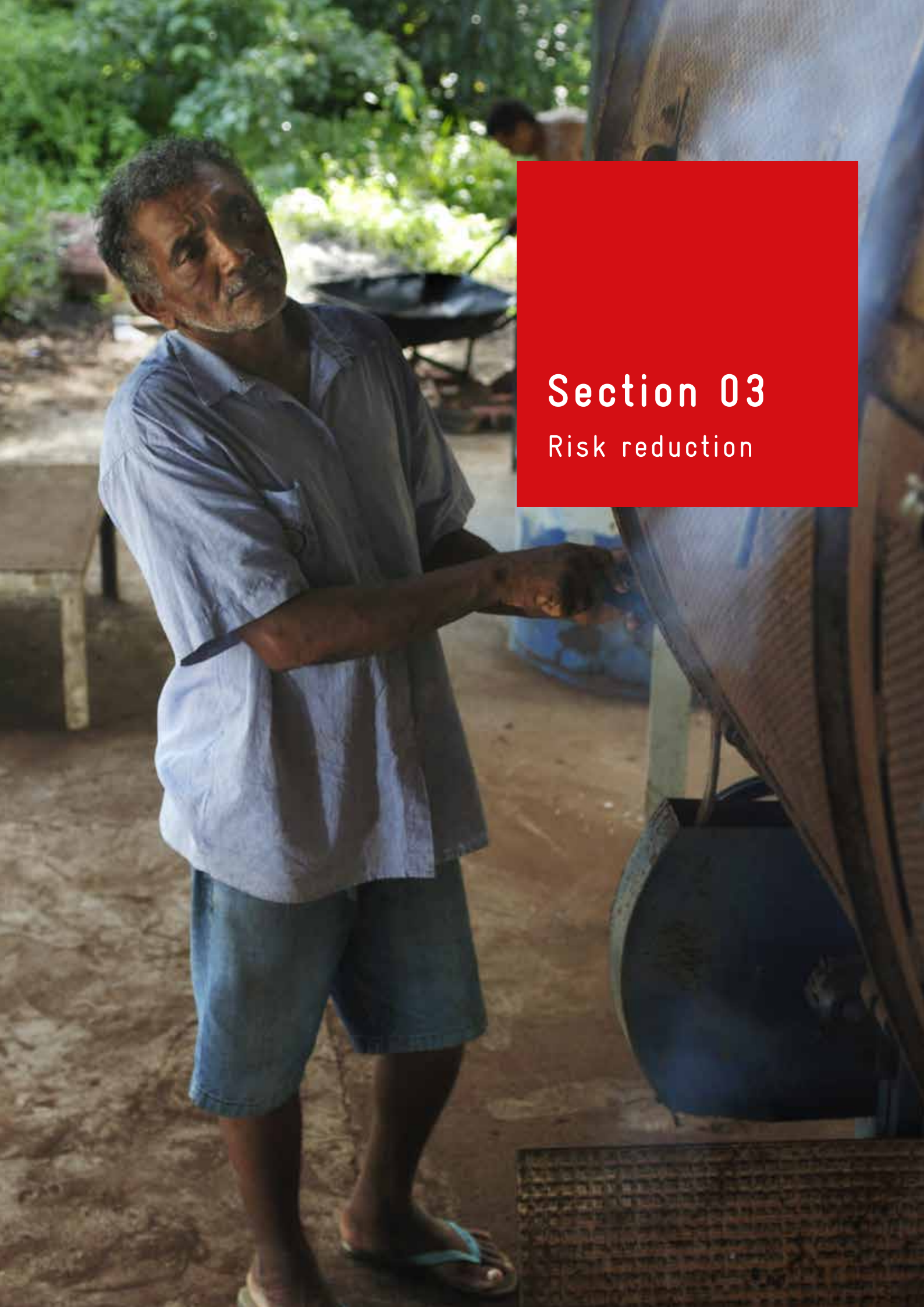
Nevertheless, climate and disaster risk financing has been scaling up the priority list of governments, donors and international finance due to the growing incidence of climate-induced disasters and, in their wake, lasting socio-economic devastation. Human and physical costs are skyrocketing and not only strain, but increasingly overwhelm response and management capacities, particularly in developing countries. As a result, there is growing recognition that climate- and disaster-risk financing needs a significant boost relative to conventional (and mitigation-oriented) climate finance with a view to enhancing resilience to climate-related hazards through adaptation measures and their financing.

Evidently, disasters following natural hazards are not only the result of the hazards proper but also of the exposure and vulnerability to these hazards and the inadequate capacity to reduce their impact. Thus, risk analytics – in other words understanding how such hazards lead to disasters and how this process will continue to evolve over the coming years – are a basic requirement to adapt to such impacts pre-emptively. Left unaddressed, disasters continue to draw massive resources into reactive responses instead of deploying more moderate resources for preventive action and building resilience.

To mitigate the eye-bulging price tag of covering ever-worsening disaster events, the finance and insurance industry has started to urge governments and development partners to accelerate investing in risk-reduction measures to diminish response and reconstruction costs.

10 'Building-back-better' is an approach in post-disaster recovery with the aim of reducing vulnerability to future disasters by building resilience in infrastructure and the socio-economic environment.

11 Although technical development co-operation overall does increasingly cover disaster-risk reduction and climate-change adaptation activities



Section 03

Risk reduction

3. RISK REDUCTION

Climate- and disaster-risk reduction describes the practice of reducing disaster risks through systematic efforts to understand the causal drivers and mitigate the impact of disasters. It can have several dimensions and include aspects of preparedness (readiness), response (management) and recovery (risk reduction with respect to future damage through building-back-better[12]) both at operational and financial level. This publication uses a process-driven approach, treating these elements sequentially *(see section 2, CDRFI, pp. 15)* and only covering financial instruments and public policy tools that have a financial element at their core.

Risk reduction is the first step of CDRM, and risk holders such as governments can reduce the cost of financing risk retention and transfer by prioritising risk-reduction investments. As an example, risk exposure and liability are minimised when no construction work is permitted in high-risk areas and this is enforced. Making critical infrastructure more resilient by retrofitting will also reduce net costs, for example in terms of insurance premiums or reconstruction costs.

The instruments presented in this section are applicable more broadly to financing investments in risk-reducing measures and thus, some may also be referred to in other sections of this publication. They either have direct financing characteristics or indirect ones, such as incentivising the implementation of risk-reducing measures.

CONDITIONAL LOANS

Bank loans are among the most common financial instruments. They are usually provided by commercial banks or development banks at market-based or concessional rates to companies, households or other institutions. Loans are debt instruments extended for a specified tenor at a fixed or floating interest rate and, in contrast to bonds, are based on a bilateral agreement between lender and borrower. The interest rate is composed of a market-based reference rate (for the respective tenor), such as the EURIBOR, and a risk-based mark-up in accordance with the risk profile of the borrower. Loans are a common instrument used to channel funding into investments.

Loans, in particular concessional loans, can be made conditional on their use for specific purposes, such as climate- and disaster-risk reduction measures, or on taking resilience considerations into account in project finance. Lending can also be used as a tool in green finance similar to green bonds *(> see pp. 24)*. For instance, development banks may provide a credit facility that local commercial banks or microfinance institutions (MFIs) draw on for on-lending to the private sector or individuals to implement risk-reducing, resilience-enhancing or environmental projects.

Design:

As loans need to be repaid – quite often within a shorter time frame than bonds – and require the payment of interest, they tend to be used for revenue-generating purposes, unless they are solely intended for liquidity-management purposes (e.g. revolving credit facilities for working capital).

Lending entails financial risk that varies depending on the type and financial standing of the borrower as well as the country, tenor and purpose of the loan. A critical feature is also whether the loan is unsecured or collateralised by the asset it finances, for example. As credit risk determines the interest rate, secured loans are cheaper because the creditor has recourse to the asset and can seize the collateral if the borrower defaults.

Conditional loans can only be used for very specific purposes or obtained if strict criteria are satisfied. Thus, green loans or sustainability-linked loans, which incentivise the borrower to achieve pre-determined sustainability-related performance objectives, can be labelled conditional loans. In addition, development banks lending to small banks or microfinance institutions for on-lending may impose conditions (usually in exchange for concessional terms).

Contingent facilities, such as guarantee lines or letters of credit, become loans too when they are drawn by beneficiaries.

Loans can also be used beyond risk reduction, in particular to finance the procurement of goods in preparation for a

12 'Building back better' is an approach in post-disaster recovery with the aim of reducing vulnerability to future disasters by building resilience in infrastructure and the socio-economic environment.

disaster event or to finance post-disaster reconstruction (where risk reduction might be achieved by a commitment to building back better). Loans supporting investments that reduce risks are likely to be proportionally more effective at reducing risks from high-probability, low-severity events. Conditional loans can have an embedded 'resilience' feature whereby a development bank (or an insurer) allows the borrower to monetise the risk-reducing benefit (e.g. in a climate-smart infrastructure investment) through lower interest rates (or premiums).

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 by the asset that it finances (or other collateral) such that the financial institution can claim the asset in the event that the borrower defaults as well as the interest rate and other fees charged on the loan. In cases where loans are supported by credit lines issued by national or international development banks, they may require that lending to the final borrowers is priced at more favourable terms than would otherwise be available in the market. This may also apply to conditional loans where the investment in resilience projects may be subsidised through concessional lending rates.

Considerations:
(Conditional) loans have a long history. However, several potential pitfalls and restrictions/limitations need to be considered:

- Borrowers might default on their loans, with potential consequences for them (illiquidity, insolvency), but possibly also for the financial institution that granted the loans (when its overall loan portfolio is impaired) or, even worse, for the financial system (when a systemically important bank is affected).
- Borrowers such as governments, companies or households can become over-indebted, which may not only result in multiple loan defaults or cross-default, but also lock them out of the capital/loan market for years.
- Access to loans can be challenging for certain types of borrowers in the first place, especially for those with uncertain or informal incomes and from risky sectors. Financial institutions are reluctant to lend when credit scores are difficult to assess and/or when collateral is either unavailable or hard to get hold of. Increasingly, parameters for climate change or vulnerability to disasters are included in credit-risk assessments, with the consequence that lending in disaster-prone areas or exposed sectors may be curtailed.

To ensure that stated objectives are met, conditional loans, including green loans, need to be embedded in a monitoring and evaluation structure with safeguards to ensure that the use of proceeds is in line with the programme's conditions.

Financial institutions engaged in lending activities usually need to be licensed by, and are subject to supervision from regulators or central-bank authorities in the countries in which they operate. MFIs providing microloans commonly require formal registration with the regulators; some markets even demand a banking licence.

As financial institutions such as banks or insurers take on risks and may suffer losses if risks materialise, they are required to hold adequate risk capital, mostly in the form of equity or hybrid capital, and to extend loans on the basis of appropriate risk assessments.

Jamaica's conditional loan under the Resilience and Sustainability Facility

The IMF's Resilience and Sustainability Facility (RSF) provides conditional financing to low-income and vulnerable middle-income countries to build resilience to external shocks, undertake risk-reducing reforms and ensure sustainable growth. The facility complements the IMF's existing lending toolkit by providing longer-term, more affordable financing to address longer-term challenges, including climate change and pandemic preparedness. It does this by (i) supporting policy reforms that reduce macro-critical risks, such as those associated with climate change, and by (ii) augmenting financial buffers to mitigate such risks. Each disbursement under the facility is connected to one policy action or a set of pre-agreed actions that may constitute a reform, for example.

In the case of Jamaica, the IMF has extended USD 764 million to strengthen physical and fiscal resilience to climate change, advance decarbonisation of the economy and manage transition risks. Envisaged reforms aim to create a natural-disaster fund as well as incentives to switch to renewables, reduce energy consumption, strengthen climate-related elements in public-investment management, develop green financial instruments and enhance climate-risk analytics in the financial system to embed these considerations into supervisory activities.

Such RSF loans are expected to catalyse funding from other official lenders and the private sector. In this context, it was reported in April 2024 that Jamaica was in discussions with the Green Climate Fund, Inter-American Development Bank, World Bank, European Investment Bank, USAID, and the United Kingdom to establish a 'Blue Green Facility', a blended financing structure, of up to USD 500 million over five years to introduce scalable approaches towards adaptation and mitigation needs.

(CONDITIONAL) MICROCREDIT

(Conditional) microcredit does not differ much from (conditional) lending in terms of its climate and disaster risk-reduction capacity, but it may differ conceptionally. Microcredit involves the provision of relatively low-value, unsecured loans with short tenors to low-income individuals, micro-entrepreneurs, households and MSMEs. It is argued that microcredit can increase the resilience of households or small businesses by building up capital assets and by providing indirect coping mechanisms (through higher incomes, financial inclusion, integration in value chains, etc.). This transformation potential makes microcredit a suitable tool to foster those population groups that are vulnerable and typically most directly exposed to the effects of climate change and extreme weather.

Microcredit emerged in response to conventional financial institutions' unwillingness or inability to lend to this target group. Commonly perceived as high risk, borrowers of microcredits usually work in the informal sector and are not able to offer collateral. Microcredit is typically provided by dedicated MFIs who in turn are financed by commercial lenders, impact investors, multilateral and bilateral development banks, NGOs and/or state banks (intermediated lending) and often cannot take deposits.

Design:
To very poor population groups microcredit is typically granted in the form of community-based lending, whereas loans are a joint liability of a borrowing group, granted to individuals in rotation and on the basis of peer monitoring. Generally, however, borrowers of MFIs are small farmers or entrepreneurs who obtain loans individually, possibly facilitated by a co-operative or association and for specific purposes.

Microfinance in general and microcredit in particular can also specifically target women. This is not only based on pro-poor policy objectives – as women dedicate larger portions of their income to their families and household consumption – but mainly for business reasons, as women have higher repayment rates. For socio-economic reasons, women also tend to be more vulnerable to climate change and disaster events.

The mechanics of microcredit are similar to those of conventional lending, albeit with shorter tenors and typically uncollateralised. Loans tend to be provided for specific purposes (e.g. agriculture) and thus do not always get paid out to the borrowers, as they are sometimes channelled directly to providers of goods or services (e.g. agro-dealers). Development partners can also leverage this approach by imposing specific conditions (e.g. climate-smart agricultural practices) on concessionary microlending.

Increasingly, microfinance is embedded in digital payment solutions via mobile banking. There is growing interest in using mobile-banking solutions to improve access to microcredit and its operation, aside from reducing its high transaction costs.

Considerations:
Once touted as a means of lifting households out of poverty, microfinance (including microcredit) simply offers more reliable and tailored financial options for low-income people. It is argued that a major benefit is the access it provides people living on irregular and unpredictable incomes to liquidity or capital to adapt to climate change or deal with shocks. Yet the repayment of loans that have not been invested in income-generating activities is challenging for low-income households. Microcredit therefore looks more suitable for risk reduction than for post-disaster shock-absorbing purposes.

Besides the comparatively high operational cost base of microfinance, small MFIs' risk capital could be wiped

out by a covariant risk event, such as an extreme weather event in the area from where they draw their client base. Accordingly, the providers of the microcredit also need to strengthen their resilience to risks, including climate and disaster risks *(> see discussion of insurance and contingent credit on pp. 44 and 40 respectively)*.

As in the case of (conditional) loans *(>see pp. 20)*, over-indebtedness among the client base can endanger the viability of MFIs. While delinquency rates are generally low in microcredit, especially among women, intense peer pressure from borrowing groups at the poorer echelon of microcredit may result in borrowers even foregoing food and other necessities to repay their loans.

Microfinance programmes 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, in finding distribution models that reach the most climate-vulnerable and, when programmes are supported by public funds, sometimes in ensuring loan repayments.

Most countries have introduced regulation to license and supervise microfinance institutions, especially in cases where the MFIs take deposits as well as advance credit. MFIs need a strong credit risk-assessment approach that is adapted to their target market, is cost-effective and increasingly includes climate risk in their credit scoring.

Climate adaptation in microfinance, Tajikistan (wholesale perspective)

In Tajikistan, the multilateral Climate Investment Funds provided an intermediated credit facility of USD 10 million (half at concessionary terms) for on-lending to microfinance clients that was conditional on the implementation of adaptation investments. The facility was supported by funding for technical assistance. The primary target group for the concessional loans was small businesses and farmers investing in sustainable technologies for climate adaptation. As is so often the case, an evaluation after allocating 90% of the funding found that 61% of the total had been committed to mitigation, albeit often with an adaptation-finance component. Energy (58%) and water efficiency (39%) were the primary investment targets, with the remainder going into land-management technology. The evaluation found that awareness-raising at the level of the intermediate MFIs for the need to engage in climate (risk) finance was a particular challenge.

Climate adaptation in microfinance, Colombia (micro)

The MFI Bancamía (BBVA Microfinance Foundation) offers a microcredit product to facilitate its clients' adoption of technologies for climate-change adaptation (as well as a similar product for mitigation purposes).

The product is aimed at smallholder farmers and micro-entrepreneurs, and the extension of credit is supported by technical assistance. The credit scheme finances a wide range of technology and equipment such as small water-pumping and drip-irrigation systems, milking machines, bio-digestors, water tanks, but also the implementation of climate-smart techniques such as rainwater-harvesting, soil conditioning and organic fertilizers, cover crops, terrace-farming construction and other measures. The MFI has formal agreements with suppliers of equipment and agricultural inputs to install equipment and provide after-sales services.

In 2017, UNEP, Bancamía and Bancoldex launched a 'demonstration farm' North of Bogotá so that smallholders in the area could observe and study the implementation of 11 adaptation measures. Free technical assistance to small farmers within the region was provided by project partners, complementing the financial and installation support.

