Disaster Risk Financing in APEC Economies

PRACTICES AND CHALLENGES

This report was prepared by the OECD Secretariat and delivered to APEC Finance Ministers for their meeting on 19-20 September 2013 in Nusa Dua, Bali, Indonesia.

This report is based on input provided by APEC member economies in response to an APEC-OECD survey questionnaire. It benefited from the support and input of the OECD's High-Level Advisory Board on the Financial Management of Large-Scale Catastrophes, the Asian Development Bank, World Bank and UNISDR.

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Background and Main Results

In their Joint Ministerial Statement of 30 August 2012, APEC Finance Ministers highlighted the importance of strengthening resilience against disasters in the region through the introduction or expansion of risk sharing and risk transfer markets and products. They called for the exchange of knowledge and information on good practices regarding financial strategies among APEC member economies. In pursuing this initiative, APEC Finance Ministers aimed to complement the work already undertaken in 2012 by the G20, who endorsed last November the G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing.

Prepared by the OECD in cooperation with the Asian Development Bank, UNISDR and the World Bank, this report provides a survey of disaster risk financing (DRF) practices within APEC, including implementation challenges. It constitutes the first step towards promoting effective and widespread implementation of the G20/OECD Methodological Framework in the APEC region and beyond in the area of DRF. This report is based on a survey questionnaire circulated to APEC economies, the responses to which now constitute an inventory available to member economies.

The report shows that efforts have been made within APEC to promote financial resilience against disasters, although important implementation challenges exist. Key priorities for future work have thus been identified in this field.

Initiatives have been undertaken within APEC to strengthen disaster risk assessment and modelling. The results have been used for multiple applications: from emergency management, urban planning, and risk reduction investments, to budgetary planning and risk transfer and financing. Efforts are also being made to improve the collection and analysis data on hazards, exposures, vulnerabilities and losses. Notwithstanding progress in this area, developing an accurate risk assessment based on quantitative approaches remains a challenge for governments.

Private insurance is one of the main risk financing tools that businesses and households may use to strengthen their capacity to withstand the financial impacts of disasters. APEC economies are seeking to enhance the availability and penetration of disaster insurance. Institutional arrangements have been established in some economies to support private-sector development of products. Initiatives have also been undertaken to ensure that the financial sector is sound and resilient, capable of delivering promised payments and financing in the event of a disaster.

To manage their own exposures, many governments within APEC employ a broad range of *ex ante* DRF tools, such as government reserves, insurance, contingent credit arrangements and/or catastrophe-linked securities. Other APEC governments, instead, finance disaster risk on an *ex post* basis – e.g., through budget reallocations, debt financing, increased taxation and international aid – or by adopting an approach that blends *ex ante* and *ex post* mechanisms. Risk pooling of disaster risks at the regional level has been tested by some smaller economies, with a view to achieving mutual risk sharing and economies of scale when accessing the international reinsurance marketplace.

Among the top priorities for strengthening financial resilience in the APEC region, the improvement of the availability and quality of data on hazards, exposures, vulnerabilities and losses deserves special attention. Key priorities also include the improvement of financial sector resilience to disaster events and the enhancement of technical and institutional capacities and coordination among the various governmental authorities in charge for DRM at the central and local level. Promoting awareness of the financial impacts of disasters and the need for financial protection is yet another priority area. There is also strong interest in fostering the development of DRF markets, including insurance, reinsurance, and micro-insurance markets.

Many APEC economies have stressed the value of strengthened cooperation and knowledge and information exchange among member economies on topics related to disaster risk financing. Such cooperation and exchange of knowledge and information should focus on addressing APEC member economy priorities and support capacity building and the evaluation of DRF strategies and policies within member economies.

DISASTER RISK FINANCING IN APEC ECONOMIES

PRACTICES AND CHALLENGES

Promoting the implementation of the
G20/OECD Methodological Framework
for Disaster Risk Assessment and Risk Financing

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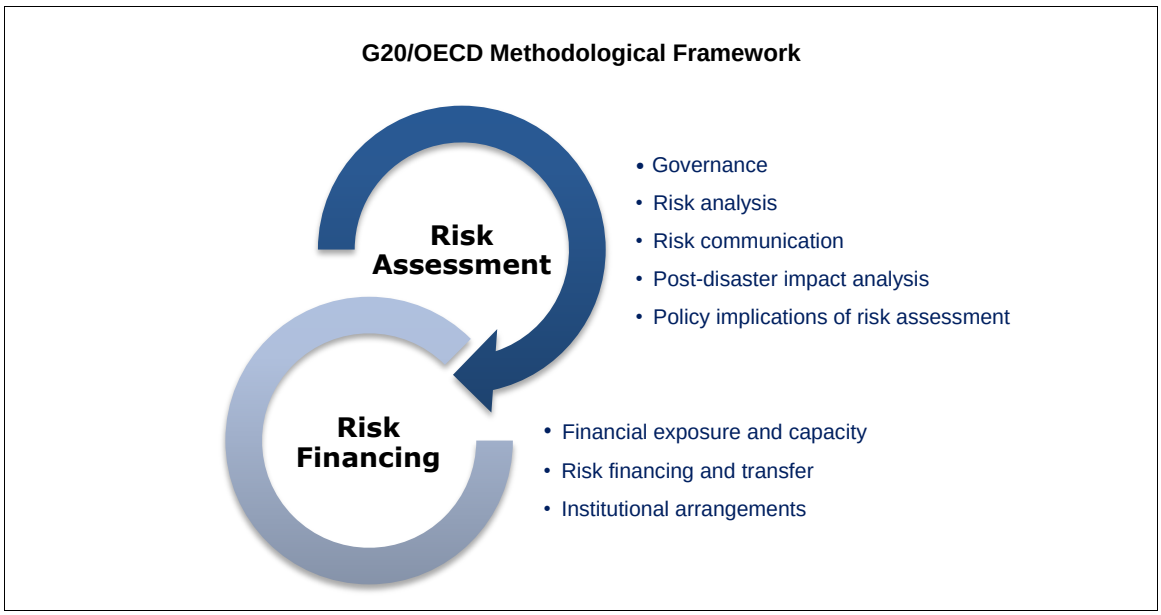
EXECUTIVE SUMMARY

Introduction

Recent years have witnessed an impressive concentration of disaster events in the Asia-Pacific region, causing major human, social, economic and financial impacts. In 2012, for instance, seven of the ten costliest disaster events, measured by overall losses, occurred in APEC economies. This is not surprising as many APEC economies sit on the so-called "Pacific Ring of Fire", a region of high volcanic and seismic activity that surrounds most of the Pacific Ocean Basin, or are exposed to severe weather and flood risks.

In their Joint Ministerial Statement of 30 August 2012, APEC Finance Ministers reiterated the importance of strengthening resilience against disasters. They launched an initiative aimed at supporting the exchange of knowledge and practices on financial strategies among APEC member economies, in collaboration with international organisations and financial institutions, with a view to identifying relevant innovations and good practices within APEC.

In pursuing this initiative, APEC Finance Ministers aimed to complement the work already undertaken in 2012 by the G20, who endorsed, last November, the *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing*. The G20/OECD Methodological Framework provides a step-by-step guide for conducting comprehensive risk assessments and linking risk assessment to the development of effective financial strategies, highlighting the central role played by financial policymakers in DRM.



Confronted with disasters that can present fiscal challenges in developed and emerging economies alike and can impair economic development, Finance Ministers can take a lead in the design and implementation of disaster risk financing strategies. These strategies help to ensure that populations, businesses, and governments have the resources necessary to manage the adverse consequences of disasters, thereby ensuring financial and economic resilience.

This report is the main outcome of the APEC Finance Ministers' initiative on disaster risk financing, supporting the implementation of the G20/OECD Methodological Framework.

Prepared by the OECD, in cooperation with the Asian Development Bank (ADB), the UNISDR and the World Bank, it is directed to APEC Finance Ministers and aims to present examples of policies and practices in disaster risk financing with a view to promoting the exchange of knowledge and practices on financial strategies among APEC members and illustrating progress being made by economies in strengthening financial resilience against disasters within APEC. It also aims to identify challenges that APEC economies have encountered in implementing disaster risk financing strategies.

The examples and case studies are based largely on the responses of participating APEC economies to an APEC/OECD questionnaire. They also build, however, on other OECD work and the work of other international organisations such as the ADB, the ASEAN, the UNISDR, and the World Bank. Examples from non-APEC economies are also presented when relevant to put APEC economy practices into a broader perspective and enrich the report with further inspiring experiences and good practices.

STRUCTURE OF THE REPORT
❖ **Assessment of disaster impacts**
❖ **Assessment of private disaster risk financing markets and financial sector resilience**
❖ **Government use of disaster risk financing tools**
❖ **Promotion of disaster risk financing markets and institutional arrangements**
❖ **Government compensation and financial assistance arrangements**
❖ **Fair and efficient deployment of funds**
❖ **Improvement of public awareness**
❖ **Conclusions and key priorities**

This report complements an inventory that compiles the responses to the APEC/OECD questionnaire. This reservoir of APEC knowledge and practices on disaster risk financing strategies may provide the basis for future work in this area, meant to address key priorities and challenges in disaster risk financing.

1. Assessment of future disaster-related financial and economic impacts and tracking of disaster losses

Disasters present a broad range of impacts, with potentially long-lasting, multi-generational effects. In addition to causing direct damages to lives, buildings, equipment and infrastructure, they may produce major indirect consequences such as business interruption, loss of employment and output, decreased tax revenues, impaired institutional capacities and a rise in poverty levels.

Measuring the costs of disasters, whether conducted as part of a forward-looking assessment or as part of an exercise to estimate damage and losses following a disaster, requires an estimation of financial and economic impacts, both direct and indirect. The risk-bearing capacities of exposed populations, economic sectors and governments must also be assessed, with a view to identifying possible *financial vulnerabilities* or *financing gaps*.

Main findings of the report:

- **In some APEC economies, the assessment of financial and economic impacts is built on a comprehensive economy-wide risk assessment process, following an approach that evaluates the impacts of specified worst-case scenarios.**
- **Probabilistic risk assessment has been employed in other APEC economies as part of a strategy to develop risk financing options for government.**
- **Pre-disaster impact analysis and risk modelling are also being used to address specific DRM purposes, such as emergency management, zoning and urban planning.**
- **A number of APEC economies are making efforts to identify financial vulnerabilities within the population and economy in order to better understand risk financing needs.**
- **As a foundation for disaster risk assessment, initiatives have been undertaken to collect data on hazards, exposures, vulnerabilities and losses and elaborate risk maps, in some cases in collaboration with research institutions and the insurance sector.**
- **For estimating disaster damages and post-disaster needs, methodologies have been developed in some APEC economies to ensure coherence and consistency in estimations.**
- **Systems, tools, and databases have been established in many APEC economies to track disaster impacts and losses systematically. This data provides input for future risk assessment but is also critical for disaster response and recovery, including disaster aid.**
- **Despite important progress being made, developing an accurate risk assessment based on quantitative approaches remains a challenge.**

The main **implementation challenges** in disaster risk assessment reported by APEC members include the lack of technical expertise, the difficulty in gathering data and information to be able to quantify the economy's full exposure, the time-consuming nature of assessing economic impacts due to the need for a certain level of precision, the constraints in capacities across levels in order to sustain the multidisciplinary tasks involved in catastrophe risk modelling and the lack of systematic funding for these efforts, and the institutional fragmentation of actions, hence requiring an effective coordination among the various stakeholders to ensure appropriate actions. Identified challenges relating to the tracking of disaster impacts and losses include the lack of experts who can estimate the impact of damage to assets and extent of disaster-damaged areas, the low level of human resources capacity at sub-regional government institutions, the lack of a clear standard for estimating damage caused by the disaster, uncertainty regarding some of the costs involved, and the lack of proper information flows within the government.

2. Private disaster risk financing tools and financial sector resilience

As emphasised by the G20/OECD Methodological Framework, a comprehensive and integrated approach is required for financial strategies, following an assessment of the availability, adequacy and efficiency of different types of financial tools available to the population and within the economy, as well as of their relative costs and benefits, in comparison with possible further risk reduction to complement or substitute for these tools.

Main findings:

- **In a very limited number of APEC economies, the availability and affordability of disaster insurance is not considered problematic, due to a relatively low level of risk.**
- **In some other APEC economies, although insurance markets are developed, the sizable scale of disaster risks has led governments to provide support for disaster insurance through subsidies or guarantees for insurers, intended to ensure availability and affordability in coverage.**
- **More generally within APEC and particularly in economies where insurance markets are limited, efforts are being made to enhance the penetration of disaster insurance, for instance through micro-insurance and other innovative types of financial instruments.**
- **APEC economies are also seeking to ensure that financial institutions are resilient to adverse events such as disasters, which has involved ensuring adequate capital adequacy for extreme risks, liquidity, and robust business continuity plans and arrangements.**

Implementation challenges linked to private risk transfer markets that have been cited include, on the *demand side*: a weak willingness of people to take out private insurance, due possibly to the expectation of government aid in the event of a disaster or due to inadequate income; an undeveloped insurance culture; a mistrust of the insurance industry due to experiences of mismanagement and unpredictable claims payments; and high premium taxes. On the *supply side*, challenges include: inadequate pricing of disaster risks due to downward undue competitive pressures or insufficiency of data for proper risk assessment; a lack of promotion; lack of human capacity at the regional level; and a lack of adequate disaster risk management tools in many smaller-sized insurers. Challenges related to efforts to strengthen financial sector resilience include the need to ensure effective and timely coordination and communication among supervisory authorities, the level of uncertainty surrounding the occurrence and impacts of natural disasters, and human resource constraints at sub-regional government institutions.

3. Government use of disaster risk financing tools

In order to mitigate disaster impacts, governments may complement investments in physical risk reduction with *ex ante* disaster risk financing tools. These *ex ante* financial tools may address short-term (emergency response), mid-term (recovery) or long-term (reconstruction) disaster impacts, and can be used in combination to cover different risk layers, based on the relative frequency and severity of the expected events. The choice of risk financing and transfer instruments should be based on cost-benefit analysis.

