



SOVEREIGN CLIMATE AND DISASTER RISK POOLING

World Bank Technical Contribution to the G20

SOVEREIGN CLIMATE AND DISASTER RISK POOLING

World Bank Technical Contribution to the G20

© 2017 International Bank for Reconstruction
and Development / International Development
Association or
The World Bank
1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

This work is a product of the staff of The World Bank with external contributions. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent.

The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Rights and Permissions

The material in this work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.

Any queries on rights and licenses, including subsidiary rights, should be addressed to the Office of the Publisher, The World Bank, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2422; e-mail: pubrights@worldbank.org.

ACKNOWLEDGMENTS

This report has been prepared by the World Bank, drawing on inputs from a group of internationally renowned experts comprising David Bresch, Dario Luna, and Simon Young.

The World Bank team was led by Olivier Mahul and included Bianca Adam, Benedikt Signer, Simeon Abel, Roberto Dario Bacchini, Richard Poulter, and Emily White, all from the Disaster Risk Financing and Insurance Program, a joint partnership between the World Bank's Finance and Markets Global Practice and the Global Facility for Disaster Reduction and Recovery.

The team thanks Isaac Anthony, CEO of the Caribbean Catastrophe Risk Insurance Facility (CCRIF SPC), for sharing information on CCRIF and CCRIF for Central American countries (CCRIF-CA); Mohamed Beavogui, General Director of African Risk Capacity (ARC), and Dolika Banda, CEO of ARC Ltd., for sharing information on ARC;

Salvador Perez Maldonado, Associate Director General of Insurance, Ministry of Finance and Public Credit, Mexico, for sharing information on Mexico's Natural Disaster Fund (FONDEN). The team also thanks participants in the stakeholder consultation meetings held in Berlin on February 9 and March 21, 2017.

Internal reviews and inputs from Luis Alton, Michael Bennett, Martin Buehler, Samantha Cook, Julie Dana, Francis Ghesquiere, Eugene Gurenko, Stephane Hallegatte, Hideaki Hamada, Niels Holms-Nielsen, Nicholas Jones, and John Pollner greatly enhanced the report. The report was edited by Anne Himmelfarb. Design and layout were by Studio Grafik.

The report was prepared during the period October 2016–April 2017 and was sponsored by the Federal Ministry for Cooperation and Development of Germany (BMZ).

ABBREVIATIONS

ACP-EU	African, Caribbean, Pacific–European Union
APEC	Asia-Pacific Economic Cooperation
ARC	African Risk Capacity
ARC Ltd.	African Risk Capacity Insurance Company Limited
ARV	Africa RiskView
ASEAN	Association of South East Asia Nations
BMZ	Federal Ministry for Economic Cooperation and Development
CARICOM	Caribbean Community
CAT bond	catastrophe bond
CAT-DDO	Catastrophe Deferred Draw-Down Option
CCRIF	Caribbean Catastrophe Risk Insurance Facility (CCRIF SPC since 2014)
CCRIF-CA	Caribbean Catastrophe Risk Insurance Facility for Central American countries
COSEFIN	Council of Finance Ministers of Central American countries plus the Dominican Republic and Panama
DFID	United Kingdom Department for International Development
DPF	Development Policy Financing
EAP	East Asia and Pacific
ECA	Economics of Climate Adaptation
FONDEN	Natural Disaster Fund (Fondo de Desastres Naturales)
GDP	gross domestic product
GFDRR	Global Facility for Disaster Reduction and Recovery
HSNP	Hunger Safety Net Programme
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IMF	International Monetary Fund
IRMS	Integral Risk Management Strategy
L4D	Licensing for Development program
MDB	multilateral development bank
NPV	net present value
OECS	Organization of Eastern Caribbean States
PCRAFI	Pacific Catastrophe Risk Assessment and Financing Initiative
PEF	Pandemic Emergency Financing Facility
PSNP	Productive Safety Net Programme
SDG	Sustainable Development Goal
SPC	Secretariat of the Pacific Community
TCIP	Turkish Catastrophe Insurance Pool
V20	Vulnerable Twenty Group

TABLE OF CONTENTS

Overview	3
Introduction	8
PART 1. Managing the financial impact of climate and disaster risks	10
1.1. The drivers of disaster impacts: A look into the future	11
1.2. The many impacts of disasters: From public finances to poverty reduction	14
<i>Fiscal and economic impact</i>	14
<i>Development and poverty impacts</i>	14
1.3. The elements of an effective approach to disaster preparedness and crisis response	16
<i>Coordinated plan for post-disaster action agreed in advance</i>	16
<i>Fast, evidence-based decision-making process</i>	17
<i>Pre-planned financing to ensure that the plan can be implemented</i>	17
<i>Growing interest</i>	18
<i>Going beyond climate and disaster risks: A comprehensive approach to risk management and crisis response</i>	19
1.4. Financial protection: From post-disaster emergency borrowing to proactive risk management	20
1.5. Selecting the appropriate financial protection instruments	24
1.6. Insurance: A powerful tool to be used with caution	28
PART 2. Lessons learned from experiences of sovereign catastrophe risk pools	30
2.1. Global landscape of sovereign catastrophe risk pools for developing countries	33
<i>Existing sovereign catastrophe risk pools</i>	33
<i>New initiatives for sovereign catastrophe risk pools</i>	39
2.2. Efficiency of catastrophe risk pools	40
<i>Political ownership</i>	41
<i>Financial efficiency</i>	43
<i>Operational efficiency</i>	48
2.3. Sustainability of catastrophe risk pools	50
<i>Who owns the risk?</i>	50
<i>Technical expertise</i>	50
<i>Risk-based pricing</i>	51
<i>Premium financing</i>	51
<i>Regional ownership</i>	56
2.4. Increasing the impact of sovereign catastrophe risk pools	57
<i>Public financial management of natural disasters</i>	57
<i>Shock-responsive social protection</i>	58
<i>Critical infrastructure</i>	59
<i>Crowding in the private sector</i>	59
PART 3. Recommendations moving forward	60
3.1. Catastrophe risk pools can enhance the financing of climate and disaster risks	61
3.2. Catastrophe risk pools do not solve all climate and disaster risk financing problems	63
3.3. Recommendations for G20 members	64

Glossary	66
Annex 1. Brief description of existing sovereign catastrophe risk pools	69
Caribbean Catastrophe Risk Insurance Facility (including CCRIF-CA)	69
African Risk Capacity	70
Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)	71
Sovereign catastrophe risk transfer: The experience of Mexico	72
Annex 2. Sovereign catastrophe risk pools: Annual portfolios	74
References	76
BOXES	
Box 1. Turn down the heat: Climate change impacts around the world	11
Box 2. The economics of climate adaptation	13
Box 3. A comprehensive disaster risk management framework	21
Box 4. Index insurance: A few definitions	22
Box 5. Turkish Catastrophe Insurance Pool	23
Box 6. The principles of effective financial protection	26
Box 7. Quantifying the benefits of financial protection	27
Box 8. Insuring the world: Risk pooling and reduction in capital requirements for low- and middle-income countries	32
Box 9. Toward a regional approach for disaster risk finance in Asia	38
Box 10. Exploratory work on new catastrophe risk pools	40
Box 11. Leveraging donor funds in risk pools	43
Box 12. Diversification benefits and their limits: An illustrative case	45
Box 13. Gathering further diversification benefits through risk swaps between regional pools?	46
Box 14. CCRIF-CA options for risk transfer	47
Box 15. Concessional financing of premium	53
Box 16. Quantitative comparison of seed capital versus premium subsidies	54
Box 17. PCRAFI Facility	56
FIGURES	
Figure 1. Loss events worldwide, by hazard type (1970–2015)	12
Figure 2. Welfare impacts from climate shocks	15
Figure 3. The elements of an effective approach to disaster preparedness and crisis response	16
Figure 4. Sovereign disaster risk layering	24
Figure 5. Map of countries participating in a sovereign catastrophe risk pool (as of December 2016)	34
Figure 6. Catastrophe risk insurance premium decomposition	41
Figure 7. Diversification benefits modeled for the PCRAFI program: Simple aggregates versus pooled risk for 1-in-250-year return period losses	44
Figure 8. Flow of funds	58
TABLES	
Table 1. Summary overview of existing regional sovereign catastrophe risk pools (as of December 2016)	5
Table 2. Costs of different instruments for financing post-disaster expenditure	29
Table 3. Detailed overview of existing regional sovereign catastrophe risk pools (as of December 2016)	35
Table 4. FONDEN risk transfer program, 2006–2015 (US\$ million)	73

OVERVIEW

More than 1 billion people have lifted themselves out of poverty in the past 15 years, but climate and disaster risks threaten these achievements.

Global economic losses from disasters are now reaching an average of more than US\$300 billion a year. A recent World Bank report finds that the impacts of disasters on well-being are equivalent to a US\$520 billion drop in consumption (60 percent more than the asset losses usually reported) and force some 26 million people into poverty every year (Hallegatte et al., 2017). And countries face increasingly complex threats that often compound the negative impacts of disaster and climate shocks—from migration caused by fragility and conflict situations, to the risk of pandemics. It is estimated that 93 percent of people facing extreme poverty today are living in countries that are politically fragile or environmentally vulnerable, and in many cases both. The United Nations’ humanitarian appeal for 2017, for example, stands at a record US\$22.2 billion, to help almost 93 million people affected by conflicts and natural disasters.

Climate change exacerbates some of these risks by increasing the frequency and intensity of extreme weather events.

In addition, economic growth and rapid urbanization increase exposure. Building resilience is therefore crucial to safeguard poverty reduction efforts and promote sustainable and inclusive development— particularly for the poor and vulnerable who are the least able to cope with and adapt to increasing risks.

Current post-disaster response financing, including donor assistance and commercial insurance, covers only a fraction of disaster losses, creating a protection gap.

On average only about 30 percent of catastrophe losses have been covered by insurance over the past 10 years. That means that about 70 percent of catastrophe losses have been borne directly by individuals, firms and governments (SwissRe, 2016). Donor assistance is struggling to keep up with growing needs. In 2015 for example, almost half of the of the UN’s humanitarian appeals were left unmet (UN, 2016).

A growing number of governments are moving toward a proactive (and more cost-effective) approach to financial planning to protect national budgets, as well as the lives and livelihoods of their citizens, from the impacts of disasters.

This approach helps governments consider disaster and climate shocks as part of their fiscal risk management strategies. In addition, it complements other elements of a comprehensive disaster risk management strategy, ranging from investments in risk reduction to improved preparedness and resilient reconstruction.

Financial protection involves planning ahead to better manage the cost of disasters, ensure predictable and timely access to much-needed resources, and ultimately mitigate long-term fiscal impacts.

By combining various financial instruments—such as contingency budget, contingent loans and grants, and risk transfer solutions—financial protection allows governments to manage the full range of disaster impacts. Different instruments help address different risks (ranging from recurrent to more rare events) and different funding needs (ranging from short-term emergency relief to recovery and reconstruction).

Financial protection is also an important topic on the global agenda, for example under the Sendai Framework for Disaster Risk Reduction, the Humanitarian Financing Agenda, and the G7 InsuResilience Initiative.

The G7 InsuResilience Initiative, sponsored by the German presidency of the G7 with the goal of expanding climate risk insurance coverage to an additional 400 million poor and vulnerable people in developing countries by 2020, has already taken significant steps toward expanding existing disaster and climate risk insurance programs and creating new ones.

In the immediate aftermath of a disaster, being able to rapidly access financial resources is crucial to save lives and livelihoods.

Quick-disbursing financial protection instruments, such as contingent credit and insurance, can reduce humanitarian impacts and save money by

enabling rapid crisis response and relief efforts. In Ethiopia, for example, every US\$1 secured ahead of time for early drought response can save up to US\$5 in future costs (Wiseman and Hess 2007).

Catastrophe risk pools are emerging as a cost-effective vehicle to help countries access rapid financing for disaster response. They allow countries to (i) pool risks in a diversified portfolio; (ii) retain some risk through joint reserves/capital; and (iii) transfer excess risk to the reinsurance and capital markets. By putting a price tag on risk, risk pools also increase the value of risk information and create incentives to invest in risk reduction. Their emergence over the last decade provides governments with access to a new set of instruments to enhance the financial management of climate and disaster risks.

Over the past 10 years, 26 countries in three regions—Africa, the Pacific, and the Caribbean and Central America—have joined sovereign catastrophe risk pools. They have purchased parametric catastrophe risk insurance for an aggregate coverage of US\$870 million and an aggregate premium volume of US\$56.6 million (2016/17), backed by more than 30 reinsurance companies. The three pools have so far made payouts totaling just over US\$105 million (table 0.1 provides an overview of existing risk pools).

Parametric insurance solutions allow for rapid payouts in the event of a disaster, providing liquidity within a couple of weeks to finance rapid response. For example, having purchased insurance through the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), the government of Vanuatu received a payout of almost \$2 million just seven days after Tropical Cyclone Pam made landfall in March 2015. This amount was eight times the government's emergency provision and was critical for funding a number of urgent priorities, including flying nurses to the most affected areas and providing lifesaving assistance.

Beyond parametric insurance, other financial instruments can be structured and offered by risk pools. For example, Mexico's disaster fund, which acts as a national level risk pool,

provides indemnity coverage, where payouts are based on actual losses on public infrastructure. Catastrophe risk pools could also be used to aggregate insurance of public infrastructure, or to manage the contingent liability from shock-responsive social protection schemes more cost-effectively. Some countries in South East Asia are also exploring risk pools as a more effective approach to reserves as standby financing.

A decade of experience has shown that political commitment, sound operational design, and financial sustainability are at the foundation of successful risk pools. When those foundations are in place, risk pools can in turn generate positive externalities that further enhance their impact, by fostering political, operational, and financial effectiveness.

The establishment of sovereign catastrophe risk pools relies on a combination of highly specialized technical assistance, significant financial support, and strong political commitment. The long-term sustainability of sovereign catastrophe risk pools depends on their ability to generate regular and large enough premium income, possibly with financial support from donor partners; broaden the set of financial instruments offered beyond parametric insurance; maintain strong political commitment; and link financial instruments to pre-agreed post-disaster programs, such as shock-responsive social protection programs or critical infrastructure recovery programs, to ensure that funds can be efficiently channeled to support targeted post-disaster responses.

Catastrophe risk pools have significantly relied on donor partners for their technical and financing capacity. All sovereign catastrophe risk pools have benefited from donor support to start operations and to remain sustainable during their first years. Donor financing has at various stages covered start-up costs, capitalization, and sometimes (partial) premium financing. Existing sovereign catastrophe risk pools have also required many years of sustained technical assistance from credible third parties; the World Bank Group has assisted the Caribbean Catastrophe Risk Insurance Facility (CCRIF) and PCRAFI, and the World Food Program has assisted

African Risk Capacity (ARC). Risk pools have also relied on the technical expertise and capacity of the private insurance and reinsurance industry.

Regional catastrophe risk pools require a regional partner organization to facilitate the political and policy dialogue and coordination between participating governments. Given the level of cross-country coordination required to establish and manage such a pool, regional political bodies are essential to facilitate the process. Sovereign pools have relied on their respective regional political organization at various levels.

Sovereign catastrophe risk pools—and disaster risk financing solutions more generally—require that participating countries be committed to implementing necessary policy reforms. In this context, humanitarian and development donors have a role to play in creating incentives (both at the country level and within donor organizations) for investments in pre-agreed risk management and risk financing solutions, and for reducing reliance on post-disaster humanitarian assistance. Innovative concessional financing instruments may be necessary to create

the enabling environment and incentives for systematic adoption of disaster risk finance and insurance solutions, including catastrophe risk pools.

The private sector has contributed to making catastrophe risk pools cost-effective. The private insurance industry has been heavily involved in the preparation and implementation of sovereign catastrophe risk pools. It provides not only risk capital but also technical expertise to inform the design of effective risk pools.

This report focuses on sovereign climate and disaster risk pools as a mechanism to enhance financial protection of national and subnational governments. It discusses for G20 consideration how those pooling mechanisms could be further expanded and replicated, how the cooperation between G20 countries and developing countries could be further strengthened to integrate disaster and climate risk into broader financial protection strategies for vulnerable people, and how to set expectations about the role of catastrophe risk pools as a meaningful, cost-effective instrument to that end.

TABLE 1. SUMMARY OVERVIEW OF EXISTING REGIONAL SOVEREIGN CATASTROPHE RISK POOLS (AS OF DECEMBER 2016)

	CCRIF (Caribbean)	CCRIF-CA (Central America)	ARC	PCRAFI
Perils	Earthquake, tropical cyclone, extreme rainfall	Earthquake, tropical cyclone, extreme rainfall	Drought, tropical cyclone, flood	Earthquake, tropical cyclone, extreme rainfall
Initial capital	Multi-donor grants via World Bank	Multi-donor grants via World Bank	Interest free loan from 2 partners	Multi-donor grants via World Bank
Participating countries	20 eligible; 16 have participated, 14 have purchased coverage in 2016	6 eligible; 1 has purchased coverage	32 signatories; 8 have participated, 6 in 2016/17	15 eligible; 6 have participated, 5 have purchased coverage in 2016/17
Avg premium income	US\$20 million	US\$1.5 million	US\$22 million	US\$2 million
Cumulative payouts	US\$67.3 million	US\$0.7 million	US\$34 million	US\$3.2 million
Avg aggregate coverage	US\$622 million	US\$28 million	US\$50 million	US\$45 million
Source of premiums	IDA credits, CDB credits, grants	IDA credit	National budgets, grants	Grants, national budgets, IDA credits
Reserves	US\$117 million	US\$1.3 million	US\$98.5 million	US\$6 million

Note: IDA = International Development Association; CDB = Caribbean Development Bank.

RECOMMENDATIONS FOR G20 MEMBERS

The G20 could promote a set of priority action areas designed to **reduce the protection gap** in vulnerable developing countries. These actions would **advance financial protection** against climate and disaster risks, in part by encouraging the **scale-up of catastrophe risk pools** at the supranational, national, and subnational levels. Specifically, the G20 could promote activities that support the following priority action areas:

- **Facilitate the adoption of financial protection strategies that include a mix of financial instruments** against disaster and climate risks, such as budgetary instruments, contingent credit, and catastrophe risk transfer to increase the ownership, impact, and cost-efficiency of disaster response financing.

Activities under this action area could include

- ♦ Technical assistance to support the development of financial protection strategies, including diagnostic reviews of countries' approach to financial protection, and identification of policy options for strengthened financial resilience
- ♦ Technical assistance and investments to support the implementation of national financial protection strategies, including for specific line ministries or sectors
- **Support the development of pre-agreed disaster response plans** backed by financial protection strategies to help poor and vulnerable households and protect key lifeline infrastructure. Such plans can help raise awareness of the benefits of risk reduction and financial protection by engaging a wide range of stakeholders, including members of civil society.

Activities under this action area could include

- ♦ Knowledge exchange to learn from experience and consolidate good practices in disaster response planning
- ♦ Technical assistance and investments to develop shock-responsive scalability mechanisms for existing social safety nets to protect the poor and vulnerable
- ♦ Technical assistance and investments to identify, prioritize, and protect critical infrastructure at risk, both ex ante (by mainstreaming disaster risk reduction in investment planning) and ex post (by developing pre-agreed financial plans for post-disaster reconstruction)
- **Promote institutional and legal frameworks that enable the implementation of financial protection strategies.** This includes creating the legal base that enables governments to establish disaster risk management funds, pay insurance premium and manage insurance proceeds, and join supranational financial entities such as catastrophe risk pools.

Activities under this action area could include

- ♦ Knowledge exchange among countries to learn from experience in public financial management of climate and disaster risks
- ♦ Technical assistance to incorporate climate and disaster risks into public finance frameworks

- **Develop new concessional financing for catastrophe risk transfer** instruments to incentivize vulnerable developing countries to develop and adopt sustainable financial protection strategies.

Activities under this action area could include

- ♦ Cofinancing of capitalization and operating costs of catastrophe risk pools
- ♦ Cofinancing of premiums for insurance solutions (designed to incentivize countries to progressively increase their contributions over time)

To achieve the overarching objective of reducing the protection gap in vulnerable developing countries, and to catalyze action around these priority areas and activities, the G20 could promote the creation of a **Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions**.

The Global Partnership could **bring together relevant partners** from developing and developed countries, international organizations, the private sector, and civil society. To achieve maximum impact, the Global Partnership would leverage the comparative advantages of all partners and build on the work of existing platforms and initiatives. In particular, it would leverage the technical expertise and capacity of the private insurance and reinsurance industry.

The G20 could **develop a work program** structured around the four priority action areas identified above to specify how countries would support specific activities. Such efforts would not only promote financial protection and help close the protection gap, but would also support the broader disaster and climate resilience agenda.



INTRODUCTION

Climate change and extreme weather events threaten global efforts on poverty reduction and sustainable development. In this context, more and more governments are making financial resilience a priority to protect national budgets as well as the lives and livelihoods of the poorest and most vulnerable. How to better manage climate and disaster risks is an increasingly important topic on the global agenda, for example under the Sendai Framework for Disaster Risk Reduction, the Humanitarian Financing Agenda, and the G7 InsuResilience Initiative.

Financial protection, including climate and disaster risk financing and insurance, can help countries increase their financial resilience against disaster and climate risks in several ways: it allows them to secure access to rapid financing to address emergency response and early recovery needs; to smooth the budget volatility associated with post-disaster expenditures; and to incentivize disaster risk reduction.

The insurance industry has a long record of dealing with the risks associated with natural hazards, and the international community has learned valuable lessons from this experience. But the specific challenges faced by low-income populations and the new challenges posed by climate change call for development partners and industry to think beyond the financial instruments currently available. By applying proven financial risk management tools and insurance systems to public policy, countries can unlock new solutions to improve their financial resilience. When applied to rules-based programs such as shock-responsive social protection systems that rapidly increase assistance following a disaster shock, insurance can reach large numbers of people.

Risk pooling is a fundamental principle of risk management and insurance: by combining and spreading the risks faced by a large number of contributors into a single portfolio, pools ensure that each contributor's share of the portfolio is less risky than its initial share. It should be

noted that risk pooling does not reduce the underlying risk (which should be reduced through appropriate risk mitigation measures), but rather allows for improved spreading of risk, leading to potentially significant reductions in the cost of risk, particularly for severe events. Risk pools therefore contribute to more effective and more affordable financial risk management.

The principle of risk pooling is extensively used for managing catastrophe risks. The insurance industry has developed catastrophe risk insurance pools as a way to offer affordable coverage to homeowners and enterprises in developed countries and, more recently, in developing countries (e.g., the Turkish Catastrophe Insurance Pool established in 1999). In countries where subnational government entities (such as provinces or states) have substantial power and responsibility in the financial response to disasters, subnational risk pools can increase the financial resilience of local governments (e.g., Mexico's FONDEN). This approach has recently been used to establish sovereign catastrophe risk pools, that is, pools where the contributors and beneficiaries are sovereign governments. Sovereign catastrophe risk pools include the Caribbean Catastrophe Risk Insurance Facility (CCRIF, originally established for Caribbean countries and now expanded to Central American countries); the Pacific Catastrophe Risk Insurance Facility (the PCRAFI Facility); and the African Risk Capacity (ARC).

The G7 InsuResilience Initiative, sponsored by the German presidency of the G7 with the goal of expanding climate risk insurance coverage to an additional 400 million poor and vulnerable people in developing countries by 2020, has already taken significant steps toward expanding existing disaster and climate risk insurance programs and creating new ones. To date, 26 countries in Africa, the Pacific, and the Caribbean and Central America have purchased sovereign catastrophe risk coverage. However, climate and disaster

risk insurance coverage for vulnerable people in developing countries is far from comprehensive, and indeed remains low. A key question for G20 consideration is how to strengthen cooperation between G20 countries and developing countries to build solutions that integrate disaster and climate risk into broader financial protection strategies for vulnerable people, and how to set expectations about the role of catastrophe risk pools as a meaningful, cost-effective instrument to that end.

Risk pools can play an important role in moving the management of disaster and climate shocks away from uncertain, ad hoc humanitarian assistance and making it part of planned development. The challenge for the international community is to provide the right set of incentives. Both international partners and potential recipient governments have a responsibility to plan and program financing in advance.

This report focuses on sovereign climate and disaster risk pools as a mechanism to enhance financial instruments available to national and subnational governments.

Part 1 presents the broader framework for financial resilience that policy makers in G20 countries should consider and the role of risk pools within this framework. It briefly describes the main drivers of risks and their development

and poverty impacts. It presents key principles for effective risk management: a coordinated plan for post-disaster action agreed in advance; a fast, evidence-based decision-making process; and pre-planned financing to ensure that the plan can be implemented. Finally, it describes the menu of financial instruments and approaches (including risk pooling) available to governments, and presents an approach to defining the optimal mix of financial instruments, given a government's specific needs and priorities.

Part 2 describes the sovereign catastrophe risk pools now operating, examines potential gaps in coverage in those pools, and identifies possible opportunities for new sovereign pools. It discusses the efficiency of pools from a political, operational, and financial perspective and reviews pools' sustainability and impact. The purpose of this discussion is not to evaluate the effectiveness of the different instruments offered by existing sovereign pools, but rather to identify key success and failure factors and opportunities for further improvement.

Taking into account lessons learned from existing sovereign climate and disaster risk pooling and transfer mechanisms, part 3 recommends a set of priority action areas that G20 member countries could consider to strengthen the existing landscape of climate and disaster risk finance and insurance solutions, including risk pooling.

PART 1.