Between 2016 and 2023, Bancamía extended some 6,600 green loans overall, around 41% thereof to women. The average loan size was around USD 800, with tenors ranging between 3 and 60 months. The amortisation schedule is set by reference to the client's business cycle, and the MFI demands collateral for credit extension.

GREEN BONDS

Green bonds and other debt instruments geared towards sustainability are becoming a relevant part of global fixed-income markets. Through these instruments investors can align their portfolios not only with their financial goals but also with internationally recognised sustainability goals such as the Paris Agreement or the UN Sustainable Development Goals (SDGs).

The terms 'green' bonds and 'climate' bonds tend to be used interchangeably. For the purpose of this document, green bonds serve as the overarching term and include bonds that tend to be geared towards climate-change mitigation and sustainable infrastructure (e.g. waste-water treatment plants). By the same token, climate bonds are part of the green-bond universe, although they have the distinction of also covering adaptation and disaster-resilience aspects, albeit on occasion in a less project-specific way.

Bonds are issued by national and local governments, development banks and large companies to finance investments. In exchange for payment of the bond by the purchaser, the issuer agrees to pay the bond investor interest payments (coupons) on a set schedule and repay the principal at maturity. Bonds are debt instruments and are often listed on stock exchanges. Typically, bonds are risk-rated according to their risk profile and their structure. Government-issued bonds in the US and many countries of the EU are often associated with the lowest financial risk and thus, are easily traded. Due to the complexity of the issuance process (in the case of public instruments), bonds are more expensive than loans (with the same risk profile and tenor) and hence are typically used for financing larger-scale projects.

Climate bonds as a sub-sector of green bonds can relate to climate-change adaptation, financing risk-reducing infrastructure such as flood gates or the reconstruction of assets after a catastrophic event.

Design:
Bonds issued by corporations are classified into investment-grade and high-yield bonds, the latter having a less favourable risk rating and thus requiring higher interest rates. Conventional investment funds are often not allowed to invest in non-investment-grade bonds. Corporate bonds, specifically those issued by the finance sector (e.g. banks, insurers), can also be differentiated according to their ranking in the capital structure (senior, sub-ordinated/hybrid, preferred). Bonds can have equity-like features and/or be automatically converted into equity by triggering events.

Especially bonds issued by governments (national and local) are classified according to their tenor (e.g. bonds, bills, notes). There are also very large markets for bonds collateralised by real-estate portfolios (covered bonds).

A number of features define the specific characteristics of the bond including size, the use of proceeds, whether repayment will come from general sources (e.g. corporate cash flow or tax revenues) or from the specific revenues generated by the financed asset(s), the tenor of the bond and the interest rate (coupon) that will be paid to investors. The main characteristic that distinguishes green or climate bonds from regular bonds is the use of proceeds.

Led by green bonds, there are by now a range of bond types whose proceeds finance sustainability and/or resilience. In 2007-2008, the European Investment Bank and the World Bank successfully issued the first green bonds, which were bonds financing a specific green project (environment- or climate-related). These days, there are blue (marine-related), transition (decarbonisation), sustainability or sustainability-linked (corporate sustainability or ESG), resilience (usually targeting a more resilient infrastructure) and climate bonds *(see above)*.

A non-trivial barrier preventing additional resilience finance is the ambiguity over what green bonds across all their sub-sets look and behave like – there is no consensus on the taxonomy and structure yet, such that the exact terminology, classification and reporting of such bonds remain in flux. It is estimated that only 10–20% of green bonds so far have climate-adaptation components, and bonds issued with a specific focus on disaster-risk reduction are still negligeable.

Green bonds may come with tax incentives such as tax exemption and tax credits, making them a more attractive investment in relation to a comparable regular bond.

Considerations:
Bonds are relatively expensive to structure and issuance takes months. Costs and time increase further if the bond is rated and listed.

Due to the relatively broad and still debated criteria for what constitutes a green, climate or similar bond and the lack of formal guidelines for their issuance, especially in

emerging markets, there is a danger of 'greenwashing' or of issuers misrepresenting environmental/climate impacts of the proceeds although the establishment of a number of guiding principles is improving the integrity of the market.

In 2020, the EU adopted a classification system, the EU Taxonomy, for environmentally sustainable economic activities. To assist in the transition to a low-carbon economy, it aims to provide the private sector, financial investors and policymakers with guidance on what constitutes an environmentally sustainable economic activity[13] and thus to support the transformation of the EU to meet its European-Green-Deal objectives.

These include a European Green Bond Standard[14] – a tool with which issuers can now demonstrate that they are funding legitimate green projects aligned with the EU Taxonomy and with which investors will be able to corroborate that their investments are indeed sustainable and not a form of greenwashing.

Issuers can decide whether to issue their bond as an EU Green Bond (EuGB). Alternatively, they can abide by a voluntary information standard for bonds that are not European Green Bonds but that are marketed within the EU as environmentally sustainable or that are linked to certain sustainability targets. Issuers can also choose to comply with other sustainability standards, such as the Green Bond Principles of the International Capital Market Association or the Climate Bonds Standard created by the non-profit international Climate Bonds Initiative.

It is expected that in time also the labelling of the various sub-categories of green bonds (sustainability bonds, transition bonds, etc.) will converge.

A new beginning: first climate bonds by developing countries and true adaptation finance through bonds in the making

In 2017, Nigeria became the first African country to issue a green bond. While most green bonds are issued for climate-change mitigation purposes, some governments have started to issue bonds for climate-change adaptation and risk-reduction purposes. For example, Fiji's Green Bond Framework targets both climate-change mitigation and adaptation, but also sustainable land use and biodiversity protection and more broadly assists in achieving the Sustainable Development Goals (SDG). In 2017 the Government of Fiji issued a climate bond raising FJD 100 million (approx. USD 50 million) focused on resilience-building and climate-change adaptation, with the remaining 10% of the proceeds dedicated to mitigation efforts. Activities and infrastructure financed comprised the rehabilitation of cyclone-damaged schools and other structures and their reinforcement to serve as future evacuation centres, the construction of coastal protection and the restoration of roads and bridges, the installation of cyclone-resilient solar-home structures, clean-water systems for purification and rainwater harvesting, waste management and forest conservation.

The dual-tranche climate bond is issued by the Reserve Bank of Fiji, with technical assistance from the IFC and Australia. The bond is listed on the London Stock Exchange. Fiji's landmark transaction represents the first international sovereign green offering from an emerging economy.

In 2021 Columbia issued a green bond, the proceeds from which can be used for management of disaster risks associated with climate change.

Bonds that aim to finance climate adaptation are also becoming increasingly popular in Europe. The City of Paris has issued a bond of EUR 300 million, of which 20% finances adaptation projects with the majority of funds going towards mitigation (in particular sustainable urban transportation). In 2019, the Dutch Government issued a bond and is using the proceeds towards flood-risk reduction in coastal areas and other purposes.

13 There are enabling and transitional sustainable economic activities. For example, an enabling activity meaningfully contributes to at least one of six environmental objectives: climate-change mitigation, adaptation, use and protection of water/marine resources, transition to circular economy, pollution prevention/control and/or protection/restoration of biodiversity and ecosystems. At the same time, the activity does not count as sustainable when it causes significant harm to any of the other objectives or basic human rights and labour standards.

14 While the legislation was published in November 2023, it does not come into effect until December 2024.

Approved through a ballot in November 2024, California will issue a massive adaptation-oriented bond of USD 10 billion. The plan is to dedicate funding to projects to reduce wildfire risk near communities and ensure forests are healthy enough to withstand more intense wildfires, to reduce the risk of catastrophic flood events by slowing and capturing runoff, to protect coastal communities from sea level rise and to assist urban communities in adapting to rising temperatures by reducing heat-island effects through greening projects and supportive measures such as cooling centres.

In 2023, the Asian Infrastructure Investment Bank issued its first climate-adaptation bond of AUD 500 million to support infrastructure-based adaptation projects across Asia, for example by making electricity distribution, water services and flood-recovery infrastructure more resilient.

DEBT SWAPS

A debt swap is better described as a financial transaction than a financial instrument, such as a derivative. An obligation is exchanged for an asset; in conventional finance, usually debt is exchanged for equity *(see Investment Funds and Green Equity, pp. 27)* to write off funds owed, thereby essentially representing a refinancing deal. In international development this tool does not raise additional financing either but frees up fiscal space in government budgets. It forgives debt against the commitment to invest the funds freed up in health, education, conservation or climate resilience. This way financial streams are reallocated to a good cause.

Debt-for-nature swaps (or nowadays usually debt-for-climate swaps) are structured to reduce a country's debt levels in return for environmental commitments. Although in existence for decades already, debt-for-nature swaps have taken on a new life as a further tool in the climate-finance taxonomy and the loss & damage debate.

Design:
In any context and at any credit rating, sovereign-debt management is a complex matter (let alone any reallocation to climate action or other purposes): debt usually consists of (private) loans or (public) bonds; the latter may be traded and repurchased at a premium or a discount, retired at par at maturity or early by the issuer (debtor) or bought at a discount for instance, due to an issuer's impaired credit rating, by a donor or via an intermediary.

In a typical debt-to-climate swap debt service and repayment to a sovereign (bilateral) creditor is redirected to the funding of mutually-agreed climate projects, upon which the debt is being forgiven. Sometimes a bond is called and replaced by new debt with better terms and only the savings thus generated are allocated to climate action. Tripartite swaps are used when outstanding debt is publicly traded and/or held by a number of investors (creditors); a sponsor such as an impact-investment intermediary buys debt titles on the market (often at discounted values) and replaces them with a green-bond instrument for instance, possibly at a lower interest rate *(see p. 26)*. Alternatively, a development bank lends the funds to the debt issuer (debtor country) at concessionary rates contingent upon the country buying back its debt securities at discounted levels and using the savings for climate related projects.

The reallocation of the funds generated through such debt conversion is typically managed by a special purpose vehicle, such as a trust fund, with its own governance structure. The climate-investment commitments entered into by the government are laid out in detailed agreements with specific timelines for each project. Missed milestones may result in penalty payments, such as higher investment funds by the government.

Considerations:
Debt-for-climate swaps are not suitable for highly indebted or financially distressed countries in terms of debt management. Moreover, some countries find themselves in a vicious cycle when climate-change effects or disasters increase debt vulnerability, reduce productive capacity and erode the tax base, while access to capital markets is hampered and financing climate-risk reduction becomes elusive.

It remains up for debate if debt-to-climate swaps are more efficient and impactful than keeping the instruments separate, i.e. dealing with climate finance independently from debt relief in developing or emerging markets.

The 'blue' transactions of Barbados

After its 2022 deal, Barbados prepares for another green-bond transaction in a debt conversion later in 2024. The country secured two guarantees from development-finance banks (European Investment Bank and Inter-American Development Bank, USD 150 million each) and hopes to add a private-sector based guarantee to increase the fully-secured deal to around USD 360 million or more. The transaction aims to create financing for climate-resilient infrastructure stopping waste-water discharge into the sea. Buying back discounted debt, Barbados estimates that about USD 130 million in savings could be generated over 15 years allowing the government to service and repay new green loans and to invest in water and food security as well as increase its financial resilience to extreme-weather events.

Given the country's debt levels and budget constraints Barbados would not be in a position to make such investments otherwise. Already in late 2022, it implemented a debt conversion by swapping USD 150 million of bonds into marine-conversation investments of USD 50 million over 15 years. The government was able to replace expensive outstanding debt at an average interest rate of 7.2% by all-in costs of 4.9% for a 'Blue Loan' *(see also Conditional Loans, pp 20)* partially funded by a green bond and fully guaranteed by the Inter-American Development Bank and The Nature Conservancy, an NGO. The investment aimed to develop Barbados' blue economy in a sustainable fashion and protect some 30% of its ocean waters.

INVESTMENT FUNDS and GREEN EQUITY

Equity represents the proportionate ownership of a company (shareholding). It is capital that a company raises to set up business and, alongside debt, to invest in projects, buy assets and pay for operations. Equity investments are subordinated to debt in a company's capital structure and, as a result, debtors such as lenders or bondholders are paid out first in case of the company's liquidation. However, as owners of the company, shareholders have a say in all major decisions. They commonly receive an annual dividend as a cash component and hope for capital appreciation over time as compensation for their investment. If a company is listed on the stock exchange, equity investors can buy and sell shares freely. By contrast, private equity is not accessible to the public and can only be bought and sold with the company's agreement, either directly or through a private-equity fund. Outside of strategic investments in a company or mergers, equity investment is commonly made through investment funds.

'Green equity' is a term used to describe an investment focus on environmental sustainability, such as to ensure climate-compatibility of projects or company operations, in particular with respect to the Paris Agreement. It is less common than green bonds, emerging in the wake of the well-established ESG (environmental, social, governance) investment style. This pedigree hints at the limitations of green equity: investments are made in companies that offer products and services deemed beneficial to the environment and/or the climate. This could be as simple as investing in a company providing (waste)water management services or building wind turbines. Given limited additionality effects, the investment style is often criticised as 'greenwashing'.

Design:

Non-strategic equity investment is typically made through investment funds, such as mutual funds, exchange-traded funds (ETFs) or private-equity funds. The asset-management and private-banking sector offer an abundance of sustainability-oriented investment products, which sometimes simply turf out climate-damaging companies within a sector or entire sectors (e.g. the fossil-fuel industry). There are countless sustainability or specifically climate-risk reporting frameworks that may guide ESG efforts or impact investors.

Besides private investors and high-net-worth individuals (HNWI), institutional investors are increasingly allocating assets to the ESG space and/or green equity (and bonds). This includes in particular pension funds as well as sovereign wealth funds, despite the fact that the contributions of some of the biggest investors stem from the sale of non-renewable resources. Even central banks such as the European Central Bank have started to discuss whether their monetary-policy-driven investments could support the green transition by tilting their asset allocation towards more climate-friendly investments (only some central banks such as Japan's or Switzerland's invest in stocks). Development banks often choose to make equity investments in commercial banks, which in turn then finance climate-related activities.

Target sectors for green equity are mostly in the energy and infrastructure universe. While disaster-risk reduction so far plays an indirect role in infrastructure or utilities' investments, the theme of climate-change adaptation finance may gradually become more relevant. Companies offering innovative and technology-based solutions (e.g. carbon sequestration) continue to be

mainly covered through private-equity funds.

Considerations:
As equity represents risk-bearing capital, it is more expensive for a company to raise equity than debt; conversely, an equity investor has a higher upside (share of profits and growth), yet bears more risk (including volatility risks) than a bond investor.

The greenwash debate is based on questions of effectiveness, additionality and attribution. Is the investment indeed meaningfully reducing a company's environmental or climate impact? Is an investment of green equity causal for a change in the asset composition, and does it only substitute or does it increase existing financing? Can a green investment be directly linked to a specific climate-friendly project? From a corporate-finance perspective this may be easier to accomplish through green or climate bonds than green equity or sustainability-linked bonds.

Insurance and tech investments by the InsuResilience Investment Fund

With an anchor investment by the German Government through its development bank KfW, the InsuResilience Investment Fund (IIF) contributes to climate change adaptation by improving access of low-income populations and micro, small and medium-sized enterprises (MSMEs) in developing countries to climate- and disaster-risk protection. Its two closed-end equity funds managed by BlueOrchard invest in insurance companies and brokers offering coverage against climate and disaster risk, in particular in agriculture, and in technology-driven companies across the world that provide ancillary services such as climate-data generation, risk modelling and disaster-impact measuring. KfW also provides technical assistance and premium support. Both closed-end funds have private investors as well as public investors. The first one closed in 2020 at EUR 80 million, while the second is close to its EUR 100 million target for late 2024 (second closing at EUR 50 million in 2023).

GUARANTEES

Financial guarantees are contractual obligations under which a third party, such as a government entity, agrees to repay a borrower's debt to a lender or pay for the supply of goods should the borrower default or the recipient of the goods not pay. The guarantor assumes responsibility for all related payments including interest.

Outside of concessional financing, this instrument offers an alternative way to overcome markets' (perceived) risk-return concerns especially with respect to large-scale (e.g. resilient) infrastructure projects in developing countries or the procurement and installation of (disaster-risk-reducing) technical facilities. The aim is to de-risk the project and to crowd in the private sector, in particular as investor, and/or to turn it into a viable project for (commercial) bank funding. Guarantee structures can also be deployed on a temporary basis to help maintain or stimulate investment during economic downturns or price spikes in order to preserve national climate goals.

Governments or donors might introduce a guarantee scheme to catalyse investment in climate- and disaster-risk-reducing measures, climate-smart equipment or resilient infrastructure. The investors might be local governments, business or private households who would otherwise not have the funding capacity to undertake these activities and/or not be sufficiently creditworthy. Guarantees provide no financing as such, but rather serve to mitigate credit risk and enhance credit.

Design:
With these instruments, governments or donors do not directly provide loans to support investment or economic activity. Rather, they purely serve as facilitators encouraging financial institutions to engage. As such, these instruments use the superior financial capacity of the guarantor to mitigate the financial risk of dealing with a weaker counterparty, which therefore de-risks the project in question and essentially effects the transfer of financial risk. Commonly, governments act as guarantors using banks as intermediaries; yet guarantees can in fact be provided by a variety of parties from insurance companies to individuals, and this may also involve the pledging of collateral. Guarantees differ in format but not necessarily in substance from insurance and they can be transaction-specific or ongoing, for example when guaranteeing the solvency of a government-owned entity such as a development bank.