Main findings:

- **Many economies within APEC employ disaster risk financing *ex ante* tools, including:**
  - ***Government reserves* such as dedicated contingency reserves for disasters**
  - ***Insurance* for the protection of public assets and infrastructure**
  - ***Contingent credit facilities* with an international financial institution**
  - ***Catastrophe bonds* or other types of alternative risk transfer products**
- **Many APEC economies establish reserve funds or budgetary mechanisms to ensure the post-disaster aid can be quickly secured and released in the event of a disaster; there is a trend toward enabling a portion of disaster reserve funds to be invested in risk reduction.**
- **Other APEC economies rely instead on *ex post* financing, for instance through budget reallocations and debt financing, or a mixture of *ex ante* disaster risk financing tools and *ex post* financing.**
- **Insurance is in some APEC economies purchased to cover public assets against disaster risks; a number of economies have highlighted the need to conduct cost-benefit analysis of available options, of which insurance is one option.**
- **There is interest in the pooling of disaster risks at the regional level to allow smaller economies to benefit from mutual risk sharing and from economies of scale when accessing international reinsurance markets.**

Implementation challenges highlighted by APEC economies include the lack of financial resources to be committed *ex ante* to disaster risk financing tools, both at central and local levels of government, the lack of information sharing among government divisions and communities, the lack of proper documentation to demonstrate the credibility of risk assessments, and the unavailability of a proper legal and regulatory framework for the design and implementation of market-based sovereign risk transfer mechanisms.

4. Private market solutions for disaster risk financing and establishing institutional arrangements

As highlighted by the G20/OECD Methodological Framework, promoting financial protection within the economy can serve to better protect populations against disasters, reduce government exposures, and provide signals regarding needed risk reduction measures.

Following the assessment of financial vulnerabilities and possible financing gaps, targeted policies and measures can be established to support the development and sustainability of private sector solutions for disaster risk financing and to promote widespread access to such markets. These measures include:

- Strengthening the legislative and regulatory framework for the financial sector, especially the insurance sector, to encourage the development of specific instruments or the coverage of specific risks, for instance by enacting special regulatory regimes for parametric products, micro-insurance schemes or catastrophe-linked securities; introducing tax incentives for insurance; and enabling the use of insurance as a risk management tool for public entities.

- Establishing a financial scheme by industry, government or both.

Main findings:

- **Legal, policy and regulatory measures have been developed in a wide range of APEC economies to promote the availability and affordability of disaster risk financing tools, including insurance and micro-insurance, particularly for vulnerable populations or sectors of the economy.**
- **In APEC economies where private disaster risk financing markets such as insurance are not yet developed, government resources are severely constrained, or the paying capacity of the most vulnerable layers of the population is very low, the promotion of risk financing and transfer tools has led to the introduction of innovative products, instruments and solutions.**
- **With the agricultural sector occupying an important place within many APEC economies, and being one of the sectors most affected by disasters, special efforts have been made to promote relevant disaster risk financing tools, such as micro-insurance and index-based risk transfer products.**
- **Innovative insurance solutions have also been developed within some APEC economies to meet the needs of smaller lending institutions seeking to reduce credit risks linked to disaster events.**
- **In APEC economies with more developed insurance markets, different forms of disaster insurance schemes have been established to address perceived market failures and encourage widespread disaster coverage, with the government potentially acting as direct insurer, reinsurer, or ultimate guarantor depending on market capacities and other factors.**

Concerning **implementation challenges**, the establishment of index-based risk transfer schemes requires significant investments in technology, as well as extensive and high-quality data sets to model the hazard and quantify loss probabilities. Risk market infrastructures, including legal and regulatory framework and delivery channels, are also critical to scale them up. One of the major hurdles to be overcome in implementing a sustainable market for index micro insurance products is the lack of financial literacy; knowledge transfer and communication to the cooperatives and microfinance institutions – and, more generally, to all potential users – is, therefore, required. Another challenge is to move beyond financial support provided by international donors for these products and make the schemes commercially viable, yet affordable. Regarding disaster insurance schemes, the lack of an insurance culture was identified as an obstacle to establishing a compulsory scheme of disaster insurance.

5. Government compensation and financial assistance arrangements

Government compensation or financial assistance arrangements are intended to address financial vulnerabilities where private coverage by disaster risk financing tools may be lacking or unobtainable at an affordable price.

Main findings:

- **In some APEC economies, disaster aid schemes have been created to cover basic living expenses and losses due to disasters; these programmes are designed to ensure timely appropriations or release of funds, thereby ensuring rapid disbursement of disaster funds for emergency assistance, social protection, recovery and reconstruction.**
- **Within APEC, such schemes are financed on either an *ex ante* basis, taking the form of a governmental reserve fund (which could, as shown by one economy, leverage risk financing markets to augment capacity), or an *ex post* basis, with appropriations made when needed.**

The main **implementation challenges** identified by economies include establishing disbursement procedures for a timely yet accountable process for providing aid and criteria to fairly allocate limited available financial resources among different categories of disaster victims.

6. Fair and efficient deployment of funds

Securing a fair, timely and efficient disbursement of funds for disaster relief, recovery and reconstruction is a key component of effective disaster risk financing strategies. Not only must financial resources for disaster response and reconstruction efforts be available following a disaster event, they must also be deployed in a well-timed and targeted manner.

Main findings:

- **Some APEC economies have improved efficiency, transparency, and accountability in disaster compensation, both public and private, by:**
  - **Establishing *ex ante* clear and streamlined administrative procedures and guidelines for the disbursement of public and/or international donors' funds after an event**
  - **Appointing an independent body tasked with reviewing public disaster spending**
  - **Monitoring the performance of insurers in their claims management, with a view to ensuring fairness in the treatment of claims and speed in compensation.**

Concerning **implementation challenges**, the main obstacles identified by APEC economies are the lack of resources, the lack of specialised personnel and the practical difficulties in establishing procedures that allow for speedy compensation while guaranteeing transparency and accountability.

7. Public awareness of the financial impacts of disasters and the need for financial preparedness

Disaster risk awareness is a key element of DRM strategies. Promoting awareness of the financial impacts of disasters and the need to plan for – and mitigate – these impacts through financial strategies, including investment in financial tools and physical risk reduction measures, can boost financial resilience.

Main findings:

- **In some APEC economies, awareness and financial preparedness have been enhanced by communicating information on disaster impacts and providing information about the availability and main characteristics of disaster risk financing tools.**
- **Many APEC economies have launched campaigns seeking to raise public awareness about the importance of preparing for disasters; some economies have launched campaigns specifically focussed on the financial impacts of disasters and the need for financial preparedness.**

As regards **implementation challenges**, a number of APEC economies recognised that improving financial literacy and the financial culture is a complex process, requiring substantial investment of time, resources and organisational capacities.

8. Conclusions and key priorities for strengthening financial resilience in APEC economies

The concentration of catastrophic risks in the Asia-Pacific region, the high economic losses inflicted by natural hazards and man-made threats in the recent past, together with the expected impacts of future potential events, make financial resilience against disasters a key policy objective for APEC economies. This report constitutes the first step towards promoting effective and widespread implementation of the G20/OECD Methodological Framework in the APEC region and beyond in the area of disaster risk financing.

While the G20/OECD Framework underscores the central role played by financial policymakers in DRM and provides a general framework for action, this report provides practical illustrations of the concrete ways in which the step-by-step action items can be implemented in different economies, including those with scarce financial resources and limited insurance markets and infrastructures. It shows that relevant actions can be taken even in economies where the paying capacity of the most vulnerable layers of the population is severely constrained.

The specificities of local disaster risk exposures, the historical development of private insurance, reinsurance and financial markets and the insurance culture, the legal and administrative frameworks, the level of economic development and financial capacities within the economy among other factors contribute to shape domestic and regional risk financing strategies across the APEC region. Given the diverse economy profiles that collectively comprise APEC, policies designed to manage the financial impacts of disaster risks are not fully replicable from one economy to another. Keeping this in mind, illustrative practices – such as those presented and discussed in the report – facilitate learning across economies and can help to identify viable risk financing options that can be adapted to each economy's circumstances and thus implemented.

Among the ***top priorities for strengthening financial resilience in the APEC region***, the improvement of the availability and quality of data on hazards, exposures, vulnerabilities and losses was highlighted by several member economies. At the international level, the existing discrepancies have led to calls for in-depth reviews of data collection and dissemination practices. Finance Ministers and other public and private institutions concerned would benefit from the promotion of regional and international co-operation and synergies in the collection and sharing of data on disaster risks, as well as in the modelling of the nature of these risks. The development of an international risk assessment platform which amalgamates the risk assessments of economies within proximity to one another, for instance, was identified as a tool that could prove useful for developing a common regional perspective of risk.

Key priorities also include the strengthening of financial sector resilience, including business continuity planning, and the enhancement of technical and institutional capacities and coordination among the various governmental authorities in charge of DRM at the central and local levels. Promoting awareness of the financial impacts of disasters and the need for insurance protection is yet another priority area. APEC economies are also seeking to foster the development of disaster risk financing markets and enhance insurance market penetration.

Many APEC economies have stressed the value of strengthened cooperation and knowledge and information exchange among member economies on topics related to disaster risk financing. Strengthened cooperation can support capacity building and enhance understanding of different disaster risk financing strategies and tools and their potential benefits and limitations, including necessary preconditions, and thus support the development and evaluation of disaster risk financing strategies and policies within member economies.

KEY PRIORITIES	
Disaster data	Improving the availability, consistency and quality of data on hazards, exposures, vulnerabilities and losses for a full range of applications: from domestic and regional risk assessment, to zoning, planning and emergency preparedness, to risk modeling and financing
Technical and institutional capacities	Strengthening technical and institutional capacities in disaster management, risk assessment, and risk financing Building proper capacities within Ministries of Finance
Domestic and regional coordination	Enhancing coordination among the various domestic stakeholders in disaster management Supporting international risk assessment, which can enhance regional perspectives on risks and risk reduction and recognition of interlinkages and interdependencies among economies
Financial capacities and disaster risk financing markets	Enhancing the financial capacity to deal with disasters by promoting the development of disaster risk financing tools and markets
Financial sector resilience	Ensuring financial sector resilience, including through business continuity planning
Deployment of funds	Securing a fair, timely and efficient disbursement of funds for disaster relief, recovery and reconstruction, while ensuring transparency and accountability
Risk awareness and financial preparedness	Promoting awareness of the financial impacts of disasters and the need for insurance protection
APEC Finance Minister and officials network	Promoting cooperation and the exchange of knowledge and information on good practices and challenges regarding disaster risk financing strategies among APEC Member economies

1. INTRODUCTION

1.1 Disaster risk in the APEC region

Recent years have witnessed an impressive concentration of disaster events in the Asia-Pacific region,[1] causing major human, social, economic and financial impacts.

In 2012, for instance, seven of the ten costliest disaster events, measured by overall losses, occurred in APEC economies.[2] At the top of the list was Hurricane Sandy, which inflicted large property damage on the East Coast of the United States; severe storms, drought and heat waves also affected the United States, resulting in very high crop and livestock losses. Floods and landslides occurred in China causing more than USD 10bn in total damages and more than 270 fatalities. Typhoon Bopha, in turn, was the deadliest event worldwide that year, with more than 1,000 fatalities in southern Philippines.

In 2011, continuous heavy precipitation for several months led to persistent flooding along the Chao Phraya river basin, which inundated Central Thailand causing widespread disruptions and more than USD 45bn in economic losses and damages. During fall 2010 through to 2011, Christchurch, New Zealand was hit by severe and repeated earthquakes. Japan, meanwhile, suffered USD 210bn in overall losses and almost 16,000 fatalities due to the Great East Japan Earthquake and Tsunami. At year end 2010 and early 2011 the Australian state of Queensland was affected by major flooding. In February 2010, a devastating earthquake and ensuing tsunami struck Chile. Further back in time, the 2008 Sichuan earthquake in China and the 2004 Indian Ocean Tsunami also stand out among the major catastrophic events that hit economies in the APEC region during the past decade.

Such a concentration of disasters is not surprising: many APEC economies sit on the so-called "Pacific Ring of Fire", a region of high volcanic and seismic activity that surrounds most of the Pacific Ocean Basin or are exposed to severe weather and flood risks.[3] Man-made disasters, including terrorism and industrial accidents, also present threats for APEC economies.

1.2 The role of Finance Ministers in disaster risk financing: the APEC initiative and G20/OECD Methodological Framework

In view of the high economic costs incurred by many APEC economies due to disasters in the recent past, as well as of the significant and growing risk exposure going forward, APEC Finance Ministers reiterated last year the importance of strengthening resilience against disasters. In their Joint Ministerial

[1] Asia-Pacific Economic Cooperation (APEC) has 21 member economies: Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong (China), Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, the Philippines, Russia, Singapore, Chinese Taipei, Thailand, the United States and Viet Nam.

[2] Munich Re NatCatSERVICE, March 2013: http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/annual_statistics.aspx; Sigma n.2/2013, *Natural catastrophes and man-made disasters in 2012*, Swiss Re 2013: http://media.swissre.com/documents/sigma2_2013_EN.pdf

[3] According to the APEC Working Group on Emergency Preparedness, the Asia-Pacific region comprises 52% of the earth's surface area and 40% of the world's population, and experiences over 70% of the world's disasters triggered by extreme natural hazards: http://www.apec.org/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/Emergency-Preparedness.aspx

Statement of 30 August 2012, they affirmed that: *"the development and adoption of coordinated disaster risk management (DRM) strategies are important in this regard"*, recognising *"that integrated disaster risk financing policies are part of overall disaster response preparedness"* and acknowledging that *"in developing these policies, attention should be given to advance planning and preparation by financial authorities, including the maintenance of effective and resilient payment systems and, where appropriate, the introduction or expansion of risk sharing and risk transfer market products."*

APEC Finance Ministers sought to support the exchange of knowledge and practices on financial strategies among APEC member economies, in collaboration with international organisations and financial institutions such as the Asian Development Bank (ADB), the Organisation for Economic Co-operation and Development (OECD), the United Nations Office for Disaster Risk Reduction (UNISDR) and the World Bank, with a view to identifying relevant APEC innovations and good practices.

In pursuing this initiative, APEC Finance Ministers aimed to complement the work already undertaken in 2012 by G20 Finance Ministers and Central Bank Governors who, along with G20 Leaders, recognised the importance and priority of DRM strategies. The G20 had mandated the OECD to develop a voluntary framework that could strengthen disaster risk assessment and risk financing, considered to be two key components of DRM. A *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing* (the "G20/OECD Methodological Framework" or the "Framework"))[4] was developed in response and endorsed by the G20 in November 2012. As follow up, the G20 called on the OECD, World Bank, and other international organisations to leverage the G20/OECD Framework to address remaining challenges.