Managing the financial impact of climate and disaster risks



1.1. THE DRIVERS OF DISASTER IMPACTS: A LOOK INTO THE FUTURE

Economic growth, demographic trends, and rapid—often unplanned—urbanization are among the main drivers of disaster losses worldwide. When people and economic assets concentrate in cities located in hazard-prone areas, exposure to disaster risk rises, pushing potential losses upward. Half of the world's population now lives in cities, compared to 39 percent in 1980. In most developing countries, rapid urbanization is leading to the creation of informal settlements that are not reached by public services and where

construction standards are not applied. For instance, it is estimated that over half of Africa's urban population (61.7 percent) lives in slums (UN-HABITAT 2013).

This increasing urbanization is likely to continue apace and has implications for future trends in disaster risks. The urban population is expected to reach two-thirds of the global population by 2050, with most of that growth concentrated in middle and low-income countries (UNDESA, 2014).

BOX 1 - TURN DOWN THE HEAT: CLIMATE CHANGE IMPACTS AROUND THE WORLD

MIDDLE EAST AND NORTH AFRICA

Extreme heat will spread across more of the land for longer periods of time, making some regions unlivable and reducing growing areas for agriculture. Rising temperatures will put intense pressure on crops and already scarce water resources, potentially increasing migration and the risk of conflict.

EASTERN EUROPE AND CENTRAL ASIA

The impact of climate change will vary region to region. Melting glaciers and warming temperatures will shift the growing season and the flow of glacier-fed rivers further into spring in Central Asia, while in the Balkans, worsening drought conditions will put crops at risk.

SOUTH ASIA

Inconsistencies in the monsoon season and unusual heat extremes will affect crops. Reduced snow melt from the Himalayas will decrease the flow of water into the Indus, Ganges and Brahmaputra basins. Together, they threaten to leave hundreds of millions of people without enough water, food, or access to reliable energy. Bangladesh and the Indian cities of Kolkata and Mumbai will be confronted with increased flooding, intense cyclones, sea-level rise, and warming temperatures.

LATIN AMERICA AND THE CARIBBEAN

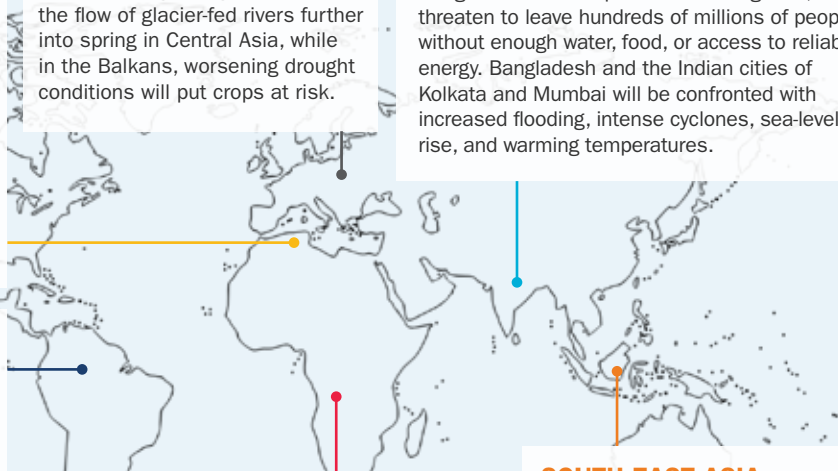
Longer droughts, extreme weather, and increasing ocean acidification will affect the region. In the tropical Andes, rising temperatures will reduce glacier ice and the meltwater that some 50 million people in the low-land farms and cities rely on. Rising temperatures will affect food security.

SUB-SAHARAN AFRICA

Food security will be the overarching challenge, with dangers from droughts, flooding, and shifts in rainfall. With 1.5°C-2°C warming, farmers will lose 40-80% of cropland from drought and aridity by the 2030-40s. In a 4°C warmer world, around the 2080s, annual precipitation may decrease by up to 30% in southern Africa, while East Africa will see more rainfall.

SOUTH EAST ASIA

A sea-level rise of 30 cm, possible by 2040 if business as usual continues, would cause massive flooding in cities and inundate low-lying cropland with saltwater. In Vietnam's Mekong Delta this could reduce rice production by 11%. At the same time, storm intensity is likely to increase.



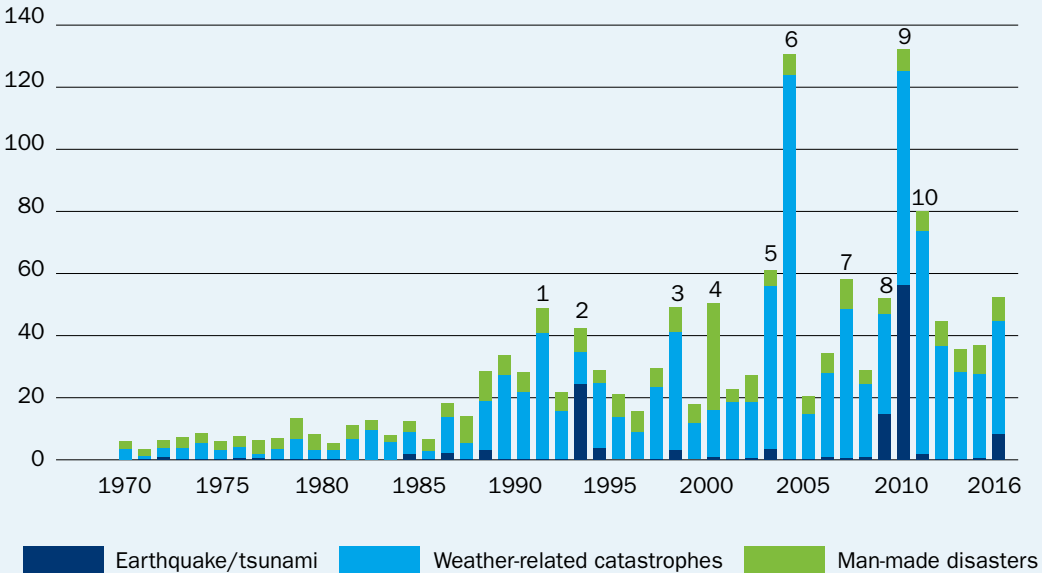
Climate change compounds this increase in exposure, exacerbating potential impacts of disasters. In some regions, changes in climate patterns are expected to cause an increase in the frequency and intensity of climatic disasters, in the form of rising temperatures (e.g., heat waves), changing precipitation patterns (e.g., heavier rains leading to flash floods), and sea storms (IPCC 2013) (see Figure 1).

Over the past 30 years, over 70 percent of total economic losses from disasters have been attributable to hydrometeorological and climatological events (storms, floods, droughts, and extreme temperatures). The threat of more

intense or frequent hydrometeorological hazards and climate extremes is a potential driver of future losses (see Figure 1). The world's largest coastal cities, for example, could experience losses of US\$1 trillion by mid-century (Hallegatte et al. 2013).

Clearly, climate change threatens the objective of eradicating poverty. Climate is involved in many if not most of the shocks that keep households poor, or cause them to fall into poverty: these include natural disasters such as floods (which cause asset loss and affect human capital), health shocks such as malaria (which result in health expenditures and lost labor income or worse), and crop losses and food price shocks

FIGURE 1. LOSSES AND LOSS EVENTS WORLDWIDE, BY HAZARD TYPE (1970–2015)



- | | |
|---|--|
| 1 1992: Hurricane Andrew | 6 2005: Hurricanes Katrina, Rita, Wilma |
| 2 1994: Northridge earthquake | 7 2008: Hurricanes Ike, Gustav |
| 3 1999: Winter Storm Lothar | 8 2010: Chile, New Zealand earthquakes |
| 4 2001: 9/11 attacks | 9 2011: Japan, New Zealand earthquakes, Thailand Flood |
| 5 2004: Hurricanes Ivan, Charley, Frances | 10 2012: Hurricane Sandy |

Source: Swiss Re 2016

(due to drought or crop disease). A recent World Bank report estimates that climate impacts could push an additional 100 million people into poverty by 2030 unless there is action to reduce extreme poverty, provide access to basic services, strengthen resilience, and increase adaptive capacity (Hallegatte et al. 2016).

While combating climate change will require investments in mitigation, inclusive, climate-informed development—development that invests in cost-effective adaptation measures and builds the resilience of economies and people—can prevent most (though not all) of climate change’s impacts on poverty (see Box 2).

Countries face increasingly complex threats that often compound the negative impacts of disaster and climate shocks, from migration caused by fragility and conflict situations to the risk of pandemics. For instance, it is estimated that 93 percent of people facing extreme poverty today are living in countries that are politically fragile or environmentally vulnerable, or in many cases both.

BOX 2. THE ECONOMICS OF CLIMATE ADAPTATION

Decision makers understand that adaptation measures can make societies more resilient to adverse weather and the impacts of climate change. Hence finance ministers, mayors, private sector leaders, and others have sought to quantify the potential weather- and climate-related damage to their economies and societies over coming decades.

The Economics of Climate Adaptation (ECA) methodology is a tool that can help decision makers understand the impact of weather events and climate change on their economies, and identify actions that will minimize impact at the lowest cost to society.

Assuming that current development trajectories continued to 2030, the ECA methodology was applied to some 20 regions worldwide. The results showed that national and local economies could lose between 1 and 20 percent of gross domestic product (GDP) (or between US\$47

million and US\$26 billion) annually as a result of existing weather patterns. Climate change could worsen this picture significantly: under an extreme climate change scenario, annual losses from flood, drought, heat waves, and tropical storms could increase by US\$33 billion in the decades to come.

But prevention and mitigation measures can help manage such weather and climate risks. Adaptation measures, from strengthened flood defenses and improved building codes to beach nourishment and roof cover retrofits, can avert between 15 and 80 percent of the total risk.

For risks that cannot be mitigated, risk financing strategies can provide protection by capping losses and smoothing the costs of climate events to individuals, corporations, and governments. Effective risk reduction notably lowers the costs of such arrangements.

Source: Bresch and Müller 2014.

1.2. THE MANY IMPACTS OF DISASTERS: FROM PUBLIC FINANCES TO POVERTY REDUCTION

In 2015, the share of the global population living in extreme poverty was estimated to have fallen below 10 percent for the first time. More than 1 billion people have lifted themselves out of poverty in the past 15 years alone (World Bank 2016). However, climate and disaster risks threaten these achievements. Global economic losses from disasters are now reaching an average of US\$250 billion to US\$300 billion a year (UNISDR 2015). With climate change exacerbating some disaster risks and economic growth and rapid urbanization increasing exposure, building the resilience of societies is ever more crucial to protect poverty reduction efforts and promote sustainable and inclusive development. When governments are ill-prepared to respond to fiscal shocks, development programs and budgets often suffer. When productive assets are destroyed and savings wiped out by extreme events, it is much harder for the poor to get back on their feet and recover, let alone prosper.

FISCAL AND ECONOMIC IMPACT

Governments play a central role in emergency relief, recovery, and reconstruction in the aftermath of climate and disaster shocks. During and directly after a disaster, the government and international partners provide emergency relief to the affected population, ranging from the distribution of food aid in areas affected by drought, to the drainage of water in flood zones. Such disaster response expenditures require immediate access to liquidity and swift mobilization of funds to mitigate the negative impact of disasters on people and assets. If public infrastructure is damaged (and not insured), the government will also need to pay for significant reconstruction costs.

Disasters (especially those that affect large and/or industrial areas of a country) can also have

long-term macroeconomic impacts that affect the government's budget. When record floods inundated large swaths of Thailand in the fall of 2011, for example, total damage and loss was estimated at some US\$46.5 billion, more than 13 percent of that year's GDP. But the financial impact continued even after the water receded. According to estimates, the floods reduced real GDP growth in 2011 by 1.1 percent from pre-flood projections, reduced the current account to US\$11.9 billion from a projected US\$20.6 billion, and caused a loss in tax revenue of 3.7 percent from estimated pre-flood revenues (World Bank and Government of Thailand 2012).

In addition, there is some evidence that disasters can have an impact on a country's credit rating. Recent Standard & Poor's analysis finds that tropical cyclones have the potential to lead to downgrades of up to two notches. Post-disaster financing costs might therefore substantially increase after a disaster, especially for countries with low ratings (S&P Global 2015b). And climate change can further aggravate the situation (S&P Global 2015a).

DEVELOPMENT AND POVERTY IMPACTS

Statistics on macroeconomic and fiscal impacts do not reflect the direct and indirect impacts that disaster losses can have on the poorest members of society, nor their long-term impacts on human and economic development. Often, the absolute economic losses of the poorest households are small relative to those of the wealthy, and thus the consequences for the poorest communities are marginalized in the analysis. This is not just a monitoring issue but one that has implications for the selection and design of projects to mitigate risks, as more weight is often given to impacts that can be expressed fairly easily in monetary

FIGURE 2. WELFARE IMPACTS FROM CLIMATE SHOCKS



EDUCATION

The impacts of disasters on education are two-fold. On one hand, poor households often take children out of school in the aftermath of a disaster to help with manual labor or simply because they cannot afford school anymore.

In **El Salvador**, for example, school attendance fell by 7 percent and children from affected households were three times more likely to work after the 2001 earthquake. And after Hurricane Mitch in **Nicaragua**, child labor increased as much as 58 percent in the affected areas.

On the other hand, children may not be able to go to school because the building collapsed or was damaged during a disaster. In **China** for example, the Wenchuan earthquake destroyed more than 7,000 schools.



MALNUTRITION

Even temporary malnutrition in early childhood (as early as in utero) can permanently stunt growth and lower cognitive abilities, with consequences potentially lasting a lifetime. Stunted children are likely to grow up to be less productive adults and will earn less.

Children who had suffered from stunting during the 1982–84 drought in **Zimbabwe**, for example, were still doing worse in school than non-affected peers some 16 years after the disaster.

And there is clear evidence that early childhood nutrition plays a huge role in future development prospects. Studies on nutrition supplementation programs in **Guatemala**, for example, have found that children who received supplements until the age of three earned as much as 46 percent more than others as adults.



POVERTY TRAPS

The poor are at risk of getting locked into poverty traps. A disaster can destroy their productive assets, or wipe out their savings, making it harder for poor households to recover, let alone prosper. In the absence of insurance, lending opportunities, or social security institutions, even the prospect of a disaster can have devastating consequences.

For instance, in anticipation of future disasters a household may decide to minimize savings (such as in-kind savings in the form of physical assets), because they risk being destroyed in the event of a disaster. This results in limited financial buffers that would otherwise allow households to smooth consumption in the event of transitory shocks such as droughts or floods—and may thus have further poverty implications.

terms, such as aggregate damages, rather than impacts on well-being¹

A recent World Bank report finds that when impacts on well-being are accounted for, natural disasters are equivalent to a US\$520 billion drop in consumption in the global economy (or 60 percent more than the asset losses usually reported), and that they force some 26 million people into poverty every year (Hallegatte et al. 2017).

Looking at the impacts on households and communities, it is clear that the poor are the ones that bear the brunt of disasters and climate shocks (figure 2). Through their impact on human capital (in particular, nutrition, education, and health), disasters can severely affect household's

earning potential. Within households, the impacts of disasters are also not spread equally; women and girls often bear the brunt of both direct impacts (mortality rates as a result of disasters are higher among women) and indirect impacts (negative impacts on nutrition and school performance are disproportionately high among girls) (Baez, de la Fuente, and Santos 2010).

In this context, it is ever more urgent both to address key drivers of risk through mitigation and adaptation measures and to improve preparedness and response capacity. Section 1.3 provides an overview of the elements of an effective approach to disaster preparedness and crisis response, based on pre-agreed post-disaster plans and pre-planned financing.

1. When projects to reduce disaster risk are assessed on the basis of the value of damages that can be avoided, analyses favor projects that will protect or support richer areas or people. Imagine two flood protection projects with similar costs. The first would cover a wealthy neighborhood in a capital city. Because of the density of high-value assets, it would avert on average US\$10 million a year in losses. The second project would target poorer areas in a second-tier city and prevent just US\$5 million a year in losses. A traditional analysis would unambiguously select the first project. But a US\$5 million loss may matter more to poor people than a US\$10 million loss to richer people. If the second project benefits very poor people, it may generate greater benefits for well-being. And because well-being is the ultimate goal of public policy, the second project may be more attractive (Hallegatte et al. 2017).

1.3. THE ELEMENTS OF AN EFFECTIVE APPROACH TO DISASTER PREPAREDNESS AND CRISIS RESPONSE

Preventing losses and alleviating the impacts of disasters requires a comprehensive approach to disaster risk management—one based on reducing and managing conditions of hazard, exposure, and vulnerability, but also on coordinated and pre-agreed post-disaster plans backed by effective financial protection measures. Not all disasters and crises can be prevented, and governments must be ready to manage the impacts of any residual risk. To manage and mitigate the impacts of increasingly complex threats, governments must move away from reliance on traditional humanitarian support financed with funds raised after an event and toward a system that emphasizes preparedness based on national response systems.

An effective approach to managing the impacts of disaster shocks should be based on the principles described below and summarized in Figure 3.

COORDINATED PLAN FOR POST-DISASTER ACTION AGREED IN ADVANCE

The first element of a coordinated approach to disaster response is a single, solid disaster response plan agreed in advance. Without such a plan, responsibilities may be ill-defined, work steps may be either duplicated or omitted, and the exploitation of economies of scale in logistics may be lost. To avoid such inefficiencies, all stakeholders need to work together before disasters strike to establish a credible plan with a clear decision

FIGURE 3. THE ELEMENTS OF AN EFFECTIVE APPROACH TO DISASTER PREPAREDNESS AND CRISIS RESPONSE

COORDINATED PLAN FOR POST-DISASTER ACTION AGREED IN ADVANCE

- Consists of a single, credible plan for disaster response
- Defines explicit responsibilities and liabilities of all stakeholders (who or what will be protected, against what, and who will pay for what)
- Establishes clear decision process
- Clarifies what risks the national/local government will take on, and what risks have to be shared with households and firms, as well as the role of international partners

FAST, EVIDENCE-BASED DECISION-MAKING PROCESS

- Identifies ahead of time objective and transparent rules to guide decision making
- Requires investing in early warning systems and better data/information (ground data on loss of human life, building damage, area average index data on damage and losses, parametric indexes), including the human and technological capacity to collect data in a timely manner
- Define rules and triggers that result in pre-agreed interventions to promote decisive, timely action

PRE-PLANNED FINANCING FOR EARLY ACTION

- Ensures that funds are available quickly when—and only when—they are required
- Binds partners to pre-agreed objectives, decision processes, and implementation modalities
- Promotes greater discipline, transparency, and predictability in post-disaster spending
- Ensures rapid mobilization of funds, reducing humanitarian costs and potentially saving money

Source: Based on Clarke and Dercon 2016.

process and explicit responsibilities and liability. The relevant stakeholders must decide who or what will be protected, against what, and who will pay for what. By removing any ambiguity about responsibility, such a plan clarifies what risks the national or local government will take on, and what risks have to be shared with households and firms.

It is also necessary to plan in advance how post-disaster financial resources will be included in the national budget, how they will be disbursed and executed, and how they will reach end beneficiaries, especially the poor and vulnerable. Delivery mechanisms are just as important as the resources they will channel, and selecting the right modality will ensure that funds reach beneficiaries rapidly and efficiently. Applying insurance principles to enable the scale-up of existing social safety nets is increasingly considered an effective way to reduce the negative impacts of shocks on the most vulnerable. Using data-driven, rules-based triggers ensures rapid, transparent, and accountable responses in the immediate aftermath of a disaster, or at the early stages of slow-onset disasters such as droughts.

FAST, EVIDENCE-BASED DECISION-MAKING PROCESS

Effective disaster response must avoid costly delays. Thus countries must not only invest in early warning systems and better information, but also identify well in advance objective and transparent rules to guide decision making. Clear rules and triggers tied to pre-agreed actions will promote decisive, timely action and limit the number of decisions that stakeholders must make when a disaster strikes.

The data driving these decisions need to be resistant to manipulation and strike the right balance among cost, speed, and accuracy. Any data that could trigger action will depend on pre-disaster investments in design of the data collection system, and in the human and technological capacity to implement the system. Three types of data are particularly useful for triggering post-disaster action: individual damage and losses (affecting people and buildings), area average index data on damage and losses, and

parametric indexes. No rule is perfect, so there should be some discretionary backup system to deal with situations in which the rules fail.

PRE-PLANNED FINANCING TO ENSURE THAT THE PLAN CAN BE IMPLEMENTED

Finally, a coordinated approach to disaster response involves financial planning. Pre-planned financing not only ensures that the money is available when it is needed; it also serves as the glue that holds all the pieces of the plan together and makes it credible. Specifically, it ensures that funds are available quickly when—and only when—they are required by the plan, and it binds the various partners to pre-agreed objectives, decision processes, and implementation modalities so that the plan is strong enough to withstand the whirlwind of highly charged post-disaster politics. Sections 1.4 and 1.5 describe in greater detail the elements of a pre-planned approach to financing disaster response, also known as financial protection.

This strategic approach to financing disaster response offers a number of benefits, including greater discipline, transparency, and predictability in post-disaster spending (see Box 6). Pre-planned financing also helps ensure the rapid mobilization of funds to support relief efforts, which is crucial to limit humanitarian impacts. This rapid response can also save money. For example, well-targeted early interventions in slow-onset disasters such as droughts cost a fraction of emergency aid after a famine develops (Clarke and Hill 2013).

Experience shows that seemingly minor improvements in the way disasters are planned for and financed have significant positive impacts on people's lives. Below are just a few examples that highlight the benefits of a coordinated, pre-agreed approach to disaster response backed by pre-planned financing. These examples suggest how such an approach helps national governments manage the impact of disasters on their budget, while also reducing the negative consequences of disasters for individuals.

In **Kenya**, donors, nongovernmental organizations (NGOs), the World Bank, and the government are working together on the Hunger Safety Net Programme, which uses a system based on insurance principles to provide pastoralists with additional cash transfers in the event of a shock. Such approaches are proving useful in (re)designing disaster response programs, even in cases that do not involve commercial insurance contracts. The Kenya scheme has simple triggers and rules about when, where, and how additional support will be provided to vulnerable pastoralists. It pays a cash transfer to a predefined group when the rains fail and the harvest is bad, so that pastoralists can afford to buy inputs and food for their families—that is, so they can invest in their cows, goats, and camels without worry that the next drought will ruin them. Donors and government cofinance the program by drawing on specific contingency funds, and costly need assessment and delays are avoided.

In **Mexico**, the country's Natural Disaster Fund (FONDEN, or Fondo de Desastres Naturales), operates a rules-based system to reconstruct public infrastructure such as roads, hospitals, and schools after a disaster hits.² In this collaboration among the federal government, state governments, and the private sector, all participants have agreed to an objective procedure to determine the degree of damage, which is implemented by an independent third party and audited by all parties. The result is clarity before a disaster about who will pay for what. FONDEN also offers incentives for investments in risk reduction by rewarding them. Financial markets are used to lock in this rules-based approach. By facilitating faster reconstruction of infrastructure assets, FONDEN has contributed to increasing post-disaster local economic activity by 2–4 percent on average (De Janvry, del Valle, and Sadoulet, 2016).

In **India**, the government and farmers share the cost of crop insurance. This approach allows cheaper input credit because the banks can now trust that farmers will be able to repay even if their harvests fail. Meanwhile, farmers are protected and able to invest more in their farms.

In **Ethiopia**, a major drought in 2011 did not result in major loss of life (unlike in Somalia). One important reason was that the government, with donor support, had set up the Productive Safety Net Programme, which was designed to be scaled up to absorb more funding and reach more people during a crisis. In 2011 it expanded to support 9.6 million people. By providing support to households at the early signs of droughts, it allows them to maintain consumption, reduce malnutrition, and keep children in school. By ensuring that beneficiaries receive financial support before the lean season begins, the program is estimated to reduce drought impacts by as much as 25 percent.

GROWING INTEREST

Recognizing the benefits of this proactive approach to managing the financial impacts of disasters, a growing number of donors, development partners, and international financial institutions are supporting financial protection solutions in developing countries.

In addition, financial protection has become an increasingly important topic in high-level global policy initiatives. This attention is serving to increase awareness of the agenda and is driving political commitment, investments, and new partnerships. The World Bank supports many of these initiatives as a neutral broker, bringing together stakeholders to invest in technical advice and knowledge that support the implementation of policy reforms and financial instruments.

A number of examples show how the post-2015 development agenda has embraced disaster risk management and financial protection as key elements for building resilience and securing development gains:

- The Sendai Framework for Disaster Risk Reduction, adopted by UN member states in 2015, guides global efforts to prevent new and reduce existing disaster risk through 2030 and highlights financial protection as a key element of resilience.

2. FONDEN also covers low-income housing. It provides building materials that amount to US\$250 for minor damage, US\$1,200 for partial damage, and US\$6,000 for total damage.

- The Addis Ababa Action Agenda, adopted in July 2015, lays out the level of ambition for financing the Sustainable Development Goals (SDGs), which replaced the Millennium Development Goals in September 2015. Climate and disaster resilience are mainstreamed across the SDGs and their associated targets, ensuring that global development priorities over the next 15 years will integrate climate and disaster risk management considerations.
- The benefits of financial protection as part of the agenda of the G20 Mexican presidency were first discussed by the G20 finance ministers in 2012. Most recently, the 2015 G7 German presidency sponsored InsuResilience, an initiative to expand climate risk insurance coverage to an additional 400 million poor and vulnerable people in developing nations by 2020.
- The 2015 Asia-Pacific Economic Cooperation (APEC) ministerial statement highlighted innovative and regional disaster risk financing and insurance mechanisms as key tools to increase financial resilience as part of broader disaster and fiscal risk management frameworks. The statement emphasized the need to explore (with World Bank support) the possibility of developing regional risk pools and other risk financing mechanisms for interested APEC economies. A dedicated APEC Working Group on Regional Disaster Risk Financing Solutions has been established to take this forward.
- The Vulnerable Twenty (V20) ministers of finance, representing a group of countries that share a vulnerability to climate and disaster risks, is also exploring joint risk financing solutions—including regional options for Asia—to protect against the financial shocks of climate risks.
- The Association of South East Asia Nations (ASEAN) and the ASEAN+3 (Japan, Republic of Korea, and China) have discussed opportunities for regional disaster risk financing for several years. In 2015, ASEAN announced the establishment of the ASEAN Disaster Risk Financing and Insurance Programme, which aims to further explore national and regional disaster risk financing solutions.