In the context of climate- and disaster-risk finance, guarantees are predominantly deployed to unlock private-sector investment, which makes them an important tool in blended finance. This de-risking model has expanded

from the banking market and can increasingly be observed in other instruments, such as in green/climate bonds. This is mainly driven by restrictions that many institutional investors (e.g. pension funds) are bound by with respect to non-investment-grade securities.

Considerations:
Guarantees for institutions (e.g. from a government to its development bank) may have structural and thus legal reasons, but may sometimes also be used for political purposes, in which case they can distort markets or fail to achieve their objectives. Guarantees have proven useful as a transitional tool to allow investors and creditors to familiarise themselves with new markets, players, financial products and projects. Accordingly, they work best in a market-building or market-transformation context.

In lightly regulated markets, guarantees may be easy to extend yet tough to draw on, since guarantees represent contingent risk and as such may not be as strictly risk-managed as they should be. In the event of a shock, high and covariant risk concentrations could place a strain on public finances or even threaten the financial stability of institutions or countries.

Guarantees ought to be regulated as strictly as insurance policies, with which they share some features. However, in many parts of the world this is not yet the case. Considering that fraud involving public guarantee schemes is not uncommon, guarantees and their issuance require transparency and clear rules.

Guarantee schemes act as catalysts

While guarantees are a common tool to establish 'programmatic' credit facilities, such as from development banks financed by governments or international donors, their deployment in the context of climate change and disaster-risk reduction more generally and/or climate/green bonds specifically, is relatively new. Specific case studies or evaluations are hard to come by because guarantees tend to be only one component of a more comprehensive financing package, yet early evidence shows that guarantees are highly effective in unlocking private capital and thus, are a good catalyst for yet underdeveloped markets.

As an example, the Green Guarantee Company funded by UNFCCC's Green Climate Fund and other public investment/development institutions was officially launched in February 2024. It intends to mobilise large amounts of climate finance from the private sector with a focus on green bonds and private credit. This credit-enhancement tool will be provided at concessional terms, mostly through debt-originating banks and aims to unlock private-sector investment predominantly in climate-change mitigation.

IMPACT BONDS

The term 'impact bond' is a misnomer because it is essentially a tripartite value-for-money mechanism and does not have a conventional bond structure, as is the case with green bonds. Impact-bond structures build on results-based finance schemes. While there are no impact bonds in the disaster and climate-change space yet, environmental impact bonds exist, but are predominantly focused on conservation themes.

Impact bonds tie interest and repayment to the achievement of forecasted benefits, which are independently verified and valued. While investors provide upfront funding, final payments are based on realised measured benefits. Thus, impact bonds are a pay-for-performance and not purely a funding instrument.

Design:
Impact bonds are designed to encourage the provision of (environmental) services at high quality by offering a pay-for-performance contract between a funder ('outcome payer', typically a government or development agency/donor), a service provider ('implementer', such as an NGO, maybe also a company) and private-sector impact investors (e.g. high net-worth individuals or foundations) in relation to a project with pre-defined environmental, development or social objectives.

The funds raised from impact investors, essentially representing front-loaded funding, are paid to the service provider to provide the agreed deliverables at the agreed level of quality, in other words to provide the outcomes or, ideally, impacts. Only if they are achieved will the development agency or donor proceed with making payments to the impact investors. Thus, development agencies cede (implementing) risk to investors who in turn have themed (e.g. environmental)

investment opportunities that are not correlated with markets and have a strong philanthropic or sustainability component.

Impact bonds differ from other forms of outcome-based or impact-based contracts in that third-party investors are explicitly involved. The interest rate payable can either be fixed (pre-determined) or be performance-based, sharing a feature of sustainability-linked bonds.

The instrument is suitable for financing the resilience of critical services that include an infrastructure component. It could also be used to incentivise climate- and disaster-risk reduction services with communities/local governments in focus, such as the management of city-based flood-prevention services (cleaning up of drainage systems, ecosystem-based adaptation measures).

In contrast to conventional development financing, the structure does not prescribe the activities to be implemented, therefore it allows implementers flexibility, room to innovate and to focus on results.

Considerations:
Impact bonds are complex to design: three parties need to come to an agreement on specific outcomes/impacts, their quantification and validation and the level of risk returns (and potential losses) for investors, among other aspects.

The main challenge for development partners in utilising impact bonds is that they struggle with the concept of compensating investors for risk-taking by paying them a financial reward (interest). Yet the aim of impact bonds is that payers can monetise anticipated savings (e.g. as a result of preventing adverse impacts) or leverage efficacy (e.g. thanks to better outcomes) as the notional 'source' of returns to investors. Investors therefore actually benefit from the successful aversion of adverse effects.

Given the bespoke nature of impact bonds, there is no 'market' for them yet. This could change should development institutions consider replicating such schemes on a broader scale, resulting in a certain degree of standardisation.

The basis of an impact bond is a contract, which needs to be very precise and detailed, contain clearly defined roles and responsibilities and an alignment of interests between parties, parameters that are measurable and allow for outcomes/impacts to be attributed to the interventions and balanced risk/return expectations.

Flood-related hybrid impact bond for Atlanta, USA

Technically a hybrid between an impact and a green bond, the security issued in 2019 (-2024) raised USD 14 million to reduce storm-water run-off and increase flood-water storage, thus improving water quality with the help of eco-based infrastructure. The Atlanta Department of Watershed Management is the beneficiary and acts as funder. It pays private investors interest of between 3.55% and 4.67% depending on results, which means the interest is indexed to realised environmental benefits that in turn consist of a monetisation of cost savings. The probability of overperformance is calculated at 27.7%, which would trigger a higher interest rate payment to investors. The project design was supported by The Rockefeller Foundation.

GRANTS and SUBSIDIES

A common way to increase the attractiveness of risk-reduction activities is for governments or donors to reduce companies', municipalities' or households' investment costs through grants/transfers or subsidies. Funds are thus 'tied' to specific purposes and are intended to incentivise or kick-start risk-reduction-related projects that might not be undertaken without such financial support. Often the terminology distinguishes between grants/transfers as relating to investment costs and subsidies supporting ongoing operating costs. Both tools ought to be considered either a one-off or be used temporarily, yet they have a tendency to outlast their effectiveness. Grants and subsidies can support investments, such as in resilient infrastructure, and activities such as for refitting existing buildings or expanding mangroves or climate-smart agriculture. This way, they reduce the exposure and vulnerability of physical infrastructure, the environment and livelihoods to extreme weather events.

Grants and subsidies can finance recipients at all levels, and funds can be allocated in various forms such as cash, vouchers or concessionary loans *(> see p. 20)*. Like subsidies, grants are disbursed by governments or multi- and bilateral donors in favour of households, businesses and local and national governments. Both instruments are well suited for risk reduction and resilience-building, but also prove useful tools for preparedness, if rapidly arranged, for response and relief activities, as well as in the context of post-disaster recovery.

Design:
Most grants and subsidies or other incentives take a relatively simple form, whereby payments are made concurrently, or in advance of incurring costs. Grants come in various formats, such as earmarked grants, incremental top-up grants and performance-based grants. Large transfer payments may be disbursed in separate tranches and made conditional on evidence that the previous tranche has been used as intended.

Grants and subsidies are earmarked for specific purposes upfront (i.e. they are conditional) and some grants are 'results-based', with payments being made only after certain activities, outputs or outcomes have been delivered or achieved. This mechanism can help strengthen the incentives to improve programme effectiveness, but it can be arduous when recipients face challenges in accessing the necessary upfront finance.

Some grants are also offered on a matched basis, incentivising beneficiaries to make large investments and thereby maximising the grant contributions from their government or other grantor.

Subsidies can also be provided in conjunction with other instruments such as loans to vulnerable households and businesses, in the form of subsidised interest rates or insurance in the form of premium support. Grants can also be extended to cost- and revenue-sharing schemes.

While governments or sovereign donors have the option to transfer grants and subsidies directly (and bilaterally) to governmental bodies or households, humanitarian-related finance is usually provided through multilateral agencies, such as the UN, or pooled funds/facilities in line with the humanitarian principles.

Considerations:
By improving the economics of undertaking risk-reduction investments, subsidies and grants can be powerful instruments to encourage such activity. However, investing may become reliant on such incentives, which can result in an entitlement attitude and, over time, may threaten the financial sustainability of the mechanism.

Crowding-out and moral-hazard effects tend to emerge over time as risk holders may stop or delay risk-reduction activities when they come to rely on donors or governments to pay for or subsidise such investments. So grant and subsidy programmes need an exit strategy to maintain the incentive momentum during implementation and to eventually wean risk holders off the costly support.

In this context, there is also a debate on the policy effectiveness of subsidies for disaster-risk reduction and climate-change measures in terms of triggering behavioural change. The effectiveness of grants and subsidies is determined by their ability to access new target groups or sectors that would not have taken the measures without the grant or subsidy.

Challenges may be caused by poorly designed grants and subsidies diverting the focus away from effective risk-reduction measures that may not receive such support. Added to this, in the case of performance-based programmes, there is the difficulty of identifying and measuring parameters to demonstrate that the investments and activities have successfully reduced risks.

Diverting activities and investments to areas covered by grants and subsidies and reliance on financial support may result in 'maladaptation', for instance when cyclone-prone areas continue to attract new residents because governments subsidise risk-adjusted property insurance cost.

Green subsidies

The world has become accustomed to national fuel subsidies. Despite their harmful effects, such schemes have a remarkable longevity. While official programmes in the developed world have mostly been discontinued (while countless implicit incentives endure), fuel subsidies in developing countries continue going strong for political reasons until balance-of-payment problems of both oil-importing and -exporting countries prompt their repeal (*see e.g. Nigeria*[15]).

Developed countries are increasingly shifting to green subsidies to manage the transition to net zero. If well-designed, green subsidies can mitigate market failures, such as when fossil-fuel emissions are underpriced with regard to their true costs or when there is no effective carbon-pricing regime yet due to international-competition concerns. However, there is a risk that a new subsidy race is being launched, this time to compete for and lure international green investments. Geopolitical interventions are already beginning to fuel such a subsidy race, which will disadvantage developing economies with their weaker economic clout, reduce global economic efficiency and make the world worse off rather than better. An example of this development can be seen in the competitive stance between the EU's Green Deal (2021) and the United States' Inflation Reduction Act (2022).

GREEN CREDITS and CERTIFICATES

Credits and certificates can be used as an ancillary instrument to minimise risks. They are typically not applied in a disaster-risk context but rather in a climate-change context, in particular in mitigation to manage greenhouse-gas emissions. The mechanism is introduced by governments, including supranational and subnational ones, and aims to gradually reduce the volume of emissions over time. Increasingly, such instruments have been integrated in an offsetting system and made tradeable.

Such schemes incentivise emission-reduction investment by allowing the benefits from these projects to be recognised in a 'credit' that can then be traded, typically among companies that choose to purchase the credits either for regulatory-compliance purposes or for reasons relating to corporate social responsibility (CSR). The sale of credits boosts revenue realised from the investment, making it more economically attractive. While virtually non-existent at present, it is conceivable that such a crediting mechanism might also be introduced for disaster risk-reduction purposes. Indeed, monetising risk-reduction benefits through the sale of credits/certificates may be the only revenue source for such projects.

Design:

Generally speaking, investments supported by this type of mechanism can help to reduce not only fossil-fuel emissions, but also the risk that disasters pose to physical infrastructure, people's lives and livelihoods.

Some of the key issues to determine in such mechanisms are whether credit/certificate purchases will be voluntary or mandated by regulation, what type of investments are allowed to generate credits and the extent to which credits are exchanged just bilaterally or whether they can be traded between third parties. The latter would potentially allow for the formation of a more liquid commodity market, but is also likely to introduce additional price volatility. While such schemes are most likely to thrive on an international level only, at least initially, the sponsors are governments. The time needed to set up and maintain a crediting mechanism is not trivial.

The attraction of certificates is that they can eventually create an additional economic incentive for risk-reduction/mitigation investments without drawing on (scarce) public resources. However, to be effective, there needs to be a sustainable source of demand for such credits. This is achieved through regulatory requirements, for example on developers to make good on the negative biodiversity impact of their developments (in the case of mitigation banking) or on industrial manufacturers to reduce their carbon emissions (in the case of emission-trading systems).

The United Nations Clean Development Mechanism *(> CDM, see p. 33)*, defined under the Kyoto Protocol, allows countries to fund carbon-emission-reducing projects in other countries and claim the saved emissions as part of their own efforts to meet international emissions targets. The CDM is the main source of income for the UNFCCC Adaptation Fund that helps vulnerable communities in developing countries to adapt to climate change.

15 https://www.ifpri.org/blog/nigerias-lesson-how-scrap-fuel-subsidies

Considerations:

CSR demand may not be consistently high enough to make the instrument meaningful or even run a scheme. However, the design and management of mandatory systems is complex, even more so as large international schemes benefit from network effects and generate economies of scale and cost efficiencies. Well monitored, credit schemes avoid distorting effects and gaming between participants.

Another critical challenge lies in quantifying, on a comparable basis, the risk- or carbon-reduction benefits that a wide range of varying investments deliver.

As soon as credits or certificates become tradeable, price finding may be challenging and some form of 'market-making' be required. In emission-trading systems, market deflation due to overallocations of emission allowances can rapidly sound the death knell of the market.

The regulatory requirements for this approach are relatively light in cases where any credits are purchased on a voluntary basis, such as for CSR purposes. However, if demand for credits stems from a compliance obligation placed on purchasers by regulation, then an associated regulatory architecture – possibly laid down in international agreements such as in the case of the CDM – will be needed to ensure that the risk-reduction investments and the associated credits they generate, are consistent with the objectives of the regulation and fit-for-purpose.

From CDM to Article 6

The Clean Development Mechanism (CDM) is a scheme under the UNFCCC's Kyoto Protocol that aims to stimulate emission-reduction projects in developing countries, thereby generating certified emission reduction credits.

These credits are subsequently sold and traded. Developed countries or private companies can buy them to supplement their domestic reductions to meet national or corporate targets, the driver being that greenhouse-gas reduction is usually cheaper in developing countries than in developed ones. These credits can be purchased from the primary market, in which case they are bought from the party that achieved the reduction, or from the secondary market, when they are traded on an exchange. Credits are retired or cancelled upon completion of the emission-reducing projects.

A 2% levy on these credits represents the main funding source for the UNFCCC's Adaptation Fund, which was established to finance adaptation projects in developing countries that are particularly vulnerable to the effects of climate change.

Initially, only the EU and Japan had committed to the CDM and purchased credits as part of emission-capping schemes, with Switzerland and New Zealand following suit. While the carbon price of the credit in its first year (2008) hit USD 25, it collapsed in 2012 – along with the CDM overall – due to the Eurozone's debt crisis and an overallocation of allowances under the connected EU ETS, a cap-and-trade mechanism which had generated the largest demand for CDM credits, and due to Japan reneging on its targets ('carbon panic'). As a result, the CDM scheme started to go into liquidation.

While discussions on how to fully transition the CDM to the Paris Agreement (Article 6) have finally concluded at COP29 in November 2024, by 2015 the scheme had already opened to voluntary offsets through the participation of a broad range of purchasers of credits, including individuals (EU parties remained the top buyers also in voluntary purchases, accounting for a share of almost 50%). The scheme was revived when 14 U.S. states, Australia and New Zealand as well as a number of emerging markets started setting up proprietary emission-capping and/or carbon-tax systems and linking them to the CDM. While this allowed the CDM to recover in terms of traded volume, the price of credits remained at very low levels. The official commitment period ended in 2020, and the transitioning to the Article-6 mechanism is expected to last until 2025. China's ETS (from 2021) has meanwhile become the largest in the world, three times the size of the EU's, the second largest and most liquid carbon market. In 2023 the EU introduced the world's first carbon tariff; as of 2024, marine transportation is included in the EU's emissions trading, while a new similar trading system (EU ETS II) will come into effect in 2025 that mainly covers emissions from road transport and buildings. Free allowances will finally start to be phased out from 2026. A handful of countries with Switzerland in the lead had in the meantime begun trading emission reductions and removals with one another through bilateral or multilateral agreements (Article 6.2) and counting them towards their Nationally Determined Contributions (NDCs; Article 6.8). Crediting overseen and registered on the UN platform (Article 6.4) commenced operation in 2024. Until November, participants submitted transition requests of CDM activities to the new Paris Agreement Crediting Mechanism. At COP29 in late 2024, Article 6.4. became fully operationalised, with the Supervisory Body resuming its work in early 2025. Overall, the Article 6-related negotiations created a highly complex and opaque system that can easily be gamed by carbon-market players. Therefore, there is need for strong monitoring and oversight by neutral external parties and governing bodies.

BUDGET ALLOCATION

Budgetary appropriation is the core mechanism for governments to spend public funds on climate and disaster risks. With respect to risk reduction, budget lines can finance capital spending, such as on grey and green infrastructure protecting against the impact of hazards. Examples include the protection and maintenance of sand dunes or mangroves or the construction of sea walls or shelters. In addition, budget lines can be used to strengthen institutional, policy and legislative arrangements, for example by conducting or updating risk assessments and having the results inform and guide planning (e.g. infrastructure, urban, etc.), zone classification and building codes.

Pre-emptive budgeting for disaster risks or resilience-oriented budgeting aims at reducing the overall cost of disasters, especially as it exceeds direct rescue and repair costs in the public context and has countless knock-on effects on health, supply chains, production and consumption as well as the state of the economy as a whole, also for years to come.

Ultimately, governments' annual and multi-year (investment) appropriations should optimise the public financial-response capacity without compromising fiscal balances or longer-term development objectives.