The G20/OECD Methodological Framework highlights the central role played by financial policymakers in DRM. Confronted with disasters that can present fiscal challenges in developed and emerging economies alike and that can impair economic activity, Finance Ministers can take a lead in the design and implementation of disaster risk financing (DRF) strategies that can help to ensure that populations, businesses, and governments have the resources necessary to manage the adverse consequences of disasters, thereby ensuring financial and economic resilience (see **Box 1**).

The Framework provides a step-by-step guide for conducting comprehensive risk assessments and linking risk assessment to the development of effective financial strategies (see **Box 2**). *Risk assessment* enables a well-developed understanding of disaster risks and their underlying physical and societal drivers and is thus instrumental for DRM strategies and financial recovery strategies in particular. Financial strategies and especially *risk financing strategies* help to ensure prompt recovery and reconstruction.

Box 1: Key responsibilities of Finance Ministries in DRM

Financial policymakers play a central role in disaster risk management (DRM) given their responsibilities for economic, financial, fiscal and budget policymaking, planning of public investment, and coordinating public expenditures. They play a pivotal role in DRM by:

- Ensuring that ***financial vulnerabilities within the economy are addressed*** through ***adequate and efficient compensation mechanisms***, whether public or private

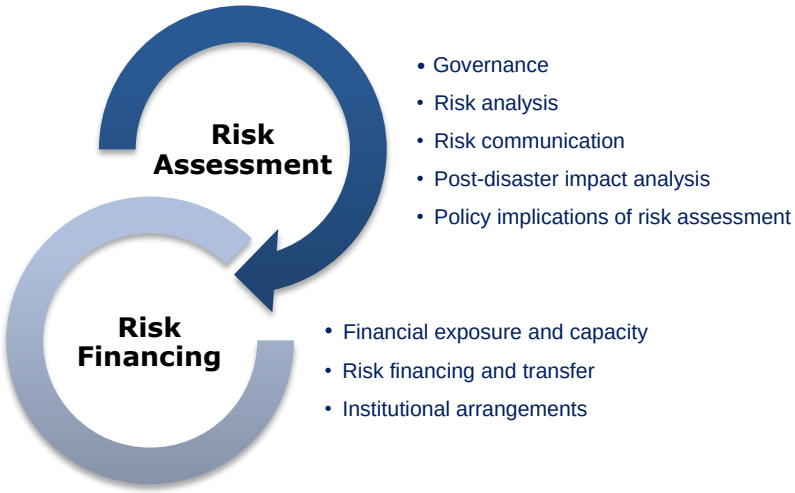
[4] See *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing* (2012): http://www.oecd.org/finance/insurance/G20disasterriskmanagement.pdf The Methodological Framework benefited from input from the G20 Country Steering Group on DRM and the OECD's High-Level Advisory Board on the Financial Management of Large-Scale Catastrophes, Insurance and Private Pensions Committee, Committee on Financial Markets and High Level Risk Forum, as well as from the Asian Development Bank, UNISDR, and World Bank.

- Ensuring ***proper fiscal management*** of risks by anticipating potential budgetary impacts and planning ahead to ensure adequate financial capacity and rapid release of funds
- Establishing ***clear rules regarding post-disaster financial compensation*** to enable rapid compensation, demonstrate solidarity and ensure sound incentives
- Ensuring the ***soundness and resilience of the financial sector*** with respect to disaster risks, including through proper regulation, business continuity planning, and stress testing
- Ensuring the ***optimal allocation of resources for disaster risk management***, including assessment of the cost-effectiveness of major public investments in disaster risk reduction

Finance Ministers thus have a key role in ensuring ***financial resilience***, a critical component of effective DRM at all levels of government and the society.

Source: *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing*

Box 2: G20/OECD Methodological Framework



Risk assessment	***Governance***	Establish an all-hazards approach, agreed procedures, transparency and accountability and structured interaction with stakeholders
	Risk analysis	Identify hazards and threats and assess their probabilities and impacts based on the vulnerability of populations and assets to damage
	Risk communication	Communicate results of risk analysis to policymakers and the public to enable decision-making and enhance risk awareness
	Post-disaster impact analysis	Evaluate and quantify the impacts of disasters including financial, and updating risk assessment information
	Policy implications of risk assessment	Leverage risk assessment for the full range of disaster risk management actions, especially financial strategies
Risk financing	***Risk exposure and risk-bearing capacity***	Identify risk exposures within the economy and risk-bearing capacities in order to identify financial vulnerabilities and the need for financial tools
	Risk financing and risk transfer	Evaluate the availability, adequacy and efficiency of risk financing / risk transfer tools and considering alternative tools
	Institutional arrangements	Design appropriate institutional arrangements, where government intervention is deemed to be necessary

DRF strategies become increasingly critical when an economy's disaster risks are substantial and insurance markets are absent or unable to cover these risks effectively, for instance where there is low insurance penetration or where insurance markets are underdeveloped or weakly capitalised, leaving the government with potentially large financial exposures. In these circumstances, governments may not only be expected to engage in emergency response activities, but also be called upon to cover a large proportion of damages and losses. Thus, in addition to inflicting social, economic and environmental impacts, disasters can, in some economies, impose a major drain on governmental resources.

Financial strategies can complement and reinforce broader disaster risk reduction strategies. In fact, the G20/OECD Framework emphasises the strong interconnections between disaster risk assessment, risk reduction and financial management, key building blocks for dynamic and continually evolving DRM strategies. The identification and evaluation of disaster risks are essential preconditions for the development of risk reduction and financial strategies as they enable the efficient allocation of resources and critical funding of disaster response, recovery and reconstruction, including post-disaster investments in risk reduction and enhanced resilience capabilities.[5]

In undertaking the initiative on DRF, APEC Finance Ministers – with the support of the ADB, the OECD, the UNISDR and the World Bank – are providing a leadership role in supporting the implementation of the G20/OECD Methodological Framework, which will benefit both APEC and non-APEC economies.

1.3 Aim and content of this report

This report is the main outcome of the APEC Finance Ministers initiative on DRF initiated in August 2012. Prepared by the OECD, in cooperation with the ADB, the UNISDR and the World Bank, it is directed to APEC Finance Ministers and aims to present examples of policies and practices in DRF with a view to promoting the exchange of knowledge and practices on financial strategies among APEC members and illustrating progress being made by economies in strengthening financial resilience against disasters within APEC. The report also aims to identify challenges that APEC economies have encountered in implementing DRF strategies.

The provision of examples and case studies is made with reference to key elements of DRF strategies as set forth in the G20/OECD Methodological Framework. Given the diverse range of economies within APEC, this report provides illustrations of the concrete ways in which the general step-by-step action items with the G20/OECD Framework can be implemented in different economies contexts, including those with scarce financial resources and limited insurance markets.

The examples and case studies are based largely on the responses of participating APEC economies[6] to an APEC-OECD questionnaire circulated in April – May 2013. They also build, however, on other OECD work and the work of other international organisations such as the ADB, the ASEAN, the UNISDR, and the World Bank. Examples from non-APEC economies are also presented when relevant to put APEC

[5] The need for more reliable funding and resources in DRM, as well as for the establishment of national risk financing strategies that build on all available financial mechanisms was recently recognised also by the UNISDR in the 2013 edition of the Global Assessment Report on Disaster Risk Reduction (GAR 2013): UNISDR (2013), *From Shared Risk to Shared Value –The Business Case for Disaster Risk Reduction*. Global Assessment Report on Disaster Risk Reduction. Geneva, Switzerland.

[6] Sixteen APEC economies provided a response to the questionnaire: Australia, Brunei Darussalam, Canada, Chile, Hong Kong (China), Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, The Philippines, Russia, Singapore, Thailand and the United States.

economy practices into a broader perspective and enrich the report with further inspiring experiences and good practices.

The structure of this report is modelled on the structure of the APEC-OECD questionnaire. As such, it reflects the main elements of the Risk Financing section of the G20/OECD Methodological Framework. It should therefore be read in conjunction with the Framework, as well as with relevant publications on DRF, in particular the special joint G20 publication on disaster risk assessment and risk financing issued by the Government of Mexico and the World Bank in June 2012, which brings together the contributions by fifteen G20 members and invited countries, as well as the OECD.[7]

Table 1: Structure of the report
❖ **Assessment of disaster impacts**
❖ **Assessment of private DRF markets and financial sector resilience**
❖ **Government use of DRF tools**
❖ **Promotion of DRF markets and institutional arrangements**
❖ **Government compensation and financial assistance arrangements**
❖ **Fair and efficient deployment of funds**
❖ **Improvement of public awareness**
❖ **Conclusions and key priorities**

This APEC Finance Minister report complements an inventory that compiles the responses to the APEC-OECD questionnaire. This reservoir of APEC knowledge and practices on DRF strategies will support the advancement of DRF strategies within APEC, as well as promote regional and global efforts on DRF strategies, for instance within the ASEAN, the G20, the OECD, and other regional or international fora. The APEC report and inventory may also provide the basis for future work in this area, meant to address key priorities and challenges in DRF.

[7] See: Government of Mexico (G20 Presidency) and World Bank, (June 2012) *Improving the Assessment of Disaster Risks to Strengthen Financial Resilience*, https://www.gfdrr.org/G20DRM. Contributions were made by: Argentina, Australia, Brazil, Chile, China, Colombia, France, Germany, Italy, Japan, Republic of Korea, Mexico, Turkey, the United Kingdom, and the United States. A World Bank contribution introduces the country experiences, outlining the main issues, while an OECD chapter examines policy options for promoting risk transfer and risk financing tools. The OECD contribution also presents and discusses issues related to the quantification of disaster losses and exposures.

2. ASSESSMENT OF FUTURE DISASTER-RELATED FINANCIAL AND ECONOMIC IMPACTS AND TRACKING OF DISASTER LOSSES

2.1 Understanding the economic and financial dimensions of disasters

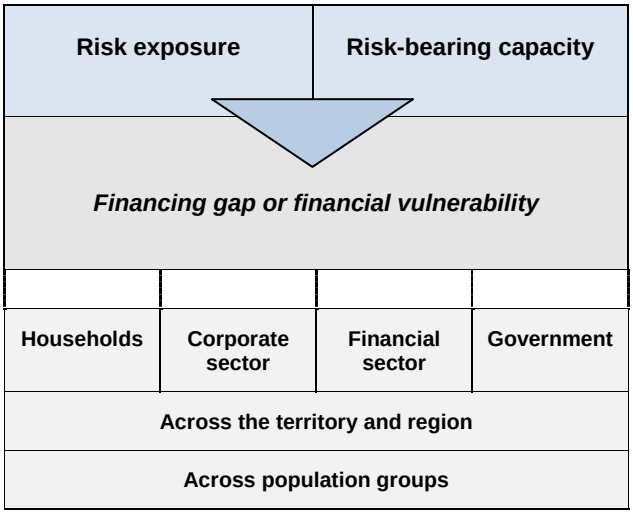
Disasters present a broad range of impacts, with potentially long-lasting, multi-generational effects. In addition to causing direct damages to lives, buildings, equipment and infrastructure, they may produce major indirect consequences such as business interruption, loss of employment and output, decreased tax revenues, impaired institutional capacities and a rise in poverty levels.

These direct and indirect impacts generate losses for households, businesses, governments, and other segments of the economy insofar as income is lost and wealth destroyed. These costs may be catastrophic, aggravating economic and social impacts. As highlighted by the G20/OECD Methodological Framework, Finance Ministries need to understand the nature and scale of these impacts and their relevance for financial, economic, and fiscal management strategies and policies for which they have central responsibility.

In order to design and implement targeted DRF strategies to ensure that the financial consequences of disasters can be managed efficiently by populations, and within the economy, there needs to be an assessment of the expected financial impacts of disasters within the economy and the risk-bearing capacities of exposed populations and economic sectors, that is to say their capacity to absorb and recover from losses from a short and long-term perspective.

In particular, the scale and distribution of risks across the territory and major segments of the economy – namely, households, the corporate sector, the financial sector, and government (both central and local) – and the financial capacities to absorb these impacts – need to be evaluated with a view to identifying possible *financial vulnerabilities* or *financing gaps* (see **Figure 1**).

Figure 1: Assessing disaster risk and financial vulnerabilities



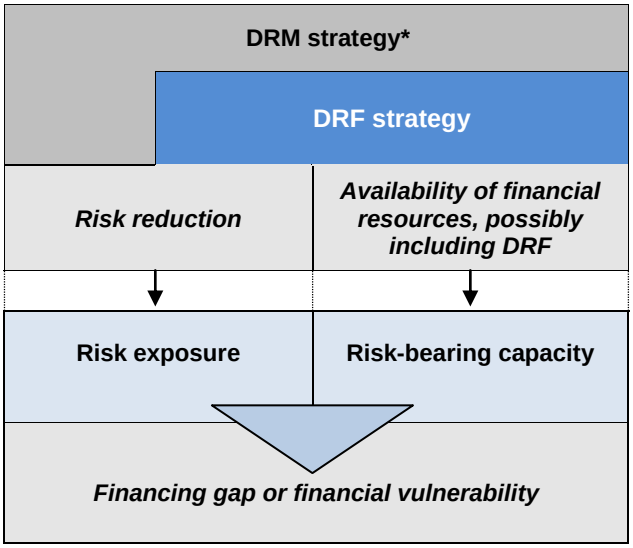
Based on *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing*

Financial vulnerabilities exist when economic agents would be unable, given their resources, to absorb and recover from losses in the event of a major disaster, thus causing financial harm or economic disruption. These vulnerabilities can be addressed through risk reduction measures (thus reducing risk exposure and disaster costs) or the use of risk financing tools (thus securing post-disaster financial resources to meet disaster costs).

Given the central role of governments in supporting disaster relief and recovery, it is important to assess the capacity of governments, at central and local levels, to manage the public finance implications of disaster risks arising from contingent liabilities, both explicit (e.g., direct costs or losses linked to emergency response, damage to government property and infrastructure, pre-arranged financial aid) and implicit (e.g., *ad hoc* pay-outs given expectations of disaster aid), and from expected changes in macroeconomic conditions, for instance due to supply disruptions.

DRF strategies seek to ensure the adequacy of financial resources to meet the costs of the full potential range of disaster events, with the overall goal of strengthening financial resilience within the population and economy (see **Figure 2**). DRF strategies are achieved through own resources or debt financing, risk financing tools such as reserves and insurance, and risk reduction. They are embedded within a broader DRM strategy.