GOING BEYOND CLIMATE AND DISASTER RISKS: A COMPREHENSIVE APPROACH TO RISK MANAGEMENT AND CRISIS RESPONSE

Financial protection against climate and disaster risks is increasingly seen as a model with wider relevance, one that can be adapted to, and offer lessons for, efforts to manage the financial impacts of other shocks and crises, including pandemics and crises related to fragility and forced displacement.

The Pandemic Emergency Financing Facility (PEF), for example, is a global financing facility designed to channel funds swiftly to governments, multilateral agencies, NGOs, and others seeking to respond to dangerous epidemic outbreaks before they turn into pandemics. Developed by the World Bank in partnership with the World Health Organization, the PEF will include both an insurance component and a cash component to provide more flexible funding.

Risk management and crisis response are becoming key elements of an approach to development focused on global public goods. Given the rapid expansion of the financial solutions available to governments it is necessary to package available instruments and mechanisms in a comprehensive and coherent offering that cuts across sectors and focuses on helping countries manage the full range of risks they face. In this spirit, the World Bank Group recently announced its Global Crisis Response Platform (GCRP), an umbrella to organize existing crisis management tools, so as to improve effectiveness, strengthen complementarity, and fill gaps .

1.4. FINANCIAL PROTECTION: FROM POST-DISASTER EMERGENCY BORROWING TO PROACTIVE RISK MANAGEMENT

When disaster strikes, governments often face acute financing needs. If national resources are limited and financing options were not agreed upon and set up in advance, governments are left with a limited set of options in the aftermath of a disaster:

- They can appeal for *international assistance* and wait for it to materialize, which takes time and implies significant uncertainty, as commitments do not always match emergency appeals.
- They can use *budget reallocation* to divert funds from other government programs, with potential negative impacts on long-term development programs. Since opportunity costs of post-disaster budget reallocations can be high, particularly if funds are not replaced and reprogrammed, this approach has clear disadvantages. In addition, the process often takes time, as it requires an analysis of available resources as well as a certain level of consensus across affected line ministries. Nevertheless, this is a fairly standard way of accessing the immediate liquidity needed to finance early response, especially following small disasters.
- They can *issue debt*, though this is not always an option or may be very costly. For countries where debt sustainability is a concern, or if markets are not liquid and/or costs are high, this approach can be prohibitively expensive. Unexpected borrowing could also derail debt management strategies and/or progress toward debt targets.

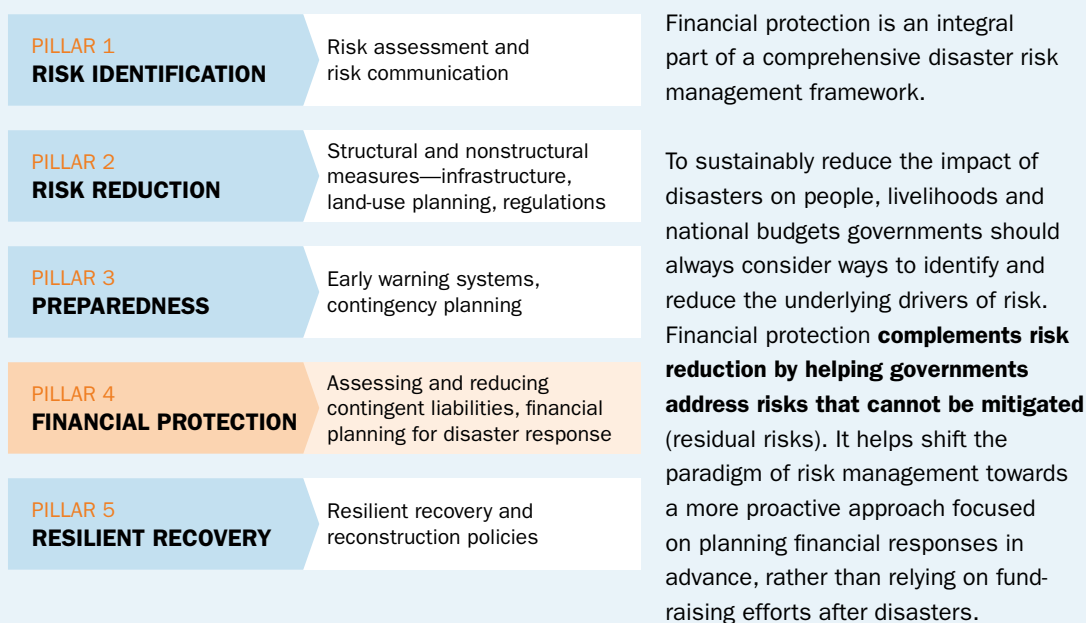
To better manage the cost of disasters, ensure predictable and timely access to much-needed resources, and ultimately mitigate long-term

fiscal impacts, governments can adopt a strategic approach built on pre-planned financing mechanisms. This approach to financial protection complements other elements of a comprehensive disaster risk management strategy, ranging from investments in risk reduction to improved preparedness and resilient reconstruction. It works by helping governments proactively manage the residual risk that cannot be fully mitigated (because doing so is not feasible or not cost effective).

Financial protection involves planning ahead—before the disaster actually happens—and setting resources aside to finance disaster response activities. Governments can choose from a menu of financial instruments and mechanisms that help address different risks (ranging from recurrent to more rare events) and different funding needs (ranging from short-term emergency relief to recovery and reconstruction). Based on experiences over the past 15 years across more than 60 countries, the menu of *ex ante* financing options available to governments includes the following:

- In many countries, *contingency/reserve funds* are used to finance relief, rehabilitation, reconstruction, and prevention activities for national emergencies. Sovereign funds specifically dedicated to disaster response exist in Colombia, Costa Rica, India, Indonesia, the Lao People's Democratic Republic, the Marshall Islands, Mexico, the Philippines, and Vietnam, among others. In the Philippines, the National Disaster Risk Reduction and Management Fund finances a range of disaster-related expenditures, but it is not able to disburse rapidly in response to a crisis. For that reason, the government created the Quick Response Fund for

BOX 3. A COMPREHENSIVE DISASTER RISK MANAGEMENT FRAMEWORK



emergency response. In Mexico, FONDEN was created as a budgetary tool to rapidly allocate federal funds for emergency response and rehabilitation of public infrastructure affected by disasters.³

A number of other countries are working to establish similar funds. In Kenya, for example, the government is in the final stages of operationalizing a national contingency fund dedicated to drought emergencies.

- *Contingent loans* are financial instruments designed to give countries access to liquidity immediately following an exogenous shock, such as a terms-of-trade shock, financial shock, or natural disaster. They are typically offered by multilateral development banks and international financial institutions (including the World Bank, the Asian Development Bank, the Inter-American Development Bank, and the International Monetary Fund).

The World Bank's contingent instrument for natural disasters, the Development Policy Loan with Catastrophe Deferred Draw-Down Option (CAT-DDO), allows countries eligible to borrow from the International Bank for Reconstruction and Development to secure immediate access to budget support of up to US\$500 million, or 0.25 percent of GDP (whichever is lower), following declaration of a national emergency. Since the introduction of the instrument in 2008, CAT-DDOs have been used in 10 countries for an aggregate amount of US\$2.3 billion. These loans also provide a platform for policy reform and strengthening of national risk management capacity. Going forward, the CAT-DDO will be adapted to address pandemic risks and will be made available to low-income countries eligible for International Development Association (IDA) financing.

- *Market-based risk transfer solutions* are used in every sector of the economy and have

3. FONDEN is complemented by FOPREDEN (Fondo para la Prevención de Desastres Naturales), which finances prevention activities (mainly studies) for subnational governments.

growing relevance in development due to increased exposure to risks that result in economic loss. A broad menu of underlying instruments—derivative contracts, insurance contracts, and catastrophe bonds (CAT bonds)—can be used to transfer the risk of specific meteorological or geological events (droughts, hurricanes, earthquakes, and floods) to actors in the market (insurance companies, reinsurance companies, banks, and investors) who are willing to accept them. These market-based risk transfer products use scientific information and actuarial modeling to estimate losses that would be sustained due to a specific event and to “price” the risk.

Disaster risk transfer solutions can rely on a parametric trigger, where payments are triggered by the performance of a prespecified index such as levels of rainfall, length and intensity of

drought, tropical cyclone wind speeds, etc. Box 4 has more detail on index-based products.

- *Catastrophe risk pools* in particular are emerging as a promising vehicle to help countries access cost-effective risk transfer solutions. They facilitate (i) diversifying risk across multiple countries with different risk profiles; (ii) establishing joint reserves (joint surplus capital) to self-insure a part of the risk; (iii) transferring excess risk to the reinsurance and capital markets; (iv) sharing operational costs, such as program development and day-to-day back-office operations; and (v) building up a better foundation of risk information. Examples of sovereign/supranational pools include CCRIF, PCRAFI, and ARC. Part 2 presents a detailed discussion of the role of sovereign catastrophe risk pools in the financial management of climate and disaster risks.

BOX 4. INDEX INSURANCE: A FEW DEFINITIONS

Unlike traditional **indemnity-based** insurance products that require the assessment of individual losses following an insurable event, **index-based** (including parametric) insurance policies make payouts based on a predetermined trigger, such as crop yield estimates, in a given geographical area. Other triggers could be based on the location or intensity of natural hazards such as wind speed, rainfall levels, or ground acceleration from earthquakes.

The particular index used can be tailored to the availability of data: when only hazard data are available, a **parametric index** (which pays out on a given hazard event) can be used; but when exposure data are available, it is more appropriate to use a **modeled loss index** (which pays out in line with loss modeled using actual exposure data and parameters such as wind speed from the actual event). Parametric coverage demands improved accuracy of hazard risk data collection systems because of the heavy reliance on objective measurement of weather and hazard parameters. Index insurance offers several advantages over traditional or indemnity insurance, such as quicker

payouts, lower administrative costs, and reduced moral hazard and adverse selection. For example, at the micro level it allows domestic insurance companies to offer farmers simple and transparent solutions for transferring weather risks such as drought, excess rainfall, or low temperatures.

But index insurance is not without its challenges, notably **basis risk**. Implicit in all index insurance, this is the risk that the index measurement will not match individual losses. For example, an insured individual or asset may experience a loss from a disaster that is not fully captured by the parametric index, and hence does not lead to a payout. Alternatively, a payout could be triggered without any damage and losses incurred. Improved accuracy of hazard data collection systems, increased openness and centralization of historical data, and better-quality risk assessments could reduce basis risks, enabling a more efficient and effective use of parametric insurance. Capacity building and education are key to ensure understanding of basis risk. For governments considering parametric insurance, it is crucial to carry out a cost-benefit analysis of different potential indexes with different levels of basis risk.

Beyond sovereign catastrophe risk pools that can assist governments in accessing rapid (but limited) post-disaster financing, governments can also promote the development of domestic catastrophe risk pools to transfer disaster risks from households and small and medium enterprises to the private insurance and reinsurance markets. Since the establishment of the Turkish Catastrophe Insurance Pool (TCIP) in 1999 (see Box 5), very few developing and emerging countries have implemented such pools. (Indonesia and Romania are among the few exceptions in emerging economies.) The role of the government is essential in such endeavors, which must align incentives and generate a sustainable demand for catastrophe risk insurance, especially where insurance literacy and penetration are low.



BOX 5. TURKISH CATASTROPHE INSURANCE POOL

With a majority of the population living in earthquake-prone areas, the persistent potential for large-scale natural disasters has become a fiscal and social issue for the Turkish government. These pressures led to the establishment of the Turkish Catastrophe Insurance Pool in 1999. Aside from fiscal exposure, the main rationale for the creation of TCIP was a very low level of catastrophe insurance penetration among households. TCIP was established as a public sector insurance entity providing catastrophe risk insurance for Turkish homeowners. A genuine public-private partnership, TCIP has no public employees. All of its business functions—from sales to reinsurance to claims management—are subcontracted to the private insurance industry. The government's role is limited to (i) enforcing compulsory earthquake insurance for all urban dwellings and (ii) providing contingent liquidity support in the remote event that TCIP's financial capacity is insufficient to pay all claims in full. The program has four principal objectives:

1. Provide compulsory earthquake insurance coverage at affordable but actuarially sound rates for all registered urban dwellings

2. Limit the government's financial exposure to natural disasters
3. Build long-term catastrophe reserves to finance future earthquake losses
4. Encourage risk reduction and mitigation practices in residential construction

The program provides earthquake insurance coverage to approximately 4.5 million Turkish homeowners (corresponding to approximately 30 percent of the insurable housing stock).

The creation of TCIP has greatly increased public awareness of earthquake risk due to a wide, ongoing public information campaign dedicated to earthquake insurance. For example, the concept of earthquake risk management and insurance has recently been introduced in school textbooks. The program also provides incentives for local builders to comply with the construction code because TCIP does not provide insurance coverage for any buildings that do not carry valid construction and occupancy permits.

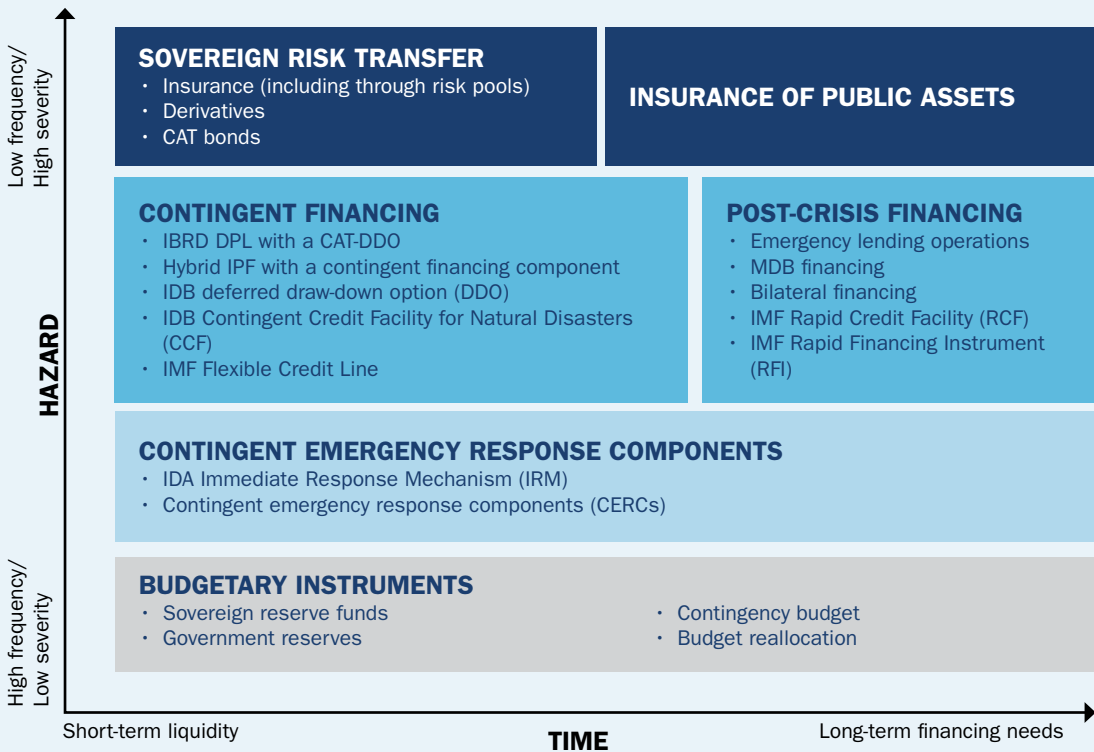
1.5. SELECTING THE APPROPRIATE FINANCIAL PROTECTION INSTRUMENTS

Not all instruments serve the same purpose, and governments can take a strategic approach to financial protection by combining instruments with different characteristics.

More specifically, depending on the frequency and severity of risks to be managed, governments can combine (or layer) financing instruments that address different needs and have different cost implications. Such an approach prioritizes cheaper sources of funding, ensuring that the most expensive instruments are used only in exceptional circumstances. For example, sovereign insurance may provide cost-effective

cover against severe events, but using it to protect against low-intensity and recurring events may be inefficient and costly. For such disasters, a dedicated contingency fund that retains this lowest layer of risk may be a more appropriate solution (Figure 4 provides a graphic representation of this risk-layering approach). Since climate change may over time affect a country's risk profile by potentially increasing the frequency and intensity of such hazards, the combination of financial instruments used to address disaster impacts will also need to evolve to account for changes in risk and other considerations beyond pure financial aspects.

FIGURE 4. SOVEREIGN DISASTER RISK LAYERING



Note: IBRD = International Bank for Reconstruction and Development; IDA = International Development Association; DPF = Development Policy Financing; CAT DDO = Catastrophe Draw-Down Option; IMF = International Monetary Fund; MDB = multilateral development bank.

Combining instruments also enables governments to take into account the evolving need for funds—initially for emergency response and eventually for long-term reconstruction. For example, a government could purchase (ex ante) quick-disbursing risk transfer instruments to ensure immediate liquidity in the aftermath of severe events, but raise the much larger sums required to finance reconstruction efforts through (ex post) budget reallocations or by issuing bonds.

Policy makers considering the most effective approach to financial protection need to evaluate various potential instruments. An evaluation framework is helpful for this purpose because it allows public officials to assess (i) whether a given instrument is the right tool to achieve their objectives, and (ii) how well the selected instrument is implemented and ways to make it more efficient.

A possible framework for evaluating risk financing solutions draws on the key principles of effective financial protection, listed here and described further in Box 6:

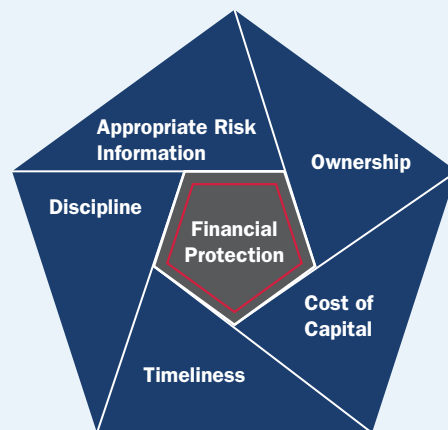
- **Cost of capital:** How cost-effective is the instrument in accessing financial resources after a disaster, either in absolute terms (i.e., how much does US\$1 of disaster response cost?) or relative to other instruments available?
- **Timeliness:** Can the selected instrument make funding available at the right time?
- **Discipline:** How well can the instrument support post-disaster spending discipline, accountability, and transparency? Does the instrument support risk-based pricing?
- **Ownership:** How well can the instrument clarify risk ownership? Is the entity that pays the cost of the instrument (e.g., premium) also the entity that bears the risk?
- **Risk reduction:** Does the instrument incentivize investments in risk reduction and preparedness?
- **Risk information:** Can the chosen instrument help countries understand and price their risk?



BOX 6. THE PRINCIPLES OF EFFECTIVE FINANCIAL PROTECTION

Effective disaster risk financing strategies are marked by several mutually reinforcing characteristics that promote disciplined, timely, and appropriately priced access to finance:

- **Cost of capital.** Access to capital (i.e., public and/or private financial resources) is necessary for effective emergency response and reconstruction as well as for investment in risk reduction and prevention. Yet different sources of funds come with different costs. Through optimal use of instruments such as reserves, contingent credit, risk transfer solutions, and post-disaster credit, disaster risk financing policies can secure access to disaster financing for governments, businesses, and households before an event strikes and ensure timely and cost-effective financial resources for recovery and reconstruction.
- **Timeliness.** Different levels of funding need to be available at the appropriate time to cover relief, response, and reconstruction efforts. Rapid mobilization of funds to support relief efforts is crucial to limit humanitarian impacts. This rapid response can also save money. For example, well-targeted early interventions in slow-onset disasters such as drought cost a fraction of emergency aid after a famine develops. While immediate liquidity is crucial to support relief and early recovery operations, the government has more time to mobilize the majority of resources for reconstruction. Businesses and households also need access to timely financing through catastrophe risk insurance and/or post-disaster credit.
- **Discipline.** Disaster risk financing helps governments, businesses, and households plan in advance of a disaster and agree ex ante on rules and processes for securing funds through their budget (budget mobilization) and spending this money (budget execution). This approach fosters discipline, transparency, and accountability in post-disaster spending. Discipline is also important for a government to credibly commit when it will or will not act, thus facilitating ownership of risk.



- **Ownership of risk.** Clarity about who owns the risk—that is, about the contingent liability of the national government, subnational governments, donors, the private sector, and households—promotes better decision making. In the absence of clear rules regarding what share of costs for response and reconstruction the national government will assume, businesses and households have little incentive to invest in risk reduction or purchase catastrophe risk insurance, and delays can occur in post-disaster response and recovery. Clearly established rules for the amount and timing of payouts under social protection programs allow vulnerable households to plan and budget effectively.
- **Risk information.** Lack of knowledge about exposure to risk can lead to suboptimal investment decisions by public and private actors. Better information on which populations and assets face potential disaster impacts can help overcome behavioral biases, such as the reluctance of businesses and households to buy catastrophe risk insurance. It may also help monitoring and evaluating the effectiveness of risk finance and insurance instruments. Finally, putting a price on risk can help elevate decision making to the finance ministry level and provide further incentives for ex ante risk reduction and adaptation efforts.

Source: World Bank Group 2014.

BOX 7. QUANTIFYING THE BENEFITS OF FINANCIAL PROTECTION

Cost-benefit analysis provides governments with a quantitative tool to assess (i) whether a specific financial instrument would offer effective financial protection against the risks faced by the country; (ii) how a specific instrument would complement an existing portfolio/approach; and (iii) whether the price of the proposed instrument is cost-effective compared to other options.

The World Bank recently published a framework for evaluating the economic costs and benefits of disaster risk financing instruments, which can be used to inform the design of an appropriate and cost-effective approach to the financing of disaster response (Clarke and Mahul et al. 2016). The framework was used to analyze different risk financing approaches to support drought response

in Ethiopia through an expansion of the Productive Safety Net Programme (Clarke and Coll-Black et al. 2016). The analysis compared three strategies, each involving different combinations of federal contingency budget, emergency budget reallocation, insurance, and humanitarian response.

In the case of Ethiopia, the analysis showed that financing disaster response costs through a combination of budget reallocation, reserves, and insurance could on average reduce the cost of response by a quarter, as compared to waiting for humanitarian aid to be mobilized. The cost savings from including insurance as part of a disaster risk financing strategy become far greater for more severe droughts, which are expected to occur less frequently.

Evaluating an instrument against these indicators helps governments take informed decisions on whether a given instrument serves their purpose. The objectives, and hence the most appropriate tool, will not be the same across countries, and each government will have to find its own preferred combination of sources of funding. For instance, a government that prioritizes speed and predictability of post-disaster funding may be willing to pay a potentially higher price for these benefits in the form of an insurance premium. On the other hand, a government without sufficient resources to respond even to more frequent and less severe events might more cost-effectively

achieve its objectives through contingent financing. If a government has sufficient reserves for short-term response but is looking for the cheapest possible source of longer-term financing for reconstruction, ex post borrowing may be the most attractive option.

Box 7 presents an approach to support decision making through the quantitative analysis of the costs and benefits of different combinations of financial instruments.

1.6 INSURANCE: A POWERFUL TOOL TO BE USED WITH CAUTION

Market-based risk transfer and insurance solutions play an important role in the mix of financial instruments available. But while insurance can be a powerful tool for risk management, it is also an expensive one for governments that otherwise have access to sufficient sovereign financing.

Insurance can effectively reduce the volatility of disaster impacts on government accounts and therefore promote budget stability. In addition, it provides rapid liquidity without requiring access to credit. This is a significant benefit to some governments, particularly small states that lack sufficient capacity to build reserves and are restricted in their access to credit due to already high debt-to-GDP ratios.

An important consideration when assessing risk transfer and insurance is the comparative cost of the instruments. Different sources of funding come with different costs.

Table 1 provides an indicative cost multiplier for different financial risk instruments. This multiplier is defined as the ratio between the cost of the financial product (such as the premium of an insurance product, or the expected net present value of the cost of a contingent debt facility) and the expected payout over its lifetime. A ratio of 2 indicates that the overall cost of the financial product is likely to be twice the amount of the expected payout made over a long period of time. Note that these multipliers are only indicative and aim to illustrate the cost comparison of financial products. The speed at which funds can be obtained is also determined by the legal and administrative processes that drive their use (Ghesquiere and Mahul 2010).

Insurance, like some other ex ante financing instruments, allows for rapid response financing. It secures access to immediate (but limited) liquidity in the aftermath of an insured disaster event. While there is not a clear consensus on the effect of delay on post-disaster costs, there is agreement that this effect occurs, and the range seems to be between 2:1 to 5:1 depending on the peril and the location. For example, evidence from Ethiopia shows that every US\$1 secured in contingency financing for timely and predictable disbursement for emergencies can save up to US\$5 over the long term.⁴

Taking these considerations into account, a government can combine market-based risk transfer with other instruments to ensure that cheaper sources of money are used first, with the most expensive instruments used only in exceptional circumstances. For example, while insurance can provide cover against severe events, it is likely not appropriate to protect against low-intensity events that recur regularly. For such events, the government could consider setting up a dedicated contingency fund or access pre-arranged donor resources to retain this lowest layer of risk.

Part 2 of this paper considers how risk transfer can be implemented most effectively and efficiently through catastrophe risk pools.