The deliberations on disaster-risk finance and on which instruments to deploy for which purpose as part of the national budgeting process can also improve fiscal policy, enhance the stability of public finance and turn climate- and disaster-informed budgeting into a systematic process.

Design:
Design considerations with respect to budgetary appropriation for risk-reduction purposes consist of a cost/benefit analysis of what amounts promise the highest efficacy in what format and towards which identified risk type and magnitude. Furthermore, the vertical and horizontal distribution of funds has to be determined, including the allotment to the appropriate line ministries as well as the allocation among national and local government levels. Governments also have the option to either carry the full fiscal weight of risk-reduction spending or to limit public contributions to seed financing or (fiscal) incentives to mobilise private-sector funds *(see Grants and Subsidies, pp. 30 and Green Taxes and Tax Breaks on pp. 35)*.

While budget appropriation in effect only contains line items in a budget, the actual funding may be effected in countless forms, ranging from cash to securities or guarantees to insurance cover. Such instruments are discussed individually in this document.

Considerations:
The predominant challenge when allocating funds for climate- and disaster-risk reduction in annual budgets is political prioritisation. Often the problem of short-term goal prioritisation is prominent in governments changing in 4- to 5-year legislative cycles, and finite budgets contrast with infinite demands. Therefore, it is very challenging to successfully allocate funds ex-ante to reduce climate and disaster risks, as climate change continues to be underestimated and perceived as a slow process with implications in the far future and disasters tend to be considered low-frequency events.

Governments play an absolutely critical role in dealing with and financing climate-change-induced events and other disasters. In terms of risk reduction, governments are obviously embedded in a network of climate negotiations, mostly but not exclusively under the IPCC[16] umbrella. Apart from the policy level, governments are responsible for protecting public assets, in particular infrastructure, from the effects of climate change and disasters.

The process of budgetary appropriation is embedded in a wider public-finance management system that is formed by policies, institutions and procedures. Risk reduction-related allocations thus need to be integrated in the general budgeting process and do not necessarily require amendments in the budget outside of ordinary planning cycles. Therefore, it makes sense that public risk-reduction funding also follows the standard public-finance management stages from strategic planning, budget preparation and approval to execution and monitoring/budget control.

To enhance the financial resilience of a country, governments conduct a risk assessment as described

16 UN body for assessing the science related to climate change. It issues comprehensive scientific and technical Assessment Reports about climate change, its impacts and likely developments.

in section 1 (> pp. 09) quantifying the expected fiscal and economic impact of climate change and disasters. Financing gaps are evaluated on the basis of a cost/benefit analysis. Considerations centre on the question of which costs can be avoided or reduced by taking risk-reducing measures ex-ante, which measures should be taken in preparation for an adverse event and which costs need to be financed ex-post. This creates budgetary transparency and leads to sound liabilities management.

Budget tagging

Budget tagging and tracking allows governments to identify, track and measure climate-and disaster-risk-related spending in national (and local) budgets. It is a useful tool to create more consistency, accountability, balance and transparency in public spending to mitigate climate and disaster risks. It is effective in pinpointing misallocated spending that adversely impacts the climate and increases the vulnerability to disasters and in optimising investment in strategic risk-reduction as well as funding for risk-management purposes. Budget tracking is also conducive to increasing and monitoring Nationally Determined Contributions and assists with tracking the use of proceeds from sovereign green bonds.

There are various methodologies to account for climate- and disaster-risk spending, and countries tend to develop a proprietary approach suitable to their budgeting policies. Besides such policy-based techniques, they can also be objective-based – and thus in line with international frameworks. To date, however, there is no commonly accepted global framework or methodology for comprehensive disaster- and climate-budget tagging and tracking. Some methodologies also use weightings depending on their relevance for climate and disaster risks or specific aspects of their management such as ex-ante risk reduction. While commonly implemented in budgeting only, it would be useful to link the methodology also to the monitoring of executed expenditure ex-post at the end of a budget cycle.

IIED and UNDRR have identified and reviewed over 40 countries including developing countries that use some form of budget tagging for both climate-change adaptation and disaster-risk reduction purposes. They found that only two countries (France and Finland) also tag 'negative expenditure', which refers to spending with harmful effects on the climate.

GREEN TAXES and TAX BREAKS

Green-tax incentives are financial benefits designed to encourage investment and activities reducing climate and disaster risk and environmental damage more broadly. While the introduction or modification of tax policies in relation to climate change is becoming more popular as a tool for climate-mitigation financing on the basis of carbon taxes, there are also opportunities to incentivise and finance climate adaptation through tax breaks and penalties. Similarly to subsidies, tax breaks or exemptions can stimulate behavioural change and/or incentivise risk-reduction measures. Tax penalties (such as green taxes), on the other hand, aim to discourage activities that are perceived as detrimental to disaster- and climate-risk reduction. They can equally encourage behavioural change and bolster government revenues, which in turn could be channelled to risk-reducing activities.

Like green fiscal-policy reform more broadly, environmental tax reform can generate multi-faceted benefits: reducing climate and disaster risk, putting economic growth on a more robust and resilient footing as well as improving living conditions by reaping co-benefits such as saving water, preserving biodiversity or safer infrastructure. Yet, like in the case of green grants and subsidies, policies need to be well-designed to avoid the misallocation of funds and maladaptation.

Design:

Conceptionally, environmental taxes aim to incorporate the cost of negative externalities in prices with a view to steering production and consumption decisions in an eco-friendly direction. Tax rebates or exemptions may be used to incentivise climate action or risk reduction by lowering investment and operating costs directly or indirectly. This way, governments could apply permanent tax breaks or temporary tax holidays to risk-reducing corporations, financial investors or households. Alongside the opposite tool of green/climate taxing, risk holders can be 'nudged', that is encouraged, to behave in an ecologically beneficial way and support climate action.

While emission taxes are well established, albeit underutilised, tools for mitigation purposes, tax incentives and penalties are still rarely applied to promote adaptation measures and disaster-risk reduction.

Essentially all kinds of taxes (and tax shields) can be modified and deployed for adaptation purposes, whether they are asset-related, income-based, consumption-based or trade-related taxes. Green taxes commonly cover transport, pollution, carbon specifically, energy and natural resources.

In addition to its (dis)incentivisation effects, tax income may be recycled and earmarked for public investments in climate- and disaster-risk reduction. This way, it may generate a further dividend, instead of allowing it to disappear into a government's general-purpose tax coffers.

On the one hand, tax advantages can also be used to incentivise the provision of other risk-finance instruments, such as reduced or no taxes on climate bonds or insurance policies. On the other hand, temporary or permanent tax increases or the introduction of new taxes or levies can be considered a fiscal-management tactic to pay for climate- and disaster-risk reduction programmes.

Considerations:
Providing tax breaks and raising taxes is not only a fiscal-policy task, but also implies a high administrative burden (transaction cost) – for both the government and the taxed entity. It is therefore important that the implementation of such (dis)incentives can be administered in such a way that the cost of handling them does not exceed its benefits. Measures to limit tax evasion are also important to preserve the effectiveness of green taxes. More broadly, achieving an optimal balance between the level and cost of (dis)incentives and their benefits is not trivial.

Leveraging fiscal policy for climate action may be hampered by concerns about the international competitiveness of high-pollution and/or high-energy industries or those with high land use. It is often argued that companies could relocate in response to (green) fiscal reform.

Climate-related taxes and tax breaks are intended to correct existing distortions in a country's fiscal system and assist in discouraging taxpayers from engaging in damaging behaviour and in enticing beneficial behaviour. In order to achieve this, such (dis)incentives need to be fine-tuned and integrated in a comprehensive framework of climate- and disaster-risk reducing policies.

China's environmental protection tax

While carbon taxes are by far the most common, also among emerging countries, and generate the highest incomes in the field of environmental taxes, some countries have additionally introduced other green taxes.

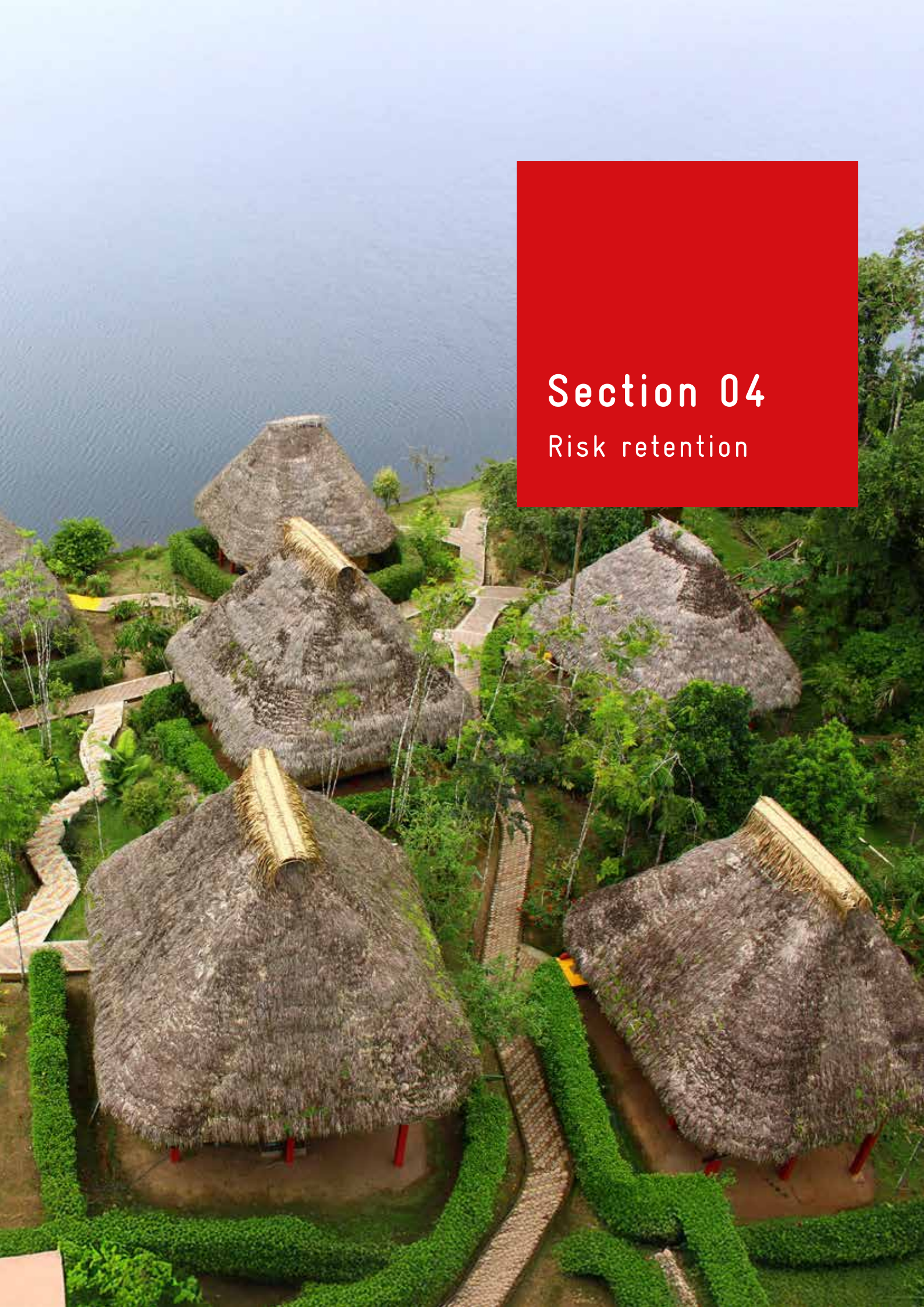
In 2018 China transitioned from its traditional pollutant discharge fee to an environmental protection tax covering the same four categories of air pollution, water pollution, solid waste and noise pollution. In contrast to the preceding uniform fee, local governments apply different tax rates depending on the level of pollution, thus penalising heavy polluters. In addition, the system provides tax deductions for emission reductions in relation to the local standard (25% and 50%).

While the incentivisation scheme provides considerable flexibility for provincial governments in terms of varying tax rates for each kind of pollutant within a range set by the central government, China has moved away from its past practice of letting off heavy polluters lightly.

Nevertheless, there is no independent monitoring system and the fear of potentially driving significant employers and income taxpayers who are (heavy) polluters into more lenient provinces has resulted in relatively low tax rates, especially in manufacturing hubs. In contrast, Beijing – prominent on the central government's radar – has imposed the highest rates. The tax effectiveness is further curtailed, given that firms that discharge pollutants and dispose of waste in the appropriate central sewage and waste-treatment systems are excluded from the tax altogether. Moreover, carbon is not captured in the context of this tax[17] and neither are pollutants from agriculture and transport.

Consequently, the tax structure in its current form has only a limited impact on pollution levels and local governments continue to prioritise economic growth over environmental degradation and climate-change concerns. Research has concluded that green benefits from the tax have been weak, that larger companies are at an advantage compared to smaller ones and that local institutional implementation capacity is essential.

17 Yet in connection with China's ETS



Section 04

Risk retention

4. RISK RETENTION

Once all possible and appropriate measures to reduce climate and disaster risks have been taken ex-ante as a precaution, risk holders can consider which risks they are willing to retain and which they wish to transfer to third parties. Risk retention is based on a planned decision to accept losses, for example as a consequence of not insuring against the risk or by acknowledging deductibles and attachment points with an insurance policy.

In general, risk retention means that those affected retain responsibility for covering the costs of an adverse event, such as a disaster or due to climate change. Therefore, it is sometimes described as 'self-insurance'. Governments and other public-sector institutions are increasingly aware of the risks they absorb and the associated fiscal challenges. Cases, in which they decide not to transfer risks can become problematic when certain population groups, especially those with a low risk capacity, are expected to bear the brunt of climate or disaster events without having a say in the matter. Depending on how influential these groups are and how devastating the event is, they may demand ex-post compensation or damage repair from governments anyway.

Risk retention is commonly used:

- For high-frequency and low-severity types of risks
- When the risk is considered lower than the cost of protection
- When the risk cannot be transferred or insured against
- When the risk holder has sufficient funds readily available to cover losses

Even in risk-transfer scenarios, the risk holder is usually required to retain a percentage of the risk to reduce moral hazard and ensure that interests are aligned.

Risk-retention instruments are pre-arranged mechanisms providing access to funds that have been set aside or at least been earmarked or can be drawn on from an external source. Regardless of whether funds are formally or informally agreed, it is advisable to define a trigger upon the occurrence of which the funds become accessible.

BUDGET CONTINGENCY

While a contingency plan is part and parcel of CDRM, contingency budgeting is a typical process in project management and annual budgeting. A certain percentage of the overall budget or an absolute amount is designated to unanticipated and/or emergency costs. Contingency funding in government budgets correspondingly relates to fiscal planning for managing the risk of cost escalations or for covering potential shortfalls.

Pre-arranged, contingency finance in climate and disaster risk is released ex-post after an adverse event occurs, and is thus used for response and recovery purposes. A government contingency allocation may well be the first funding that becomes available after a disaster incident.

Design:
In contrast to reserve funds *(> see pp. 39)*, contingency lines in a government budget are allocated annually and, if not used, returned at the end of the year and possibly reallocated in the new budget for the following year.

To avoid delays in accessing the funds in the wake of an adverse event, it is necessary to determine well in advance what the funds can be used for, in which circumstances they can be drawn (trigger) and how they can be accessed. Contingency budgets can be allocated specifically for climate and disaster risks or be general in purpose, which might possibly give rise to 'competition' with other emergencies or shortfalls that may occur.

Considerations:
Contingency plans increase the adaptive capacity by allowing for a more efficient and rapid response to disaster incidences. So, while budgeting for contingencies is considered prudent, the allocation of larger sums is viewed sceptically, however, as it defeats the purpose of the budgeting process. Earmarking funds for contingencies ultimately comes at the expense of investment or development goals (opportunity cost) and it can be politically tempting for governments to use such funds for other purposes.

A clear prioritisation of demands on contingency provisions is needed to ensure that funds remain unencumbered and available to meet high priority needs.

Facing fiscal constraints, highly indebted and/or poorly managed countries typically forego any contingency budgeting and rely on humanitarian aid when they need to deal with disaster incidences.

Contingency funds represent comparatively low-cost and flexible instruments and can usually be released rapidly, which is vital in the context of a disaster.

For more background, please refer to *> section 3, Budget Allocation, p. 34.*

South Africa

South Africa's annual budget provides for a number of ad-hoc funding needs, among them disaster-relief (and rehabilitation) funding. The annual Division of Revenue Bill allocates contingency funding labelled 'Provincial Disaster Response Grant' and 'Municipal Disaster Response Grant' to sub-national government entities. Besides these, there are also Provincial/Municipal Disaster Recovery Grants, which are larger. When a disaster has been proclaimed, affected provinces and municipalities apply for these funds to the National Disaster Management Centre and Department of Human Settlement, who in turn submit them to National Treasury. These funds become available once the National Treasury has received and processed an application. Slow response and red tape are frequently mentioned as impediments to the efficient operationalisation of these (and other) contingency allocations. Generally, the budget line for municipalities is more than double that of provinces, in line with the respective responsibilities in a disaster event. In 2022, allocations from the budget lines were predominantly made to the local government entities in and around Durban in KwaZulu-Natal in the wake of devastating floods; in late 2023 as well as January and June 2024 further funds were released following heavy rains in a number of provinces, with the greatest damage reported in the Eastern Cape and KwaZulu.