Figure 2: Role of DRF strategies in strengthening financial resilience



* Includes other elements such as emergency preparedness and response and physical reconstruction.

Based on *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing*

Thus, the first challenge in the development of a DRF strategy is to perform a forward-looking analysis of disaster risks, based on the identification of hazards and threats and an assessment of their likelihood and impacts, following a well-governed process and using relevant data. The provision of accurate, accessible and transparent information on disaster risks thus becomes an essential precondition for sensible decision making in the public and private sectors.[8]

[8] See: *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing* (2012), Section I and Section II.1; see also: UNISDR (2013), *From Shared Risk to Shared Value –The Business Case for Disaster Risk Reduction*, cit., Chapter 15.

The outcome of comprehensive risk assessments can be used as a starting point for gauging the level of disaster risk exposure and assessing disaster-related financial vulnerabilities across the territory and within the economy. However, the results likely need to be complemented and augmented by a more detailed, comprehensive analysis of financial impacts and affected parties.

2.2 The quantification of disaster risks and losses

Working to quantify disaster risk as part of disaster risk assessment, while not costless, is beneficial in that it supports the development of targeted measures to reduce financial vulnerabilities and the evaluation of risk financing tools and their efficient use. Quantification is, for instance, important for governments evaluating the use of risk financing tools to mitigate the fiscal costs of disasters or secure post-disaster liquidity, or to undertake major public investment projects in disaster risk reduction. For the insurance sector, quantification is critical for sound disaster risk underwriting practices.

From an operational viewpoint, the quantification of disaster risks is based on the periodic analysis and assessment of past direct and indirect disaster losses, as well as of evolving changes in the frequency and intensity of natural hazards, for instance due to climate change, and in risk exposure – including assets, populations and economic activities. The systematic collection of data is key to the success of any risk assessment effort. Yet, as shown by the devastating earthquakes that occurred in 2011 in Japan and New Zealand, past loss experience alone proves to be insufficient to determine either the underlying geography or cost of risk. Rather, it is necessary to consider the full range of disaster scenarios, particularly worst-case scenarios including those that may not yet have occurred in recorded history but which can be expected to cause major impacts.

Catastrophe models can provide relevant outputs in this regard: the *probabilistic approach* may be considered - in which the full spectrum of potential disaster events and their respective probabilities are accounted for – as well as the *scenario approach* – in which specific disaster events are constructed to determine their potential impacts and spill-over effects. If risk is evaluated from a probabilistic perspective, it can be assessed and measured according to specific metrics, namely:

- **Risk cost**: Quantification of the expected Annual Average Loss (AAL) for the risk over a long period of time (i.e., the sum of each event loss multiplied by its respective probability of occurrence) measures the annualised risk cost and provides the basis for risk pricing; and,

- **Probable maximum loss** (PML): The maximum amount of loss that can be expected to be incurred in a year with a certain probability. Knowledge of PML enables the management of risk, for instance through risk transfer.

These metrics enable a better understanding of disaster costs and scale of impacts and thus more fine-tuned decision-making in financial strategies. Probabilistic risk assessment uses probability distributions to characterise the variability in risk estimates, as opposed to deterministic methods that are based on single-point estimates and discrete (stress case) scenarios.

Computer-based catastrophe models for measuring potential disaster losses enable a rapid calculation of disaster impacts. These models link information on natural hazards, exposed assets, structural vulnerabilities, and historical loss occurrences to produce loss estimates. Modelled loss results provide insight into the frequency and potential severity of disaster losses and the volatility of these losses over time. Catastrophe risk models require, however, substantial amounts of reliable data on hazards, exposures

and vulnerabilities for model construction and validation. In many economies these data are missing, lack sufficient granularity, are not geo-referenced, or are unavailable in the required format.[9]

For governments, developing an accurate risk assessment based on quantitative approaches remains a challenge and a weak link in the DRM cycle. As revealed in a survey conducted by the OECD (see **Box 3**), many governments do not systematically collect data on disaster losses. Some economies prefer, moreover, to maintain localised loss databases, leaving the responsibility for data collection to local governments or individual ministries. This contrasts with, and may in some instances possibly be explained by, the existence of several long-standing domestic, regional, or global initiatives in the field of collection and dissemination of data on disaster losses or risk coverage/risk exposures.[10] Comparability of information across these initiatives is, however, problematic given non-homogeneous parameters in the choice of definitions, classifications, adjustments, geographic areas, and other features. Efforts to harmonise classification criteria have been undertaken, such as the implementation of a common disaster category classification and peril terminology.[11]

Box 3

OECD Survey on challenges in the quantification of losses

In 2011 the OECD conducted a survey[12] on data and procedures to quantify disaster risks, the possible difficulties encountered by members and other selected economies, as well as relevant national initiatives in this field. While nearly all respondents see themselves as prone to disasters, the outcome shows that:

Quantification of insured and uninsured losses

- More than half of the respondents find it difficult to provide aggregate amounts of insured losses resulting from disasters in recent years, and many of them do not collect such data at the national or sub-national level.
- In more than half of the responding economies, information is collected by the private sector and in about half of them by the public sector as well. Several respondents refer to private sources only. These data collection activities are conducted on a voluntary basis in some members.
- Aggregate data on uninsured losses, which are difficult to estimate as they affect many different populations, communities, goods, buildings or infrastructure are computed at the national level in only about one fourth of the responding economies.

[9] See: OECD, *Policy Options for Disaster Risk Financing and Transfer, Quantification of Disaster Losses and Exposures: an OECD Perspective*, cit. and **Box 3** above. The UNISDR Global Assessment Report 2013 also identified the inadequate availability of disaster data, due to the fact that disaster losses are often not systematically accounted for, as one of the key obstacles to risk assessment and planning at the national level. As a result, the lack of visibility of disaster risk and the uncertainties around risk ownership pose major challenge for the implementation of effective DRM strategies: UNISDR (2013), *From Shared Risk to Shared Value –The Business Case for Disaster Risk Reduction.* , cit., Chapter 15.

[10] Such as ISO's Property Claim Services (PCS) in the United States, PERILS AG in Europe, Swiss Re sigma, Munich Re GEO risks research, the Centre for Research on the Epidemiology of Disasters (CRED) EM-DAT, the DesInventar methodology and ADRC Global Disaster Identifier Number (GLIDE).

[11] See: Disaster Category Classification and Peril Terminology for Operational Purposes – Common Accord Centre for Research on the Epidemiology of Disasters (CRED) and Munich Reinsurance Company (Munich RE) (2009), UCL Working paper 264.

[12] See: OECD, *Policy Options for Disaster Risk Financing and Transfer, Quantification of Disaster Losses and Exposures: an OECD Perspective*, cit.

Quantification of insurance coverage

- Data on insured exposures to natural and man-made disasters is collected/disseminated at a national (or sub-national), regional, or international level in only a few economies.

Quantification of government spending after a disaster

- In about one third of the respondents reviewed, aggregate data on government spending incurred to cover uninsured economic losses after a disaster (e.g., emergency response costs, temporary housing, payments to households for physical damage, reconstruction) are collected.
- The production of spending data requires in-depth cooperation between different governmental agencies that is often time-consuming. To overcome this difficulty, some governments have established a special entity to co-ordinate the data collection at national level.

In several responding economies, the process of data gathering/dissemination on insured losses and/or level of risk coverage is attracting rising interest: it is currently being reviewed and improved in a number of them.

Measuring the costs of disasters, whether conducted as part of a forward-looking assessment or as part of an exercise to estimate damage and losses following a disaster, requires an estimation of financial and economic impacts, both direct and indirect.[13]

A methodology to support these estimations can bring rigour and consistency to the analysis. Methodologies have been developed to support governments in the *ex post* valuation of damages and economic losses, for instance the Damage and Loss Assessment (DaLA) Methodology developed by the UN Economic Commission for Latin America and the Caribbean (UN-ECLAC). DaLA methodologies[14] such as the UN-ECLAC enable governments to assess post-disaster needs, permitting an efficient targeting of resources in the disaster recovery phase. DaLA methodologies include estimation of the following:[15]

- **Direct damages**: Damage as the replacement value of totally or partially destroyed physical assets (e.g., infrastructure, buildings, installations, machinery and equipment, transportation vehicles, damage to farmland, irrigation works and reservoirs).
- **Indirect losses**: Losses in the flows of the economy that arise from the temporary absence of productive damaged assets (e.g., losses due to lost industrial production, decreased agricultural yield due to flooding or prolonged droughts, increased transportation costs).
- **Macroeconomic effects**: The resultant impact on post-disaster macroeconomic performance, e.g., economic growth, balance of payments, and fiscal position.

The importance of a methodological approach to estimating disaster costs was highlighted by a major research project sponsored by the European Union[16] (Costs of Natural Hazards, or CONHAZ) in which a comprehensive review of existing cost assessment approaches and key knowledge gaps was undertaken,

[13] Anticipated government interventions may be relevant in this respect; for instance, more timely availability of funding can reduce the indirect impacts and secondary consequences of a disaster.

[14] A more recent version of the DaLA methodology is the multi-sectoral post-disaster needs assessment (PDNA) methodology that takes into account recovery and reconstruction priorities in short, medium and long term time frame basis.

[15] See GFDRR Global Facility For Disaster Reduction and Recovery - https://www.gfdrr.org/Track-III-TA-Tools

[16] The CONHAZ project ran from February 2010 to January 2012. The project adopted a comprehensive approach, considering natural hazards ranging from droughts, floods, storms and coastal hazards to Alpine hazards. At the same time it looked at different sectors such as housing, industry, transport, agriculture, the environment and human health. See: http://conhaz.org/

with a focus on natural hazards (see **Box 4**).[17] The CONHAZ project highlights the different methods that might be used to assess the costs of disasters. These methodologies employ a variety of terminologies and approaches for different types of hazards and different impacted sectors.[18] This further impedes efforts to obtain comprehensive and comparable cost figures.

Box 4

CONHAZ (Costs of Natural Hazards)

A Coordination Action Project funded by the EU 7th Framework Programme, CONHAZ aimed at compiling and synthesising current knowledge on cost assessment methods to strengthen integrated natural hazard management and adaptation planning. CONHAZ adopted a comprehensive approach, considering natural hazards ranging from droughts, floods and coastal hazards to Alpine hazards, as well as different impacted sectors and cost types. Its specific objectives included the compilation of the state-of-the-art methods for cost assessment and the analysis of these methods in terms of technical aspects, as well as terminology, data quality and availability, and research gaps.

CONHAZ defined the following working terminology on cost categories:

- **Direct tangible damages**: Damages to property due to the physical contact with the hazard, i.e. physical destruction of buildings, inventories, stocks, infrastructure or other assets at risk. "Tangible" implies that a market exists for these goods or services;
- **Losses due to business interruption**: Business interruption takes place, for example, if people are not able to carry out their work because their workplace is destroyed or not reachable due to a hazard or if industrial or agricultural production is reduced due to water scarcity;
- **Indirect costs**: Losses which are not caused by the hazard itself but which are induced by either direct damages or losses due to business interruption. This includes e.g. induced production losses of suppliers and customers of affected companies, or the costs of traffic disruption;
- **Intangible costs**: Damages to goods and services which are not (or at least not easily) measurable in monetary terms because they are not traded on a market (non-market values or costs). The intangible effects of natural hazards include e.g. environmental impacts, health impacts and impacts on cultural heritage;
- **Cost of risk mitigation**: The cost of risk reduction, including adaptation to anticipated changing risks as a result of climate change, can be regarded as part of the total costs of natural hazards, and these investments are therefore considered an essential cost category.

Source: CONHAZ – www.conhaz.org

[17] Meyer, V., Becker, N., Markantonis, V., Schwarze, R., van den Bergh, J. C. J. M., Bouwer, L. M., Bubeck, P., Ciavola, P., Genovese, E., Green, C., Hallegatte, S., Kreibich, H., Lequeux, Q., Logar, I., Papyrakis, E., Pfurtscheller, C., Poussin, J., Przyluski, V., Thieken, A. H., and Viavattene, C. (2013), *Assessing the costs of natural hazards – state of the art and knowledge gaps*, Nat. Hazards Earth Syst. Sci., 13, 1351-1373.

[18] World Bank and United Nations (2010), *Natural Hazards, UnNatural Disasters: The Economics of Effective Prevention.* Washington, DC.

As acknowledged by the APEC Emergency Preparedness Working Group,[19] a consistent domestic or international approach to post-disaster economic damage and loss assessment does not necessarily mean achieving a uniform approach, but one that produces consistent and comparable results and is based on agreed principles.

2.3 Illustrative practices in APEC economies

Several noteworthy initiatives are presented below, some of which have been undertaken at the regional level. They aim to assess disaster risks and their economic and financial impacts on the population and the economy, by collecting and analysing data on hazards, exposures, vulnerabilities and losses. The examples cited may not necessarily be used for the elaboration of DRF strategies but may instead serve other purposes in a DRM strategy, such as emergency preparedness and urban planning.

2.3.1 Disaster risk assessment and modelling initiatives

In a number of APEC economies, risk assessment of financial and economic impacts is built on a more comprehensive risk assessment covering the whole territory, following a scenario-based approach. In **Canada**, the potential financial impacts of future hazard events are assessed through the federal All Hazards Risk Assessment (AHRA) exercise, conducted on an annual basis and coordinated by Public Safety Canada with substantive input from a number of departmental agencies.[20] As one of the six impact categories that this initiative examines, "Economy" involves an assessment of the direct and indirect economic cost of emergency events, as estimated by the Finance ministry, Finance Canada. A basic methodology is followed for this estimation, which is based on an identified extreme scenario (see **Box 5**). Fictitious worst-case, but credible, scenarios are selected that permit subject matter experts to judge the potential impacts that the scenario might produce. The AHRA only examines risks to the federal government. Macroeconomic studies are considered to be a complementary way to assess the direct and indirect economic losses of major events.

In **Japan**, scenario analysis is currently employed as part of a comprehensive assessment of impacts of expected major events such as the Tokyo Inland Earthquakes and the Nankai-Trough Great Earthquake, which considers not only expected human and physical damages but also financial future expected losses from such events.[21] For instance, in the case of the Nankai-Trough Great Earthquake, the possible impact on economic activities was estimated to be approximately JPY 30.2 trillion. On the basis of these risk assessments, the government has taken measures to reduce impacts.