4. See Wiseman and Hess (2007). Cabot Venton et al. (2012) suggest even higher figures for Ethiopia and double the cost of a late response in Kenya compared with an early response.

TABLE 2. COSTS OF DIFFERENT INSTRUMENTS FOR FINANCING POST-DISASTER EXPENDITURE

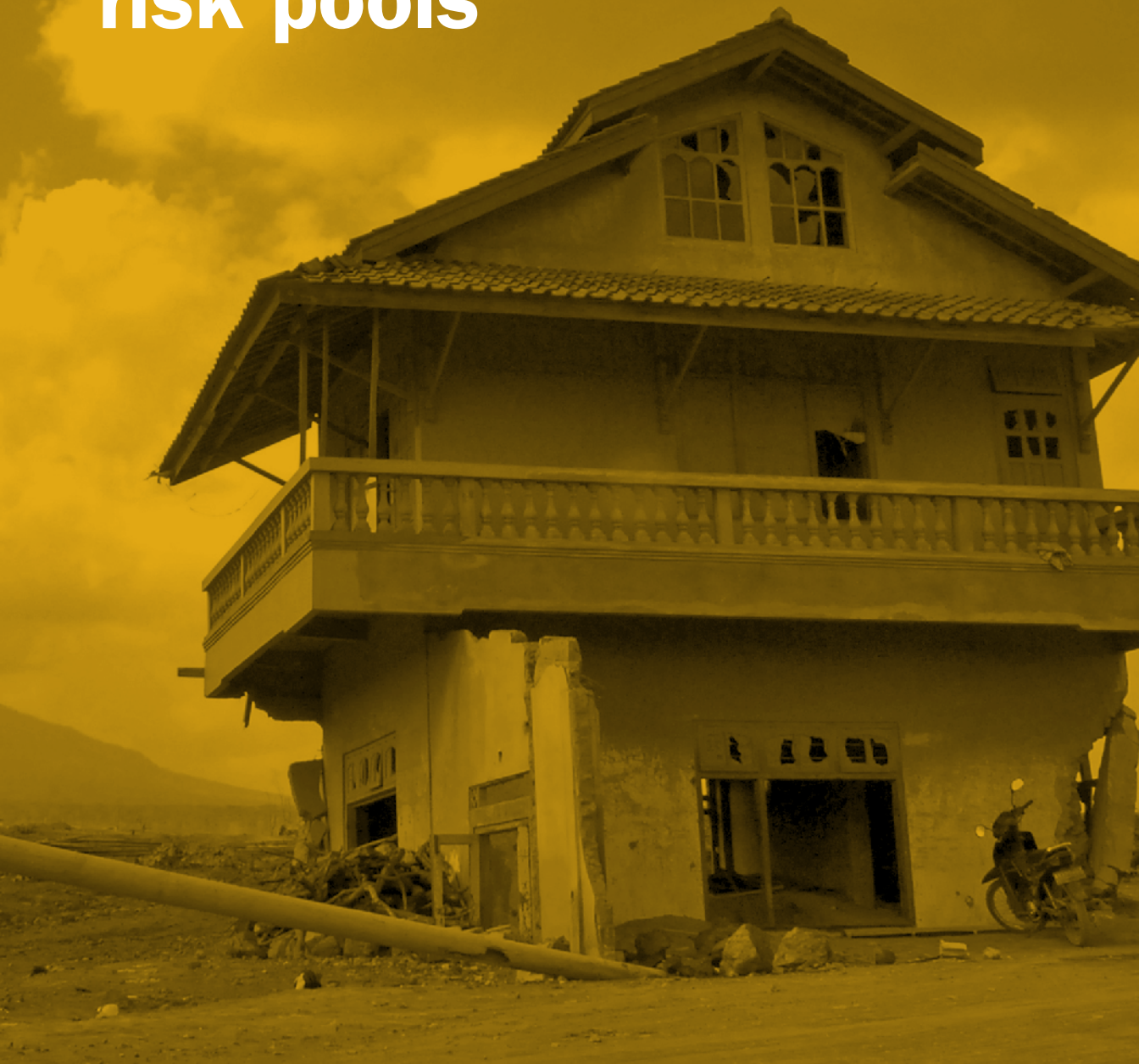
Instruments	Indicative cost multiplier	Disbursement (months)	Amount of funds potentially available
Ex post financing			
Donor support (humanitarian relief)	0–1	1–6	Uncertain
Donor support (recovery and reconstruction)	0–2	4–9	Uncertain
Budget reallocations	1–2	0–9	Small
Domestic credit (bond issue)	1–2	3–9	Medium
External credit (e.g., emergency loans, bond issue)	1–2	3–6	Large
Ex ante financing			
Budget contingencies	1–2	0–2	Small
Reserves	1–2	0–1	Small
Contingent credit	1–2	0–1	Medium
Parametric insurance	1.3 and up	0–2	Large
Alternative Risk Transfer (for example CAT bonds, weather derivatives)	1.5 and up	1–6	Large
Traditional (indemnity-based) insurance	1.5 and up	2–12	Large

Source: Based on Ghesquiere and Mahul 2010.



PART 2.

**Lessons learned
from experiences of
sovereign catastrophe
risk pools**



For governments defining cost-effective combinations of financial instruments, risk transfer solutions can be implemented in various forms, including direct access to the reinsurance and capital markets or indirect access through a dedicated vehicle such as a catastrophe risk pool. Catastrophe risk pools create a platform that allows governments to (i) take a collective and standard approach to quantitative analysis and modeling; (ii) improve information sharing; (iii) coordinate response; (iv) lower costs of coverage (through pooling of diverse exposures, retention of some risk, and transfer of excess risks to the capital and reinsurance market); and (v) strengthen regional/subregional cooperation and policy dialogue.

In the Caribbean, for example, the World Bank Group has supported 16 countries that decided to join efforts through the Caribbean Catastrophe Risk Insurance Facility, which pools hurricane, earthquake, and excess rainfall risks. The purpose of this regional approach was to enable countries to access rapid (but limited) response financing—with payouts disbursed within two or three weeks after a disaster. The sovereign mechanism CCRIF set up in 2007 in the Caribbean was the first of its kind. Since then, the concept has been replicated in two other regions, in the Pacific through the PCRAFI Facility, and in Africa through the ARC. The government of Mexico has also drawn on some of the principles of catastrophe risk pools in its subnational disaster response pool, which relies on a standardized approach to disaster risk modeling and assessment. Globally, a number of countries and their development partners are exploring how risk pools, or similar financing structures, could help them manage the financial impacts of disasters.

There are a number of reasons why national and subnational governments may seek to collaborate and pool their catastrophe risks. The benefit of diversification of losses (and ultimately its tendency to lower premiums) is the principal driver. Diversification of losses through pooling of risk is the underlying basis of the global (re)insurance markets. Other drivers include economies of scale (in shared administrative costs and larger transactions with the reinsurance markets) and political cooperation and solidarity in managing disasters.



Risk pools also entail certain risks and costs that should not be underestimated, including the time and (technical and political) effort to establish such pools, the cost of insurance (premium), and the political risk of an insurance policy not triggering a payout after several years.

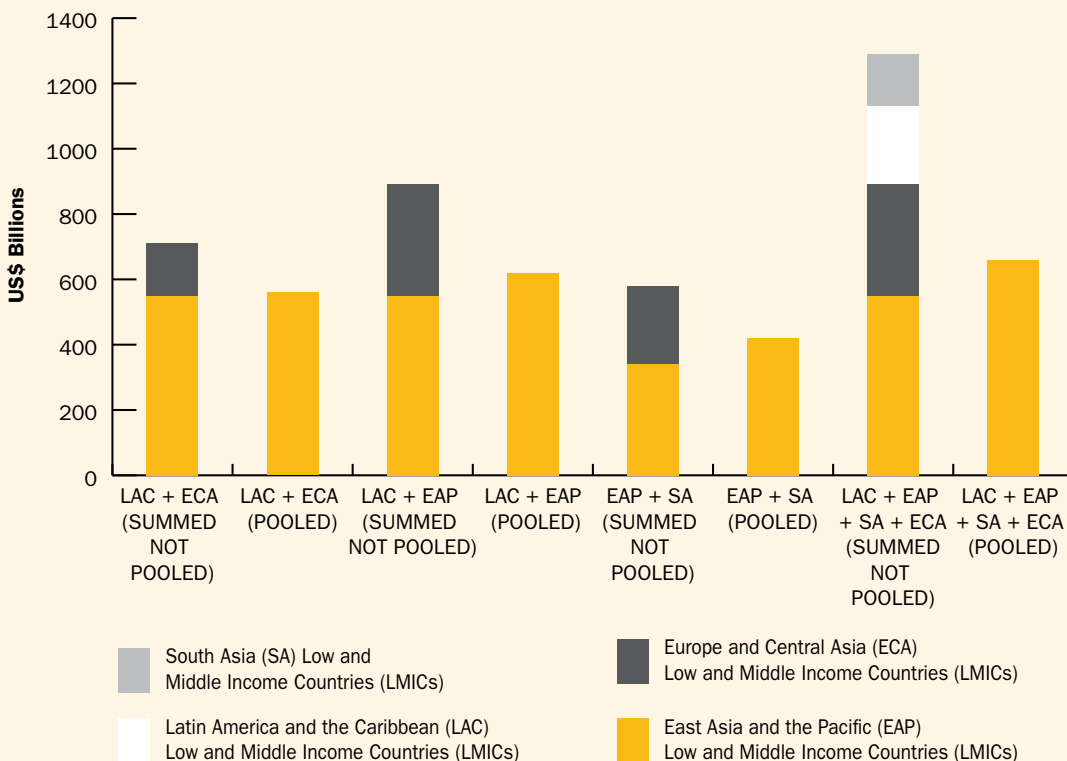
Box 8 illustrates the potential benefits of risk pooling with countries from Latin America and the Caribbean, East Asia and Pacific, South Asia, and Europe and Central Asia. The risk-pooling benefit is captured here as a reduction of the capital requirements to sustain a 1-in-200-year loss, that is, the amount of capital that should be held to sustain a loss with an annual probability of occurrence of 0.5 percent. This parameter directly influences the price of insurance (premium): the more (less) capital a pool needs to hold, the more (less) expensive the premium is. Using data provided by the risk modeling firm AIR Worldwide, the analysis shows that the 1-in-200-year level of loss in the aggregate portfolio is about 45 percent lower than the sum of the 1-in-200-year level of regional losses.

BOX 8. INSURING THE WORLD: RISK POOLING AND REDUCTION IN CAPITAL REQUIREMENTS FOR LOW- AND MIDDLE-INCOME COUNTRIES

An analysis was undertaken to illustrate the hypothetical impacts of pooling low- and middle-income countries' economic losses on a global scale. The benefit of risk pooling manifests as a reduction in the amount of capital required to manage the occurrence of severe but infrequent loss events. For the purposes of illustration, a 1-in-200-year return period level of loss (standing for the level of a severe but infrequent loss that would need to be managed) is examined as a simple aggregate (i.e., countries managing severe losses separately) versus a pooled risk (i.e., a common fund for financing severe losses). The following scenarios are considered:

- Separate regional values for low- and middle-income countries in Europe and Central Asia, East Asia and the Pacific, South Asia, and Latin America and the Caribbean.^a (data for Africa were not available for this analysis)
- Values for selected regional collaborations

The figure below shows the difference in capital requirements for pooled risks versus nonpooled risks. This reduction in capital requirement generated by risk pooling leads to lower premiums.



Source: World Bank based on results provided by AIR Worldwide.

Note: ECA = Europe and Central Asia; EAP = East Asia and the Pacific; LAC = Latin America and the Caribbean; SA = South Asia. All losses presented here represent AIR Worldwide's upper-bound estimates of economic losses for low- and middle-income countries on an aggregate basis. The income categories and regional country classifications adopted are as defined by the World Bank (see note a). While AIR models losses in over 90 countries, assumptions were made regarding losses from perils and countries that AIR does not currently model; assumptions were also made concerning the nature of the scaling factor between insured/insurable and economic losses. These assumptions are based on AIR's current understanding of historical losses and relative hazard levels. Numbers presented should therefore be interpreted as estimates.

a. World Bank income classifications were used, with high-income countries removed from the analysis. Where data were not available for in-scope countries, AIR Worldwide used an extrapolation methodology to make estimates. See World Bank, "World Bank Country and Lending Groups," <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.

2.1. GLOBAL LANDSCAPE OF SOVEREIGN CATASTROPHE RISK POOLS FOR DEVELOPING COUNTRIES

Sovereign catastrophe risk pools can provide a mechanism for governments to access rapid liquidity post-disaster in a cost-efficient and mutually supportive way. They enhance financial preparedness against climate and disaster risks by (i) pooling risks into one single, more diversified, less risky portfolio; (ii) retaining some risks through joint reserves/capital; and (iii) accessing the reinsurance and capital markets when it is the most cost-effective. However, risk pools do require significant technical and political support and time to be established, and even longer time to become sustainable.

Three sovereign catastrophe risk pools currently exist, covering 26 countries in three regions—the Caribbean and Latin America, Africa, and the Pacific. All are heavily supported by donor partners. Pool members represent the vast majority of developing countries that have purchased sovereign catastrophe risk insurance. Opportunities for one or more supranational pools may arise in Asia, and large countries across the world are exploring national level solutions, following the example of Mexico.

EXISTING SOVEREIGN CATASTROPHE RISK POOLS

The three existing sovereign catastrophe risk pools could potentially cover more than 50 countries in Africa, the Pacific, and the Caribbean and Central America, for multiple perils. Many current members are among the world's most vulnerable nations (see Figure 5). Since its launch in 2007, CCRIF has been restructured as a segregated portfolio company to be able to expand to gradually include countries of Central America (as of December 2016 only Nicaragua has joined). ARC was launched by the African Union in 2012 and issued its first insurance contracts in 2014.

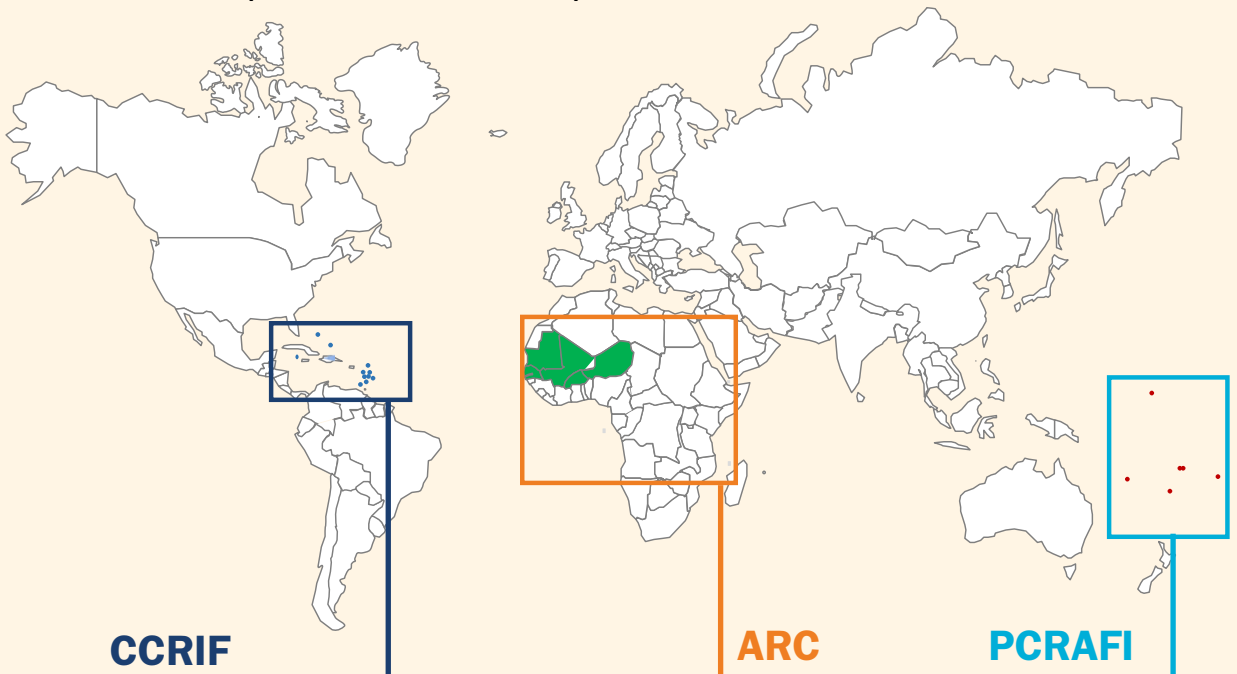
PCRAFI began facilitating insurance transactions for a number of Pacific island states starting in 2013, and in November 2016 issued the first policies from the newly established catastrophe risk pool, the PCRAFI Facility.

As of December 2016, the three programs provide an aggregate coverage limit of US\$870 million (80 percent from CCRIF-Caribbean). While these existing sovereign risk schemes share many common features, they are different in detail. Table 2 provides a comparative matrix summarizing the schemes' key features as well as a detailed description of their evolution and current status. Further information on each program and its respective annual portfolio is provided in annex 1 and annex 2.⁵



5. Annex 2 also includes a description of Mexico's fund for natural disasters FONDEN.

FIGURE 5. MAP OF COUNTRIES PARTICIPATING IN A SOVEREIGN CATASTROPHE RISK POOL (AS OF DECEMBER 2016)



CCRIF

 Anguilla	 Dominica	 St. Kitts & Nevis
 Antigua & Barbuda	 Grenada	 Saint Lucia
 Barbados	 Haiti	 Trinidad & Tobago
 Belize	 Jamaica	 Turks & Caicos Islands
 Cayman Islands	 St. Vincent & the Grenadines	 Nicaragua

ARC

 Burkina Faso	 Niger
 Mali	 Senegal
 Mauritania	 The Gambia

PCRAFI






 Marshall Islands
 Samoa
 Tonga
 Cook Islands
 Vanuatu

TABLE 3. DETAILED OVERVIEW OF EXISTING REGIONAL SOVEREIGN CATASTROPHE RISK POOLS (AS OF DECEMBER 2016)

Scheme	CCRIF (Caribbean)	CCRIF (Central America)	ARC	PCRAFI
Form of insurance	Modeled loss parametric	Modelled loss parametric	Modelled loss parametric	Modelled loss parametric
Perils covered	Earthquake, tropical cyclone (wind + surge), extreme rainfall	Earthquake, Tropical Cyclone (wind + surge), Extreme Rainfall	Drought, Tropical Cyclone (wind + surge), Flood under development	Earthquake (ground shaking + tsunami), Tropical cyclone (wind + surge)
Modeling	EQ/TC - built for and licensed by CCRIF, available to participants for noncommercial use. XSR - in-house	EQ/TC - built for and licensed by CCRIF, available to participants for non-commercial use. XSR - in-house	In-house (license owned by ARC Agency), TC and FL will use licensed feed for hazard data	AIR Worldwide model
Date of first policies	2007	2015	2014	2013
Initial capitalisation	Multi-donor grants via World Bank	Multi-donor grants via World Bank	Development capital (interest-free loan) from 2 partners	Multi-donor grant via WB
Ownership	Purpose trust	CCRIF Purpose trust	Mutual insurance company formed at direction of ARC Conference of the Parties	Foundation
Operational entity	Segregated portfolio company, multiple cells	Cell in CCRIF SPC	Class 2 captive insurer	Captive insurance company
Domicile	Cayman Islands	Cayman Islands	Bermuda	Cook Islands
Governance	Board of 5 directors, 2 appointed by Caribbean Development Bank, 2 by CARICOM, and 1 by other 4 Directors	Management Committee for CA cell, under CCRIF SPC board	Board of 7 Directors, appointed by the members	Board of 5 Directors appointed by Council of Members
Operational staffing	CEO and COO on staff, remainder outsourced to service providers	Operated by CCRIF SPC	CEO and small technical/ operations support team, remainder outsourced to service providers	Operated by Pacific Catastrophe Risk Insurance Company (PCRIC). CEO, remainder outsourced to service providers

Scheme	CCRIF (Caribbean)	CCRIF (Central America)	ARC	PCRAFI
Number of participants	20 are eligible for coverage, 16 have participated, 14 purchased policies in 2016	6 are eligible, 1 has purchased a policy	32 have signed ARC Treaty, 8 have participated, 6 are participating in 2016/17	15 are eligible, 6 countries have participated, 5 countries are participating in 2016/17
Average premium income	US\$20 million	US\$1.5 million	US\$22 million	US\$2 million
2016 premium income	US\$27.7 million	US\$1.5 million	US\$25 million (2015/16 policy year)	US\$2.3 million
Cumulative payouts since inception	US\$67.3 million	US\$0.7 million	US\$34 million (to close of 2015/16 policy year)	US\$3.2 million
Average aggregate coverage	US\$622 million	US\$28 million	US\$150 million	US\$45 million
2016/17 aggregate coverage limit	US\$697 million	US\$28 million	US\$100 million (2016/17 policy year)	US\$45 million
Source of premiums	Initial IDA credits for 4 countries for 3.5 years premium. CDB credits for 0.5 years premium for 8 countries, full grant of premium each year for 1 country	IDA credit for sole current participant (3-5 years premium)	National budgets, grants (1 country)	Grants (first 3 years), national budget, IDA credits
Payout process	Initial estimate in 3-5 days, payout made after 14 days (partial payouts have been made sooner). Self-certification of loss required.	Initial estimate in 3-5 days, payout made after 14 days (partial payouts have been made sooner). Self-certification of loss required.	Payout calculated within 10 days of end of risk period (for drought), 7 days for TC/FL. Self-certification of loss required. Certified contingency plan also required before payout is made.	Payouts made within 10 business days.

Scheme	CCRIF (Caribbean)	CCRIF (Central America)	ARC	PCRAFI
Reinsurance summary	Panel of traditional reinsurers and capital market element, most recently via World Bank CAT Bond	Traditional reinsurers, separate placement for CA cell	Traditional reinsurance agreement with 24 participants, multi-peril	Panel of 5 reinsurers
Portion of Agg. Limit reinsured (2016/17)	25%	66%	41%	90% (to decrease significantly once the facility is fully capitalized in 2017)
Capital/Reserves (2016)	US\$117 million	US\$1.3 million	US\$ 98.5 million (Statutory Capital & Surplus as of end-2015)	US\$6 million (to increase to US\$25 million in 2017)
Associated meso or micro schemes	Two products co-developed by CCRIF, one meso (inactive) and one micro (active), both utilize CCRIF model to some extent, no risk taken by CCRIF to date	n.a.	Licensing for Development initiative allows for use of ARC model to underpin commercial transactions. Revenue to L4D Trust to support ARC, ARC Ltd. could take some risk	n.a.

Note: EQ = earthquake; TC = tropical cyclone; XSR = excess rainfall; FL = flood; L4D = Licensing for Development.

BOX 9. TOWARD A REGIONAL APPROACH FOR DISASTER RISK FINANCE IN ASIA

According to a review undertaken by the World Bank in partnership with the Rockefeller Foundation, a regional approach to disaster risk financing could improve Asian countries' resilience if structured to accommodate the particular conditions of the region. Asia presents particular challenges of significant heterogeneity in peril exposure, and also in both the geographic and economic size of countries. A proposal for a platform that could accommodate a range of country priorities is shown below. Such a platform could make floods a priority, given the prevalence of this peril across the region; but it should also offer solutions to protect against less frequent but more severe shocks, such as earthquakes and tropical cyclones. In addition, it would need to serve countries focused on livelihoods assistance as well as those focused on reconstruction of homes and infrastructure. It should build on the extensive national level work that has already been undertaken on financial management of disasters across the region.

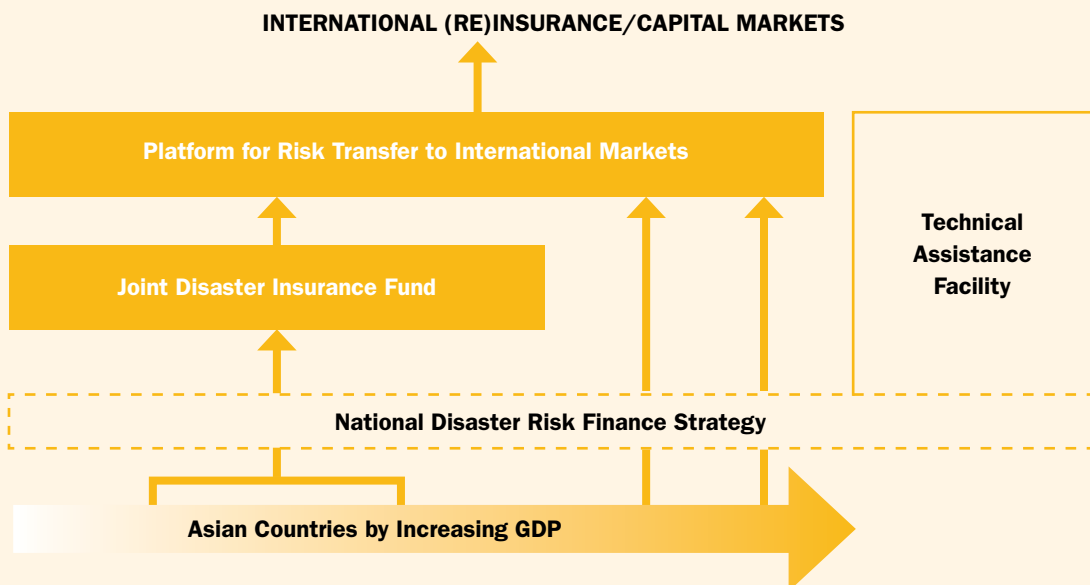
The joint disaster insurance fund would be best suited for smaller economies, with uncorrelated but similar risk, looking to gain from the benefits

of risk pooling. A model similar to that of CCRIF, where countries enter into an insurance contract with the facility and pay a premium for access to rapid liquidity as post-disaster bridge financing, could be considered.