RESERVE FUNDS

Proper reserve funds not just in name are segregated multi-year accounts or fund structures that receive regular – for example, annual – contributions by governments or international aid agencies (the latter are covered in section 7, Grants and Donations, pp. xy). Reserve funds dedicated to climate and disaster events are mechanisms to accumulate ex-ante capital over time for post-disaster relief and reconstruction efforts. If the requisite policies, structures and procedures are in place, reserve funds are able to release funds speedily, similar to budget contingencies. Reserve funds are the most common risk-retention instruments available to countries.

Design:
While budget contingencies merely represent a line item in the annual government budget, reserve funds are commonly fully funded. Depending on the latter's financial structure, usually in the form of accounts/facilities or fund vehicles, they require more or less formal rules governing them. Such 'pools of money' warrant rules in terms of access and use of funds and thus need to be buttressed by at least a contractual framework.

In the case of fund vehicles, they are either owned by their managers or in the case of trust funds, for example, they hold their own legal personality. As a consequence, they require a further degree of 'institutionalisation' in terms of legal constitution, governance and functions, among other aspects. While financial facilities represent essentially conduits through which money flows, funds hold assets that they commonly invest (e.g. in company shares, bonds) and thus they can distribute (investment) income or cash from liquidated investments (monetised assets).

In some countries, reserve funds are set up as fully fledged disaster-risk finance agencies that either advise the government on climate- and disaster-risk finance or hold full responsibilities for the arrangement and management of a country's financial protection against climate and disaster risk.

Considerations:
Reserve funds need sound risk modelling and careful fiscal management to ensure they accumulate assets to match exposure liabilities.

They require strong oversight mechanisms providing accountability and preventing corruption and wasteful spending.

If the reserve fund is structured in the form of a fund vehicle, it may take a while to liquidate assets after a major disaster and, depending on the asset allocation, liquidation may take place at reduced valuation levels.

Building regional rather than national reserve funds may be more cost-effective, provided that clear rules govern their capital accumulation, spending and management.

Few pure-play reserve funds

Among the world's most known reserve funds in emerging and developing countries is the Philippines' Calamity Fund with its national and sub-national components. In reality, however, the Fund represents an annual-budget-related allocation financed by the national government as well as provincial and municipal governments.

Mexico's FONDEN, now defunct, also had a similar inception in 1996, yet evolved into a multi-year catastrophe fund accumulating the unspent annual allocations towards disaster risk and, later on, oil-revenue surplus (if any). Alongside the national trust fund managing FONDEN's assets, all provinces of Mexico had set up state-based trust funds with local and federal funding. Over many years, FONDEN predominantly financed the repair of public infrastructure after an event and relief support for low-income households. Its prevention programme was dedicated to disaster-risk reduction. In 2006 Mexico issued its first cat bond (> see section 5, pp. 43), a programme that continues today under FONDEN, while the government under López Obrador eliminated FONDEN as a separately managed reserve fund on corruption grounds, making disaster-risk financing a politically controlled, annual budget-line item again. While the category 5 hurricane OTIS in October 2023 triggered the Pacific cat bond (renewed in April 2024), the government was criticised for its slow response and inadequate funding from the budget.

CONTINGENT CREDIT

Contingent credit lines or bonds along with their equivalent on the equity or hybrid side *(> see Contingent Convertibles, pp. 41)* as well as derivatives provide funding from a third-party source upon a trigger event.[18] In climate- and disaster-risk financing, contingent credit covers urgent financing needs that arise immediately after a catastrophic event. It is predominantly used by governments (as borrowers) and development banks (as lenders).

Design:
The main purpose of contingent credit is to provide liquidity in the event of a disaster and hence ensure that there are enough resources available to respond appropriately. Contingent credit is a pre-arranged instrument that can be drawn upon quickly if the drawdown trigger is met. Credit lines are based on a loan agreement that stipulates the conditions, including trigger parameters and the validation method, for releasing funding. Contingent-bond structures have evolved into cat bonds *(> see section 5, pp. 50)*. By their nature, (insurance) derivatives are contingency-based, yet they tend to be used by specialists in the insurance and commodities market only *(>see section 5, pp. 50)*.

If there is no trigger event before the maturity date of the loan or bond, the principal is returned to lenders/investors as usual in addition to the interest payments they have received. With the different underlying of these instruments (e.g. weather instead of finance) these instruments are categorised as insurance-linked securities.

In the sovereign space, the World Bank dominates the market with its Development Policy Loans with CAT DDOs (Catastrophe Deferred Drawdown Options), effectively a loan-cum-option.

Considerations:
Specifically for governments, but also more generally, contingent liabilities can be explicitly covered by the government and therefore also laid down in a contractual obligation to finance them, or be implicit when the government steps in as a last resort, assuming responsibility based on moral obligation. In the latter case, countries may not have pre-arranged credit for such emergency situations at hand.

Like in the case of contingent budget lines, contingent credit can be generic for any emergency, although it is then challenging to define it unambiguously, unless the declaration of a state of emergency is simply used as trigger, or it may be exclusively tied to climate and disaster risk. In addition, it is self-evident that arranging contingent credit, especially in the bond format, is time-consuming and complex, and even if not triggered, pricey.

In many cases, the development of an adequate disaster-risk management plan is a condition precedent for offering contingent credit to borrowers, again especially for governments.

18 Considering that contingent credit or a contingent-credit line has both risk-transfer and a risk-retention features, this instrument could be put in both categories.

A contingent-credit facility for recovery lending

Along with Global Parametrics, one of its investees, KfW's InsuResilience Investment Fund (IIF) supported VisionFund, a microfinance network of World Vision, in launching a disaster-risk finance scheme in 2018. If a disaster event triggers the contracts, VisionFund's microfinance institutions can repair their balance sheets by obtaining capital from a payout of a multi-peril parametric disaster cover (in the form of a derivative) provided by the Natural Disaster Fund (funded by Germany and the United Kingdom, managed by Global Parametrics and matched by Hannover Re) and through a contingent-credit line. These two instruments were set up to mitigate the blow that both the microfinance institutions and their borrowers are likely to experience in a disaster: borrowers experiencing significant losses preventing them from continuing to service their debts, while large numbers of loans falling into arrears hit the balance sheets of microfinance institutions and result in them having to curtail lending and increase regulatory capital. Experience from past disasters shows that lenders require debt restructuring in the form of payment deferral and maturity extension and, when impacted more severely, additional lending to rebuild their livelihoods (recovery lending). This way, borrowers recover within a comparatively short time frame and can resume debt servicing such that loans need to be written down, but not written off. On the part of microfinance institutions, spiking non-performing loans may eradicate capital buffers and even threaten the institutions' survival if they cannot refinance themselves or raise capital. Converted into equity by the holding company, for example, both instruments provide sufficient liquidity to not only repair the microfinance institutions' balance sheets, but also to increase lending to affected borrowers so that they can recover and to secure the eventual repayment of outstanding loans.

Between 2020 and 2022 five countries in VisionFund's network of 15 received payouts for drought or tropical cyclones.

CONTINGENT CONVERTIBLES

Contingent convertibles (CoCos) are well established instruments in the banking industry and have also been issued by some insurance companies. Like conventional convertibles they are hybrid securities. CoCos are structured as fixed-income instruments and converted into equity if the trigger (strike price) is activated. They were originally designed by European regulators after the 2007–08 global financial crisis. Their purpose was to reduce the likelihood of government bailouts by automatically absorbing losses, thereby helping financial institutions to satisfy regulatory-capital requirements[19]. They have not been used in the context of climate and disaster risks yet, but their structure would certainly be suitable for the purpose.

Design:
The instrument is contingent because a loss is imposed on a third party/investor[20] should an issuer's capital fall below a predetermined threshold, typically a percentage of the institution's total risk-weighted assets. While a financial loss can also be the result of a disaster event (e.g. as a consequence of non-performing loans or asset write-downs), the trigger itself could be disaster-related, in which case shock-absorbing capital would be created upon the impact of a disaster exceeding a pre-defined threshold.

Considerations:
For an instrument to become relevant, especially in public markets, a certain depth in terms of volume and liquidity has to develop. Kick-starting CoCos for climate finance in emerging and developing markets from scratch would not be feasible; however, a steady build-up of such a market, initially through issuances and trading in Europe and the United States, would be conceivable.

SHOCK-RESPONSIVE SOCIAL PROTECTION

Climate change increases the social vulnerability of communities, especially poor ones. This may result in higher exposure to loss of livelihoods, income and assets and thus a higher claims load on social-protection systems, in particular social-assistance programmes. Such systems increasingly aim to become shock-responsive, so that the mechanism can be re-purposed to serve as a channel for emergency funds for timely distribution among affected households in a disaster context.

19 U.S. banks typically use preferred stock for this purpose; both instruments rank similarly in the capital structure of a bank.

20 As mentioned before in the context of contingent financial instruments, CoCos also have both risk-retention and risk-transfer features and can thus be put in both categories.

Rather than finance instruments, such adaptive and shock-responsive social-protection systems[21] are delivery mechanisms, i.e. conduits through which funding can be allocated efficiently in the aftermath of a disaster event or as a result of slow-onset hazards.

Design:
National social-protection schemes tend to be viable in middle-income countries only, that is in contexts with reasonably stable institutions, a solid infrastructure and data-management capacity as well as sustainable funding. International agencies/NGO run programmes that function in a similar way, although on a more rudimentary basis *(> see box below)*. Adaptive social protection (ASP) schemes tend to be developed on the basis of reserve-fund structures *(> see Reserve Fund, pp 39)*; funds are distributed via cash transfer, voucher or in-kind. The shock-responsive component could be based on an insurance contract or on contingency financing. A pre-requisite for the operability of an ASP system is the capacity to identify and reach poor and vulnerable households as well as those who are likely to suffer transitory destitution due to the impact of a hazard. This is particularly challenging for developing countries.

In response to a major shock, e.g. a disaster event, a government would activate a scalable component of its ASP scheme, sometimes by vertical or by horizontal expansion or both. This way regular beneficiaries may receive top-ups on their normal benefits for a certain period and/or pre-registered vulnerable households temporarily receive benefits when they would usually not.

Considerations:
Although it is recognised that better alignment and integration of social assistance with disaster-risk management is vital, examples of such systems are still few and far between. Increasingly, climate-change adaptation is also being folded into the nexus, raising complexity.

Ideally, ASP is not only considered an ex-post funding mechanism (i.e. shock-responsive), but likewise a resilience-enhancing tool - if structured in the right way.

Rules and norms need to be established - like in the case of any social or humanitarian programme - right from the outset in terms of who can become a beneficiary, for how long and how comprehensive coverage can be or has to be.

The Hunger Safety Net Programme in Kenya

The Hunger Safety Net Programme (HSNP) provides unconditional cash transfers to some 125,000 poor households in Northern Kenya. The region is largely arid and experiences high food insecurity. In 2009 the Government of Kenya with support from the United Kingdom, set up the scheme to safeguard food consumption.

It expands the programme with temporary emergency payments to additional vulnerable and/or affected households in times of severe drought and flooding. Triggers are based on a vegetation-condition index. The programme can scale up by approximately quadrupling the number of beneficiaries in an emergency situation. Households already receiving regular cash transfers under the programme do not benefit from emergency payments.

Beneficiaries spend this cash not only on food but also to cover health expenditures, expenses in the context of accessing education for their children or home improvements.

Payments are made to bank accounts, which can be accessed via debit cards that also hold a digital-wallet function.

For 2024 the Kenyan government allocated some EUR 30 million to the programme and it intends to expand it further. Besides the HSNP, Kenya maintains other social-protection programmes (e.g. for severely disabled people), social security (old age) and a number of socio-economic empowerment funds.

21 Per definition, adaptive and shock-responsive social protection provides help to poor and at-risk households to cope with severe disruptions like disasters, crises, pandemics, and armed conflict. Increasingly, adaptive social protection (ASP) is considered the umbrella term, while shock-responsive social protection is a sub-set. ASP tends to be broader in scope, e.g. by also dealing with accessibility questions for disadvantaged groups (i.e. applying a gender and/or disability lens).

Section 05

Risk transfer

RISK TRANSFER

After determining the risk threshold, up to which a risk holder is able to carry risk, it is advisable to transfer risk exceeding this capacity to third parties. These are often insurance companies with higher risk capacities and more diversified portfolios or investors in various forms of risk pools using a range of financial instruments.

Transferring risk to third parties has a price tag as these risk takers will apply a safety buffer to their risk calculations and also need to earn a return. Therefore, risk transfer, often in the form of insurance, is typically applied to low-frequency and high-severity climate and disaster events that could eventually overburden or financially ruin the current risk holders.

The tipping point between retaining and transferring risk (components) is not only determined by the financial capacity of the risk holder but also the 'insurability' of the risk in question. As such, among other factors, insurable risk must be the result of an unintended action or an uncertain event and hence be unplanned in its exact timing and impact. At the same time, it needs to be measurable, allow for statistical modelling and be based on a sufficiently large and random sample of insured parties.

With increasing manifestations of climate change, climate and disaster risk is arguably approaching a threshold, above which it is no longer insurable – in extremis when the annual premium for an insurance policy equals the sum insured with a theoretical one-year return period. This means that essentially risk transfer is a bridge mechanism, and significant climate action (risk reduction) is inevitable.

INCLUSIVE CLIMATE INSURANCE

Inclusive climate insurance is the umbrella term for transferring risks associated with disasters from vulnerable and/or underserved groups or sectors, such as households or MSMEs in developing countries, to the insurance market.

The target group for such insurance has so far been neglected and has either been excluded or underserved by the insurance sector. Vulnerability in the context of inclusive insurance is understood to be caused by the target group's lower income, social status and/or exposure-related concerns – for example, small farmers working their fields in arid zones or micro-enterprises located on a river bank. An insurance model for low-income population segments, often in developing countries, microinsurance is a – dominant – subset of inclusive insurance.

Design:
Coverage and premium payments under inclusive and microinsurance are by design low due to affordability constraints. In addition, to cater to low-income people, premiums are paid in small instalments and tenors tend to be short.

Inclusive insurance can be offered on the micro (individual policyholders), meso (group policies often facilitated by an aggregator such as an MFI) or macro (national/regional) level. As climate insurance covers 'covariate' or 'covariant' risks, which are systemic risks of a hazard impacting an entire region, it is therefore often provided on a macro or meso level. Climate insurance includes agricultural insurance, which is addressed separately below *(> see p. 45)*.

Climate insurance used to be offered in the form of conventional indemnity insurance, with loss adjustment taking place onsite after an insured event in order to assess the damage. With the help of technology, climate insurance is increasingly being provided in the form of index insurance based on parametric triggers. Rapid developments in remote sensing, especially satellite technology, have made it possible to measure perils, such as wind speed, rather than the actual damage to the insured object. If the measured value exceeds a certain threshold, the insurance payment is triggered. Measured parameters are compared to a 'normal' level, derived from spatial and temporal data and measured or modelled covering many years/events, and payouts are determined based on the severity of a hazard proper and not its impact on the ground.

Considerations:
In order to be viable in a vulnerable low-income context, inclusive insurance needs to take into account the low level of insurance literacy of its target group. Thorough explanation is necessary, especially for parametric insurance, which may result in policyholders with no

damage receiving a payout and those with high losses not receiving one (due to basis risk[22]).

To access population segments that so far have been neglected by the insurance industry, it is necessary to utilise novel distribution models and channels, for example by working through aggregators (MFIs, retail shops) that are trusted and used by the target group in question.

For economic reasons, inclusive insurance is only viable in a mass-market context where high volumes as well as automated and digitalised processing can compensate for the high transaction costs.

Microinsurance in the Philippines

The Philippines has a strong track record in microinsurance provided by the private/non-governmental sector. One of the largest providers are the CARD Mutually Reinforcing Institutions (CARD MRI), a network of 23 institutions focused on microfinance and community-based social development undertakings especially targeting women. Also owned by members, its insurance arm CARD MBA (microinsurance mutual benefits association) developed from an informal credit-life initiative and now offers a broad suit of life and pension products to its 7.5 million customers (members), holding an 85% market share in the MBA sector (2023).

As a response to the devastating effects of Super Typhoon Durian in 2006, CARD MRI set up CaMIA to provide non-life and life protection to low-income people predominantly in connection with extreme-weather and disaster events. One of its schemes combines property as well as life and health insurance cover for low-income families in the wake of disaster events such as earthquakes or typhoons. In 2023 it paid out close to EUR 1.8 million to some 58,000 claimants. This and other products are sold across the CARD MRI group including by CARD Pioneer, a microinsurance provider that emerged from a partnership between Pioneer's Life microinsurance line of business and CARD.

According to the Philippines Insurance Commission, microinsurance provided by MBAs and life and non-life insurance companies generated around EUR 220 million in collected premiums in 2023, of which MBAs accounted for a share of 55%. Life products make up the majority. Premiums are usually paid on a weekly basis and capped for affordability reasons, for example in Metropolitan Manila at 7.5% of the minimum wage.

AGRICULTURAL INSURANCE

Agricultural insurance accounts for the majority of climate-insurance schemes. It transfers risks associated with climate- and weather-related hazards and may include a wider range of hazards than the typical drought, excessive precipitation or cold spell/frost, also covering hail, lightning/fire, wind and other perils. Although only indirectly weather-related, pests and diseases tend to be covered too. While insurance for crop cultivation is by far predominant, there is also insurance for livestock, aquaculture and horticulture, among other economic activities.

Agricultural insurance is often provided in the form of a public-insurance scheme managed or mandated by governments and is generally heavily subsidised. The largest agricultural-insurance markets are the United States, China and India. Schemes run by the private sector or NGOs in developing countries tend to struggle (as they are generally not viable without subsidies or donor funding).