[19] APEC (2011), *Guidelines and best practices for post-disaster damage and loss assessment*, Report from APEC Workshop on Damage Assessment Techniques, Yogyakarta, 3-6 August, 2009. http://www.apec.org/Groups/SOM-Steering-Committee-on-Economic-and-Technical-Cooperation/Working-Groups/Emergency-Preparedness.aspx

[20] The AHRA methodology is publically available on the Public Safety Canada website at www.publicsafety.gc.ca/ahra

[21] See: *Lessons Learned from the Great East Japan Earthquake: Hazard Information and Damage Scenarios to Inform Effective Countermeasures to Extreme Events*, in Government of Mexico (G20 Presidency) and World Bank, (June 2012) *Improving the Assessment of Disaster Risks to Strenghthen Financial Resilience*, Chapter 11.

Box 5

Canada: All Hazards Risk Assessment (AHRA) initiative - "Economy" impact category

Within the federal All Hazards Risk Assessment (AHRA) initiative, the Economy impact category captures the monetary value following damage(s) or loss to economically productive assets and disruptions to the normal functioning of the Canadian economic system, which may result in the loss of service as a result of a risk event occurring. This loss is broken down into the following:

Direct Economic Loss

Direct economic loss (stock losses) is the immediate economic damage generated by the disaster. These losses can be measured by the repair or replacement costs (at the pre-event price level) for assets that have been damaged or destroyed. In particular, this would include damage to:

- ***Building construction***: industrial, commercial, and institutional buildings (e.g. plants, offices, recreational facilities, hospitals, etc.).
- ***Engineering construction***: road infrastructure, water systems, marine construction (irrigation, docks, terminals, etc.), other transportation, electric power, and oil and gas engineering.
- ***Machinery and equipment*** used in the production process (furniture, agricultural and industrial machinery, computers and software, telecommunication equipment, trucks, etc.).
- ***Residential housing and contents***.
- ***Raw materials***: mineral fuels (coal, crude oil, natural gas), grains (crops ready to be harvested), animal and animal products (e.g. cattle and hogs-swine for slaughter, milk and eggs, fish), wood, ferrous and non-ferrous metals, non-metallic minerals, etc.

Indirect Economic Loss

Indirect economic loss (flow losses) refers to the flows of goods and services which will not be produced due to damages to productive assets and economic infrastructure. This interruption or reduction in production should be measured in terms of value-added to avoid double-counting issues. For instance, this would include:

- ***Production or service provision losses*** due to the full or partial paralysis of activities (e.g. losses in agricultural/industrial production due to damage to factories or shortages of raw materials/energy supplies)
- ***Higher operational costs*** due to the destruction of productive assets or losses to production and income (e.g. a ban on beef and cattle exports would first translate into higher maintenance cost due to rising inventory levels of live animals).
- ***Lost production due to linkages effects*** (e.g. the destruction of a factory reduces the economic activities of suppliers who have no alternative markets or of clients who have no other suppliers).
- ***Additional costs incurred*** due to the need to use alternative and potentially inferior means of production or provision of essential services (e.g. greater operating costs arising from reduced transportation or energy capacity).
- ***Costs of required government response*** (e.g. emergency and rescue operations).

Estimates of indirect losses are undertaken with caution as some effects might be difficult to identify or quantify. It is suggested that only relevant external factors that significantly modify the estimate of the economic loss should be considered. Indirect losses should be made relative to the duration of the disruption. Also, the assessment should ensure that no double-counting takes places: if effects are calculated on the production side, they must not be included again on the income side. For example, government compensation to farmers affected by an outbreak of foot and mouth disease (FMD) should not be included in addition to the associated production losses.

There may also be counterbalancing factors, such as built-in mechanisms or behavioural changes that offset impacts, e.g., reallocation of resources, use of alternative transport routes. It is considered important to capture these counteractions as assumptions along with the rating of the Economy category. In addition, disasters may produce benefits that must be estimated and deducted from the estimate of total losses.

Once all the contributions to the economic loss have been identified, all costs are added and the rating for this category is based on the final monetary figure (scale from 0 to 5 based on an exponential path of values).

Macroeconomic studies provide a complementary way to assess the repercussions of direct and indirect economic losses. For instance, estimates of macroeconomic effects would take into account that some indirect effects could be exacerbated or mitigated in the aggregate by changes in prices or flexibility in the production process (e.g. through reallocations in spending/production across sectors or through the mobilisation of production factors if production is not at full capacity). Estimates of high-order impacts of disasters require the use of more sophisticated economic models.

In contrast, probabilistic risk assessment has been employed, or is currently under development, in some APEC economies as part of a strategy to develop risk financing options for government. A well-known example is **Mexico**, which has developed sophisticated probabilistic risk assessment methods to evaluate the scale of disaster risks threatening this economy. Based on the results of these studies, which initially focussed on seismic, flood and tropical cyclone risks,[22] Mexico has designed financing mechanisms to protect the financial resources of the FONDEN.[23] These studies were also aimed at assessing the risk profile of the government dependencies, for example, to improve the technical specifications of insurance contracts for public infrastructure. By aiming to fulfil the requirements of reinsurance and capital markets, there is a strong incentive to quantify the vulnerability of major federal assets (see **Box 6**). This has required a high degree of coordination among institutions in order to collect accurate data on all those assets exposed to risk as well as has required cooperation between various experts (scientists, public officers, advisors).

The effort in Mexico to collect high quality information for risk assessment and ultimately the assessment of risk financing options has resulted in the creation of a physical inventory of assets for each of the government institutions that manages public assets: roads and bridges, water distribution, hospitals, schools, and others. This inventory was the first step towards building the capability of estimating each agency's assets' vulnerability, an exercise that also required:

- **Location data**. This was particularly important to determine damages from hazards such as floods, for which high-resolution, geo-coded information about infrastructure, terrain and nearby water bodies is vital for the accuracy of estimations.
- **Structural type and original design**. Materials, structure, use, and contents of structures included in the asset inventory contributed to the estimation of losses and the resistance of structures to the impact of natural elements (ground acceleration, wind speed, water depth, and so on). This information was also useful for estimating human exposure inside the assets, such as statistics of occupation, demand of services, and working personnel.
- **Replacement or reconstruction cost**. To obtain economic losses derived from damages to assets, an economic valuation of the infrastructure was obtained. Information about the cost of reconstructing the asset to replace it with similar characteristics was crucial for insurance-based risk transfers.
- **History of losses**. Whenever possible, data for historical losses were requested to calibrate loss modelling or verify accuracy of estimations.
- **Inventory of hazard characteristics**: Historical data from meteorological and seismic stations, soil characteristics, orography maps, LIDAR information regarding terrain, etc were centralised, requiring close collaboration with specialised public institutes.

Once information was gathered, the next process was to identify the fundamental variables on hazards necessary to generate useful loss estimates.

[22] Although initial efforts focussed on these three natural hazards, the goal is to have estimations for all hazards relevant for Mexico. Mexico currently uses models for up to ten natural hazards.

[23] FONDEN is a federal government reserve fund that is used to finance damaged public infrastructure and low-income housing.

Box 6

Mexico: modelling disaster risk at the federal level

The case of Mexico demonstrates the importance of a well-developed technical infrastructure for conducting probabilistic risk assessment within the public sector and the need for strong coordination among government departments and with research institutions. Specifically:

The **first step** in developing loss models capable of estimating damages to infrastructure, considering all hazards, was to guarantee the availability of technical and human resources. For such purpose, the Federal Government of Mexico drew on the scientists devoted to researching natural hazards and structural engineering. In particular, the National Autonomous University of Mexico (UNAM), through its Engineering Institute, was engaged to construct the risk models. An ample body of research was made available for this purpose, holding more than 40 years of papers on natural hazards (particularly earthquakes), probabilistic simulation hazard models, and vulnerability functions all focusing on Mexico.

The **second step** was to catalog enough information on natural phenomena to feed the models in order to simulate a range of natural hazard events. Event catalogs produced through the years by UNAM, SINAPROC, the National Disaster Prevention Center (Centro Nacional de Prevención de Desastres, CENAPRED), and the National Meteorological Service (Servicio Meteorológico Nacional, SMN) were compiled. In addition, these organisations provided fundamental information to develop, feed, and calibrate models for earthquakes by performing seismic sources analysis, verifying attenuation dynamics, site effects studies, and historical loss information for earthquakes. For tropical cyclones, these institutions provided a wind model, topographical effect studies, storm surge models and flood precipitation models, among others. This information is combined with the data collected in the inventory of public assets. Gathering information for public assets was fundamental (location, characteristics and replacement costs) since this information provided the needed input for vulnerability functions. Federal government departments supplied this data, in many cases with a high degree of quality.

The **third step** was to develop computational tools adequate to analyse disasters. The main tool produced is known as R-FONDEN, a tool capable of producing probabilistic simulation and replicating historical as well as potential material and human losses. R-FONDEN estimates losses for a single scenario or for the entire catalogue of modelled events at any geographic zone within Mexican territory using vulnerability functions for every kind of infrastructure included in the database. For a given portfolio of assets, the system provides the fundamental financial risk measures necessary to design financial risk transfer schemes, such as the "annual average loss" and the "exceedance probability curve", and identifies the scenarios that produce the highest risk. Visualisation of results and information can be produced in any geographic information system (GIS).

Source: Ministry of Finance, Mexico

In **Indonesia** studies are underway to provide preliminary estimates of future possible public spending linked to disasters. Data of past events, as estimated from the number of buildings destroyed and damaged, have been used as a basis for simulating possible future spending needs related to natural hazards. Moreover, risk metrics such as Annual Average Loss (AAL) and Probable Maximum Loss (PML) are being calculated. It is currently estimated that the potential cost of a major disaster in Indonesia could exceed 3% of GDP. While the annual economic impact of natural disasters is estimated at 0.3% of GDP over the last decade, simulations show that a major earthquake (with a return period of 250 years) could cause losses in excess of USD 30bn, that is, 3% of GDP of this economy. [24]

In **Peru,** as part of its efforts to design a financial management strategy for disaster risks linked to natural hazards, estimations are going to be carried out to assess both probable maximum losses due to seismic risk (by the Ministry of Economy and Finance) and to assess flooding risks by river basin (by the National Center for Estimation, Prevention and Reduction of Disaster's Risks, or CENEPRED). A Seismic Risk Profile that quantifies probable maximum losses for several periods was created in 2009.

[24] World Bank & GFDRR (2011), Indonesia: Advancing a National Disaster Risk Financing Strategy – Options for Consideration, Washington, DC, p.6.

In the **Philippines**, a catastrophe risk modelling exercise is underway to assess the risk to public assets and determine appropriate risk financing arrangements for the public sector. A similar initiative is underway to evaluate models for crop insurance to improve the public crop insurance scheme. In parallel, the Department of Finance, with the support of the World Bank, is elaborating a policy strategy to determine appropriate actions to be taken to reduce the economy's overall fiscal and economic vulnerability.

Papua New Guinea is one of the fifteen economies[25] involved in the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI),[26] a project launched in 2007 aimed at providing Pacific Island Countries (PICs) with state-of-the-art disaster risk assessment and modelling tools. The initiative also aims to engage in a dialogue with the PICs on integrated financial solutions for the reduction of their financial vulnerability to extreme natural hazards and to enhance their broader DRM and climate change adaptation agenda (see **Box 7**).

PCRAFI offers an illustrative example on how to conduct a quantitative analysis of disaster risk for the purpose of risk financing and transfer. It shows that a detailed, quantitative understanding of potential costs to the fiscal budget allows for the subsequent design and implementation of sovereign disaster risk financing strategies tailored to the needs of the economy. It also shows that ensuring local participation in the development of the pilot program increases the likelihood of the establishment of a longer term strategy.

Box 7

Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)

Pacific Island Countries (PICs) are among the world's most vulnerable to natural hazards such as tropical cyclones, earthquakes, tsunamis and volcanic eruptions, based on annual expected disaster losses scaled by GDP. Reportedly, every year on average, the PICs experience losses caused by disasters are estimated at USD 284m. In the past, financing for disaster recovery has been left to the international donor community since PICs are constrained by their size, borrowing capacity, and limited access to international insurance and financial markets.

Under the auspices of PCRAFI, technical tools have been developed to support *ex ante* disaster risk reduction measures, such as planning, emergency preparedness, climate change adaptation, disaster risk financing, and post disaster support such as rapid assessments. The tools developed so far, include:

- ***A regional historical hazard and loss database*** for major disasters which contains a historical earthquake catalogue covering approximately 115,000 events of magnitude 5 or greater that occurred in the region between 1768 and 2009 and a historical tropical cyclone catalogue includes 2,422 events from 1948 to 2008;
- ***The hazard models***,[27] which include earthquakes (both ground shaking and tsunamigenic) and tropical cyclones (wind, storm surge, and excess rainfall);
- ***The regional GIS exposure database*** contains components for buildings and infrastructure, agriculture, and population. For the building and infrastructure data set, more than 400,000 building footprints for structural classification were digitised from high-resolution satellite images;

[25] The other participating countries are: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Republic of the Marshall Islands, Nauru, Niue, Palau, Samoa, Solomon Islands, Timor-Leste, Tonga, Tuvalu, and Vanuatu

[26] PCRAFI (http://pcrafi.sopac.org/) is a joint initiative between the Secretariat of the Pacific Community (SPC) – its Applied Geoscience & Technology Division (SPC-SOPAC) – the World Bank and the Asian Development Bank, with financial support from the Government of Japan and the Global Facility for Disaster Reduction and Recovery (GFDRR) and technical support from AIR Worldwide, New Zealand GNS Science, Geoscience Australia, Pacific Disaster Center (PDC), OpenGeo and GFDRR Labs.

[27] The tropical cyclone and earthquake hazard models have been subjected to a comprehensive independent peer review conducted by researchers at Geoscience Australia.

- ***Probabilistic catastrophe risk models*** **specific to each economy** have been developed integrating data collected and produced through the risk modelling process and include maps showing the geographic distribution of hazards, assets at risk, and potential losses that can be used to prioritise DRM interventions.