The risk transfer platform could function as a clearinghouse for transferring sovereign disaster risk in Asia to the international markets. It would allow large economies to approach the market directly and smaller economies to approach the market as a group, as the Pacific countries have done. Standardized contracts could be used as well as a standardized process for readying countries for transacting. An approach for collectives of subnational entities (such as cities) to this platform could also be considered.

The technical assistance facility would be the home of public goods such as catastrophe risk models that would support the above components. It could also assist countries with their national strategies for financial protection, and specifically with mechanisms for disbursing funds in country to better reach affected households and businesses.

A REGIONAL PLATFORM FOR DISASTER RISK FINANCING FOR ASIAN COUNTRIES



Source: World Bank and Rockefeller Foundation 2016.

NEW INITIATIVES FOR SOVEREIGN CATASTROPHE RISK POOLS

Asia: With its high exposure to flood, tropical cyclone, earthquake, and drought events, Asia remains perhaps the most conspicuous coverage gap with regard to regional sovereign disaster risk financing programs. Asian countries face particular challenges in establishing an efficient regional sovereign disaster risk financing pool due to the heterogeneity of perils they confront and their vastly different geographic and economic sizes (World Bank and Rockefeller Foundation 2016). See Box 9.

Still, although no Asian facility has been established to date, some activity has occurred at the national level, and a number of Asian countries are already individually using ex ante disaster risk financing mechanisms to manage the impacts of disasters. In addition, regional platforms for collaboration on disaster risk financing more generally now exist. In 2015, the Association of Southeast Asian Nations announced the establishment of the ASEAN Disaster Risk Financing and Insurance Programme, a regional platform through which options for managing the financial impacts of disaster could be put

forward, assessed, and ultimately implemented by participating countries. Preliminary technical conversations on the subject of sovereign catastrophe risk pooling are also underway for Cambodia, Lao PDR, and Myanmar (Box 10). India, Pakistan, and the Philippines are exploring subnational structures for disaster risk financing, with advanced technical work underway in the Philippines on the possibility of creating a pooling mechanism for Local Government Units (Box 10).

Latin America: Chile, Colombia, Mexico, and Peru are exploring a multicountry (parametric) catastrophe bond against earthquake under the Pacific Alliance.

Subnational catastrophe risk pools: Another significant gap is the establishment of subnational structures for pooling and managing the financial impacts of disaster risk. As the FONDEN case study shows (See Annex 1), such structures can add significantly to the financial resilience of countries where subnational government entities (such as provinces or states) have substantial power and responsibility in the financial response to disasters. India, Pakistan, and the Philippines are exploring subnational structures for disaster risk financing.



BOX 10. EXPLORATORY WORK ON NEW CATASTROPHE RISK POOLS

Although no regional risk pool currently exists for Asia, technical work is already underway to explore the feasibility of risk-pooling solutions at the sovereign level for Cambodia, Lao PDR, and Myanmar, and at the subnational level for the Philippines.

For Cambodia, Lao PDR, and Myanmar, technical assistance work is underway with the World Bank, with financial support from the Global Facility for Disaster Reduction and Recovery (GFDRR) and the government of Japan. The goal is to develop options for a catastrophe risk pool, especially for floods. While rainfall-induced flooding has been included as part of parametric tropical cyclone triggers (e.g., by PCRAFI) and as part of a standalone excess-rainfall product (by CCRIF), capturing flood impacts using the indirect hazard measure of excess rainfall has its limitations. The work for Cambodia, Lao PDR, and Myanmar seeks to improve on existing parametric triggers and use innovative methods for near-real-time

flood loss estimation as the basis for a potential future rapid-response financing instrument. The work will comprise the development of hazard, loss, and exposure data collection and analysis.

The development of a subnational risk pool for Local Government Units in the Philippines is further advanced; international market-standard catastrophe risk models for tropical cyclone and earthquake are complete and ready to form the basis of a modeled loss trigger. This work is led by the Philippine Department of Finance and the public insurance company GSIS, with technical support from the World Bank and financial assistance from the UK Department for International Development (DFID) through GFDRR. The development work for the parametric insurance contracts themselves is also complete, with the intent to transform a bundle of parametric insurance contracts at the Local Government Unit level into a derivative product passing 100 percent of the risk onto the international markets.

2.2. EFFICIENCY OF CATASTROPHE RISK POOLS

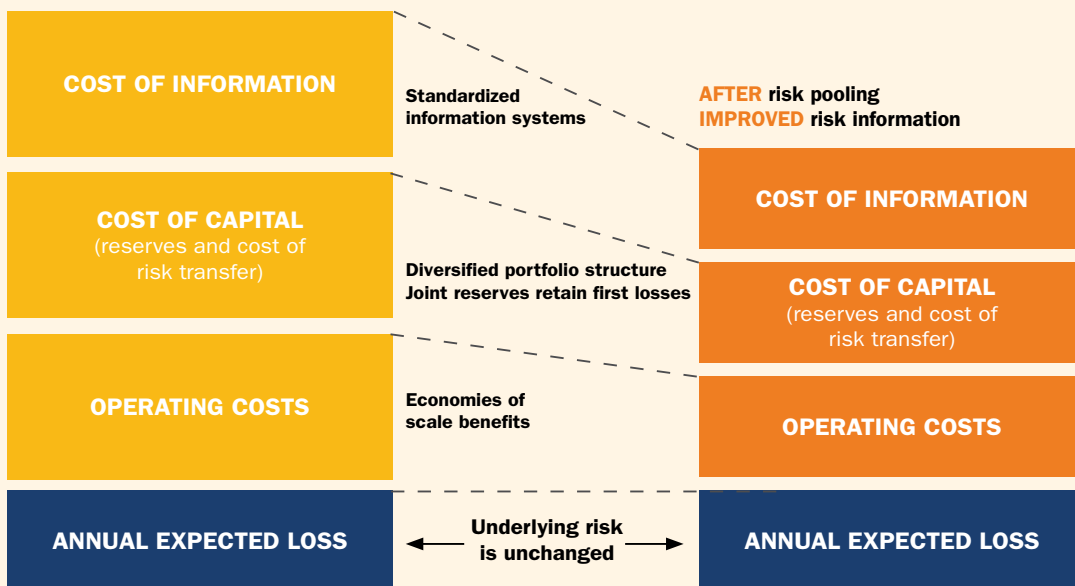
To assess the efficiency of implementation and operations of a catastrophe risk pool, some key indicators can be considered:

- **Political ownership:** Do risk pools support political ownership by one country or collaboration by multiple countries for increased attention to building resilience?
- **Financial efficiency:** How financially efficient is it to transfer risk jointly through a catastrophe risk pool as compared to individually? How financially efficient is it to retain some risk through joint reserves?
- **Operational efficiency:** How efficient is the operation of a catastrophe risk pool as compared to individual risk transfer?

Financial efficiency and operational efficiency aim ultimately to reduce the cost of insurance (that is, the insurance premium in excess of the average annual loss paid) while ensuring the financial viability of the catastrophe risk pool. Financial efficiency helps reduce the cost of capital, and operational efficiency helps reduce the operating costs (i.e., the cost of establishing and running the pool) and the uncertainly loading (i.e., the quantity and quality of risk information available to design and price an insurance product). It is important to note that catastrophe risk pools cannot reduce the underlying risk measured by the annual expected loss; only risk mitigation measures can reduce the annual expected loss. See Figure 6.

FIGURE 6. CATASTROPHE RISK INSURANCE PREMIUM DECOMPOSITION

WITHOUT risk pooling
WEAK risk information



Source: World Bank Disaster Risk Financing and Insurance Program (2015).

Note: The size of the boxes is not meant to be proportional to each component's actual contribution to the insurance premium.

POLITICAL OWNERSHIP

Ownership and discipline

Catastrophe risk pools allow sovereign states to work together for their mutual benefit before and after disasters, and demonstrate solidarity through a fair and transparent mechanism. However, sovereign states can face financial and political costs for participating in those catastrophe risk pools. Politicians often have difficulty justifying investments in risk management that require governments to pay for something that does not demonstrate an immediate benefit. Investment in insurance has a value proposition that extends over a long period of time, while budgetary and political cycles have short-term time frames. Moreover, uncertainty about the trajectory, size, and scale of disaster shocks means that governments frequently face questions about whether the insurance will be “needed.” These factors make it difficult for politicians to justify insurance investments in the first place; continued investment becomes even more difficult when an insurance policy

has not triggered any claim for several years. In low-income countries where public resources are scarce, these challenges can be even more problematic. Multiyear insurance contracts and premium discounts (e.g., in case of no claims) may help mitigate this problem.

The payment of an insurance premium is often poorly perceived even by government officials, who see it as competing directly with the (limited) resources available for preparedness and risk reduction. In reality, both investments are worthwhile, and a cost-benefit or other financial analysis should allow the government to allocate efficiently their limited resources.

While countries may value solidarity with one another, they are reluctant to cross-subsidize payments of premiums. For this reason, the premium paid by each country should reflect only its own risk exposure and coverage. The use of parametric triggers helps avoid this risk of cross-subsidization, but even when insurance is properly priced, problems may arise. Countries

that have contributed for several years without any payout may question the insurance product and its pricing when they see payouts made to other participants.

Capital ownership of the facility is also an important element in the overall political ownership. All existing risk pools were built on a large base of seed capital—capital that helps reduce premiums, but also contributes to increasing ownership of the risk pool by participating countries.

For participating countries (and supporting donor partners), risk pools can offer a platform for political dialogue on the financing of climate and disaster risks and collective action against them—dialogue that may be even deeper because the participating countries own the pool and are ultimately responsible for its success (or failure). Sovereign catastrophe risk pools can also be a vehicle allowing member countries to negotiate with donor partners and secure funding that would not be available to individual countries, as donor partners are often keen to promote and support regional initiatives.

In addition, catastrophe risk pools can serve to promote financial and operational discipline by members. Pools should apply a systematic rules-based approach to the request for and release of funds for post-disaster activities. They can also require that countries consider in advance how any proceeds released through the pool will be deployed. Such discipline can sometimes be difficult to maintain. The governance structure of the pools is therefore critical to ensure that the pool is managed according to sound operational and financial principles and to avoid any political interference that may not be consistent with the long-term sustainability of the pool (such as setting premiums below sound rating or requesting payouts for noninsured events).

FONDEN provides an example of how a collaborative approach to financing can instill financial and operational discipline across multiple entities. FONDEN comprises a system of federal and state-level reconstruction financing managed

by the Mexican Ministry of the Interior. In the event of a declaration of disaster, states submit funding requests based on damage assessments, and a prescribed process is followed to determine access to funds from the central FONDEN structure. Under the FONDEN rules, the FONDEN financing mechanism finances 100 percent of the reconstruction costs for federal assets and 50 percent for state and municipal assets. If states do not purchase insurance for their reconstructed assets, they are penalized under FONDEN by a reduction in the percentage of reconstruction costs deemed eligible for funding.

Leveraging donor funding

Catastrophe risk pools allow entry points for development partners to support financial resilience in targeted ways across a group of countries. For example, when the Multi-Donor Trust Fund established to support CCRIF was approved, three donors put forward around US\$30 million in grant funding, after an initial US\$2 million grant from Japan for the preparation work.⁶ This amount subsequently grew close to US\$70 million. The use of donor contributions for CCRIF has provided further leverage on funds by giving the facility the space to build a substantial asset base—now supporting over US\$115 million of capital—and by protecting premium income from insurance payouts and expense erosion in the early years. CCRIF has benefited from investment income from the original donor funding and from the asset base these funds have allowed it to develop. In the Pacific, Japan provided premium subsidies and grants for technical assistance to support the piloting of the PCRAFI insurance program during its first three years. Now that a successful proof of concept has been established, the evolution of the pilot into a stand-alone facility has prompted involvement by Germany, Japan, the United Kingdom, and the United States, with contributions of US\$40 million in funding toward the establishment and capitalization of the facility and additional technical assistance to the countries. In the case of ARC, multiple donors have contributed to funding the development of the program and the ongoing capacity building and client support work undertaken by ARC Agency. The UK and German

6. The donors were DFID, the Agence Française du Développement, and the Canadian International Development Agency.

BOX 11. LEVERAGING DONOR FUNDS IN RISK POOLS

Risk pools offer a number of mechanisms through which donors can apply effective financial support:

Premium subsidies. Direct subsidization of premiums is facilitated when countries collaborate on risk pooling, allowing donors to support pilot programs and to create a proof of concept to test demand from countries. Some participating countries in all three sovereign catastrophe risk pools have benefited from (partial) premium subsidies, including Marshall Islands, Samoa, Tonga, and Vanuatu during the pilot phase of PCRAFI; Haiti under CCRIF; and Senegal under ARC. Premium subsidies should be designed to incentivize countries to contribute to the payment of the premium over time.

Start-up costs. The early years of risk-pooling schemes are the most expensive, and donors may look to apply funding to initial costs. In the case of the Pacific, donors funded the large up-front cost of developing catastrophe risk models essential to disaster risk financing.

Operating costs. Operating costs, including management costs and reinsurance costs, can be reimbursed for a given amount of time to allow the premium income to be used to build up reserves and capital. This approach was taken by CCRIF.

Seed capital. Insurance becomes more cost-efficient per dollar of coverage when a higher attachment point is set, that is, for lower-frequency/higher-severity events (e.g., major floods, severe earthquake, or tropical cyclone). Since donor support of risk pools can finance joint reserves that cover first loss layers, the pool can transfer higher layers of risk where this is most cost-effective. The principle of applying risk-bearing capital can also extend beyond the first loss layer, to provide more cost-effective alternatives to market-based reinsurance for additional layers of loss. This approach has been used by ARC and PCRAFI.

governments have provided interest-free 20-year loans (“development capital”) to ARC Ltd. as the founding risk capital⁷.

Pooling initiatives deliver additional efficiencies in donor funding by offering donors a range of options for subsidizing the cost of financial management of disasters, and thereby allowing donors to apply funds in the most effective way possible. These mechanisms are described in Box 11.

FINANCIAL EFFICIENCY

There are a number of financial benefits to transferring climate and disaster risk through a risk pooling mechanism, which ultimately reduces the cost of insurance:

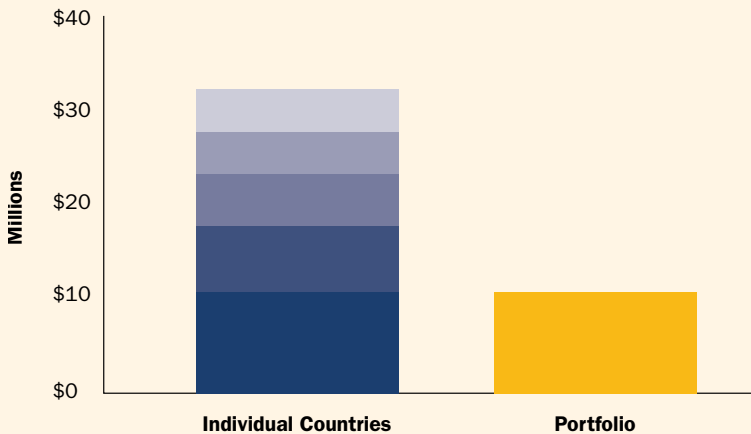
- *Risk diversification.* Covering each country in a pool requires much less capital than if

each country were covered to the same level on an individual basis. Diversification occurs both across multiple perils and across a geographical area. Diversification does not reduce the risk (as measured by the annual expected loss), but does reduce the capital requirements to cover the full risk spectrum.

- *Joint reserves.* Establishing joint reserves allows the pool to retain a fraction of the risks (typically more frequent losses) and to transfer the excess risks to the reinsurance and capital markets when it is most cost-efficient.
- *Larger reinsurance transaction size.* Pooling creates larger transactions that are more attractive to global reinsurance and capital markets, thus reducing the cost of reinsurance and ultimately the premiums paid by the participating countries.

7. See Annex 1 for a detailed description of ARC, including the different roles of ARC Agency and ARC Ltd.

FIGURE 7. DIVERSIFICATION BENEFITS MODELED FOR THE PCRAFI PROGRAM: SIMPLE AGGREGATES VERSUS POOLED RISK FOR 1-IN-250-YEAR RETURN PERIOD LOSSES



Source: World Bank and PCRAFI (2016).

Risk diversification

The principle benefit of pooling catastrophe risk is the impact that diversification of losses has on the risk-bearing capital needed to support the risk across the pool. This applies whether countries opt to retain the risk collectively, or transfer it to the international markets. This benefit manifests as a reduced catastrophe load (see Figure 7) applied to the premium charged for risk transfer, or a reduced amount (and thus cost) of capital that needs to be held to support a risk retention mechanism such as a joint reserve facility. It arises from the fact that severe losses will not be experienced simultaneously across all participating entities. Therefore, the “backstop” required to ensure that the pool or risk transfer product can (with a very high level of certainty) meet its obligations to the insureds is lower than the sum of supporting capital required if countries consider their possible maximum losses (to the same level of certainty) individually.

Figure 7 uses the PCRAFI program to illustrate this effect; the combined portfolio shows a 65 percent reduction in the 1-in-250-year return period loss compared to the sum of individual values for

countries. This reduction leads to a premium reduction in excess of 40 percent. In its first year, ARC Ltd. likewise captured a significant portion of the full diversification benefits despite having only four countries (five growing seasons) and a single peril. ARC Ltd. wrote a total of US\$129 million in drought coverage, and the 1-in-250-year loss to the portfolio was just US\$62 million, a 52 percent reduction in required capital. This reduction in capital requirement could exceed 60 percent with further expansion of the portfolio to new countries and perils (e.g., flood), thereby further reducing the insurance premium paid by the participating countries.

There is, however, a limit to the additional diversification benefits delivered by adding extra units of uncorrelated risk to a pool. Once a critical mass of uncorrelated units (or units with low correlation) has been added, the marginal benefits of adding more become small and may not merit the cost of expansion. Box 12 illustrates such limitations. In this specific example, 80 percent of the diversification benefits (in terms of premium reduction) can be achieved when one-third of the potential states/provinces join the pool.

BOX 12. DIVERSIFICATION BENEFITS AND THEIR LIMITS: AN ILLUSTRATIVE CASE

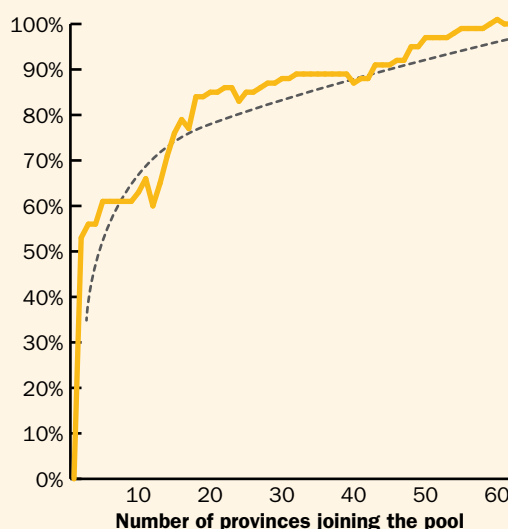
To illustrate how the benefits of risk pooling evolve with pool expansion, an analysis was conducted using data from a large Asian country for tropical cyclone risk. The analysis takes estimated premiums for covering the modeled tropical cyclone losses in each of 60-plus provinces/states, and compares the aggregate of these against the estimated premium for a pool of provinces, as provinces are incrementally added to the pool.

The figure below shows the share of premium reduction (compared to the maximum premium reduction when all provinces join) as the number of provinces joining the pool increases. Twenty provinces joining the pool allows for 80 percent of the maximum premium reduction due to risk diversification.

The results show that the premium reduction generated by adding provinces is most significant at the beginning of the pool expansion, tapering off as more and more provinces are included. The rate of occurrence of this effect will vary from pool to pool depending on the correlation between incorporated units, and their respective sizes and risk exposure. However, the trend of decreasing marginal benefits beyond a critical mass of units is universal. It is important to note that the tropical

cyclone risk for this case study is correlated across provinces. There are varying degrees of correlation between individual provinces, depending on their respective locations; the order in which provinces are incorporated therefore affects the premium benefit trend. In this analysis, provinces were incrementally added to the pool with no ordering with respect to correlation.

PREMIUM REDUCTION (AS A PERCENTAGE OF MAXIMUM PREMIUM REDUCTION) FOR INCREMENTAL ADDITION OF PROVINCES



Where pools have reached optimal diversification benefits, they could potentially achieve additional savings by swapping risk via financial instruments between regional pools (see Box 13). However, assuming that the potential savings are significant, such an approach would require not only stable and mature portfolios of risks but also specific underwriting and pricing expertise (which

may not be available in most of the existing sovereign catastrophe risk pools). It would also require strong political will on the part of pool members, who may not support an arrangement that uses a substantial amount of the capital to pay claims faced by another pool, even if they are adequately compensated.

BOX 13. GATHERING FURTHER DIVERSIFICATION BENEFITS THROUGH RISK SWAPS BETWEEN REGIONAL POOLS?

While significant diversification benefits are already being captured by the existing regional risk pools, each is constrained in diversifying further for two main reasons. First, all the existing risk pools serve the client/member states within the pool, so that maximization of diversification is not a key factor in building a portfolio; rather, client demand in terms of coverage selection supersedes other considerations. Second, political and/or governance constraints are a barrier to offering coverage to countries outside of the region of the pool, so that further geographical diversification may be difficult.

One potential mechanism for addressing the second constraint is to swap risk between catastrophe risk pools. Risk could be swapped directly between two catastrophe pools, so that a pool in one region could take on some portion of risk from a pool in another region (which would likely bring diversification benefits) and vice versa.

Portfolio risk swapping brings some additional diversification benefit to both parties. For purposes of analysis, four separate (and matching) tranches

of US\$5 million were swapped in an illustrative portfolio from two regional pools. The result showed that compared to the technical price of a specific reinsurance transaction, savings on technical price are only 1 percent to 2 percent for the full portfolio, but that savings of up to 20 percent of the cost of a top risk layer are possible.

However, there may be significant challenges in such catastrophe risk swaps. First, they could be technically complex if the portfolios being swapped have different reinsurance periods (e.g., due to seasonality of the insured risks). Second, there are significant political risks to such transactions; countries from one pool might not like to see a substantial portion of their capital being used to pay claims of countries from another pool, even if they have been adequately compensated (through swapping out an equivalent amount of risk). Similar political concerns prevented the Central American countries from joining the original CCRIF pool; instead, a stand-alone underwriting cell, with its own capital, was formed to accommodate the incoming Central American countries.

Asset management is an area where additional financial efficiencies might be garnered, depending on the risk tolerance of the entity—which in turn depends on the nature of the capital and interest of the shareholders/country members of the risk pool. Investment income can be a significant component of overall income for a facility and can contribute to financing operational costs over the longer term, thereby contributing to the pool's sustainability. Member countries and development partners need to carefully consider what type of risk profile is appropriate for the pool's investment strategy, given the desire for financial efficiency, the need for long-term sustainability, and the objectives of all parties in establishing the pool. The developed insurance markets provide useful benchmarks for this purpose, including what balance of asset liquidity will deliver the best returns possible without compromising rapid claims-paying capacity.

The engagement of an experienced investment manager to deliver the investment strategy is critical. CCRIF has significant flexibility in this area; its effective shareholder is a passive trust, so the board has broad scope to manage the investment portfolio consistent with its own views of risk and reward. In contrast, ARC's capital providers and policyholders are its effective shareholders, and the initial capital providers in particular are highly averse to investment losses (which are a source of major political risk). Policyholder capital, once it accumulates in ARC, will be subject to different considerations coming from those policyholders, who may be less focused on total return and more on appropriate investments in Africa.

Joint reserves

A catastrophe risk insurance pool can also be viewed as a joint reserve mechanism, with contribution levels selected by individual

BOX 14. CCRIF CENTRAL AMERICA OPTIONS FOR RISK TRANSFER

In preparing the expansion of CCRIF to Central America, four options for catastrophe risk transfer were considered for Honduras and Nicaragua as part of a wider Central America grouping. The table below presents the estimated reduction in the indicative commercial premium across the options compared to the baseline option (independent catastrophe risk transfer). Preliminary analysis found that when Honduras and Nicaragua transferred catastrophe risk with other COSEFIN

states to the international reinsurance market, they could reduce the cost of catastrophe risk insurance by 27 percent without joint reserves, and by 41 percent with joint reserves. As a group, COSEFIN countries could reduce indicative commercial premiums paid by close to 45 percent should they chose to transfer risk through CCRIF. This premium reduction could be shared between participating COSEFIN countries and CCRIF member countries.

Option	Premium reduction
1. Central American countries each independently transfer catastrophe risk to the international reinsurance/capital markets	-
2. Central American countries jointly transfer catastrophe risk to the international reinsurance/capital markets, without joint reserves	27%
3. Central American countries jointly transfer catastrophe risk to the international reinsurance/capital markets, with joint reserves	41%
4. Central American countries work with CCRIF to jointly transfer catastrophe risk to the international reinsurance/capital markets	44–45%

Source: World Bank 2014a.

Note: For option 3, initial capital from donors of US\$50 million is assumed. Ranges reflect uncertainty over the correlation of tropical cyclone losses between Central American countries. Prototype CCRIF-style policies are assumed, with partial coverage in excess of retention of annual losses equivalent to 1-in-15 years for hurricane and 1-in-25 years for earthquakes.

participants and a set of rules to ensure that in the long term, each participant will receive payouts relative to the premium (contribution) it has paid. By combining resources, this vehicle can provide a higher amount of available capital than an individual sovereign contingency fund, and it also brings discipline to the management and protection of the funds, especially protection against possible political interference, so that the funds are there when really needed.