Design:
Indemnity-based products, such as multi-peril or named-peril crop insurance, tend to be used by large commercial farmers and often in developed markets, while mass-market schemes for smallholder farmers in developing markets, for example, are index-based and parametric. The trigger for the latter can be hazard-related *(> weather-index insurance, see Inclusive Climate Insurance above, pp. 44)* or yield-based (area-yield insurance). In the latter, originally developed in Sweden and predominant in the United States and India, the payout is based on the average yield of the area (e.g. county). If the predetermined threshold value of the insured yield is higher than the realised yield of the area harvested,

22 Basis risk is a mismatch between the index measurement (or the measured parameter during an event) and a policyholder's loss (or the effective damage to an insured object). Thanks to advanced technology, basis risk is markedly diminished in most geographies.

the insurance is triggered regardless of the actual yield generated on the policyholder's specific plot.

NDVI[23]-based insurance is another method used in agricultural insurance. It has broad applicability, from precision farming to land-cover identification, yet is often used for forests and forage/pastures and thus, livestock insurance of roaming herds. The index relates satellite-measured moisture deficit to pasture degradation and can be designed in such a way that payouts are triggered before a catastrophic loss of livestock takes place.

Given distribution constraints in accessing often widely dispersed small-scale farmers and in light of financial concerns regarding affordability, agricultural insurance for smallholders is often bundled with other products, such as seed or fertiliser (using the distribution network of agro-dealers) or loans. If the payment schedule of microcredit is aligned with farmers' crop calendars, premium payments may become viable and MFIs benefit from a less risky loan book when insuring farmers' crops.

Considerations:
Usually only owners of land can obtain both financing and insurance for their crops. Tenants, who in a development context tend to have few financial resources and are therefore much more vulnerable to shocks, are often excluded from finance and insurance. Taken a step further, in many countries it is predominantly men who own land, while women work in the fields. As a result, insurance benefits may not always be allocated optimally after a disaster.

The use of technology both in terms of crop monitoring (and ideally, payout settlement) and in processing is vital for agricultural insurance, especially when subsidies are scarce. While transaction costs are high, modern remote-sensing technology in combination with reliable algorithms diminishes basis risk and keeps costs down.

Index-based insurance effectively deals with moral-hazard[24] and adverse-selection[25] concerns as weather patterns and area yield – if measured correctly by third parties – cannot be manipulated by individuals.

With climate change materialising in more severe and more frequent disasters, the insurability of agriculture or, in other words, the affordability of agricultural insurance becomes a major challenge. Shifting to climate-smart agriculture by applying all kinds of adaptation measures is imperative, especially in the more vulnerable regions of the globe. Yet in some areas, conventional agriculture may become unfeasible.

India's national agricultural-insurance programme

In 2023, agriculture still made up approximately 15% of India's GDP and employed some 46% of India's workforce[26]. The largest crop-insurance scheme by number of policyholders, Pradhan Mantri Fasal Bima Yojana (PMFBY) is a government-backed crop insurance scheme launched in 2016 to support the agricultural production of some 10–18 million[27] (mostly smallholder) farmers, covering over 50 crops in two annual seasons against weather-related disasters, pests and diseases. The insurance coverage provided by PMFBY is an area-yield product based on the average yield of the crop as determined through a system of crop-cutting experiments (CCEs) conducted by the government. The sum insured is calculated as the average yield of the crop multiplied by the area under cultivation and the crop's minimum support price as determined by the government.

Insurance companies in PMFBY charge an actuarial premium rate without any cap, yet share profits and losses with the government. Farmers, however, only pay a fixed percentage (generally 1.5–2%) of the sum insured as a premium. The difference between the actuarial premium rate and the premium rate paid by farmers – the premium subsidy – is shared between the state and central governments. In poorer regions, premiums are fully paid by the (central) government.

23 Normalised Difference Vegetation Index

24 When a policyholder's behaviour, due to his or her reliance on risk transfer/sharing, causes damage or exacerbates it, e.g. when a farmer covered by indemnity-based insurance neglects his or her field

25 When schemes predominantly attract policyholders who have an expressly high exposure to the risk covered, e.g. property owners who live on the embankment of a river prone to flooding

26 Includes activities affiliated with agriculture

27 Depending on the crop season

The high administrative burden, manipulation of yield data and payment delays by (predominantly state) governments have resulted in the withdrawal of many insurance companies from the scheme over the past years. In contrast, the government reported in spring 2024 that farmers' enrolment increased by 27% for 2023/24 (after +41% and +33% in the two previous periods); about 42% of the farmers enrolled in the scheme did not hold loans. Over time, PMFBY has become a costly scheme for the government, while failing to provide adequate and timely financial support to farming households.

REINSURANCE

Primary insurers focusing on selling policies to households and businesses tend to operate in lower loss layers, characterised by comparatively high-frequency and low-severity impact events, or even just act as so-called fronting insurers,[28] retaining only some 10–20% of risks in more challenging markets such as developing countries. They commonly cede higher loss layers or even the majority of their risk exposures to reinsurers. Private-sector reinsurers operate globally and achieve economies of scale and a high degree of diversification across geographies and covers. Public-sector reinsurers, in contrast, are usually focused on the domestic market and backed by their country's financial capacity.

With climate change increasingly manifesting in more frequent and more severe catastrophes, reinsurers have started to scale back their exposure to climate-induced risks. As a consequence, certain climate-related risks and exposures are gradually becoming unaffordable, uninsurable or only transferable to a broader range of risk takers through costly capital-market solutions. Accordingly, the protection gap is increasing rather than decreasing. Reinsurers are regularly identifying climate change as their number-one risk.

Design:
Reinsurance has two basic forms: it may be transacted on a treaty basis or on a facultative basis. Treaty reinsurance is based on binding contracts between insurers and reinsurers and covers an entire portfolio of risks, while facultative reinsurance is transactional and both parties have the option to cede/accept certain risks. In both categories proportional and non-proportional business is differentiated. The former typically consists of a 'quota-share' arrangement whereby both parties essentially stand side by side and share risks, premiums and losses at a certain percentage. Non-proportional business takes the form of bilateral contracts, under which reinsurers take over a pre-agreed layer of a specified risk, such as risk above a certain threshold (excess of loss), against a negotiated premium.

In the Alternative Risk Transfer (ART) market, reinsurers, brokers and other structurers offer a broad range of non-traditional solutions that imitate (re) insurance. Some of these solutions are covered separately in this publication (e.g. self-insurance[29], contingent capital[30], derivatives[31], insurance-linked securities[32], etc.). The key drivers of such structures are cost and regulatory/risk-bearing capital.

Considerations:
While (re)insurance (in its typical format) remains the default option for risk transfer, it competes with capital-market-driven or other alternative solutions, yet often has a better cost-benefit ratio.

The cost of (re)insurance is a significant catalyst for implementing risk reduction measures, and (re)insurance companies are leading the way in promoting and incentivising such action. However, when premiums closely reflect the underlying risks, (re)insurance becomes less appealing to high-risk insurers, households and businesses.

So far unmodelled risks (especially in secondary perils[33] such as flooding or wildfires) and the inherent challenge of attributing extreme events or adverse developments to climate change may result in climate change not yet being fully reflected in catastrophe modelling and pricing.

28 Primary insurers that pass on all or most of the risk underwritten to reinsurers

29 Including through most forms of risk retention *(> see section 4, pp. 37)* or *> risk pools (p. 51)* or captives *(> see footnote 13)* or mutual insurance/Takaful *(> pp. 48)*

30 *> See section 4*, contingent convertibles, *> pp. 41*

31 *> See p. 49*

32 Such as cat bonds, *> see p. 50*

33 Resulting in knock-on impacts from primary perils

(Re)insurance companies are large investors and based on their climate-risk expertise also very active participants in global initiatives to combat climate change, reduce emissions and increase adaptation and reporting.

Facing the inevitable truth: adaptation instead of unsustainable market control

Predominantly responsible for the anthropogenic effects of climate change globally, richer countries keep straining public budgets and (re)insurance markets in order to protect households in high-risk areas, such as exposed coastal regions or at wildland-urban interfaces. The United States is a case in point and an example of where many (wealthier) countries are heading: over the course of the last years, homeowner's insurance has turned unprofitable in more and more states, well beyond California (mainly due to drought and wildfires as secondary peril) and Florida (hurricanes along with flooding). In 2023, insurers lost money in 18 states, while it had been 12 states five years ago and 8 states in 2013. In such circumstances, the (re)insurance sector mitigates losses and reduces exposure by significantly raising risk-based premiums and scaling back on high-risk business. The effect is that policyholders, for example with houses close to exposed seashores, either pay prohibitively high premiums, retain the risk by going without cover or start adapting to climate change by applying risk-reducing methods and eventually by moving more inland. Governments, however, often prevent this by providing heavily subsidised insurance through public insurers (e.g. Citizens Property Insurance Corporation in Florida) at the expense of all citizens, tampering with insurance regulation and/or directly enforcing distorted pricing, sometimes on the basis of outdated models (as in California).

MUTUAL INSURANCE/TAKAFUL

Mutual insurance, which involves a group of policy-holders self-insuring, is the historical foundation of the insurance industry.

A mutual insurance company is entirely owned by its policyholders (members), has no other investors and only provides insurance to its members. While cover is provided at or near costs, any profit is returned to policyholders, for example in the form of dividends or a reduction in premiums. Sometimes a mutual insurance structure is also used for certain types of lines within a conventional insurance company. Takaful is the equivalent of mutual insurance in Islam and when Sharia-based principles are adhered to, it is generally called Islamic insurance, a subset of Takaful.

Design:

Records suggest that the origins of mutual insurance can be traced back to Babylon and the Indian subcontinent before the concept spread, being introduced in Europe via the ancient Greeks and Romans, with the first insurance company in London founded in 1680 after the devastating Great Fire of 1666. From its inception, (mutual) insurance built on lending contracts (e.g. for ships and ship loads) and the impact of natural disasters.

The community-oriented approach means that the members' or policyholders' joint interests are at the centre of all activities and the structure can cater to specific professions or geographic regions. The community aspect is even more accentuated in Takaful, often translated as 'mutual guarantee'. Households or companies join up to form a co-operative system of contributing to a mutual pool of funds, from which they are reimbursed for losses. Islamic insurance, which is Takaful compliant with Sharia rules, has grown fast and basically makes up most of the Takaful universe these days.

The capital base of a mutual insurance company is called surplus, and capital is raised by issuing surplus notes that are bought by the members.

Considerations:

Following the path of the co-operative banks that had been established in many poorer countries to provide basic financial services and microfinance, mutual insurance has likewise been growing strongly in those countries over the past decades, with companies primarily active in microinsurance, in particular agro-insurance.

While essentially any community or village group can build an informal mutual-insurance club (similarly to a savings group), it is the larger and diversified mutuals that have the capacity to engage in climate- and disaster-risk insurance due to the systemic risk feature of climate-induced disasters. As such extreme-weather events tend to affect entire regions at the same time, the capital (or resources) of local, poorly diversified mutuals (or clubs) can easily be depleted.

Islamic insurance

Islamic insurance is built on Takaful and adheres to Islamic principles. These explain the structural differences to conventional for-profit mutual insurance: uncertainty, gambling and usury are stated as the fundamental issues with conventional insurance. Uncertainty is believed to be too high, including for example because a loss adjuster typically makes an assessment which determines the payout in case of damage, uncertainty appears to border on gambling if the insurance company stands to benefit (makes a profit) when no loss is incurred by the insured, and the investment of premiums in interest-bearing instruments along with a potential payout of the returns as bonus is perceived as usury. While originally Takaful and Islamic insurance were not meant to be for profit, this has changed in modern times and can thus chafe against traditional principles.

The first Islamic insurance company in modern times was launched in Sudan in 1979. Since then, Takaful and Islamic insurance has proliferated in the Muslim world with various models and formats and offering a range of covers. By total size of premiums/contributions they are strongest in Saudi Arabia, followed by Iran and Malaysia. Although structures differ from one country to another due to differences in practices, regulation and, for Islamic insurance, Sharia boards, the overall growth trajectory of Takaful and Islamic insurance is very strong, particularly driven by higher insurance penetration. A number of research firms expect the global Takaful market to exceed the EUR 30 billion mark in 2024.

DERIVATIVES

In finance and investment, a derivative refers to a financial contract whose value depends on an underlying asset or benchmark/index. It can be tailor-made and set between two parties (over-the-counter) or standardised and traded on an exchange. A financial derivative generally takes the form of a future or forward contract or an option or swap. Mechanisms that are more complex, by combining derivatives for example, are called structured products. Derivatives can be used to mitigate risk (hedging) or to assume risk with the expectation of a commensurate reward (speculation). In climate finance, derivatives transfer risk to a risk carrier and are predominantly used for hedging purposes, mimicking an insurance policy. Weather derivatives and industry-loss warranties (ILW) are the main products and are categorised as insurance-linked securities (ILS) like cat bonds *(> see p. 50)*.

Design:
Non-regulated providers of (climate) risk-transfer products typically use derivatives and, conversely, regulators usually do not regard weather derivatives or industry loss warranties in derivative format as (re)insurance contracts. While insurance tends to cover high-impact risk such as catastrophic weather events, derivatives address the full range of risks.

A forward represents a private and customisable contract to buy or sell an asset at a specified price at a pre-agreed time (at the end of the contract). While a forward is an over-the-counter instrument, a future is standardised and traded on an exchange. Buying an option provides the right but not the obligation to buy (call) or sell (put) an asset at a specified price if a certain threshold (strike) is reached during the contract period.

As implied by its name, an industry loss warranty is an insurance-linked security in the form of a reinsurance or derivative contract, through which a company – such as a (re)insurer or a trader (energy, hedge funds) – obtains or (under)writes coverage for the total insured loss experienced by the industry rather than their own losses from a specified event (typically above a certain threshold). ILW contracts tend to be annual and live Cat ILW are sold during an adverse event, dead Cat ILW post-event when the total loss amount has not yet been calculated and back-up Cat ILW protect against follow-on events. Payout is determined by an agreed index (for 'occurrence ILW' payout is in relation to a single event, for 'aggregate ILW' for a set of events). ILW, typically fully collateralised, can only be booked as a reinsurance contract when the buyer has an insurable interest and would suffer a certain level of retained loss from any insured events (dual trigger). Otherwise, the ILW must be booked as a financial derivative. Besides reinsurers, hedge funds but also energy traders are active in the ILW market.

The majority of buyers of weather derivatives are weather-sensitive businesses, especially energy companies, buying cover for weather risks that are likely to result in a decrease in income and/or production levels, business interruption or facility damage, such as manufacturers of sunshades seeking cover against rainy summers. Increasingly, climate-related exposures in developing countries (e.g. in agriculture) are also covered by weather derivatives as an alternative or in addition to insurance.

Considerations:
In the past, there have been cases where the agreed trigger and the index chosen to represent it have been misaligned; this led to differences in loss estimates and conflicts over whether a contract was triggered.

Investors in insurance-linked securities such as weather derivatives or ILW value weather/climate and disaster risk as an asset class largely uncorrelated with equity and bond markets.

Starting a secondary-trading market for industry loss warranties in stable coin

Typically, ILW are not issued in note format and thus, are generally considered buy-and-hold instruments and not tradable. Therefore, investors in insurance-linked securities outside of the (re)insurance industry tend to shun ILW, preferring more liquid instruments. To increase liquidity in ILW, insurtech Nayms developed a trading platform for ILW in cryptocurrencies based on blockchain technology (smart-contract system) and regulated by Bermuda.

Having partnered with Nayms to issue the first cryptocurrency-denominated ILW in early 2023, asset manager Resolute Global Partners sold 50% of its holding to a third party as of mid-2023. The ILW provides U.S. named-windstorm protection for industry losses above USD 60 million and collateralisation using USD Coin, a stable coin, and a segregated account on Ethereum.

Investors' interests in such ILW are represented by participation tokens for the respective insurance. Buyers purchasing such tokens become the new owners of the tokenised asset (risk) in proportion to their holdings and at the end of the ILW's on-risk period are entitled to a pro-rata distribution of the insurance pool's assets, including principal and profit.

This allows illiquid and chunky insurance-linked securities such as ILW to be split in smaller pieces and rendered tradable, thus increasing the instrument's suitability for investment and ultimately market depth.

CATASTROPHE BONDS

Catastrophe (cat) bonds are another example of alternative risk-transfer

(ART) instruments and insurance-linked securities (ILS). They transfer a specific set of disaster risks from the issuer (typically a (re)insurer, sometimes a sovereign) to capital-market investors, such as hedge funds or pension funds. Typically, they have a tenor of three years and if an event protected by the security activates the specified trigger, a payout to the (re)insurance company is effected and the obligation to pay interest and repay the principal of the bond is deferred or waived. Investors accept the risks of one or several named-peril events in return for attractive investment returns that are largely uncorrelated to financial markets.

Design:
In the wake of Hurricane Andrew in 1992, a category-5 storm and a major loss event, the insurance industry realised that such disasters could deplete the sector's capital base, thus requiring a significantly deeper pool of capital from alternative sources.

Payouts are either based on indemnity or industry loss or on parametric triggers. Primary insurers prefer indemnity triggers (based on actual losses experienced by the issuer), while investors and reinsurers lean towards parametric triggers, which protect them from moral hazard, pay out faster and have become more prevalent in the meantime. Industry-loss triggers (based on aggregate losses of the insurance industry) make the instrument similar to ILW *(> see Derivatives, pp. 49)* bar the format of the instrument.