According to SPC-SOPAC, the historical hazard and loss database is the result of an effort in collecting, merging, and processing data from multiple sources regarding historical Pacific earthquakes and tropical cyclones and the monetary losses and impact on populations caused by such events. The "consequence" database contains approximately 450 events from 1831 to 2009 that impacted at least one of the 15 PICs. Reportedly, this database shows that on average these economies have collectively experienced losses in the order of USD 1bn per decade, and as high as USD 4bn in both the 1980's and the 1990's.[28]

Having assembled, processed, developed, and organised a wide collection of **geo-referenced data** for hazard modelling in the region, including satellite imagery, topographic maps, bathymetry maps, surface geology maps, surface soil maps, land use/land cover maps and geodetic and fault data, PCRAFI produced detailed **probabilistic hazard models** for all 15 PICs, such as Tropical Cyclones with Winds, Storm Surge, Rain Earthquake with Ground-shaking, and Tsunami.[29]

Concerning the **exposure databases**, while most commercial risk models used in the (re)insurance industry only include insurable residential, commercial and industrial assets, PCRAFI made a significant effort to take a holistic view of the impact of extreme natural hazards in the region, including direct effects on population, on all built assets, including housing for the poor and squatted properties, as well as public and infrastructure assets and on major crops. The database includes building location, number of stories, replacement cost, and structural characteristics that affect the vulnerability to natural perils. The spatial distribution of the estimated 3.5m buildings in the database, which covers all known built areas, was assembled at a varying level of resolution and accuracy.

Catastrophe risk models specific to each economy have also been developed along with catastrophe risk profiles using the hazard and exposure databases. The risk profiles integrate data collected and produced through the risk modelling process and include maps showing the geographic distribution of hazards, assets at risk, and potential losses. They also include an analysis of the distribution of the potential cost of natural disasters by magnitude over time for each economy, as measured by the expected return period for losses of a specified amount.

The impact of simulated events on population is measured by the number of people affected, in terms of fatalities, injuries and displacements, while the impact on the built environment and crops is quantified in monetary terms. The losses reflect both the cost needed to repair or replace the damaged assets, and the emergency response costs that economies may face as a result of providing necessary relief, including debris removal, cost of temporary shelters, food and medicine.

The risk profiles can **support several different applications** for both public and private stakeholders, including: urban and development planning; prioritising physical risk reduction investments; residual disaster risk financing and insurance solutions; and *ex ante* budget planning options to increase the financial resilience of the economies against natural hazard risks, while maintaining their fiscal balance. Relevant information for building codes, in terms of specific seismic and wind loads, can also be derived from the hazard models. Finally, risk information can be used to locate the most vulnerable areas and communities. These databases also provide reliable baseline data for conducting post-disaster loss assessments.

The PacRIS is a GIS platform designed to provide the PICs, development partners and the private sector with the data and tools needed to develop disaster risk reduction applications. It includes the data and mapped information captured in the databases and makes them available in a web-based portal.[30] PCRAFI is now supporting the first of set applications using the PacRIS platform. These include the development of a risk financing and insurance pool for the Pacific, urban and infrastructure planning applications for selected locations, and a post disaster loss assessment tool.

Source: PCRAFI - http://pcrafi.sopac.org/

[28] The consequence database also includes the September 29, 2009 Mw 8.1 earthquake that caused a tsunami in Samoa and Tonga and affected a number of other Pacific economies.

[29] The threat posed by earthquakes considers both ground shaking intensity and the effects of earthquake-generated tsunamis. These latter may be caused either by local events or by distant events along the entire Pacific Rim. The effects of tropical cyclones include wind and flood caused both by precipitation and storm surge.

[30] See: Pacific Risk Information System, http://paris.sopac.org/

In **Chinese Taipei**, the Residential Earthquake Insurance Fund (TREIF) has developed an earthquake risk model, called the Residential Earthquake Insurance Fund – Earthquake Risk Assessment (TREIF-ERA) scheme, in order to strengthen the independence and professionalism of the TREIF's ability to conduct earthquake risk assessment. It has enabled TREIF to enhance its assessment of its insurance coverage, claim settlement criteria, and premium rating. There is also an Earthquake Loss Estimation System (TELES), which is a real time seismic loss estimation system, for TREIF to use to work toward a better and sounder risk assumption and spread mechanism.

There are examples of tailored efforts within APEC to develop pre-disaster impact analysis and risk modelling to address specific DRM purposes, such as emergency management and urban planning. For instance, in the Republic of **Korea**, in order to move away from the traditional post-disaster approach, the National Emergency Management Agency (NEMA) has developed an IT-based initiative called "*One Step Ahead Response System*" aimed at anticipating future disasters and assessing their potential impacts for the purpose of emergency planning. The *Countermeasures against Natural Disaster Act* ensures that local governments organise pre-disaster impact analysis to facilitate DRM planning, which is decentralised but which receives central government support.

In **Indonesia**, a hazard impact modelling tool for emergency planning called Indonesia Scenario Assessment for Emergencies (InaSAFE) has been developed to understand better the likely impacts of disasters such as floods, earthquakes or tsunamis (see **Box 8**). It is a recent example of fruitful international collaboration in the field of disaster risk assessment.

Box 8

Indonesia Scenario Assessment for Emergencies (InaSAFE)

InaSAFE, a new hazard impact modeling tool in Indonesia, is used to produce realistic disaster scenarios for the purpose of contingency planning. Designed to help Indonesia and other economies in the region to effectively prepare for natural disasters by better understanding the likely impacts of disasters such as floods, earthquakes or tsunamis, InaSAFE was developed by the Australian Agency for International Development (AusAID) and Indonesia's National Disaster Management Agency (BNPB) with support from the World Bank.

InaSAFE is free open source software that anyone with basic computer skills can use to produce realistic disaster scenarios for contingency planning. InaSAFE is designed to use and combine existing data from science agencies, local governments, and communities themselves. Normally, information on the location of people and important assets are provided by local communities and government departments responsible for each sector, often through a facilitated part of disaster preparedness and planning exercise. The more communities, scientists and governments share data and knowledge, the more realistic and useful the InaSAFE scenario will be.

AusAID and BNPB, through the Australia-Indonesia Facility for Disaster Reduction (AIFDR), have been busy developing training material to teach Indonesian disaster managers how to use InaSAFE. To date, this pilot program has trained over 150 Indonesian disaster managers across six Provinces in the fundamentals of using participatory mapping techniques, such as OpenStreetMap and Quantum GIS, for collecting data and the use of InaSAFE for analysing this data and informing contingency planning.

Source: Australia-Indonesia Facility for Disaster Reduction - http://www.aifdr.org/ or http://www.inasafe.org/

In the **United States**, the US Geological Survey (USGS) used a Science Application for Risk Reduction (SAFRR) to facilitate scenario development to assist in disaster preparedness, response and resilience. Initially developed in 2006 with the Multi Hazards Demonstration Project in California to analyse earthquake and windstorm scenarios and support the decision-making process, the scope of SAFRR has expanded. Currently SAFRR has developed scenarios for earthquake (ShakeOUT) and storm and storm surge (ARkStorm), tsunami and wildfire. After developing scenarios SAFRR analyses the

scenarios with the objective of quantifying the most likely economic costs and assisting those responsible for reconstruction in their decision making process. The economic impact category (one of the three main categories analysed) is focussed on business interruption arising from damage to physical infrastructure and the longer term impacts arising from interruptions to business activity in a disaster-affected area.

In the aftermath of the devastating 8.8 magnitude (Mw) earthquake and ensuing tsunami that struck **Chile** on 27 February 2010 (27F), the Ministry of Housing and Urban Development (MINVU) took proactive steps in disaster risk modelling for the purpose of improving urban planning. To guarantee a comprehensive approach, the MINVU, in collaboration with a series of public and private entities, carried out 25 Master Plans for the main urban centres located in the coastal edge area that was affected by the tsunami. Each master plan integrated risk assessment reports and modelling of tsunami propagation and inundation for several source scenarios, among projects and mitigation works, evacuation routes, zoning and incentives for the construction of tsunami resilient housing projects. The risk studies and models recognised the importance and specificity of local risk patterns and local geographic conditions, in order to implement a precise strategy to reduce future damages and losses. The risk modelling used in this experience allowed MINVU to promote urban planning and housing policies with the proper risk outlooks and ultimately transform reconstruction into urban reinvention.[31]

There have also been efforts within APEC to strengthen the foundations for risk assessments, such as the elaboration of risk maps and the collection of data on hazards and physical vulnerabilities. In **Australia**, in order to address the patchiness and inconsistency of flood risk information, the government is investing funds to collate existing flood risk data currently held by various levels of government into an online Flood Risk Information Portal, part of the National Flood Risk Information Project (NFRIP). A focus has been to collect information for the Flood Exclusion Zones to enhance access to insurance. The information collated could play important roles in emergency management, land use planning, and environmental management as well as informing the setting of insurance premiums. Data collation will be complemented by the development of guidelines that will cover the collection, comparability, and reporting of flood risk information that will contribute, over time, to improved data quality and consistency.

In **Chile**, the Chilean Insurance Industry Association (AACH) is developing a map to identify all the risky areas susceptible to earthquakes and tsunamis within the economy. This map is expected to be a publicly available tool that will contribute to future methodologies for disaster risk management. Jointly with the Insurance Regulatory and Supervisory Authority or *Superintendencia de Valores y Seguros* (SVS), the AACH is also developing an earthquake and tsunami risk model that will be shared with government authorities for their use in risk assessment when deciding policies of public and private infrastructure investment.

In **Indonesia**, in the aftermath of the 2009 earthquake in West Sumatra the Australia-Indonesia Facility for Disaster Reduction (AIFDR) supported an international team of engineers and scientists, co-led by Geoscience Australia and the Institute of Technology, Bandung, tasked with the collection and analysis of building damage information, including relevant structural characteristics. This resulted in a comprehensive survey of all building stock in Indonesia, providing the basis for the development of a vulnerability model for building stock.

In **Russia**, following a Presidential decree, as a basis for emergency planning, subnational governments are developing ways to assess local disaster risks. Many subnational governments have

[31] See: *Building Resilience: Risk Models and Urban Planning*, in Government of Mexico (G20 Presidency) and World Bank, (June 2012) *Improving the Assessment of Disaster Risks to Strengthen Financial Resilience*, Chapter 5.

already completed lists of risk zones. These risk zones provide rough estimates of exposed populations and assets in each area. They are classified by types of disaster risks, and help in identifying the vulnerable segments of population. In the process of assessing these risks, both natural disasters and man-made disasters were taken into consideration, for example, potential hazards of dangerous facilities, such as Kursk Nuclear Power Plant.

Within APEC there is also a critical mass of research institutions which have built up research capabilities relating to natural perils, specifically in terms of collecting and analysing data on hazards, vulnerabilities, and losses. In **Singapore**, for instance, the Nanyang Technological University's Institute of Catastrophe Risk Management (NTU-ICRM), launched in 2010, focuses on catastrophe-related reinsurance risks, sovereign risk, societal risk and other non-traditional risks in Asia. With support from the industry and the government, the NTU-ICRM embarked on two key projects on flood and seismic risk assessments. ICRM is also part of the Global Earthquake Model (GEM) Project, a collaborative effort aimed at developing and deploying tools and resources for earthquake risk assessment worldwide.

The ***implementation challenges*** reported by APEC economies in disaster risk assessment include the lack of technical expertise, the difficulty in gathering data and information to be able to quantify the economy's full exposure, the time-consuming nature of assessing economic impacts due to the need for a certain level of precision, the constraints in capacities across levels in order to sustain the multidisciplinary tasks involved in catastrophe risk modelling and the lack of systematic funding for these efforts, and the institutional fragmentation of actions, hence requiring an effective coordination among the various stakeholders to ensure appropriate actions.

One economy highlighted the importance of emphasising the objectives and nature of risk assessment throughout relevant government agencies in order to make them aware of the relevance of complete and accurate information and guarantee cooperation from those who are responsible for, and manage, the information. In particular, agencies must be made aware of the benefit of sharing their information to build financial risk management strategies that may improve their own risk transfer options, as well as enhance benefits to be derived from such schemes. This economy suggests that it may be helpful if requests involving numerous departments are sponsored by one or more top ministries ensure prioritisation and support timely information gathering. Another economy identified the lack of a real-time integrated information management system for risk assessment as a key obstacle to the development of pre-disaster impact analysis.

One APEC economy noted that there is not a great degree of understanding of the costs of cyber-attacks, a man-made threat that may have systemic impacts within the economy. The value of information and equipment, and the costs related to re-securing networks, has not been adequately assessed and could, according to this economy, be an avenue for research within APEC.

2.3.2 Assessment of financial capacities and vulnerabilities within the population and economy

As mentioned above and highlighted in the Framework, identifying risk financing gaps or financial vulnerabilities requires an assessment of the financial capacities of individuals, businesses, and governments, in addition to an assessment of disaster risks. **Chile** is in a position to identify vulnerable populations by leveraging the results of a National Socioeconomic Characterisation (CASEN) survey that takes place every 2 – 3 years. This survey helps to estimate the extent of poverty and income distribution, identifies the needs and demands of people in risk areas and assesses the gaps separating different social groups and geographical areas; moreover, it evaluates the impact of social policies.

In the **Philippines**, in order to improve the targeting of government resources, a survey to map out the poorest communities in the Philippines is being undertaken by the Department of Social Welfare and

Development. This will enable the Department to calibrate the package of social welfare support that it provides to the communities, including assistance related to disaster risk. The Philippines has noted that disaster impacts are typically borne by families, with various levels of support from government and non-government organisations; however, it is viewed that such support may not necessarily be adequate to ensure full recovery following a disaster.

In **Malaysia**, it has been observed that, despite its low level of disaster risk exposure, and the lack of a strong need to develop a sustainable domestic disaster insurance market, the penetration rate for disaster insurance is disproportionately low among financially vulnerable groups. Based on a survey conducted by Bank Negara Malaysia, property insurance coverage is only 2% for low-income households versus 10% for the rest of the population as of January 2012. Mitigating steps are being undertaken, including exploring the development of a crop insurance framework for small-scale paddy farmers to receive financial protection against natural disasters, and the development of a micro-insurance / micro-takaful framework to promote the development of micro-risk transfer products to protect the underserved from adverse financial shocks.

2.3.3 Post-disaster damages and loss assessments

Some APEC economies have systems, tools, and databases in place to track disaster impacts and losses. These may be in place in the public sector or private sector, particularly the insurance sector. This information provides input for future disaster risk assessment but also is critical for disaster response and recovery, including the provision of compensation to meet disaster losses.