Joint reserves give the pool the flexibility to retain (self-insure) some risks, so that the excess risk transferred to markets is a smaller slice of the exposure, which in turn makes premium pricing more cost-effective. All existing sovereign pools have heavily relied on donor support to build up their initial joint reserves. For example, CCRIF's annual joint reserve layer is US\$25 million, which means it is able to retain the first US\$25 million

of losses, passing a further US\$140 million to the international markets. For its 2015/16 policy year, ARC Ltd. retained about US\$22.5 million of risk through its reserves and passed a further US\$72.5 million to the international markets.

The capacity of catastrophe risk pools to diversify their risk portfolio and retain a portion of losses using joint reserves can reduce the insurance premium paid by the participating countries. According to an actuarial analysis conducted for expansion of CCRIF to Central America, where several risk transfer options were considered and the impact on premium reduction was estimated, risk pooling benefits translated into premium savings of an estimated 27 percent for the two countries analyzed. The analysis found further that retaining losses through joint reserves increased the premium savings to 40 percent or more. See Box 14.

The financial efficiency of capitalizing several pools separately can be questioned. It may be worthwhile analyzing not only the financial feasibility but also the political and operational feasibility of establishing a global fund of risk-bearing capital to support sovereign catastrophe risk pools. Such an approach could, at least conceptually, yield a number of financial benefits. It could pool resources to increase the overall retention capacity of the individual pools and potentially reduce costs through diversification across pools. From an operational point of view, it could also yield cost efficiencies through the use of a single service provider for investment management and fund administration.

The feasibility of such an approach would, however, depend on the nature of the entities looking to share the common pool and would require a strong convergence of interests across those entities. At present, PCRAFI operates with a dedicated captive insurer domiciled in the Cook Islands; CCRIF is a segregated portfolio company domiciled in the Cayman Islands; and ARC operates through a limited-by-guarantee (mutual) insurance company domiciled in Bermuda. In addition, establishing a financial structure to serve such entities with risk-bearing capital poses legal and regulatory challenges that are not trivial. Finally, detailed technical analysis would be needed to determine a financial structure able to achieve this common pool function without adding substantial additional administrative costs.

OPERATIONAL EFFICIENCY

Operational efficiency in catastrophe risk pools is critical to keep the operational costs low. The operating sovereign pools have opted for slightly different strategies to achieve this. ARC is in the process of building staff resources within ARC Ltd. and ARC Agency to support client engagement and operations. ARC utilizes external service providers for standard financial services such as insurance management, external audit, internal audit, legal counsel, and company secretary. CCRIF and PCRAFI, on the other hand, outsource the majority of back-office operations to trusted third-party service providers in order to keep the in-house operating costs as lean as possible. For example, CCRIF recently restructured as a

segregated portfolio company that operates as a virtual organization; it is supported by a network of third-party service providers covering captive management, risk and reinsurance management, risk modeling, asset management, and information technology, among other areas. Certain costs that would otherwise sit in house (such as for overhead/IT infrastructure in addition to the provision of the service itself) are pushed out to the third-party service providers and wrapped into their fees.

The comparison of operating costs for facilities is difficult, partly because facilities use differing cost classifications and partly because public information on their operation structure is limited, since these pools operate as private insurance companies. However, the average operating costs of the sovereign catastrophe risk pools are estimated to be around 10 percent of their annual premium income (when in full operation) and higher during the first years of operation. Compare this to average operating costs of 30 percent for traditional insurance companies (not including initial start-up costs incurred during the first years of operations). Some of the costs that traditional insurance businesses usually account for as operating costs (such as product development, capacity building, and communication) are financed through donor-funded technical assistance in the case of sovereign pools.

These operating models raise two questions for the efficiency of catastrophe risk pools: Is there a way for multiple regional pools to share any back-office functions without compromising the sense of regional ownership of the facility? And is an outsourcing model—which moves expertise and knowledge out of the facility, and typically also out of the region—detrimental to a pool's sustainability? The following challenges need to be addressed by facilities considering consolidating functions across regions:

- Physically locating a facility within its region, and having a distinct regionally owned entity, is critical from a political and ownership perspective, as discussed in the previous section. This limits the potential to consolidate operational functions across regions for the purpose of cost saving.

- Catastrophe models, data, and monitoring services may vary greatly from one region to another.
- Given the potential application of catastrophe risk models beyond catastrophe risk pools, there is a strong rationale to develop and retain as much expertise in this area as possible within each individual region to build the technical capacity required for the long-term resilience agenda.
- Country priorities across different regions may not be aligned with regard to the risk/return profile appropriate for the asset base of the facility, or with regard to appetite for risk retention versus risk cession.

Pools as providers of public goods

Catastrophe pools have driven the development of catastrophe risk models and other public goods that have demonstrated their utility beyond the risk pool itself. For example, the development of the PCRAFI platform, and the successful placement of risk, have had substantial positive impacts within the region. The combination of a technical and financial program has raised the profile of disaster risk financing, and managing the financial impacts of disasters has become a priority not only for disaster risk management entities, but also for ministries of finance. The insurance component of PCRAFI has been complemented by technical assistance work on public financial management—a critical link in the path from receipt of insurance proceeds to deployment of funds on the ground. One tangible result of this has been the development of post-disaster budget execution manuals for participating countries. In addition, the models developed under the PCRAFI initiative have been used for urban planning, as part of a technical assistance project by the Asian Development Bank for selected PCRAFI-covered countries (ADB 2013).

ARC provides scope for engagement with member countries for capacity building, not only in risk financing, but also in contingency planning, natural hazards early warning, and risk quantification. Engagement is led by ARC Agency as a public sector entity, and is operationalized via a memorandum of understanding and

assignment of government staff to coordinate activities in country. ARC provides technical support bilaterally as well as through regional and continental workshops and coordinates inputs with nongovernmental stakeholders. ARC's in-house risk quantification platform, Africa RiskView (ARV), helps to illustrate and promote discussion of sovereign risk profiles and offers strategies to manage the identified risk.

CCRIF's main capacity-building efforts are currently implemented via the Technical Assistance Programme. Launched in 2009, the program consists of three components: scholarship/professional development, regional strategic knowledge building, and support for local disaster risk reduction initiatives. It is designed as an ongoing mechanism offering grant support within the region for capacity-building initiatives and the development and implementation of projects likely to make risk management more effective. The program aims to help CCRIF countries deepen their understanding of natural hazards, catastrophe risk, and the potential impacts of climate change on the region.



2.3. SUSTAINABILITY OF CATASTROPHE RISK POOLS

Beyond efficiency, sustainability is essential to the long-term success of catastrophe risk pools. The field of catastrophe risk financing has evolved rapidly in recent years, as technical advances based on lessons learned have delivered increasing value for money for countries and their development and humanitarian partners. Sovereign catastrophe risk pools are recent; except CCRIF-Caribbean (established in 2007), they have been operational for less than five years. It is therefore premature to draw any conclusions on their sustainability or to seek lessons on sustainability for other pools. However, some key challenges for sustainability of sovereign catastrophe risk pools can be identified, including the ownership of risk, technical expertise, risk-based pricing, financing of insurance premium, and regional ownership of the pool.

WHO OWNS THE RISK?

Generating a sustained demand for disaster risk financing, and catastrophe risk insurance in particular, is a challenge for all ex ante financial instruments that incur costs up front, not just for catastrophe risk pools. The full costs incurred by countries after a disaster are not always easily visible, as many are not direct costs. Instead, they manifest themselves as opportunity costs associated with budget reallocation or restructuring of development projects; or they are longer-term costs associated with the impact of negative economic and social development trajectories. The increasing role of humanitarian aid also impacts countries' perspectives on the cost/benefit trade-off of ex ante financing instruments. A fundamental question that must be answered to justify the up-front cost required for instruments like insurance is "who owns the risk?" and consequently, "who should pay for it?" Ex ante financing schemes first demand that risk is quantified up front for pricing and structuring, which can highlight the magnitude of potential

costs and underline the necessity of financial management through disaster risk financing instruments. However, even with the full costs elucidated, many developing countries, and especially low-income countries, do not hold much disaster and climate risk, so the potential climate and disaster losses are not factored into their budget. As a consequence, moving countries from a largely ex post approach, where financing mainly relies on donor partners, to an ex ante model, where the countries themselves are expected to pay for some (if not all) of the cost, is a significant challenge. This is an important discussion in light of growing humanitarian costs. Demand for humanitarian assistance is growing rapidly, and an estimated 20 percent of these growing costs go to sudden-onset and recurring natural disasters. In 2000, UN OCHA estimated that the global budget for humanitarian action was US\$2 billion. In 2017, this number has risen to US\$22.2 billion. If trends continue, humanitarian costs will rise to US\$50 billion by 2030.⁸

African Risk Capacity (ARC) has recently started offering UN agencies (such as WFP) the opportunity to purchase "replica coverage"—coverage that replicates the insurance policy purchased by the ARC Member State in which the agency is active. Through this approach, humanitarian actors can access market risk capital to cover costs related to humanitarian action in specific countries.

TECHNICAL EXPERTISE

Because catastrophe risk insurance is a highly technical area, catastrophe risk pools have to rely on technical expertise in insurance production, including underwriting, product design, and pricing. To establish themselves and become operational, existing pools have required significant technical assistance and capacity building in catastrophe risk modeling and insurance operations. CCRIF and PCRAFI, for example, have benefited from

8. Estimates are from internal UN OCHA and Financial Tracking Service data provided to the High-Level Panel on Humanitarian Financing.

significant technical assistance provided by the World Bank with financial assistance of donor partners. Private reinsurers and brokers have also helped those pools build their technical expertise. However, even after several years of operations, those pools still rely on external expertise, which could impact their sustainability. Going forward, pool's sustainability will depend on their ability to develop local expertise on catastrophe risk insurance, along with international expertise.

RISK-BASED PRICING

Risk-based pricing allows for the pricing of catastrophe risk insurance based (only) on its underlying risk. This prevents cross-subsidization of premiums from occurring, but also has value as an indicator of risk. The regional pools discussed here all use risk-based pricing to determine the premiums payable for each country contract.⁹ Financial decision makers need the information on risk contained within this type of pricing in order to evaluate the costs and benefits of different types of instrument for managing their financial exposure to disasters, and such information is therefore important for the long-term sustainability of disaster risk financing programs.

Even where there is a strong political platform for regional collaboration, countries are typically not willing to cross-subsidize premiums for other pool participants by paying more for their own coverage. This type of “solidarity” mechanism has been used within a single political unit (e.g., private insurers offering UK households flood insurance incorporated an element of cross-subsidization between low- and high-risk flooding areas to keep insurance affordable for riskier households).¹⁰ But it may not be viable across borders or across distinct governance units with substantially devolved political power (such as in federal-state structures).

Risk-based pricing can be facilitated by using parametric insurance and catastrophe risk models. Parametric insurance—as implemented in all the sovereign pools examined in this report—provides an unusual case where payouts and insurance premiums are not explicitly linked to actual losses incurred on the ground. Instead, the cost of insurance is a function of the pure hazard exposure (such as the frequency and intensity of tropical cyclones) and the level of coverage chosen by the country. Catastrophe risk models have been developed to improve the assessment of catastrophe risk and the pricing of parametric insurance products. They allow the pools to calculate not only the underlying risk estimated through the annual expected loss, but also the cost of capital to be reflected in the insurance premium.

PREMIUM FINANCING

Establishing a long-term commitment to payment of premiums by, or on behalf of, countries is one of the most serious challenges affecting the sustainability of sovereign catastrophe risk pools. Insurance premiums present an up-front cost, which may not produce a financial return in the near (or even medium) term. As described above, governments face public and political pressure when payments for premiums on high-profile sovereign insurance do not yield a payout in the event of a disaster (for example, Jamaica after Hurricane Dean in 2007, the Solomon Islands after the 2013 earthquake and tsunami, and Malawi after the drought in 2016).¹¹ At the country level, allocating budget for the payment of premiums is generally not a permanent part of budgetary processes, and the expenditure is still treated as atypical, when it is possible. This section discusses potential sources of premium financing, ranging from national budgets to concessional loans/grants, long-term subsidies, and premium rebates.

9. One could argue that the pool's pricing methodology represents an element of cross-subsidization in the way it allocates capital/reserves among the participating countries.

10. In April 2016, a new public-private partnership, Flood Re, was launched in the United Kingdom to manage insurance costs for higher-risk properties, leading to a restructure in the market.

11. Malawi's policy with ARC did not initially trigger an insurance payout because the type of maize selected during customization of the parametric model differed from the actual crop planted. The insurance policy was “amended” to take account of the correct crop type, and a payout of US\$8.1 million under the contract was made. ARC, “Press Release—Malawi to Receive USD 8M Insurance Payout to Support Drought-Affected Families,” November 14, 2016, <http://www.africanriskcapacity.org/2016/11/14/press-release-malawi-to-receive-usd-8m-insurance-payout-to-support-drought-affected-families/>.

Designing risk financing products that match countries' needs and priorities, and that demonstrate maximum value for money, can help generate and sustain willingness to pay premiums. In particular, frequent and timely payouts help demonstrate the value of the proposed insurance product. But it is important to keep in mind that insurance is most cost-effective for less frequent and more severe risk, and that insurance premiums increase significantly if more frequent payouts are targeted. Finding sustainable and practical options that allow countries to finance premiums remains a key question for maintaining sovereign risk pools in the long-term.

National budget allocation

If countries decide to participate in sovereign risk insurance pools, they will need to include the required premium payments in their national budgets. As indicated above, allocating budget for the payment of premiums is generally not a permanent part of budgetary processes and the expenditure is still treated as atypical. Care must be taken that the inclusion of premium payments in budgets is in line with relevant public finance legislation. The government of Indonesia, for example, had to pass a new government regulation (PP 45/2013) in 2013 to explicitly allow its Ministry of Finance to purchase insurance with funds allocated in the national budget.

In some countries, only one entity, usually the national ministry of finance, can purchase insurance. For example, in Colombia the Ministry of Finance is responsible for purchasing insurance for all sectors of government, with clear limitations in the ability to evaluate the specific needs of single municipalities and ministries.

In countries where there is no legal and institutional framework regulating sovereign insurance, the resulting uncertainty complicates the allocation of responsibility between government entities and leaves the insurance program vulnerable to political changes.

Depending on a country's specific guidelines, insurance premiums could be budgeted either as recurrent expenditure or as investment expenditure. In practice, some countries have included expenditure on sovereign risk insurance

premiums in the investment budget (e.g., St. Lucia), whereas others have budgeted such expenditures as a recurrent item (e.g., Tonga's PCRAFI insurance premium or Jamaica's CCRIF insurance premium). However, the government budget for the provision of insurance often has to be approved separately and is not included among the line items with automatic budget appropriation. In the Philippines, for example, loan repayment and interest payments receive automatic budget appropriations, while sovereign insurance does not.

Concessional loans/grants

The use of concessional lending instruments to fund insurance premiums has been an indirect way for international financial institutions (such as the World Bank) to support premium financing. International Development Association resources in both grant and credit form have been used to fund premiums and facility entrance fees for a number of countries participating in CCRIF. For example, for the first three to four years of CCRIF's operation, the Organization of Eastern Caribbean States (OECS) Catastrophe Risk Insurance Project allowed four countries (Dominica, Grenada, St. Lucia, and St. Vincent and Grenadines) to use national and regional IDA financing to cover the cost of entrance fees and insurance premiums. This program made CCRIF participation affordable to OECS countries and allowed them to test the use of the instrument; two of the four countries had insurance payouts during the project, which led them to internalize the premium cost in their annual budget decision-making processes. Most recently, Nicaragua opted to use IDA credits to finance its CCRIF entrance fees and premiums across a multiyear timeframe. Likewise, four of the five Pacific island countries that joined PCRAFI used their IDA credit, together with national budget contributions, to cofinance their insurance premiums.

There are cases where long-term subsidies may be appropriate given the fiscal position of the country in question and the potential benefits that sovereign insurance (in pool or other form) can confer, including access to immediate post-disaster liquidity. Haiti provides such an example: fiscal constraints and high levels of catastrophe risk prohibit the country from self-funding CCRIF

insurance premiums to a level that would provide a meaningful volume of cover. Haiti has received premium subsidies since it first joined CCRIF at its inception, with the last four years of premium costs funded by the Caribbean Development Bank. The country has received two payments from CCRIF —one following the devastating 2010 earthquake, and dual payments under excess rainfall and tropical cyclone policies in 2016 following Hurricane Matthew. The US\$23.4 million payout from Hurricane Matthew represents the largest payment ever made by CCRIF for a single event. While the 2010 earthquake payout was substantially smaller (US\$7.7 million), it provided important rapid liquidity in the aftermath of the event. CCRIF's demonstrated contribution to Haiti's resilience has ensured that the donor premium subsidies have delivered strong value for money.

The use of concessional financing in this way confers several benefits. Most importantly, it makes participation affordable for countries while still requiring a financial commitment from their side. The favorable loan terms offered by development partners, such as IDA credit terms, can be seen as an implicit subsidy mechanism: the discounted value of the insurance premium financed through IDA loans ranges from 20 percent of the face value of the premium, assuming a 10 percent discount rate, to 50 percent of the face value of the premium, assuming a 5 percent discount rate. But countries use the allocation from their (limited) overall IDA allocation, and therefore need to be confident of the value of the mechanism to justify the (potentially high) opportunity cost of doing so. See Box 15 for more detail.

Seed capital injection versus up-front premium subsidies

Some donor partners have been hesitant to provide up-front premium subsidies (arguing that this may impact the long-term sustainability of the risk-pooling mechanism). However, as discussed above, low-income countries across all three operating sovereign catastrophe risk pools have received such subsidies. More recently, donor partners have preferred to provide catastrophe risk pools with capital injection (seed capital) either directly as a grant (PCRAFI) or repayable interest-free loan (ARC), or indirectly by reimbursing operating costs, including claims and reinsurance costs (CCRIF). This capital injection aims to increase the risk retention capacity of the pool and hence reduce the insurance premiums charged to member countries over a long time period (ideally in perpetuity). Conversely, up-front premium subsidies by definition reduce the cost of insurance for the beneficiaries only for the duration of the subsidy program.

To illustrate the trade-off between capital injection and up-front premium subsidies, Box 16 compares from a financial perspective the cost-effectiveness of a hypothetical grant used for either premium subsidies or seed capital. This analysis indicates that the most cost-effective option depends, among other things, on the level of premium savings that the pool can pass on to its members if using the grant as seed capital. In the example, the provision of seed capital is more cost-effective than premium subsidies (given the set of assumptions) if it allows the pool to reduce premium savings by 14 percent or more.

BOX 15. CONCESSIONAL FINANCING OF PREMIUMS

In this example a country borrows to finance its insurance premium under standard IDA terms (1.47 percent annual interest rate or service charge, six-year grace period, 38-year duration). The net present value (NPV) of the loan is calculated for various social discount rates. It can be compared with the premium amount, should the country pay its premium in full up front. The

difference between the NPV of the loan and the premium amount (as a percentage of the premium amount) can be interpreted as an implicit subsidy. With a 5 percent social discount rate, IDA financing is equivalent to an up-front subsidy of 50 percent. The implicit premium subsidy increases as the social discount rate increases.

The level of premium reduction due to the capital injection depends on several factors, including the current position in the reinsurance cycle and the current level of capital held by the catastrophe pool relative to the total premium volume. Other factors also affect the overall effectiveness of the grant, such as the availability of reinsurance capacity in the region where the pool operates, and the effect of subsidies on the operating costs of the pool (e.g., premium subsidies may create incentives to increase operating costs). The result depends on the underlying assumptions adopted, and could be significantly different under alternative (but still realistic) assumptions.

This analysis shows, however, that seed capital injection and up-front premium subsidies can be complementary. When a new catastrophe risk pool is established, it will rely on a capital injection to make it sustainable (since without seed capital the pool may not be able to build up

reserves quickly enough, and hence would heavily depend on the reinsurance markets). On the other hand, if a catastrophe risk pool is already well capitalized, additional seed capital would only marginally reduce the cost of insurance. In this case, the donor grant may be more cost-effective than premium subsidies. The example should not be seen as a general statement on how donors should support catastrophe risk pools, but rather as an illustration of the financial trade-offs to be considered when donors decide to provide a catastrophe risk pool with financial support.

Donors can also use the provision of concessional insurance (either as seed capital or premium subsidies) to create (financial) incentives for climate and disaster risk reduction and preparedness, including financial preparedness.

BOX 16. QUANTITATIVE COMPARISON OF SEED CAPITAL VERSUS PREMIUM SUBSIDIES

Consider a hypothetical catastrophe risk pool with an annual premium volume of US\$1 million. Donors are willing to provide a US\$6 million grant for either seed capital or premium subsidies.

Premium subsidies allow the pool to reduce annual premiums every year for 20 years. It is assumed the grant is depleted over the full 20 years. This leads to an annual premium subsidy of 30 percent or, equivalently, to a 30 percent increase in catastrophe risk insurance coverage. It is also assumed that each year the unused portion of the grant generates investment earnings of 2 percent compound interest.

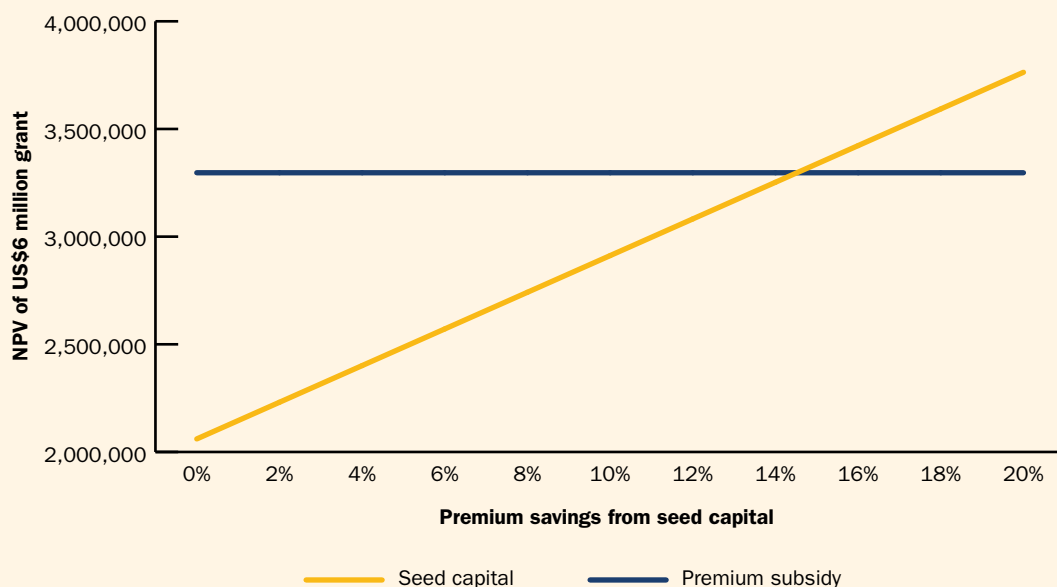
Seed capital enables the pool to retain a proportion of risk and pass on premium savings to participant countries. It is assumed the capital cannot be depleted over time, generates investment earnings of 2 percent compound interest, and is shared among the participating countries at the end of the 20-year period.

The benefits of this grant can be analyzed by comparing the NPV of the two grant options over a 20-year time horizon, with a social discount rate of 10 percent. The initial premium pricing has a premium multiple of 1.4 (before premium subsidies or premium savings due to additional capital injection).

In each case, the NPV consists of the annual premium savings to the pool and the investment return on the unused grant amounts. Based on these assumptions, the NPV of the US\$6 million grant is US\$3.3 million under the premium subsidy case. The NPV of the grant used as a seed capital injection depends on the level of premium savings the pool is able to pass on to its members (through retaining a proportion of the risk), as indicated in the figure below.

In this illustrative example, where premium savings due to additional seed capital are greater (lower) than 14 percent, a higher (lower) NPV will be achieved if the grant is used for seed capital rather than premium subsidies.

(continued)



Note: Calculations assume a 20-year time horizon and a 10% discount rate

The actual level of premium savings achieved by retaining risk depends on several factors, including the current position in the reinsurance cycle and the existing level of capital held by the catastrophe pool relative to the total premium volume:

- *The current position in the reinsurance cycle.* In a soft market characterized by increased capacity of reinsurers, lower insurance premiums, and broader coverage, the level of savings from retaining risk are likely to be reduced. Conversely, in a hard market, characterized by higher premiums and lower available coverage, the savings from a pool holding capital to retain a proportion of the risk are likely to be significantly higher.
- *The existing level of capital held by the catastrophe pool relative to the total premium volume.* If the pool has a high level of capital relative to the premium volume and is already retaining a large proportion of the risk, additional capital is likely to be used by the

pool to further reduce reinsurance coverage at higher layers of risk, where cost savings may be limited. Conversely, if a pool has a low level of capital (likely for a newly established pool, for example) then the capital is likely to be used to retain risk in the first losses (or working layer) of the reinsurance program, which can result in significant savings. In the above example, if the grant were to be US\$10 million rather than US\$6 million, then a grant used as premium subsidies is more cost-effective unless the seed capital can generate premium savings in excess of 24 percent.

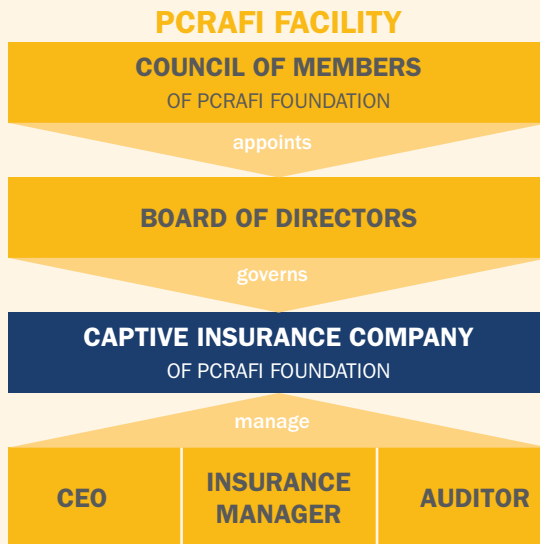
In addition to the above factors, there are other considerations that will also impact the cost-effectiveness of the grant. A lower discount rate will mean seed capital is more cost-effective (i.e., a higher level of premium savings can be achieved for seed capital). In the example above, reducing the discount rate from 10 percent to 5 percent reduces the minimum premium reduction from seed capital (to be more cost-effective than premium subsidies) from 14 percent to 6 percent.