Considerations:
Cat bonds are 100% collateralised and, after the financial crisis, are nowadays structured in such a way that counterparty risk is minimised. Although the bond structure does not come cheap, cat bonds tend to exert downward pressure on reinsurance prices (and their volatility), while increasing depth and liquidity of capital for risk-transfer purposes.

Typically, cat bonds are considered high-yield bonds. These are non-investment grade bonds and, as such, geared towards qualified investors. Their nature as an instrument activated by an unpredictable disaster event and hence by 'chance' and largely uncorrelated with financial markets, brings investing in cat bonds close to speculation.

The World Bank issues cat bonds for developing countries

Through its Capital-at-Risk Notes programme, the World Bank (IBRD) has issued a number of Ccat bonds for developing countries and for the Caribbean Catastrophe Risk Insurance Facility (CCRIF) (› see example in Risk Pools, p. 51). The Bank's AAA risk rating allows it to deviate from the conventional structure of establishing a special purpose vehicle (SPV) and a trust (holding and investing the collateral), so that it can manage capital more flexibly. It has strong growth plans and hopes to increase issuance by 400% over the coming five years.

In spring 2023, it issued a parametric Ccat bond of USD 350 million covering earthquake risk for Chile. It makes payouts on a per-occurrence basis across a three-year term. The 'quake-in-the-box' trigger activates a payout at 30%, 50% and 70% of principal, yet instead of using just one, boxes run along the length of Chile and also cover neighbouring territory including off the coast (thus also covering tsunami risk). 76% of the amount was bought by ILS funds and the price was fixed at 4.75%. In addition, USD 280 million of parametric earthquake cat swaps were issued. This deal represents the Bank's largest single-country transaction in this category so far.

In spring 2024, Mexico's parametric disaster-risk coverage issued through the World Bank was renewed and expanded: three cat bond tranches amounting to USD 420 million in total, with a tenor of four years against earthquakes (two) and Atlantic hurricanes (one) and subsequently, another one of USD 175 million against Pacific hurricanes. Payouts are funded by principal reductions of the bonds. ILS funds have bought 65% and 73% respectively.

RISK POOLS

Risk pooling is a practice whereby risks and benefits are shared across a number of parties. Such arrangements can be structured as a purely notional pool or as an actual pool to which risks and benefits are transferred. The purpose of pooling structures is to spread and diversify risks across multiple parties so that pooling results in a risk reduction compared to each party retaining their risks. Conceptually, insurance through risk pools can be considered a rudimentary form of mutual insurance or a captive[34], and it depends on its actual design whether this is best described as risk transfer or risk retention along with an element of risk reduction.

Design:
Parties contributing to a pool consist of like-minded institutions, often insurance companies, or countries. It is possible to pool only notionally, in which case risk holders continue sales and operations individually and keep the business on their balance sheets, yet notionally segregate it from their portfolios (and account for it separately). In such an arrangement, an agent calculates the pro rata capital, risk and profit and loss contributions for each participant. An actual pool, however, typically requires the establishment of an independent SPV or trust, such that the business moves off participants' balance sheets and proper management and governance structures have to be set up for the pooling entity. While an independent pooling entity has governance and aggregation advantages (e.g. facilitating reinsurance arrangements), it is costlier and more cumbersome in terms of administration.

The main rationale for risk pooling is the increased degree of diversification that can be achieved, which together with a joint capital and reserve base generates cost reductions and efficiency gains.

Risk pooling is common for catastrophe risks, especially for climate events, and for health and social protection, yet can also be seen in finance/investment and supply-chain management.

Considerations:
Risk pooling involves standardisation, such as with respect to coverage and its terms, to allow for efficient administration. Conversely, it calls for diversification, for instance regarding the risk profile of policyholders or geographic coverage, to unlock its benefits in comparison with retention or insurance. An adequate pool size is imperative for its effectiveness.

34 A captive insurer is wholly owned and managed by its insured. In contrast to an insurance mutual, an insured entity contributes capital to the captive, runs and controls it. It operates outside of the regulatory framework for insurers and often consists of corporates who self-insure through such a structure. The main drivers of such set-ups are unavailability of cover in the market and cost-effectiveness (or in other words, a different perspective on the risk exposure).

Sovereign catastrophe-risk pools

So far, four multi-country climate- and disaster-risk pools have been established: the African Risk Capacity (ARC), the Caribbean Catastrophe Risk Insurance Facility (CCRIF SPC), the Pacific Catastrophe Risk Insurance Company (PCRIC) and the Southeast Asia Disaster Risk Insurance Facility (SEADRIF).

Through risk pooling, usually on a parametric basis, these sovereign mechanisms provide coverage to countries more cost-effectively than individual governments would be able to if they had to maintain their own reserves or if they were to independently purchase insurance in the (re)insurance market.

The oldest and largest pool, originally established through the World Bank with donor funding in 2007, CCRIF effectively functions as a mutual insurance company controlled by the participating governments in the Caribbean and in Central America (via two segregated cells). While retaining a portion of the risk portfolio through its joint capital base, it cedes risks above its risk capacity by purchasing catastrophe swaps (› see Derivatives, p. 49) and reinsurance. To its members, it provides parametric-insurance coverage to protect their economies from devastating hurricanes, earthquakes and excess-rainfall events, paid out within a two-week time frame; more recently, it added cover for fisheries and public utilities. In 2014, it sponsored a USD 30 million cat swap with the World Bank as counterparty, issued its first cat bond (USD 30 million back-to-back), and transitioned from a facility to a segregated portfolio company (SPC), supported by KfW among others. In 2023 it ceded risk in excess of USD 1 billion and paid out USD 4.9 million alone during the Atlantic hurricane season, while in 2024 it paid out USD 55.6 million to Grenada alone in the wake of hurricane Beryl.

ARC was established in 2014 as a specialised agency of the African Union to advise its African members on risk preparedness and response, and as an insurance mutual. While it intends to expand its products to include more perils, up to now it offers parametric coverage for drought and tropical cyclones, launching parametric epidemic cover for Senegal in 2022 and starting to offer flood insurance in 2023. Alongside its sovereign programme, in 2018 ARC Replica was set up to support the work of humanitarian agencies for affected populations35 by essentially replicating the terms and conditions of the sovereign policy so the two programmes work in parallel. Among others, KfW supported the establishment of ARC Replica and continues to provide premium support to member countries.

Similarly to CCRIF, PCRIC traces its origins to a World Bank initiative of 2013. It continues to be donor-supported and is now structured as a foundation owning a captive insurer[36] for Pacific nations. The risk pool offers parametric cover for tropical-cyclone and earthquake risk (with a tsunami rider) and intends to launch an excess-rainfall and drought insurance product. In 2023 Fiji, a founding member, signed the first insurance policy for tropical cyclone and in early 2024 a Fiji-based NGO took out cyclone cover to protect the reefs of an island group. PCRIC has also set up a private-sector window to assist the local insurance sector.

The newest sovereign risk-pool initiative is SEADRIF, initiated and supported by the World Bank, ASEAN, ADB and donors for the benefit of South-East Asian countries. It was set up in 2019 as a trust owning an insurance company. SEADRIF underwrote its first and so far still only policy, consisting of flood cover with parametric and finite[37] components, for Laos in 2021. It made payouts against the finite contract in 2023 within one day from receiving the government's claim. In early 2024 the country's flood cover was revised and renewed.

In 2023, the four sovereign risk pools were reported to be exploring a joint reinsurance facility to further increase capacity. However, they have first settled for a partnership to jointly promote disaster-risk finance solutions under the banner of 'Resilience Risk Pools'. Such an arrangement, should it ever materialise, would amount to these risk pools pooling their risks among themselves, which could provide greater risk diversification to the 'pool of pools', thus allowing further capital efficiencies to be realised.

Generally, by putting a price tag on risk, sovereign catastrophe risk pools also intend to create incentives for countries to invest in risk reduction.

35 › See also the Preparedness section, pp. 54

36 › See footnote 34

37 Covering a fixed share of losses below the parametric trigger and a broader set of perils

Section 06

Risk prepardness

PREPAREDNESS

In CDRM, preparedness describes (an improved) capacity to cope with disasters by developing forecasting and operational disaster-management and -response capacities. The immediate objective is to reduce the impact of disasters and to help avoid disasters, namely by taking precautionary measures so that hazards do not turn into disasters.

As a consequence, funding related to readiness and anticipatory finance is predominantly geared towards spending (the release of funds) and less towards financing (the raising of funds). This also applies to the response phase *(> see p. 57)*. In other words, as of this phase in the continuum, equal attention ought to be paid to 'money in' and 'money out'.

While governments are in the driving seat in this phase and in subsequent phases of CDRFI, new actors and new funding mechanisms come into play, especially in developing countries: humanitarian-aid agencies and humanitarian finance. Albeit traditionally focused on response and recovery, donor-funded humanitarian agencies strive to reduce the time lag between disaster occurrence and humanitarian aid delivery by supplementing overwhelmed and depleted government resources. The longer-term goal is to avert a disaster by kick-starting activities and funding at an early stage.

In the past decade, the humanitarian sector has made progress in shifting from a reactive to a markedly more pro-active and thus anticipatory approach in dealing with disaster risk. Equally, financing for humanitarian assistance – previously essentially ad-hoc in nature – now strives to integrate risk assessment and preparedness beyond its earlier focus on response. It is widely recognised that better post-disaster outcomes can only be realised if both operational and financial preparedness are achieved and seamlessly integrated.

Notwithstanding these intentions, anticipatory finance continues to represent only a tiny share of total humanitarian finance. Moreover, conventional humanitarian assistance provided after a disaster event remains slow and continues to be hampered by cumbersome processes. While aid agencies need to overhaul both their logistics and their fund-raising approach, donors also struggle to commit and disburse humanitarian aid in a pre-emptive and pre-arranged manner.

Preparedness-oriented funding needs to be agreed upon, arranged and released in advance. Consequently, finance has to be embedded in early-warning mechanisms that include general disaster-risk monitoring and specific forecasting. Typical preparedness activities include establishing early-warning systems, contingency planning, stockpiling supplies and equipment, making pre-payments to vulnerable populations, identifying emergency supply delivery channels and evacuation routes as well as shelters.

FORECAST-BASED FINANCING

Forecast-based Financing (FbF) is an anticipatory financing approach that releases pre-arranged funds for pre-agreed activities when a forecast trigger occurs, to prevent a disaster or mitigate the impact of a hazard. More specifically, FbF pre-determines science-based triggers and earmarks donor funding for disaster relief before an early warning is issued. Funding is automatically disbursed when forecast triggers are met, thereby inducing activities that aim to contain the devastating impact of a disaster and prompt relief efforts as early as possible. FbF was originally developed by the German Red Cross and the Red Cross Red Crescent Climate Centre.

Design:
FbF does not follow a standard design, predominantly because it is not a financial instrument but a process. It is best described as a mechanism in which a number of activities run in parallel (which the IFRC calls 'early action protocol'), however only one component deals with funding. Each scheme is tailored to the local conditions in the target area and takes countless factors into consideration such as public administration, climate, economics and population.

What is key is the design of a meaningful and fit-for-purpose early-action trigger upon which funding is released and the other activities are kicked off. These mechanisms can also have a two-step trigger that may be layered or sequential. As an example, limited funding may become available based on a lower threshold (danger alert) or one with higher uncertainty, which then may be stepped up when forecasts become more reliable (disaster anticipated). The early-action trigger can also be applied to conventional (re)insurance schemes. In that case, a payout is effected as soon as an alert is issued that a hazard estimated to exceed the threshold is approaching

or developing; a second payout could be added for when the risk has materialised and the full impact has taken place.

Considerations:
To the extent that national social-protection schemes exist, FbF should be linked up to facilitate payouts to vulnerable and/or poor population groups located in the area where the impact is expected. For such direct beneficiary payments, mobile channels are most effective, both to achieve scale in the dissemination of early-warning alerts and to deliver the money fast and reliably.

While the humanitarian sector has been testing and upgrading FbF for some years, governments have not started to use the instrument yet. Nevertheless, there is no reason why the forecast-based triggers that are applied to release early-action funds could not also be adopted by governments to trigger public contingency structures or reserve funds *(> see section 4, pp. 37)*. A use case for this set-up could be a slowly evolving hazard such as drought, where mitigating activities are set in motion and funds released before roaming or herded livestock has died or other damage and losses have occurred.

Anticipatory humanitarian financing arrives two days before landfall, Madagascar

Start Ready is the Start Network's FbF mechanism, enabling their humanitarian-aid agencies to access funds and activate pre-arranged emergency plans before forecasted hazards potentially turn into disasters. Its risk pools run for 12 months, with the first one, fully donor-funded, having gone live in 2022. Its latest risk pool of GBP 7 million was activated six times within the first two days of its launch in May 2024 due to a heatwave in Pakistan. National networks of member agencies that are set up to address climate-risk assessments modelled based on historical exposure, loss data and demographic and economic information and have pre-arranged plans and budgets for crisis response, can apply for pre-positioned funds when the conditions are met. These funds are earmarked for crises that tend to happen regularly and have reasonably predictable patterns.[38]

In late 2022, members in Madagascar requested GBP 170,000 to be mobilised and pre-positioned ahead of the tropical-cyclone season and just under GBP 1 million to be able to act twice in advance of a forecasted moderate-level cyclone. In early 2023, tropical cyclone Freddy39 was forecasted to make landfall in Madagascar at a minimum wind speed of 166 km per hour. GBP 700,000 were disbursed to Catholic Relief Services, Welthungerhilfe, CARE, Medair, Action Against Hunger, Save the Children, and Médecins du Monde. Three days after the cyclone warning, households along the expected path, some 77,000 people, received materials to reinforce their homes, dignity kits, water purification items and mosquito nets. The following day, Freddy made its first landfall along the central eastern coast, leaving 2.2 million people exposed to storm surges and flash floods in its track. Three days later, its second landfall took place in southern Madagascar. Ultimately, close to 300,000 people were affected and more than 10,000 homes destroyed or damaged. The provision of pre-positioned items and cash ahead of the event had however prepared communities for the impacts of the cyclone.

38 Start Fund, another funding pool, is aimed at less predictable risks, such as secondary perils like landslides or flash floods, or conflicts and disease outbreaks.

39 Declared to be the longest-lasting tropical cyclone on record at 36 days in total; it made landfall twice in Madagascar.

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Section 07

Response

RESPONSE

For the purpose of this publication, the response phase in a climate context is considered to be more geared towards disaster response during or just after the impact of a rapid-onset event rather than in relation to a slowly evolving crisis, such as a food crisis, which may be as much the result of political or structural problems as simply a failed rainy season. This means that there is little lead time for mobilising funds and executing emergency action plans and readiness is therefore vital, for example in the form of readily accessible, pre-arranged funds. The aim is to save lives by reducing harm, health impacts and insecurity and by catering to the basic needs of affected population groups. Alongside governments humanitarian-aid agencies are indispensable in disaster-relief situations in developing countries and co-ordination between them and with government authorities is key.

The immediate emergency phase is followed by a rehabilitation and recovery phase that leads to the longer-term reconstruction phase. Funding for emergencies comes from government and humanitarian sources. In the rehabilitation and recovery phase, development finance starts to supplement humanitarian funding, while in reconstruction governments are fully back in the driver seat, possibly supported by infrastructure-related investments from the private sector and development-finance institutions. Reconstruction is associated with the build-back-better concept, which loops back to risk reduction as it aims to build resilience and reduce vulnerability to future disasters. It closes the CDRM cycle described in section 2 *(> see pp. 17)*.

In the response phase immediately following the incident, finance is again more a matter of spending (money out) than raising funds (money in). Similarly, operations mainly consist of activating and executing pre-arranged emergency plans with little room for planning. Thus, to be both efficient and cost-effective, response activities and funding depend on sound ex-ante preparation.

FINANCING THROUGH THE BUDGET

When confronted with a major disaster, governments and public authorities face numerous challenges ranging from financial, economic or logistical and operational aspects to health and social issues. They find themselves under pressure on multiple fronts as they seek to provide effective relief while suffering from the disruptions in physical and financial infrastructure and struggling to mobilise at the same time a massive amount of human and financial resources as well as goods and materials.

Especially when contingency funds are lacking, governments can reallocate in-year budget lines ex-post to manage the impact of a disaster event. This obviously comes at the expense of that year's public-spending plans and may thus entail high opportunity costs, while still being insufficient to cover the needs. Moreover, topping-up the budget ad hoc may also not be feasible for debt-sustainability and procedural reasons.

In the following year, it may be necessary to cut the budget, which is usually highly detrimental in view of reconstruction needs. Tax relief for affected households and businesses may again put budgets in jeopardy, if applied broadly, and tax increases to balance budgets or finance reconstruction not only take months to agree on and implement, but often overwhelm taxpayers already struggling in the aftermath of the disaster. This leaves borrowing (internationally) as an option, which may also be challenging due to heightened credit and debt-sustainability concerns, particularly when an economic downturn looms. To free up liquidity, a stopgap would be to activate the respective clause in sovereign bonds or loans that allows deferral of interest and principal payments in the event of a qualifying disaster.

Design:
To reallocate funds within the yearly budget, governments ought to first draw down budget contingencies and/or deviate funds from their original allocations, raise additional funds by attempting to increase revenues through tax-policy changes or by increasing public debt.

The disaster-response phase is not the period during which contingency funds are allocated. However, if there are no reserves earmarked for disasters or they are already depleted, general budget contingencies that were not designed specifically for disaster response could then be allocated to this purpose.

Disaster-related debt-suspension clauses[40] that allow the deferral of debt repayments (and a moratorium of interest payments) would need to be embedded in the contractual terms of debt instruments ex-ante and activation triggers be clearly defined.