The public sector plays in an important role in damage assessment and the collection of data on costs in order to obtain a view of the scale of disaster losses and respond rapidly and in a targeted manner to those affected by disasters, be it for instance in terms of emergency response and relief or financial compensation. In **Chile**, the Ministry of Finance's 2010 earthquake aftermath assessment was executed in a coordinated manner with the individual Ministries and other public entities. Specifically, each ministry calculated the losses incurred in their sector. Next, the inputs of each sector were sent to the Ministry of Finance which verified the sources and numbers and summed the totals of damages. In this way, the financial assessment of the disaster was very streamlined.

In **Mexico**, the Ministry of Finance has developed a Hazard Tracking System for Tropical Cyclones, known as R-AVISA, that tracks cyclones and estimates material and human losses at potentially affected areas. The information to update hazard characteristics - obtained from the National Hurricane Center of the U.S. National Oceanic and Atmospheric Administration (NOAA) - is automatically processed to estimate losses for the infrastructure exposed in the potentially affected areas. This in turn allows for a quick mobilisation of disaster response and prevention resources.

Mexico's FONDEN has developed a Funding Control, Request and Validation System, known as "FONDEN en Línea", which is a web tool that automates the reporting of damages by affected government agencies from the moment when a disaster happens. Government officials capture basic information and loss verification activities necessary to request federal reconstruction funds. The system facilitates the reporting of losses through standardised templates, requiring the attachment of geocoding and photos from the damaged assets by using global positioning system (GPS) equipment. As a result, FONDEN funds can be duly processed and timely channelled to reconstruct key infrastructure.

Following the 2011 Canterbury earthquake, the **New Zealand** Treasury started tracking all the costs incurred by central government entities in the relief, recovery and rebuild of Christchurch. The New Zealand *Public Finance Act* allows for expenses or capital expenditures to be incurred in emergencies without further authority from Parliament when certain conditions are met. This requires immediate

response costs to be recorded so that these can be retrospectively approved in accordance with the legislation. Treasury collects information on public expenditure for relief, recovery and reconstruction from government agencies formally three times a year - once, as part of its annual year-end audit process, and twice as part of its six monthly budget and forecasting processes. This information is held centrally by Treasury and updated regularly. The information can then be regularly accessed for use in the Government's annual financial statements and in the forecast documents, and for updates to Ministers. The annual process collects information about the costs that government departments, state-owned entities and Crown entities have actually incurred in the year to date in relation to earthquake recovery efforts in Christchurch.

Damage and loss assessment reports from recent major disasters have been prepared in **Indonesia**. These reports show a consistent ranking of reconstruction needs, with housing accounting for the largest expenditures followed by public infrastructure (primarily roads, schools and health facilities). In **Malaysia**, whilst there is no specific systematic mechanism to analyse the impact of a disaster, each agency has the responsibility for doing this for damages within the purview of their responsibility. Therefore, in the aftermath of a disaster, the response and recovery procedures would be localised and targeted to particular communities.

In the **Philippines**, the Office of Civil Defence, which is the Secretariat of the National Disaster Risk Reduction and Management Council, is tasked to put together information related to damages and losses in the aftermath of a disaster. Reporting mechanisms are in place to collect information from the field to the central level in order to report to the President the full extent of the disaster impacts. However, there are only a limited number of agencies in the Philippine Government which regularly provide such reports. As such, the full range of disaster impacts is not fully accounted.

Also in the Philippines, seismic hazard simulation software called the Rapid Earthquake Damage Assessment System (REDAS) has been developed to produce hazard and risk maps immediately after the occurrence of a strong and potentially damaging earthquake. It is the product of a collaborative effort between the Philippine Institute of Volcanology and Seismology (PHIVOLCS) of the Department of Science and Technology (DOST) and Geoscience Australia, with the support of the Australian Agency for International Development (AusAID) (see **Box 9**).

Box 9

Philippines: Rapid Earthquake Damage Assessment System (REDAS)

Developed by the Philippine Institute of Volcanology and Seismology (PHIVOLCS) of the Department of Science and Technology (DOST), in collaboration with Geoscience Australia and supported by the Australian Agency for International Development (AusAID), the Rapid Earthquake Damage Assessment System (REDAS) is a seismic hazard simulation software that aims to produce hazard and risk maps immediately after the occurrence of a strong and potentially damaging earthquake.

REDAS aims to provide quick and near real-time simulated earthquake hazard information to disaster managers which helps them in assessing the distribution and extent of the impacts of a strong earthquake and prioritising the deployment of rescue and relief operations. The second objective is for the software to serve as a tool to inform land use planners, policy makers, city and town development planners and local governments, with a view to mainstreaming disaster risk reduction into the local development planning process and thus ensuring long-term mitigation of seismic risks.

The software can model four seismic hazards (ground shaking, liquefaction, landslides and tsunami) and since it hosts exposure data, risk elements can also be plotted. Inputs required to produce hazard maps are basic earthquake and fault parameters. To make it multi-hazard in approach, static hazard maps such as volcanic and hydro-meteorological are built-in in the software. Its potential to be a risk assessment tool is being enhanced by improving the exposure database, inclusion of a building inventory module, incorporation of vulnerability curves and enhancing its modeling capability to address other natural hazards.

Risk databases can be built using GPS and maps from Google Earth. The latest version of REDAS which allows users to estimate earthquake impacts was introduced for the first time in 2013 to 17 State Universities and Colleges (SUCs) from Regions II, III and XI.

Source: Philippine Institute of Volcanology and Seismology – Department of Science and Technology (PHIVOLCS – DOST) http://www.phivolcs.dost.gov.ph/

In **Chinese Taipei**, in order to monitor the disaster losses and provide the basis for future government financial planning, 31 types of "Statistical Forms for Large-Scale Disaster Losses" were issued in 2010. The authorities responsible for various aspects of disaster management (e.g., the Ministry of the Interior is responsible for handling the effects of typhoons and earthquakes, the Ministry of Economic Affairs is responsible for handling the effects of flooding, etc.) are required to fill out these forms within 60 days after a large-scale disaster has occurred, then send them to the Office of Disaster Management (ODM). The ODM gathers and analyses the data of disaster losses methodically and reports them in the *White Paper of Disaster Prevention and Rescues*, which is published yearly.

In 2011, the government of **Thailand**, led by the Ministry of Finance and in collaboration with the World Bank and other development partners, undertook a rapid assessment of the impact of the floods in 26 of the 66 affected provinces. The assessment focused on the economic and social impacts of the major flooding on 18 main sectors and was aimed at preparing recovery and reconstruction plans. The results of the assessment are presented in a report establishing the economy's needs for post-disaster recovery and reconstruction and proposes short, medium, and long-term measures in each of the sectors for a sustainable post-disaster reconstruction program.[32]

To assist in the estimation of damages and post-disaster needs, methodologies have been developed to ensure coherence and consistency in estimations. The methodologies may also be used to guide disaster risk assessment. In the **Philippines**, the Office of Civil Defence has recently attempted to draft instructions and methodologies in order to standardise reporting of disaster impacts in the economy. A customised version of the Post-Disaster Needs Assessment of the UN, the EU, and the World Bank has been put in place. There are challenges in trying to propagate such a methodology across the territory and establishing a more effective, efficient, and transparent mechanism and platform for reporting. In **Russia**, a standard official methodology for estimating disaster impacts has been developed covering both direct and indirect losses, as well as disaster prevention expenses and forecasts. GIS technology is also employed to monitor and track damages in this economy. Systemic estimation methods are described and several official methods for classification of disasters are listed as well.

In **Chile**, following the events of 27F, the government made use of the National Socioeconomic Characterisation (CASEN) survey, normally conducted every 2-3 years to collect information of vulnerable populations, to conduct a post-disaster survey of vulnerabilities in order to assess the changes of the standard of living of the population affected by the earthquake and tsunami. The Post-Earthquake Survey[33] covered the affected regions and used panel data, which permitted an evaluation of the evolution of the quality of life of populations affected by the earthquake and tsunami.[34]

[32] World Bank (2011), *Thai Flood 2011: Rapid Assessment for Resilient Recovery and Reconstruction Planning*, https://www.gfdrr.org/node/1526

[33] For more information, see http://observatorio.ministeriodesarrollosocial.gob.cl/.

[34] The survey data was provided by the Social Observatory of the Universidad Alberto Hurtado, and was conducted between the months of May and June of 2010 through the implementation of a face to face questionnaire of a subsample of 22,456 households interviewed in the 2009 CASEN survey.

The private sector, primarily the insurance sector, is also engaged in the collection of data on losses. The insurance sector in APEC economies, such as Australia, Canada, Malaysia, Mexico, New Zealand, Thailand, and the United States, collects data on insured losses from disasters. In some economies, this data is kept in a central database maintained by the industry, while in other cases, it may be maintained by a disaster insurance scheme or systematically collected by the supervisory authority. In **Thailand**, when a disaster occurs, the Office of Insurance Commission (OIC) collects data directly from all insurance companies. The OIC regularly updates this data and follows up on the process of submitted claims. Since the National Catastrophe Insurance Fund (NCIF) was established in 2012, the NCIF collects data and this data can be requested subject to certain limitations. In **Japan**, the Financial Services Agency has been keeping track of insured losses arising from large disasters such as the Great East Japan Earthquake based on data collected from each individual insurer. In **Indonesia**, the government is seeking to track disaster losses with the support of the private insurance sector, at least with regard to insured losses.

Given the growing interconnectedness of economies, which is helping to account for disaster spill-over effects, private businesses have a genuine interest in learning about disaster impacts in other economies. For instance, in **Hong Kong, China**, in order to assist its manufacturing industries following the Great East Japan Earthquake, the HKSARG conveyed to the Japanese Government its industries' request for more information on the supply situation in Japan. Information provided by the Japanese Government was then disseminated to the affected industries in Hong Kong, China. Thus, economies with relatively low exposure to extreme hazards may have a strong interest in proper damage assessments being conducted by those parts of the world prone to disasters.

Databases, public or private, provide a key tool for tracking disaster impacts and losses over time and promoting consistency in data collection methods. This data can then be used to develop risk assessments. In **Canada**, the Canadian Disaster Database (CDD) – a publicly accessible[35] web-based repository of historical information about natural and man-made disasters –- contains information on over 1000 past disaster events (see **Box 10**).

Box 10

The Canadian Disaster Database (CDD)

The CDD contains detailed disaster information on natural, technological and conflict events (excluding war) that have happened since 1900 in Canada or abroad and that have directly affected Canadians. The CDD tracks "significant disaster events" which conform to the *Emergency Management Framework for Canada* definition of a "disaster" and meet one or more of the following criteria:

- 10 or more people killed
- 100 or more people affected/injured/infected/evacuated or homeless
- An appeal for national/international assistance
- Historical significance
- Significant damage/interruption of normal processes such that the community affected cannot recover on its own.

The database describes where and when a disaster occurred, the number of injuries, evacuations, and fatalities, as well as a rough estimate of the costs (insured and uninsured). As much as possible, the CDD contains primary data that is valid, current and supported by reliable and traceable sources, including federal institutions, provincial/territorial governments, non-governmental organisations and media sources. Data is updated and reviewed on a semi-annual basis.

[35] The Canadian Disaster Database can be accessed through the Public Safety Canada website at http://www.publicsafety.gc.ca/cdd

A geospatial mapping component has been added to the CDD, which enables users to define their search of the disaster database by using a spatially-defined area. It also displays query results charted across a map.

The CDD displays cost data in the dollar amount of the year that the event took place or the year a specific payment was made. Users may also convert this "raw", data into the dollar amount in effect for the year of their choosing to assist with analysis concerning whether costs have increased or decreased over time or whether preventative/mitigating measures have helped to lower the cost of disasters.

Housed and maintained by Public Safety Canada (PS), the CDD data is obtained from various sources such as federal institutions, provincial/territorial governments, non-governmental organisations, and media and is verified via a network of Canadian disaster experts. The contents of the database are updated as new information about previous disasters becomes available and as new disasters occur.

The CDD consultation process involves a network of participating disaster experts from academia, non-governmental organisations, and various provincial, territorial and federal governments. This network of experts is consulted in order to either provide raw data, or verify and enhance disaster information proposed for inclusion in the CDD. Conceived as an idea to better inform the public, as well as government policy and program officials on disasters in Canada, the CDD is now accessed internationally and used for awareness, risk assessment and as a tool to support decision-making.

Source: Public Safety Canada - http://www.publicsafety.gc.ca/cdd

In **Brunei Darussalam**, the National Disaster Management Centre has acknowledged the importance of disaster risk and loss assessment, as well as the need to monitor financial impacts and track disaster costs. The establishment of a centralised disaster loss database is envisaged, but several obstacles are seen as needing to be overcome, including: the lack of technical expertise and operational guidelines, the lack of coordination among relevant agencies and departments and insufficient resources to develop a data collection and sharing mechanism. The UNISDR is assisting in the development and implementation of DesInventar so that losses can be placed into a centralised disaster loss database to be utilised in disaster preparedness.

For governments, ***implementation challenges*** in monitoring and tracking disaster impacts and losses include the lack of experts who can estimate the impact of damage to assets and extent of disaster-damaged areas, the low level of human resources capacity at sub-regional government institutions, the lack of a clear standard for estimating damage caused by the disaster and fragmentation of reporting systems, uncertainty regarding some of the costs involved, and the lack of proper information flows within the government.

For one APEC economy, while it is possible to track and estimate some costs fairly easily (e.g., costs of search and rescue, and other immediate response costs), others such as the cost of fixing local infrastructure (water pipes and roads) are much more difficult to estimate: where costs cannot be reliably estimated, these present a challenge and on-going fiscal risk; where costs can be reliably estimated but an obligation exists for the government, disclosures of these risks and potential ranges (if possible) are made in forecasting documents.

In another economy, challenges exist in regard to the systematic collection of financial impacts. For instance, in one APEC economy, financial reporting remains fragmented across agencies such as the budget office, agency responsible for disaster risk management, civil defence agency, and the presidential office. This makes it difficult to implement more consistent and standardised methodologies for data collection. Another APEC economy noted that there may be problems with information flows as some agencies may view their data as proprietary and not make the data readily available to all government departments. Further, another APEC economy noted that while the government monitors disaster losses for the public sector, there is a lack of a proper systematic methodology and estimation model for the private sector to ensure the effective accumulation and analysis of information on disaster losses, especially for social economic losses.

2.4 Selected illustrative practices in other economies

Examples of policies, practices and tools experimented in other economies may become the source of inspiration for initiatives to be undertaken within APEC, depending on the specific circumstances of the economy. To this end, this section presents two very different initiatives: the Africa RiskView (ARV), an IT platform providing a transparent system to estimate drought-related crop losses and the impact on populations' food security in sub-Saharan African economies (see **Box 11**) and the newly established French National Observatory of Natural Hazards (*Observatoire national des risques naturels*), a public-private collaboration in disaster risk assessment.