Source: World Bank Disaster Risk Financing and Insurance Program (2016).

BOX 17. PCRAFI FACILITY

In 2015, the Pacific Island Countries made a decision to establish a regional facility (PCRAFI Facility) to ensure the sustainability of the Pacific Catastrophe Risk Insurance Program, and to bring the management of the program into the region. By creating a regional body accountable to the countries themselves, the facility affords countries greater control and influence over the design of future disaster and climate risk solutions. In June 2016, the PCRAFI Facility was established by legal statute in the Cook Islands; it received an insurance license in September 2016. The governance structure is shown in the figure adjacent.

Source: PCRAFI.



REGIONAL OWNERSHIP

As discussed previously, regional ownership is an important element in the establishment of sovereign vehicles like catastrophe risk pools. Countries' ownership is also important to ensure the pool's overall (and not merely financial) sustainability. A sense of ownership prompts participating countries, and especially

the ministries of finance, to discuss how the pool can better serve their needs (e.g., through the development of new insurance products), as well as how it fits into their disaster risk financing strategies and broader disaster risk management and climate change agendas.

Regional political bodies, such as the African Union, Pacific Island Forum, or Caribbean Community Market, have played a central role in establishing sovereign regional pools; and once established, the pools play a political role in promoting better financial management of disaster and climate risks in their respective regions. For example, the Pacific islands have recently worked with the support of donors and the World Bank to change the pilot PCRAFI insurance program into a stand-alone facility in the form of a captive insurer, domiciled in Cook Islands. The PCRAFI Facility's strong position within the region, along with regional ownership, help foster the use of financial mechanisms as a way to build resilience in the region (see Box 17).



2.4. INCREASING THE IMPACT OF SOVEREIGN CATASTROPHE RISK POOLS

Sovereign catastrophe risk pools are an instrument designed to provide immediate liquidity to countries after a disaster, serving as bridge financing while additional funds such as bilateral aid or reconstruction loans are being mobilized. They should be part of a country's comprehensive strategy for public financial management of natural disasters, which should also include contingent disaster response plans to ensure a timely, transparent, efficient, and effective use of the pools' resources. Shock-responsive social protection allows countries to use existing safety net programs to support poor households affected by natural disasters and reduce the negative impacts of disasters on the well-being of the poor and vulnerable. Contingency plans for the restoration of lifeline infrastructure are also critical to reduce impacts and promote swift recovery. But governments cannot bear those risks alone, and the private sector has an important role to play in this regard.

PUBLIC FINANCIAL MANAGEMENT OF NATURAL DISASTERS

A country's framework for the public financial management of natural disasters is a core element for leveraging the impact of sovereign catastrophe risk pools.

The PCRAFI program has invested heavily in building capacity in the public financial management of natural disasters, including the development of post-disaster budget execution manuals detailing what sources of finances are available for post-disaster response and how to execute these funds to complement national disaster risk management plans. The guidelines are meant to provide a desk reference for Ministry of Finance staff and other stakeholders following the proclamation of a state of emergency or the declaration of a state of disaster. These guidelines are designed to ensure that funds for disaster relief and recovery are accessed, disbursed,

and accounted for as quickly and efficiently as possible. Other ways to strengthen post-disaster public financial management may include (i) reinforcing the legal environment to support the development of risk financing and insurance solutions; (ii) strengthening risk information and risk analytics for evidence-based decision making; and (iii) improving countries' capacities to effectively allocate, disburse, and monitor recovery and reconstruction funds following disasters through dedicated mechanisms.

CONTINGENCY PLANS

The use of the insurance proceeds should also be carefully considered. This is particularly important for parametric insurance proceeds, which are not linked to any specific asset. Contingency plans can help define the potential use of the insurance proceeds and ensure that agreement about their use is reached in advance.

Contingency planning is an integral part of the ARC insurance program. For ARC member states, one of the preconditions for purchasing insurance is the up-front development of an Operations Plan. Developed in country by government officials collaborating with partners and supported by ARC, it is reviewed against detailed standards and guidelines. While primarily designed as a tool to ensure that rapid payouts reach the most vulnerable, government-led contingency planning has helped bring together disaster response actors—including international agencies and NGOs—to work on early warning, risk reduction, and disaster preparedness and response

In Mexico, the FONDEN program has a direct link to a social safety net: if the FONDEN program is triggered after a disaster, federal and state funding is made available to provide households living under the poverty line with self-construction packs that allow them to repair, reconstruct, or even change the location of their homes.

SHOCK-RESPONSIVE SOCIAL PROTECTION

By helping people to better manage climate risks and recover after disasters, shock-responsive social protection can play a prominent role in protecting the poorest and most vulnerable and in building resilience at the household level. Governments can utilize social protection systems and programs to deploy assistance swiftly to those most in need after a climate shock. By assuming this responsibility and utilizing social protection in this way, governments provide a form of insurance to those who are exposed and vulnerable to climate change but unable to access market-based insurance themselves. This approach directly contributes to resilience at the household level by smoothing consumption and supporting livelihoods after a climate shock has occurred, potentially helping to break the cycle of poverty and vulnerability that disasters often perpetuate.

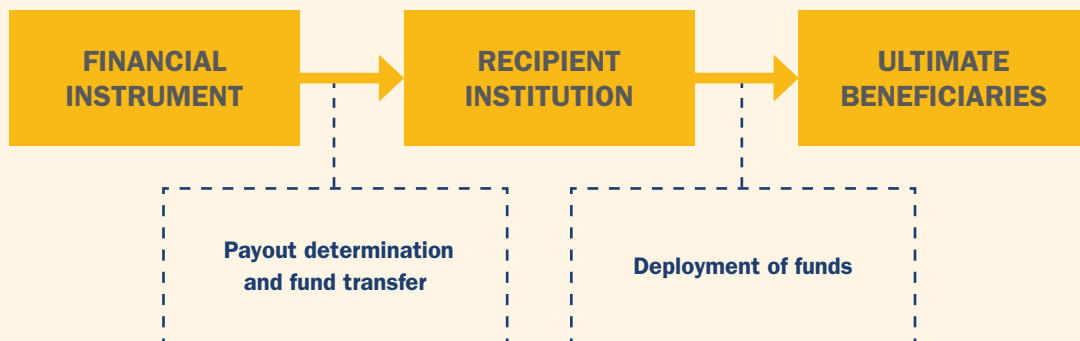
Channeling sovereign-level financing to direct beneficiaries through social safety nets is one way to increase the impact of disaster risk financing instruments in general, and sovereign catastrophe risk pools in particular.

- In Ethiopia, contingent financing mechanisms have been used at the sovereign level to fund the scale-up of the Productive Safety Net Programme and reach food-insecure

populations in the event of a drought. The contingent financing window has been supported by a number of donors and, in 2011, US\$134 million was drawn down from the window and deployed through the program to respond to the drought: in this way, over 3 million additional beneficiaries were supported, and regular program beneficiaries received expanded support.

- In Uganda, work is focusing on establishing a disaster risk financing component of the Third Northern Uganda Social Action Fund initiative. This will provide income support and build the resilience of poor and vulnerable households in the case of predefined shocks.
- In Kenya, the Hunger Safety Net Programme Phase 2 provides regular cash transfers to the poorest households in four northern counties. The program, implemented by the National Drought Management Authority, also has a shock-responsive component and is able to quickly scale up temporary cash assistance to vulnerable populations following predefined drought shocks (as discussed earlier). The development of this component required technical assistance to analyze the costs associated with different scenarios, depending on the severity of the shock, the number and location of people covered, the additional amount in cash transfers, and the time period of that extended support.

FIGURE 8. FLOW OF FUNDS



CRITICAL INFRASTRUCTURE

The rapid restoration of critical infrastructure, including critical roads and bridges and water supply, is often key for efficient post-disaster response. In small state islands, where international emergency aid comes mostly by plane, the restoration of airport runways is an essential part of the government's rapid response, along with restoration of key roads and bridges. Most maintenance programs do not take into account unexpected costs caused by natural disasters, and this oversight may ultimately delay the restoration of those assets. In addition, even when funds are available, few countries have standby contracts with suppliers and service providers that would allow for rapid restoration.

CROWDING IN THE PRIVATE SECTOR

Crowding in the private sector can help achieve scale, develop the local market, and generate demand. But public-private partnerships need to follow clear pro-poor guidelines to be credible.

The Pacific Risk Information System, a platform that includes an exposure database of over 4 million assets located in the Pacific region, and its associated catastrophe risk model have been used by domestic insurers and brokers to inform their underwriting and pricing decisions. In Fiji, for example, the model was used to inform the provision of catastrophe risk insurance for hotels and resorts. The model has also been used to explore the feasibility of crop insurance in some Pacific islands.

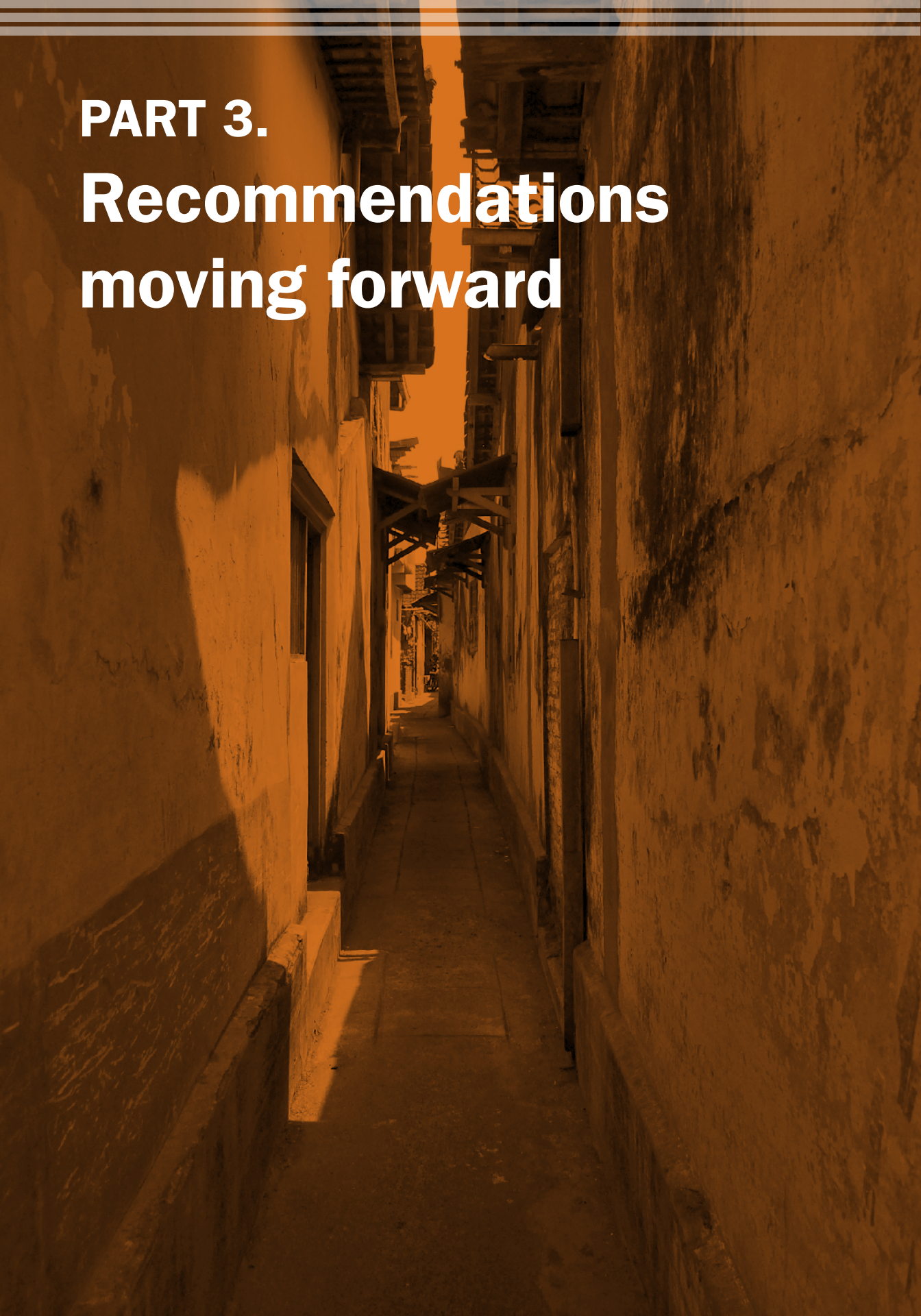
ARC developed the Licensing for Development (L4D) program to allow the use of Africa RiskView to cover nonsovereign agricultural risks on a parametric basis. During its pilot phase, L4D is

being implemented through ARC Ltd.'s reinsurance broker. The initiative will expand ARV's availability as a tool for underwriting parametric weather insurance, providing funding for ARC itself and supporting agricultural activities on the African continent. L4D allows private sector actors with African exposure to improve their understanding of the impact of weather volatility on crop production, supply chains, and business forecasting. Further, it facilitates companies' use of parametric insurance products to transfer the risk of adverse weather to the global risk markets. Lastly, L4D can contribute to growth in the insurance sector, in particular to complement the transformational agenda set for the agricultural sector in Africa.

CCRIF has provided its catastrophe risk data and platform to international partners (MicroEnsure, the Munich Climate Insurance Initiative, and Munich Re) and local insurers and financial institutions, which are collaborating to offer catastrophe risk insurance to low-income individuals and lenders affected by extreme weather events in the region. The original program, called Livelihood Protection Policy, ran from 2010 to 2014 and was piloted in Grenada, Jamaica, and St. Lucia; using CCRIF weather data, its products were designed to help protect the livelihoods of vulnerable low-income individuals (such as small farmers and day laborers) by providing quick cash payouts following extreme weather events. CCRIF data were also the basis for a loan portfolio hedge for financial institutions with portfolios of individuals and micro, small, and medium-sized enterprises, which was designed to promote investment in areas previously considered too risky for traditional lending. The results from the first phase of the pilot were positive, but limited; only a small number of policies was issued. However, the pilot will be continued in a second phase for 2017–19 and expanded to target additional countries.

PART 3.

Recommendations moving forward



3.1. CATASTROPHE RISK POOLS CAN ENHANCE THE FINANCING OF CLIMATE AND DISASTER RISKS

Catastrophe risk pools can help countries shift financing of climate and disaster risks away from a reactive approach that mobilizes resources after a disaster and toward a more cost-effective, proactive approach that plans in advance. Timing matters, and early financing is more cost-effective than late financing. In Ethiopia, for example, every US\$1 secured in financial planning for timely and predictable disbursement for emergencies can save up to US\$5 over the long term (Wiseman and Hess 2007). In addition, by securing financing ahead of time, a pre-planned approach to disaster-response reduces reliance on humanitarian aid, which is unpredictable and uncertain, and often takes time to materialize.

Catastrophe risk pools can help countries access insurance and capital markets on competitive terms. The 26 countries currently covered by sovereign catastrophe risk pools represent the vast majority of low- and middle-income countries that have purchased sovereign disaster risk insurance. (An exception is Mexico, which issued catastrophe bonds on its own). Small countries with limited financial market experience or infrastructure may struggle to access international insurance markets directly. If one small state tried to purchase insurance coverage individually, the premium volume would be too small to make the transaction commercially attractive and viable for international insurance companies. But a risk pool's joint portfolio and larger premium volume solve this problem and facilitate access to international markets.

Catastrophe risk pools can contribute to more affordable climate and disaster risk insurance solutions. Risk pools can make risk transfer more cost-effective by (i) diversifying risk through the participation of multiple countries with different risk profiles; (ii) establishing joint reserves to self-insure a part of the risk managed

by the pool; (iii) enabling access to international reinsurance and capital markets that might otherwise be impossible; (iv) sharing operational costs, such as program development and day-to-day back-office operations; and (v) involving the private sector in the operational and financial management of the pools.

Catastrophe risk pools can provide further risk management benefits. Beyond the financial benefits of transferring risk off balance sheets, catastrophe risk pools can (i) create incentives for risk reduction by putting a price on risk through the payment of insurance premiums; (ii) enable rapid disbursement of funds that can reduce humanitarian impacts and save money through rapid crisis response and relief efforts; and (iii) increase transparency and efficiency through the adoption of clear, pre-agreed triggers/rules for the disbursement of funds as identified in a post-disaster response plan. The process of developing such post-disaster plans and identifying related costs can also create incentives to step up investments in prevention and adaptation to reduce risks in the first place.

Catastrophe risk pools can serve as a vehicle for regional policy dialogue. Catastrophe risk pools have allowed participating countries and donors to improve collaboration on risk management and risk finance. They offer a vehicle to anchor key elements of collaboration:

- *Integrated financial planning.* Countries can make their participation in a risk pool part of a more comprehensive disaster risk financing strategy that brings together various financial instruments.
- *Contingency planning.* The different risk pools established to date have taken different views on this, but all encourage countries to establish contingency plans in advance to support disaster response.

- *Regional ownership.* Since risk pools inherently require regional cooperation to be established and maintained, they also serve as a vehicle to advance regional collaboration on the climate risk management agenda.
- *Discussion on climate and disaster risk ownership.* This occurs through the pricing of climate and disaster risks.

Catastrophe risk pools help clarify who owns the risk. Many developing countries still rely on donor assistance—which may come late but at low or no financial cost for the recipient country—to help fund relief and response activities following a shock. In exchange for the insurance coverage, catastrophe risk pools require participating countries to pay up front an insurance premium that reflects their actual risk exposure, thereby shifting payment so it takes place in predictable installments before disaster strikes. It may be challenging for countries that previously relied on donor support to start paying for climate and disaster risks with national resources through an insurance premium. But moving in this direction, even partially, can provide the right incentives for proactive planning and investments in risk reduction.

Catastrophe risk pools can help reduce the impacts of disasters on the poorest and most vulnerable. Social safety nets can be used to channel sovereign-level financing from catastrophe

risk pools to direct beneficiaries. To help poor and vulnerable people better manage climate risks and recover after disasters, governments can utilize social protection systems to protect assets and livelihoods and to deploy assistance swiftly to those most in need after a climate shock. By assuming this responsibility and utilizing social protection in this way, governments provide a form of insurance to those who are exposed and vulnerable to climate change but unable to access market-based insurance themselves. This approach directly contributes to resilience at the household level through consumption smoothing and livelihood support after a climate shock has occurred, potentially helping to break the cycle of poverty and vulnerability that disasters often perpetuate.

Catastrophe risk pools can contribute to the provision of public goods. The creation of risk pools has driven the development of catastrophe risk models and other public goods that have proved valuable in multiple areas. For example, domestic insurers and brokers have used the Pacific Risk Information System (a platform that includes an exposure database of over 4 million assets located in the region) and its associated catastrophe risk model to inform their underwriting and pricing decisions. In Fiji, the model was used to inform the provision of catastrophe risk insurance for hotels and resorts. The model has also been used to explore the feasibility of crop insurance in some Pacific islands.



3.2. CATASTROPHE RISK POOLS ARE NOT THE ONLY SOLUTION FOR THE FINANCING OF CLIMATE AND DISASTER RISKS

The long-term financial sustainability of existing sovereign catastrophe risk pools is still to be proven. With the exception of CCRIF-Caribbean, which started with 16 countries, pools have faced challenges in attracting a large number of countries. CCRIF-CA has only one country so far, PCRAFI has five countries, and ARC has six countries. Most sovereign catastrophe risk pools have also faced challenges in securing the annual payment of insurance premiums by member countries. There are financial and practical reasons why some countries (often low-income countries that are a high priority for donors) struggle to commit to or afford their annual premium payments through their national budgets.

Catastrophe risk pools come with risks—managing expectations is key. As with any insurance product, catastrophe risk pools are exposed to the risk that small disasters may not trigger a payout because the loss is below a pre-agreed threshold (deductible), or the peril that causes the loss is not included in the insurance policy. In addition, catastrophe pools offering parametric products (which all sovereign catastrophe risk pools now do) are exposed to basis risk (that is, the risk that the index measurement does not match the actual losses). Such risks should be carefully mitigated in the design of the insurance products as part of a comprehensive financial strategy that includes instruments beyond insurance. Moreover, such risks should be addressed in the dialogue with participating countries, to ensure awareness of the benefits and limitations of insurance.

Catastrophe risk pools cannot make insurance cheap. While these vehicles can improve the efficiency and reduce the cost of risk transfer,

insurance is inherently a costly mechanism (it pays a third party to bear the risk). Moreover, catastrophe risk pools cannot reduce the underlying climate and disaster risks faced by the countries, which should be reduced through appropriate risk reduction measures.

Catastrophe risk pools can address only specific needs. Governments considering the establishment of a risk pool need to have clarity on the objectives to be achieved. Catastrophe risk pools in the Caribbean and the Pacific are designed to ensure access immediate (but limited) funding for rapid post-disaster response. While the potential payouts following an earthquake or a tropical cyclone represent a small fraction of the overall damage and loss caused by a disaster, this immediate cash injection can be substantially larger than—sometimes several times over—the government’s contingency budget (which is typically the only source of cash available). In Africa, ARC encourages using payouts for early action against drought and incentivizes contingency planning to that effect.

Catastrophe risk pools cannot be the only solution for disaster risk financing and should be complemented by other financial instruments. Disaster risk insurance products offered by risk pools are efficient ways to provide timely (but limited) financing for rapid post-disaster response. Experience shows that payouts received from risk pools are only a small fraction of the actual disaster loss. Other financial instruments should be used by the countries to finance the cost of more frequent disasters and the cost of long-term reconstruction.

3.3. RECOMMENDATIONS FOR G20 MEMBERS

The G20 could promote a set of priority action areas designed to **reduce the protection gap** by in vulnerable developing countries. These actions would **advance financial protection** against climate and disaster risks, in part by encouraging the **scale-up of catastrophe risk pools** at the supranational, national, and subnational levels. Specifically, the G20 could promote activities that support the following priority action areas:

- **Facilitate the adoption of financial protection strategies that include a mix of financial instruments** against disaster and climate risks, such as budgetary instruments, contingent credit, and catastrophe risk transfer to increase the ownership, impact, and cost-efficiency of disaster response financing.

Activities under this action area could include

- ♦ Technical assistance to support the development of financial protection strategies, including diagnostic reviews of countries' approach to financial protection, and identification of policy options for strengthened financial resilience
- ♦ Technical assistance and investments to support the implementation of national financial protection strategies, including for specific line ministries or sectors
- **Support the development of pre-agreed disaster response plans** backed by financial protection strategies to help poor and vulnerable households and protect key lifeline infrastructure. Such plans can help raise awareness of the benefits of risk reduction and financial protection by engaging a wide range of stakeholders, including members of civil society. Activities under this action area could include
 - ♦ Knowledge exchange to learn from experience and consolidate good practices in disaster response planning

- ♦ Technical assistance and investments to develop shock-responsive scalability mechanisms for existing social safety nets to protect the poor and vulnerable
- ♦ Technical assistance and investments to identify, prioritize, and protect critical infrastructure at risk, both ex-ante (by mainstreaming disaster risk reduction in investment planning) and ex-post (by developing pre-agreed financial plans for post-disaster reconstruction)

- **Promote institutional and legal frameworks that enable the implementation of financial protection strategies.** This includes creating the legal base that enables governments to establish disaster risk management funds, pay insurance premium and manage insurance proceeds, and join supranational financial entities such as catastrophe risk pools.

Activities under this action area could include

- ♦ Knowledge exchange among countries to learn from experience in public financial management of climate and disaster risks
- ♦ Technical assistance to incorporate climate and disaster risks into public finance frameworks
- **Develop new concessional financing for catastrophe risk transfer** instruments to incentivize vulnerable developing countries to develop and adopt sustainable financial protection strategies. Activities under this action area could include
 - ♦ Cofinancing of capitalization and operating costs of catastrophe risk pools
 - ♦ Cofinancing of premiums for insurance solutions (designed to incentivize countries to progressively increase their contributions over time)

To achieve the overarching objective of reducing the protection gap in vulnerable developing countries, and to catalyze action around these priority areas and activities, the G20 could promote the creation of a **Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions**.

The Global Partnership could **bring together relevant partners** from developing and developed countries, international organizations, the private sector, and civil society. To achieve maximum impact, the Global Partnership would leverage the

comparative advantages of all partners and build on the work of existing platforms and initiatives. In particular, it would leverage the technical expertise and capacity of the private insurance and reinsurance industry.

The G20 could **develop a work program** structured around the four priority action areas identified above to specify how countries would support specific activities. Such efforts would not only promote financial protection and help close the protection gap, but would also support the broader disaster and climate resilience agenda.