Considerations:
Disaster-related debt-suspension clauses are still rare. While capital markets continue to ignore this aspect in conventional risk ratings, their inclusion may also have repercussions for a country's credit rating and spreads if the country is perceived to be vulnerable to climate and disaster risks. To be effective, these clauses would need to be included across all debt, loans and bonds, including multilateral and bilateral as well as commercial debt, with the latter especially presenting a major challenge. To maximise their benefits, disaster-prone countries with high debt-service levels would be primary targets, yet in the developing world, such countries tend to have only constrained access to capital markets anyway.

Suspension clauses in Caribbean debt

In its debt restructuring in 2015, Grenada managed to embed a debt-suspension clause in its sovereign debt stock. The clause is a two-trigger clause that is activated when a tropical cyclone causes losses of USD 15-30 million or in excess of USD 30 million. It only defers one or two semi-annual interest payments respectively. This temporary-suspension option is linked to Grenada's CCRIF[41] policy: if it receives a policy payout, it can elect to defer its interest payment(s) once CCRIF confirms that the cyclone was an insured event and estimates the loss amount. Grenada can make deferrals three times over the period until 2030.

In 2018-20, Barbados retrofitted its bonds and IADB loans with disaster-related suspension clauses, which were also linked to the island's CCRIF policy. The clause has a lower threshold that differs across three hazards (USD 5 million loss for excess rainfall and earthquake; USD 7.5 million for cyclone). These supplements offer Barbados the possibility to free up an amount of up to 15% of its GDP in debt repayments in case of a major disaster.

While the IDB led the way in offering climate-related debt-suspension clauses, such as in the Bahamas and Honduras, a number of other DFI such as the EBRD, EIB, World Bank, AfDB have announced that they will start offering them as of 2024 as well.

GRANTS and DONATIONS

Humanitarian-response activities by international agencies are predominantly funded by grants and donations. Both sourcing directly from state coffers or indirectly via multilateral organisations such as the UN system, international donors are the main contributors, while it is estimated[42] that donations from private sources make up just shy of 20% (2022).

According to the OECD, in 2023 humanitarian aid is estimated[43] to have reached approx. 16% of Official Development Assistance (ODA). By far the largest donor for humanitarian action was the USA, followed by Germany and the EU overall; these three donors alone contributed nearly two thirds of public humanitarian funding in 2022. In 2023, humanitarian assistance from public sources increased and reached a record of USD 36.1 billion, while private funding declined by 28% to USD 7.3 billion[44]. Within private donations, individuals are believed to provide by far the most (just over 75%), followed by foundations/trusts and the private sector. Overwhelmingly, private donations fund NGOs (estimated at 90%), while public donors focus on multilateral organisations.

40 Referred to as Climate Resilient Debt Clauses by the World Bank. Debt suspension clauses are an example of collective action clauses (CAC) used in debt instruments. Investors buying bonds, for example, commit to be bound by the terms of a restructuring plan if a pre-defined majority of bondholders approve the issuer's proposal.

41 › See section 5, risk pools, pp. 51

42 According to Development Initiatives; https://devinit.org/resources/private-funding-for-international-humanitarian-assistance/ and https://devinit.org/resources/global-humanitarian-assistance-report-2023/

43 Preliminary numbers published in April 2024

44 According to Development Initiatives, https://interagencystandingcommittee.org/grand-bargain-official-website/development-initiatives-falling-short-humanitarian-funding-and-reform, p. 13

Design:
Donors usually allocate contributions for international humanitarian-aid purposes in their annual budget planning. Protracted crises can already be taken into account at that point, whereas a certain amount (or reserves) should be set aside to enable the response to humanitarian appeals for ad-hoc crises such as climate-induced disasters. Ideally, public donors (along with their humanitarian-intervention partners) will start introducing risk assessments and (to the extent possible) forecasting into their budgeting process to deliver humanitarian support in a more needs-based and timely manner. Intermediaries such as UN agencies or the IFRC/ICRC receive grants and donations in the form of cash payments and utilise them to directly implement humanitarian actions or further distribute them to NGOs or implementing partners on the ground.

Grants or donations can either be earmarked for specific purposes, such as particular types of aid (food, shelter) and types of crises (climate, conflict related) in pre-determined regions, or they can be unconditional so that international agencies can use the funds as needed. Over time, pooled-funding structures have emerged in the form of facilities or funds, which may be dedicated to (specific) humanitarian purposes.

Often, pledges for development or humanitarian purposes are made on a multi-year basis by public donors. Depending on the type of commitment and the credit rating of the country making the grant, the issuance of notes or bonds against these commitments could achieve front-loading of payouts when it is critical for funding to be available as early as possible. Such a mechanism is used by the health organisation Gavi, through the International Finance Facility for Immunisation (IFFIm)[45].
Instead of monetary contributions or in addition to them, some donors, especially private-sector companies, offer in-kind contributions and/or pro-bono services.

Challenges:
Grants and donations often depend on maximising international attention to a disaster event through media coverage, an emergency appeal or during pledging events. Ad-hoc and one-off grants and donations do not allow for proper planning due to the uncertainty of when and how much funding will become available. Protracted crises can lead to 'donor fatigue', making it particularly challenging and unsustainable to depend on grants or donations. Moreover, donor-funding cycles linked to fiscal years of governments tend to be misaligned with humanitarian-emergency timelines. Finally, the expectation that such grants are likely to be released can create negative coping strategies, moral hazard or influence policymakers in neglecting risk reduction.

The Central Emergency Response Fund

The largest multi-purpose humanitarian-action fund is the United Nations Central Emergency Response Fund (CERF). Its objectives are:

(a) To promote early action and response to reduce loss of life (rapid response)
(b) To enhance response to time-critical requirements (rapid response)
(c) To strengthen core elements of humanitarian response in underfunded crises (underfunded emergencies)

Since its inception in 2006, approx. 26% of its allocations have been directed towards responding to climate-related disasters, while for 2023 the proportion made up 38%. Although conflict-related funding support remained central, climate-induced and geological disasters featured prominently: primarily tropical cyclone, flooding and drought, followed by earthquake and lastly heat and cold spells. At the COP28 in late 2023, CERF launched a Climate Action Account to attract additional funding to help address the increasing humanitarian impacts of climate-related disasters worldwide.

Over the life of the Fund, European countries have been by far the largest contributors (UK, Sweden, Netherlands, Germany and Norway in that order). While all funding is channelled through UN agencies, NGOs, governments and the IFRC/ICRC receive large sub-grants – in 2022 around 20% was sub-granted to local and national implementers. Again approx. 20% of disbursals to final beneficiaries was in the form of cash and vouchers, which represents marked growth over previous years. In 2023, the Sudan, Afghanistan and the Democratic Republic of the Congo were the largest recipients of CERF support. Overall, it disbursed USD 668 million in 2023 (USD 328 million until August 2024), while it reported contributions of USD 441 million thus far in 2024.[46]

45 See e.g. https://iffim.org/sites/default/files/2020-04/IFFIm%20resource%20guide%202019_0_0.pdf, p. 15
46 https://cerf.un.org/

Section 08

Compounding & Layering

COMPLEMENTARITY AND LAYERING

This publication is titled 'Climate and Disaster Risk Finance – a Mosaic of Instruments' for a reason: in order to do justice to the climate- and disaster-risk profile of an individual country, its demographic and economic characteristics as well as the political context it operates in, a set of diverse financial risk-management instruments needs to be put together in such a way that it responds optimally to both needs and cost/benefit considerations. A single tool or a random mix of instruments will not be effective. While it may be necessary to take this approach in light of scarce resourcing of adaptation finance in particular, it would not be able to exploit the potential that CDRFI offers.

So risk managers aim to achieve an optimal CDRFI strategy by:

- Matching the risk-management strategy to the country's contextualised and multi-factored risk profile based on a comprehensive **risk assessment**
- Electing the weight that **risk-reduction** measures should have relative to risk-management activities (without prior risk reduction), which is particularly relevant in the context of climate-change adaptation
- Combining financial solutions across the continuum of **risk retention, risk transfer, preparedness** and **response** and within each component to achieve an optimal portfolio of financial approaches and instruments
- Managing the interaction and interdependency between public and private solutions, financial and policy-based mechanisms, as well as non-profit and commercial interests along with the respective stakeholders in the national and international context

Achieving complementarity in approaches and instruments with a strong cost/benefit ratio is not trivial on its own. Compounding risks make this even more challenging, however.

Compound risks are threats that amplify when several hazards interact and exacerbate each other and/or when socio-economic[47] as well as demographic[48] factors further increase the exposure or vulnerability to climate events. Not least in developing countries, disaster-event impacts and costs spike due to amplifications in their magnitude, spatial extent or frequency, resulting in an aggregate impact that is higher than if hazards were to occur separately. Again, this is particularly relevant for adaptation and its financing since the highest near-term benefits of risk reduction can be generated by reducing exposures and vulnerabilities. The threat from evolving compound risks also warrants a shift away from short-term thinking to a better understanding of what climate-induced compound crises might look like in future.

An additional layer of complexity in managing (and financing) climate and disaster risks comes from systemic (covariate) risks, such as risks that affect largely everyone in a region. This represents the norm when dealing with climate, extreme-weather and geophysical risks, as a drought or earthquake impacts a large area. This makes risk diversification challenging; therefore such risks are best managed by investing decisively in risk reduction before transferring them to international reinsurance markets – the markets with the highest diversification capacity.

While the high cost of insuring risks may prompt risk reduction, insurance as such only transfers but does not reduce risk. Instruments monetising the value-add of risk reduction would be useful, yet are still in their infancy and markets for them next to inexistent.

Therefore, a successful CDRFI strategy brings all these drivers and considerations together, synthesising various instruments, approaches and stakeholders to achieve a comprehensive solution.

On the implementation side, dividing risk into layers that each represent a certain level of potential losses and the probability at which they may occur (e.g. low-severity/high-frequency vs. high-severity/low-frequency) forms the basis of structuring such a solution. Subsequently, different instruments are assigned to different risk layers. Individual instruments and approaches are then also layered with respect to the riskiness of each

47 E.g. more and more expensive houses

48 E.g. population growth and higher density

level/tranche and paired with investor/risk-taker categories (e.g. governments/donors taking up high-risk tranches, commercial interests or institutional investors representing the broader public such as pension funds only buying senior/less risky tranches). In sum, suitable financial instruments and risk-management approaches are assigned to individual climate- and disaster-risk layers which, in combination with financial-risk layering, results in an optimal CDRFI strategy.

Towards understanding the protection gap in Zambia

Partially drawing on research conducted by UNDRR along with CIMA Research Foundation[49], GIZ commissioned a climate-risk assessment of Zambia's agricultural sector with respect to drought and flood risk. Building on this analysis, an evaluation of various risk-finance instruments and approaches was conducted to inform the eventual development of Zambia's CDRFI strategy. More specifically, based on the results of the rapid climate-risk assessment, the potential for cost-effective risk-reduction measures was outlined with a view to subsequently identifying corresponding financing options. Setting aside the risk-reduction component, pre-existing mechanisms to fund the expected impacts of climate and disaster risk were identified, evaluated and quantified.

In a second step, based on loss estimates for the two risks considered, the 'protection gap' left after implementing and financing risk reduction and taking into account any pre-arranged funding structures already in place, was estimated. It is vital to have a good understanding of both the type and magnitude of risks that are left uncovered, both from a management and finance perspective. So in a final step, the protection gap was further analysed to pinpoint the main risk drivers, greatest shortcomings and most promising levers to tackle this residual risk and to ultimately be in a position to devise a suitable and integrated CDRFI strategy for the country.

49 UNDRR, CIMA Research Foundation, Disaster Risk Profile: Zambia – 2019

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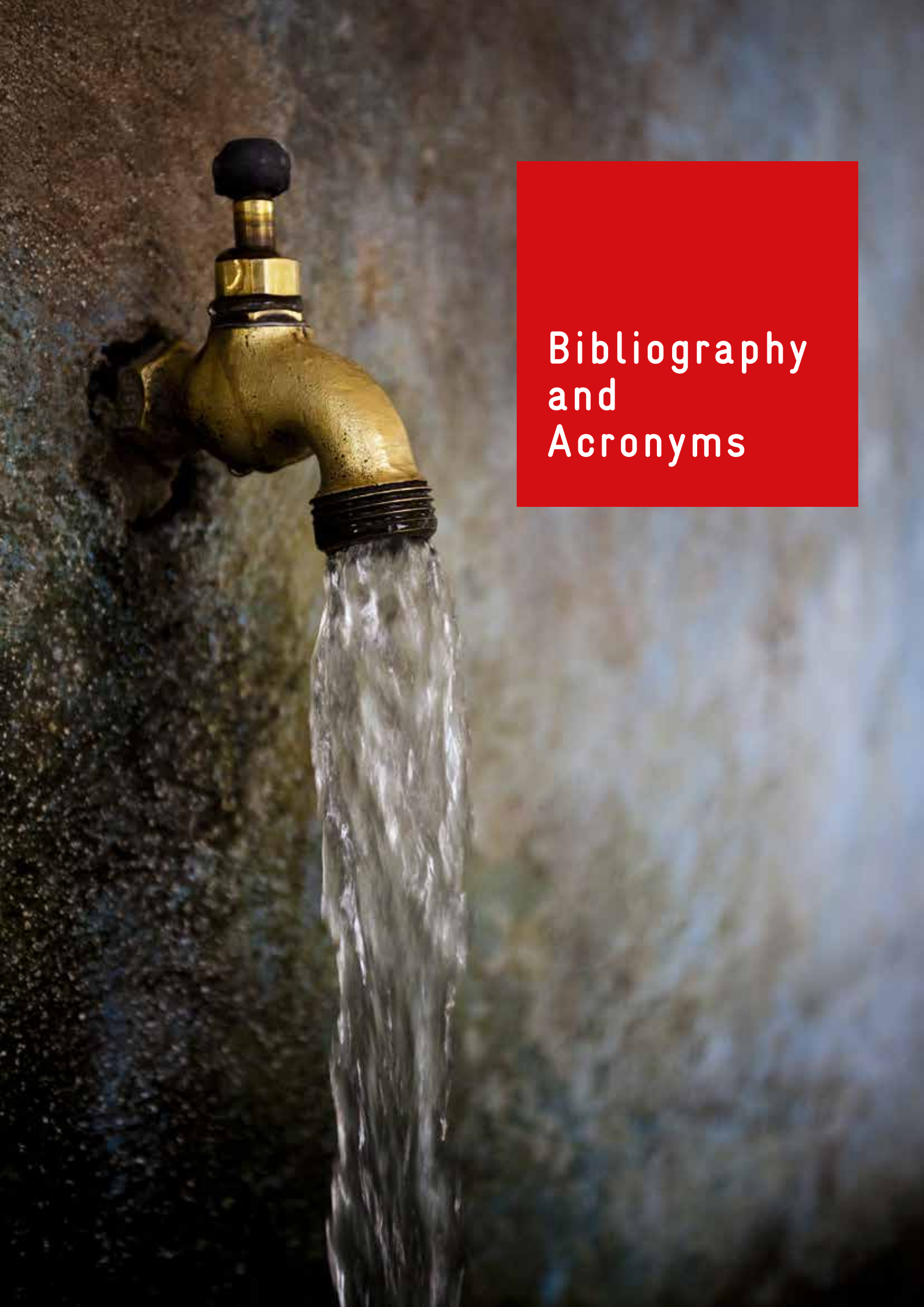

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ACRONYMS

ADB	Asian Development Bank
AfDB	African Development Bank
ASEAN	Association of Southeast Asian Nations
ARC	African Risk Capacity
ART	Alternative Risk Transfer
BMZ	Federal Ministry for Economic Cooperation and Development, Germany
Cat Bond	Catastrophe Bond
CCE	Crop-cutting Experiments
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDM	United Nations Clean Development Mechanism
CDRFI	Climate and Disaster Risk Finance and Insurance
CDRM	Climate and Disaster Risk Management
CERF	Central Emergency Response Fund
CoCo	Contingent Convertible
CSR	Corporate Social Responsibility
DFI	Development Finance Institution
DRM	Disaster-risk Management
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
ETF	Exchange-traded Fund
ESG	Environmental, Social and Governance
ETS	Emissions Trading System
FbF	Forecast-based Funding
FCDO	Foreign, Commonwealth & Development Office, UK
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HNWI	High-net-worth Individual
IADB	Inter-american Development Bank
IBRD	International Bank for Reconstruction and Development (World Bank)
IFFIm	International Finance Facility for Immunisation
IFRC	International Federation of the Red Cross and Red Crescent Societies
ILS	Insurance-linked security
ILW	Industry Loss warranty
ICDRM	Integrated Climate and Disaster Risk Management
ICRC	International Committee of the Red Cross
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
KfW	Kreditanstalt für Wiederaufbau
IMF	International Monetary Fund
MCII	Munich Climate Insurance Initiative
MFI	Microfinance Institution
MSME	Micro, Small and Medium-sized Enterprise
NDC	Nationally Determined Contribution
NDVI	Normalised Difference Vegetation Index
OECD	Organisation for Economic Cooperation and Development
ODA	Official Development Assistance
PCRIC	Pacific Catastrophe Risk Insurance Company
NGO	Non-governmental Organisation
RID	Risk-informed Development
SDC	Swiss Agency for Development and Cooperation
SDGs	Sustainable Development Goals
SEADRIF	Southeast Asia Disaster Risk Insurance Facility
SPV	Special Purpose Vehicle
UNDP	United Nations Development Programme
UNDRR (former UNISDR)	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change

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