GLOSSARY

basis risk. The risk that the index measurement will not match actual losses.

budget allocation. An amount of funding set aside to cover specific planned expenditures. In the context of disaster risk management, a budget allocation can be made so that it can be accessed only in the event of a disaster.

capital base. Money contributed by the shareholders who first purchased shares in a company, plus retained earnings.

capital market instrument. Any financial contract that can be structured to act as reinsurance, but with investors, not reinsurers, providing the protection. Examples are catastrophe bonds and catastrophe swaps.

catastrophe bond. An insurance-linked security in which payment of interest and/or principal is suspended or canceled in the event of a specified catastrophe such as an earthquake.

catastrophe swap. A contract used by investors to exchange (swap) a fixed payment for a certain portion of the difference between insurance premiums and claims.

contingency fund. A reserve fund designated for financing disaster losses. Allocations to the contingency fund can be made through budget allocations of national or local governments, international agencies, communities, or a combination of these. Funds are made available immediately after a disaster and are disbursed using clear and simple rules.

contingent credit. A financial tool that provides governments with immediate access to funds following disaster events to enable a more rapid and efficient response. This type of financing is typically used to finance losses caused by recurrent natural disasters. Contingent credit is

an ex ante instrument that allows borrowers to prepare for a natural disaster by securing access to financing before a disaster strikes.

contingent liability. A potential future expenditure. In the case of disaster risk, a government's or organization's contingent liability is a random variable denoting the liability contingent on potential disaster events.

disaster risk finance. The financial protection of populations against disaster events. Disaster risk finance strategies allow national and local governments, homeowners, businesses, agricultural producers, and low-income populations to respond more quickly and resiliently to disasters.

disaster risk management. The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies, and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

disaster risk reduction. The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, reduced vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

emergency recovery phase. The disaster response phase that follows the emergency relief phase. During recovery, initial relief efforts have been completed; typically people have access to food, water, and temporary shelter, and children are able to attend school. The recovery phase can last several weeks or months, depending on the initial situation of the country.

emergency relief phase. The disaster response phase that begins immediately after a disaster. During this phase, key objectives include ensuring food security, shelter, and medical care. The duration of the relief phase depends on the initial situation of the country following the disaster event.

ex ante. Latin for “from before.” In the context of disaster events, ex ante instruments are arranged, and ex ante decisions are made, before an event takes place.

ex post. Latin for “from after.” In the context of disaster events, ex post instruments are arranged, and ex post decisions are made, after the event takes place.

global humanitarian system. The network of interconnected institutional and operational entities through which humanitarian assistance is provided when local and national resources are insufficient to meet the needs of the affected population.

humanitarian aid. In general terms, the aid and action designed to save lives, alleviate suffering, and maintain and protect human dignity during and after man-made crises and natural disasters. Such aid may also be used to prevent and strengthen preparedness for the occurrence of such situations.

indemnity insurance. An insurance policy that pays claims based on the actual economic losses incurred by the policyholder.

index insurance. An insurance policy that pays claims based on an index. Indexes are typically chosen to be a good proxy of the economic losses incurred by the policyholder.

individual loss adjustment. The process by which a loss adjuster objectively assesses the actual damage for each insured building or injured person.

moral hazard. In the context of insurance, the problems generated when the insured’s behavior can influence the extent of damage that qualifies for insurance payouts. Examples are carelessness, fraudulent claims, and irresponsibility.

natural disaster. A disastrous event leading to loss of lives and livelihoods caused by natural hazards such as tropical cyclones, earthquakes, floods, and landslides.

parametric insurance. A type of insurance that does not indemnify the pure loss but agrees ex ante to make a payment upon occurrence of a triggering event. The triggering event is often a catastrophic natural event likely to cause a loss.

post-disaster needs assessment. A government-led exercise that assesses post-disaster needs, generally in order to provide a platform enabling the international community to assist the affected government in recovery and reconstruction.

public financial management. The systematic process designed to ensure that money is spent and accounted for in a clear and transparent fashion. A public financial management system comprises resource generation, resource allocation, and expenditure management (resource utilization).

reinsurance. A practice in which insurers transfer portions of risk portfolios to other parties in order to reduce the likelihood of having to pay a large obligation resulting from an insurance claim—in other words, insurance of insurance.

risk-based pricing. Pricing of an insurance policy to reflect the underlying risk that is transferred through the insurance contract.

risk pool. An arrangement whereby several individuals, companies, or countries jointly insure against a certain prespecified risk.

risk retention instrument. An instrument whereby a party retains the financial responsibility for loss in the event of a shock. Although risk retention instruments do not take risk off the balance sheet—the cost of a disaster must still be repaid—they do offer more flexibility in how and when to pay that cost. Contingency funds, budget allocations, and lines of contingent credit are all risk retention instruments, as are budget reallocations, tax increases, and post-disaster credit.

risk transfer instrument. An instrument such as an insurance contract that passes on the risks associated with a certain event from one party to another. For example, in disaster insurance the financial risks associated with a disaster event are passed from the insured to the insurer.

shock-responsive social protection. Social protection that has the ability to increase its caseload and/or its intensity of support in response to catastrophic events.

targeting. The process of selecting beneficiaries under a social safety net program.

trigger. The event that must occur before a particular insurance policy applies to a given loss. For example, for weather index insurance, the trigger is the weather measurement that causes the insurance policy to pay out, such as a certain amount of cumulative rainfall.

underwriting. The process of issuing an insurance policy, thereby accepting a liability and guaranteeing payment in case a loss occurs.

ANNEX 1. BRIEF DESCRIPTION OF EXISTING SOVEREIGN CATASTROPHE RISK POOLS

CARIBBEAN CATASTROPHE RISK INSURANCE FACILITY (INCLUDING CCRIF-CA)

CCRIF started as a Cayman-domiciled captive insurer offering parametric earthquake and tropical cyclone insurance policies to the 20 Caribbean Community (CARICOM) member and associate member states. CCRIF is owned by a purpose trust and operates to the benefit of the participating countries. In 2014, it reconstituted as a Segregated Portfolio Company, enabling the establishment of separate underwriting pools with differentiated capital (cells). CCRIF now also offers an excess rainfall policy and includes a cell dedicated to underwriting risk in the COSEFIN countries (Central America plus the Dominican Republic and Panama).

CCRIF offers modeled loss-type parametric policies, which input a hazard parameter (or parameters) as the sole variable to a catastrophe risk model, are locked at the start of the insurance period, and convert the hazard variable to loss. CCRIF's models use a consistent gridded exposure data set across all the perils it covers and attempt to capture the large-scale impacts of natural catastrophes on national economies and governments.

CCRIF's coverage is customizable, with pricing based solely on the quantum of risk transferred (measured by expected loss and variability of those losses). Some limitations are put in place to constrain the risk transfer transaction such that it targets that portion of the risk profile where such insurance provides a cost-effective solution. This design generally provides coverage that triggers every 10 years or so, and provides larger payouts for larger events up to a limit at the 1-in-100- to 1-in-200-year range. Earthquake policies tend to have less frequent trigger levels (due to the lower frequency of damaging earthquake events), while

excess rainfall policies have a more frequent trigger level, though generally transfer a smaller quantum of risk.

CCRIF is designed as business interruption-type coverage, providing rapid liquidity to sovereigns to meet immediate, unbudgeted needs in the weeks after a disaster. Given the basis risk inherent in any parametric insurance contract (i.e., the potential mismatch between modeled losses and actual losses), CCRIF coverage may not be well suited to covering specific infrastructure damage or long-term rebuilding programs; on the other hand, it can provide financial leeway to put in place more cost-effective financing mechanisms for full post-disaster recovery. CCRIF does not put any formal constraints on use of payout funds, although it increasingly monitors their use.

When it is efficient to do so, CCRIF utilizes the international reinsurance markets to leverage its own capital (initially provided as grants by bilateral and multilateral donors) to provide much greater aggregate coverage than would otherwise be possible. The objective nature of the parametric contracts used for risk transfer, along with the diversification of the portfolio, allows for attractive pricing from international markets, including capital markets.

CCRIF's business targets include maintaining efficiency in operations, capturing a risk-appropriate return on its capital, committing to pay claims even for the most extreme (e.g., 1-in-1,000-year) events, and offering the lowest possible (yet actuarially sound) premium pricing to its clients. CCRIF has lowered the long-term premium pricing metric as capital has been accumulated, and has also used short-term premium discounting (implemented on an equal basis across the pool) to maintain participation and provide best value to its client countries.

From 2007 to 2016, CCRIF has made a total of 21 payouts to 10 member countries amounting to US\$68 million. All payments have been made within 14 working days. In the case of Haiti, for example, payments of US\$7.8 and US\$23.4 million were made immediately after the 2010 earthquake and 2016 Hurricane Matthew, respectively.

AFRICAN RISK CAPACITY

ARC comprises two entities: a treaty-based international organization, the ARC Agency, which is a Specialized Agency of the African Union formed at the direction of union ministers of finance; and an affiliated insurance company, ARC Ltd., which is domiciled in Bermuda as a mutual captive. ARC Agency is ultimately under the control of the Conference of Parties, which appoints a governing board, with operations undertaken by a secretariat. ARC Ltd. has its own board of seven directors and operates on commercial principles as the underwriter of policies to ARC Agency member states.

ARC Ltd. offers parametric insurance policies for the key climate risks faced by African sovereigns, namely drought and tropical cyclone; policies for riverine flood are in development. The drought policy uses rainfall as the variable input parameter, and ARC's in-house modeling platform, Africa RiskView, converts that rainfall into an affected population estimate (in low-rainfall situations) and then calculates a response cost using assumptions about various types of response mechanisms (cash transfer and food aid, for example). ARV can be used by ARC member states to model a country's risk profile (as a basis for making decisions about risk financing) and as an early-warning tool. For cyclones, ARC has leveraged the experience of CCRIF and offers a very similar product to the exposed countries in the southwest Indian Ocean, including an early warning component embedded in ARV (which CCRIF also offers to its clients).

ARC was the first pool to institutionalize an incentive mechanism for contingency planning among the participating countries. Countries receiving a parametric payout from ARC Ltd. are

required to develop (and have certified by a group of experts and peers) a final implementation plan for use of the payout funds before the payout is made. This plan builds on an operations plan, which must be certified prior to the original purchase of the insurance coverage. While this approach tends to make payouts from ARC occur on the time scale of a few weeks (that is, somewhat more slowly than they would be otherwise), it is critical in ensuring that the benefits of early action are fully captured and that the most vulnerable people in a given situation are reached and assisted.

ARC Ltd. is capitalized through interest-free loans and operates on mutual principles, such that any underwriting profit is used to accumulate capital to the ultimate benefit of the premium-paying clients. It has also established cost-efficient access to the international risk markets, providing capacity to underpin expansion of ARC's insurance program. This is in addition to its efforts to build capacity in risk understanding, early warning, and contingency planning, which are critical to its long-term sustainability.

ARC Ltd. policies are constructed to pay out every three to five years, commensurate with the high frequency of droughts in many African countries. Trigger levels for cyclone and flood policies will be somewhat higher, covering risk in the 1-in-10- to 1-in-100-year return period range.

Replica insurance coverage, which exactly replicates an insurance policy paid for by an ARC member state, is available to humanitarian actors (international organizations and NGOs). Such policies are already customized to reflect the country's experience and, to the extent possible, needs.

African countries, including those that purchase insurance from ARC, also have access to technical assistance and capacity building on disaster risk finance and public financial management of natural disasters provided by the World Bank, with financial support from the ACP-EU (African, Caribbean, Pacific-European Union) Natural Disaster Reduction Program.

PACIFIC CATASTROPHE RISK ASSESSMENT AND FINANCING INITIATIVE (PCRAFI)

The Pacific catastrophe risk insurance pilot program was launched under PCRAFI in January 2013, when the World Bank intermediated a portfolio of catastrophe swap contracts on the international reinsurance markets that transferred catastrophe risk from five Pacific island countries. The pilot was supported by the government of Japan, the Global Facility for Disaster Reduction and Recovery, the World Bank Group, and the Secretariat of the Pacific Community (SPC). The placement built on several years of prior work under PCRAFI on catastrophe risk models (developed and run by the risk modeling firm AIR Worldwide) that use a unique database (the Pacific Risk Information System) for risk transfer to the international market. The Pacific Risk Information System is the largest regional database and contains information on the hazard, exposure, and vulnerability of 15 Pacific island countries, including information on over 4 million buildings and their attributes.

In its first season, the pilot program placed US\$45 million of catastrophe risk for the Marshall Islands, Samoa, Solomon Islands, Tonga, and Vanuatu. The pilot was renewed in its original form for three subsequent seasons; in its fourth season, the newly established PCRAFI facility is taking a role in the risk transfer. The Pacific Risk Information System plays a pivotal role in the insurance triggers, which are based on modeled losses. Reported hazard parameters for tropical cyclone, earthquake, or tsunami events were used to create event footprints in the catastrophe risk models, and from this a modeled loss was determined. The selection of a modeled loss trigger—unlike the simpler hazard indexes that had also been considered—allowed the inclusion of the tsunami peril, and generated a more refined loss estimate to reduce basis risk for countries. The portfolio of policies was expanded with the addition of the Cook Islands in the second season, while the Solomon Islands withdrew in the third season.

Like CCRIF and ARC, the PCRAFI insurance program aims not to cover the full losses incurred but rather to provide rapid, flexible funds within weeks of an event for use as budget support by the affected countries. Given this objective, a parametric contract was considered suitable, since these triggers lend themselves to rapid loss determination after an event—typically within a couple of weeks of an event. Contracts were designed to cover catastrophe risk for events with a return period of 10 years and above. Recognizing that insurance should fit within a framework for disaster risk financing, such that lower-return-period (and other out-of-scope) events not covered by policies can also be managed, the PCRAFI insurance program is accompanied by a technical assistance program on disaster risk finance and insurance and on public financial management of natural disasters, under which post-disaster budget execution manuals have been developed. Since its inception, the PCRAFI insurance program has made two payouts for an aggregate amount of US\$3.2 million, both times within 10 days of the disaster. Tonga received a payout of US\$1.3 million within 10 days of being struck by Tropical Cyclone Ian in 2014. The funds were mainly used to purchase fuel for boats bringing emergency goods to the affected islands. Vanuatu received a payout of US\$1.9 million within seven days of being struck by Tropical Cyclone Pam in 2015; the funds were mainly used to bring nurses to the affected areas to provide emergency care. The program has also progressed from its initial model of fully subsidized premiums to the current model of cofinancing from countries. For the 2016/17 season, participating countries have taken on full responsibility for payment of premiums, some of them using IDA loans to finance the payments. The willingness of countries to move away from fully subsidized premiums, and the decision of the Cook Islands to join without any premium support, are strong indicators of the program's value to countries.

SOVEREIGN CATASTROPHE RISK TRANSFER: THE EXPERIENCE OF MEXICO

The Fund for Natural Disasters was established in 1996 by the Federal Government of Mexico as a mechanism to finance the post-disaster recovery and reconstruction of Mexico's public assets and low-income housing. FONDEN consists of three primary financial accounts: (i) the FONDEN Program for Reconstruction; (ii) the FONDEN Trust; and (iii) the Revolving Fund. Collectively, these instruments assist the government of Mexico in its efforts to respond quickly to natural disasters by providing funding for emergency relief, rehabilitation, and reconstruction. These instruments are continuously changed to enhance their efficiency and effectiveness.

The FONDEN Program for Reconstruction provides financial support to rehabilitate and reconstruct assets destroyed by natural disasters. It focuses on the reconstruction and restoration of (i) public infrastructure at the three levels of government (federal, state, and municipal); (ii) low-income housing; and (iii) forestry, protected natural areas, rivers, and lagoons.

It should be noted that while the FONDEN Program for Reconstruction is not strictly speaking an insurance mechanism (e.g., Mexican states do not pay an insurance premium), it uses the principles of insurance to finance the reconstruction of public assets: a transparent damage reporting system, clear rules for how funds are disbursed, a clear plan for how money is spent, and a credible monitoring system for expenditures.

The Federal Budget Law requires that no less than 0.4 percent of the annual federal budget should be allocated for FONDEN and related activities through a dedicated budget line item. To further manage the volatility of the FONDEN budget and to leverage its resources, FONDEN is allowed to transfer disaster risks through insurance and other risk transfer mechanisms such as catastrophe bonds.

In 2009, the government of Mexico and the World Bank launched the MultiCat Program,¹² a catastrophe bond–issuance platform that aimed to facilitate and lower the cost of catastrophe risk transfer for governments and public entities. The thinking was that by using common documentation and legal and operational frameworks, developing countries exposed to natural disasters would have more affordable access to capital markets, and investors would be able to pool multiple perils and regions in order to achieve better portfolio diversification. Although other members of the Pacific Alliance (Chile, Colombia, and Peru) have expressed interest in using this platform, so far only Mexico has used it to issue catastrophe bonds.

FONDEN has issued three CAT bonds over the period 2006–2015, covering hurricane and earthquake risks in several high-risk areas of the country. The last outstanding issue (2012–15) expired in early 2016, and an extension was granted to receive the only claim to the notes in the history of the program (the program had triggered a partial payout after Hurricane Patricia in 2015). The program's price decreased 27 percent as the market was becoming more comfortable with the underlying risks.

In addition, FONDEN has purchased traditional indemnity-based reinsurance to cover public buildings and infrastructure. Since 2010 Mexico has transferred contingent obligations of the FONDEN program to a panel of more than 40 reinsurers. The reinsurance contract uses public loss adjustment rules set up by FONDEN, and loss adjustment is conducted by private loss adjusters and government staff. This innovative combination has allowed for more discipline and transparency in the evaluation of damage to public assets and more efficient pricing. (See table A1.1 for a summary of FONDEN's risk transfer program).

12. Mexico issued its first CAT bond in 2006 with technical assistance from the World Bank.

TABLE 4. FONDEN RISK TRANSFER PROGRAM, 2006–2015 (US\$ MILLION)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CAT bonds ^a										
Cover (sum insured)	150	150	150	290	290	290	315	315	315	
Premiums paid	8.5	8.5	8.5	31.5	31.5	31.5	27.8	27.8	27.8	
Claims received										50
Reinsurance										
Cover (sum insured)						386	418	392	376	85.2
Premiums paid						75.6	79	71.7	72.5	58.7
Claims received								124		

Source: Secretaría de Hacienda y Crédito Público.

a. In 2006–08, CatMex was a mix of CAT bonds (US\$150 million) and alternative reinsurance (US\$300 million).

During the summer of 2016, the ministers of finance of three Mexican states (Oaxaca, Colima, and Hidalgo) established a joint committee to coordinate the purchase of catastrophe risk insurance. This effort was led and supported by the federal government as a natural expansion of FONDEN's technical support to the Mexican states. As a result of accessing the international reinsurance markets together with FONDEN, the states were able to increase their insurance coverage by 20 percent and reduce their insurance premium by 30 percent.

This collaborative effort aims to help the state governments develop an Integral Risk Management Strategy (IRMS) so that they can meet requirements for federal funding (such as high data quality and a methodological approach to risk identification, measurement, and management that follows FONDEN rules). It provides the state governments with advisory

services in risk modeling (using the catastrophe risk model R-FONDEN developed by the federal government with technical assistance by the risk modeling firm ERN), as well as in catastrophe risk assessment, insurance product design, and drafting of insurance policies. The IRMS standards have brought several benefits to states. For example, the state of Oaxaca has found that its IRMS not only helped it purchase insurance on better terms, but also provided crucial information to strengthen its disaster response capacity and emergency relief strategy.

The pool of Mexican states builds on the experience of FONDEN in developing and placing catastrophe risk insurance. At least two more states have expressed interest in doing some of the preparatory work involved in joining the pool. In the next stage, it is expected that the participating states will build joint reserves to further improve insurance coverage and pricing.

ANNEX 2. SOVEREIGN CATASTROPHE RISK POOLS: ANNUAL PORTFOLIOS

(AS OF DECEMBER 16, 2016)

Insurance period	Participating countries	Number of participating countries	Aggregate insurance premium volume (US\$ million)	Aggregate coverage limit (US\$ million)	Aggregate insurance payouts (US\$ million)
Caribbean Catastrophe Risk Insurance Facility (Caribbean cell)–CCRIF					
2007/08	Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands	16	19.5	494.8	0.9
2008/09		16	21.8	563.8	6.3
2009/10		16	21.5	601.2	7.8
2010/11		16	20.8	618.4	17.2
2011/12		16	20.0	624.4	-
2012/13		16	20.3	624.5	-
2013/14		16	19.5	618.8	-
2014/15		16	23.1	656.8	3.4
2015/16		16	31.1	723.9	2.4
2016/17	Anguilla, Antigua and Barbuda, Belize, Barbados, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands	14	27.7	697.5	29.5
Caribbean Catastrophe Risk Insurance Facility (Central American cell)–CCRIF-CA					
2015/16	Nicaragua	1	1.0	18.0	-
2016/17	Nicaragua	1	1.5	28.2	1.6

Insurance period	Participating countries	Number of participating countries	Aggregate insurance premium volume (US\$ million)	Aggregate coverage limit (US\$ million)	Aggregate insurance payouts (US\$ million)
African Risk Capacity (ARC)					
2014/15	Kenya (2 seasons), Mauritania, Niger, Senegal	3	17	129	26.1
2015/16	The Gambia, Kenya (2 seasons), Malawi, Mali, Mauritania, Niger, Senegal	7	25	179	8.1
2016/17	Burkina Faso, The Gambia, Mali, Mauritania, Niger, Senegal	6	11.3	100	-
Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)					
2012/13	Marshall Islands, Samoa, Solomon Islands, Tonga, Vanuatu	5	1.5	45	-
2013/14	Marshall Islands, Samoa, Solomon Islands, Tonga, Vanuatu	5	2.2	67	-
2014/15	Cook Islands, Marshall Islands, Samoa, Tonga, Vanuatu	5	1.3	43	1.3
2015/16	Cook Islands, Marshall Islands, Samoa, Tonga, Vanuatu	5	2.3	43	1.9
2016/17	Cook Islands, Marshall Islands, Samoa, Tonga, Vanuatu	5	2.3	38	-

REFERENCES

- ADB (Asian Development Bank). 2013. "Regional: Strengthening Disaster and Climate Risk Resilience in Urban Development in the Pacific." Technical Assistance Consultant's Report. Project Number 46162.
- Baez, de la Fuente, and Santos. 2010.
- Bresch, D., and L. Müller. 2014. "A Global Overview of Case Studies with a Focus on Infrastructure: Economics of Climate Adaptation—Shaping Climate-Resilient Development." Swiss Re, Zurich.
- Cabot Venton et al. 2012
- Clarke, Daniel, Sarah Coll-Black, Naomi Cooney, and Anna Edwards. 2016. "A Methodology to Assess Indicative Costs of Risk Financing Strategies for Scaling Up Ethiopia's Productive Safety Net Programme." Policy Research Working Paper 7719, World Bank, Washington, DC.
- Clarke, Daniel, Olivier Mahul, Richard Poulter, and Tse-Ling Teh. 2016. "Evaluating Sovereign Disaster Risk Financing Strategies: A Framework." Policy Research Working Paper 7721, World Bank, Washington, DC.
- Clarke, Daniel J., and S. Dercon. 2016. *Dull Disasters? How Planning Ahead Will Make a Difference*. Oxford: Oxford University Press.
- Clarke, Daniel J., and Ruth Vargas Hill. 2013. "Cost-Benefit Analysis of the African Risk Capacity Facility." Discussion paper, International Food Policy Research Institute, Washington, DC.
- De Janvry, del Valle, and Sadoulet.
- Ghesquiere and Mahul. 2010.
- Hallegatte et al. 2013.
- Hallegatte, Stephane, Mook Bangalore, Laura Bonzanigo, Marianne Fay, Tamaro Kane, Ulf Narloch, Julie Rozenberg, David Treguer, and Adrien Vogt-Schilb. 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. Climate Change and Development. Washington, DC: World Bank.
- Hallegatte, Stephane, Adrien Vogt-Schilb, Mook Bangalore, and Julie Rozenberg. 2017. *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters*. Climate Change and Development. Washington, DC: World Bank.
- IPCC (Intergovernmental Panel on Climate Change). 2013.
- S&P Global. 2015b. "Storm Alert: Natural Disasters Can Damage Sovereign Creditworthiness." September 10. <https://goo.gl/JtZPS4>.
- . 2015a. "The Heat Is On: How Climate Change Can Impact Sovereign Ratings." November 25. <https://goo.gl/sccYb5>.
- Swiss Re. 2016. "Natural Catastrophes and Man-Made Disasters in 2015: Asia Suffers Substantial Losses." Sigma no. 1. March 30. http://media.swissre.com/documents/sigma1_2016_en.pdf.
- UN-HABITAT. 2013.
- UNISDR (United Nations Office for Disaster Risk Reduction). 2015. *Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction*. <https://www.unisdr.org/we/inform/publications/42809>.
- Wiseman, W., and U. Hess. 2007. "Reforming Humanitarian Finance in Ethiopia: A Model for Integrated Risk Financing." United Nations World Food Programme Working Paper.
- World Bank. 2012. *Turn Down the Heat: Why a 4°C Warmer World Must Be Avoided*. Washington, DC: World Bank.
- . 2013. *Turn Down the Heat: Climate Extremes, Regional Impacts, and the Case for Resilience*. Washington, DC: World Bank.
- . 2014a. "Honduras and Nicaragua Catastrophe Risk Insurance Project. Project Appraisal Document." Report No. PAD994. <http://projects.worldbank.org/P149895/?lang=en&tab=documents&subTab=projectDocuments>.
- . 2014b. *Turn Down the Heat: Confronting the New Climate Normal*. Washington, DC: World Bank.
- . 2016. *Annual Report 2016*. World Bank. <http://www.worldbank.org/en/about/annual-report>.
- World Bank Group. 2014. "Financial Protection Against Natural Disasters: An Operational Framework for Disaster Risk Financing and Insurance." World Bank, Washington, DC.
- World Bank and Government of Thailand. 2012.
- World Bank and Rockefeller Foundation. 2016. "Toward a Regional Approach to Disaster Risk Finance in Asia." Discussion Paper. <http://documents.worldbank.org/curated/en/584961480930535198/pdf/110702-WP-DRFRockefellerFINAL-PUBLIC.pdf>.