Box 11

Africa RiskView (ARV)

Developed by the World Food Programme (WFP), Africa RiskView (ARV) is an IT platform providing a transparent system to estimate drought-related crop losses and the impact on populations' food security in sub-Saharan African economies. This tool also converts the anticipated adverse impacts into monetary and financial terms, with a view to providing accurate estimates of the required response costs. It provides the technical foundation and basic infrastructure for the Africa Risk Capacity (ARC), an African-owned, continental index-based weather risk insurance pool and early response mechanism.

As a flexible tool that can be used to select accurate proxies for drought related losses and response costs needs, ARV allows ARC participating members to quantify critical financial components of their drought risk and, consequently, to determine the appropriate amount of risk to transfer to the ARC risk pool.

Several tasks can be performed by the software application, including: **early warning, risk mapping, vulnerability assessment and financial planning**. Rainfall and crop monitoring data are provided by reliable sources[36] to anticipate high-level food security needs of affected populations and budget for response costs.

Using ARV, ARC participating economies[37] can determine how changes in rainfall would affect crop performance – measured by the reference water stress indicator called "Water Requirement Satisfaction Index" (WRSI) – and, ultimately, vulnerable populations. Water stress indicators measure crop performance based on the availability of water to the crop during a growing season. They assume that crop yields are proportional to the satisfaction of crop needs for water resource. The WRSI, developed by the Food and Agriculture Organisation (FAO)[38] and currently used in different parametric insurance schemes across the world, is defined as the ratio of actual evapotranspiration (ETa) to maximum evapotranspiration (ETc). In simple terms, this index captures the impact of timing, quantity, and distribution of rainfall, comparing the amount of water available throughout the season to how much a plant needs in its different stages of growth.[39]

[36] Including: WFP, Food and Agriculture Organisation, Famine Early Warning Systems Network, and the National Oceanic and Atmospheric Administration.

[37] ARC participating countries are: Burkina Faso, Burundi, Central African Republic, Chad, Comoros, Republic of Congo, Côte d'Ivoire, Djibouti, Gambia, Guinea, Kenya, Liberia, Libya, Malawi, Mauritania, Mozambique, Niger, Rwanda, Sahrawi Arab Democratic Republic, Senegal, Togo and Zimbabwe.

[38] See: Doorenbos J. and W.O. Pruitt, (1977) *FAO Crop Water Requirements*, Pruitt. FAO, Rome, Italy*;* Frère, M. and Popov, G.F. (1979) *FAO: Agrometeorological crop monitoring and forecasting*. FAO Plant Production and Protection p) Paper, FAO Working Paper, Rome, Italy; Frère, M. and Popov, G.F. (1986) *FAO, Early Agrometeorological Crop Yield Forecasting. FAO Plant Production and Protection Paper*, Working Paper No. 73FAO, Rome, Italy.

[39] "ETa corresponds to an estimation of the quantity of water actually evaporated while ETc corresponds to the quantity of water that would evaporate if the water requirements of the plant were fully satisfied (…) Since crop sensibility to water stress depends on its growth phase, most of the insurance contracts consider those phases and take in account different references values of WRSI as triggers, depending on the phase considered (…)" Rainfall level of each (phase) is compared to the crop requirement for this particular growth stage and included in the weighted sum in order to compute the index corresponding for the whole

A second component of ARV aims to **estimate the population affected** by overlaying drought index information with sub-national data about the percentage of vulnerable population. This component tries to identify how drought may impact the needs of individuals and households. Exposure and resiliency are employed as basic variables in the exercise. Exposure to drought risk is defined by the weight of agricultural activities in the household's total annual income. Resiliency is measured in terms of household's distance from the poverty line. The percentages of the population vulnerable to droughts of various degrees of severity can be modified by the user at different administrative levels.

As a third step, ARV seeks to determine a **monetary approximation of response costs**, based on the index-based estimate of seasonal crop performance and the impact of such performance on affected populations vulnerable to food insecurity. This is crucial for policymakers in finance and disaster planning and preparedness.

Using ARV, response costs can be estimated at **different aggregation levels, including the local and regional levels,** by multiplying the population affected by a fixed cost per beneficiary. Such cost can be adjusted by the user to reflect the cost of various types of responses to food insecure populations (e.g., food aid, cash vouchers), assessing financial needs for drought events of varying magnitudes. The tool can also be used to study historical data and learn from past events, with a view to improving contingency planning and emergency preparedness for future shocks.

The risk quantification capabilities developed by ARV can assist governments in anticipating the financial consequences of future potential drought events of different magnitudes, helping them to set up appropriate contingency plans and to budget for emergency response costs. Based on such estimates, ARC participating members can also determine the desired retention level beyond which drought risks are transferred to the risk pool, the ceding percentage (or co-insurance proportion), as well as the coverage limits to be purchased. These parameters determine the cost of risk transfer. ARV can also be used on an on-going basis to monitor, in near real-time,[40] satellite-based rainfall and crop information through the season, thereby improving their emergency response planning and crisis management capabilities.

In short, ARV constitutes a flexible tool[41] that can be used to select accurate proxies for drought related losses and response costs needs, supporting multiple applications: from quantitative risk assessment to early warning and financial planning. In this regard, it is noteworthy how risk assessment is linked here with emergency preparedness.

In **France**, following the devastating effects of windstorm Xynthia in 2010, causing storm surges in the Bay of Biscay and in Brittany, the French government, the *Caisse centrale de réassurance* (CCR), the state-owned reinsurance company, and the *Mission des sociétés d'assurances pour la connaissance et la prévention des risques naturels* (MRN), established in 2012 a National Observatory of Natural Hazards (*Observatoire national des risques naturels*, or "ONRN"), a non-profit entity involving two French insurance industry associations. The establishment of the ONRN will allow for the sharing of information and data collected and elaborated by different stakeholders, at central and local levels, and for the presentation of such information and data in a reliable, harmonised, updated and consistent manner. Data providers are affiliated to the ONRN by means of special contractual agreements in order to ensure consistency of approach and interoperability of data. Within the ONRN, confidential data can also be exchanged by participants and a common, holistic approach to natural hazards can be adopted.

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period." Leblois, A., Quirion, P., (2013) "*Agricultural insurances based on Meteorological Indices: Realizations, Methods and Research Challenges"*, Meteorol. Appl. Vol. 20, pp.1–9, 3.

[40] Rainfall data in ARV is updated every ten days.

[41] ARV was designed to be highly transparent and the different parameters can be changed and customised based on country, regional and local conditions.

Until the ONRN was established, experimental indicators and studies on natural hazards, including their financial and economic impacts, had been produced independently by various stakeholders. For instance, the CCR elaborated an indicator of insured losses due to floods per municipality and per inhabitant in France during the period 2005-2008; at the same time, the MNR evaluated the adequacy of the scope of coverage of Flood Risk Prevention Plans (*Plan de prevention des risques d'inondations* or "PPRI"), at the national level in France.[42] The French Ministry of Sustainable Development and its DGPR have started a preliminary evaluation of flood risks for the purposes of implementing the EU Flood Directive to its full extent. This exercise, to be carried forward under the auspices of the ONRN, is expected to lead to a comprehensive assessment of flood risks in France, as well as to the design and adoption of targeted flood risk mitigation measures.

The ONRN is noteworthy as a collaborative effort among the State, local authorities, specialised agencies, the academia and the private insurance and reinsurance sector focusing on the improvement of consistency and interoperability of data on natural hazards for a full range of different applications, including risk assessment, risk mitigation, emergency preparedness and financial planning. End users of the data have a role in the governance of the ONRN, and can thus provide comments and input into ONRN work. This case illustrates the potential benefits that can be derived from foresight, planning and understanding the costs that have been incurred from past disaster events as well as being able to think about the likely costs that may arise in the future.

[42] According to the analysis conducted by MNR, the scope of coverage of PPRIs can be considered adequate if at least 80% of the insured assets exposed to flood risk are located in municipalities that are covered by a regular PPRI and at least 80% of the municipalities included in the priority list (higher flood risk) are covered by a regular PPRI. In the context of the ONRN, the analysis will be expanded to cover not only insured assets, but all "adverse consequences" of floods mentioned by the European Directive 2007/60/EC on the assessment and management of flood risks ("EU Flood Directive").

3. PRIVATE DISASTER RISK FINANCING TOOLS AND FINANCIAL SECTOR RESILIENCE

3.1 Private insurance and the cost of disasters

As emphasised by the G20/OECD Methodological Framework, a comprehensive and integrated approach is required for financial strategies, following an assessment of the availability, adequacy and efficiency of different types of financial tools available to the population and within the economy, as well as of their relative costs and benefits, in comparison with possible further risk reduction to complement or substitute for these tools.

Private insurance is one of the main risk financing tools for businesses and households to strengthen their financial resilience against disasters, complementing investments in risk reduction. Risk transfer instruments such as insurance allow for the shifting of a portion of disaster risks to others, in exchange for a price, and for the spreading of such risks. The financial sector and, in particular, the insurance sector can be called upon to play important roles in this field, depending on the stage of development of these markets, the robustness of their infrastructures, the level of capitalisation, solvency and soundness of insurance undertakings, as well as the financial depth of the economy. A stable and well-functioning financial sector enables continued economic activity following a disaster and supports the provision of DRF. As witnessed by recent experience in **Chile** and **New Zealand**, for instance, disaster insurance can facilitate rapid economic recovery in the aftermath of a major earthquake, by timely providing the necessary resources to fund reconstruction.

At present not only traditional insurance and reinsurance contracts can be considered as part of risk financing solutions, but also innovative financial products developed in the capital markets, which may be accessed by large corporations, insurers, and governments. The availability and cost of these instruments is influenced by uncertainties characterising the risk assessment process: supplying reliable and consistent data on hazards, exposures and vulnerabilities, or at least facilitating their collection, recording, storage and dissemination can greatly enhance the capacity of markets. The development of private market risk transfer solutions may also be influenced by the level of post-disaster assistance offered by the government.

When assessing the availability, breadth, and depth of private market risk transfer solutions for disasters, the following main elements can be considered (see also Table 2):

1. The *type of hazards* (natural and/or man-made, depending on the disaster risk profile of the economy) against which coverage is available
2. The *type of losses* (e.g., property damage, business interruption, life, accident, liability) that are covered by insurance
3. The *segments of the population and the economy* for which coverage is available (e.g., households in urban areas, households in rural areas, farmers and herders, small business enterprises, large commercial and industrial corporations, local governments)
4. The *contractual mechanism* by which disaster coverage is made available on the market (e.g., stand-alone policies, optional endorsements to other policies)
5. The *pricing mechanism* of insurance coverage.

Table 2: Key aspects of disaster insurance	
1) Hazards covered	• Single • Selected group • All
2) Scope of coverage	• Damage to property, e.g.: – Residential / commercial – Private / public (buildings and infrastructures) • Damage to motor and transport vehicles • Business interruption • Life, accident • Liability
3) Segments of the population and economy covered *(policyholders)*	• Households (e.g., urban, rural) • Corporate (e.g., large commercial, SMEs, agriculture) • Financial sector • Government (e.g., central, local)
4) Contractual mechanism	• Stand-alone policy • Extension / endorsement
	Linked to separate contract, financial or non-financial
	• Credit-linked insurance (e.g., mortgage, loan) • Insurance linked to an infrastructure concession, engineering contract
5) Pricing	• Flat • Risk-based
6) Other policy features	• Deductibles • Co-insurance

Finally, it is important to ensure that the financial sector is sound and resilient, capable of delivering promised payments and financing in the event of a disaster. Accordingly, the capacity of the financial sector to manage and absorb disaster risk (both financial and operational) should be evaluated. The assessment of financial sector resilience to disasters may involve evaluating the adequacy of the solvency regime and liquidity rules; stress testing for solvency and liquidity; ensuring adequate business continuity planning within the financial sector, at the level of financial institutions and financial infrastructures. While insurance and reinsurance companies may have important risk exposures, other financial sector participants such as banks, credit institutions, and financial system infrastructures may also be exposed to disaster risk.

3.2 Availability and affordability of private risk financing instruments

In a very limited number of APEC economies, including **Hong Kong, China; Malaysia**, and **Singapore**, the availability and affordability of disaster insurance is not considered problematic, due to a relatively low level of risk. In **Hong Kong, China,** for instance, insurance for disaster losses is provided by the private insurance sector and covers all segments, e.g. individuals, households, small business, large corporations. Earthquake coverage is included in the basic fire or all risks rate without specific charge. Almost all policies cover earthquake, either as a specified peril or as part of an all risks wording. The specified peril is earthquake shock and fire, volcanic eruption and tsunami. Cover is normally provided for the full sum insured. The typhoon season in Hong Kong, China, is in the summer time but over the last two decades typhoon losses have been minor. Despite the exposure, there is no specific windstorm rate, the peril is included within the overall fire or all risks rate and almost all policies include windstorm for the full sum insured. Most domestic and commercial policies, moreover, automatically include flood for the full sum insured.

In **Malaysia**, disaster insurance on a stand-alone basis is not available as there is little demand for such products, reflecting the low level of disaster risk except for occasional floods. However, selected natural disaster insurance coverage is available from insurers in Malaysia: household property insurance which covers hurricane, cyclone, typhoon, windstorm, earthquake, landslides and floods can be obtained; for commercial properties, such protection can be obtained at an additional premium. Fire and motor insurance with protection against additional perils e.g. floods, hurricanes, landslides, can be obtained at an additional premium. Catastrophe perils may also be extended to the Contractor's All Risk and engineering type of policies and to industrial all-risk insurance policy. At an additional premium agricultural insurance can be extended to natural disaster including floods and windstorms.

In **Singapore**, insurance products covering disaster perils are available to individuals, corporate entities, and government. Most of the perils are covered under the property insurance policies. For example, most mandatory fire insurance policies acquired together with a mortgage loan or as a Management Corporation Strata Title (MCST) property offer basic coverage against damage to the building structure or common areas by fire, lightning, bursting or overflow of water tanks and apparatus, malicious intent and floods.

In other economies, the situation is different, with disaster risks being more material, which has led governments in markets where insurance is more developed to provide support for disaster insurance through subsidies or guarantees, for instance through disaster insurance schemes. In several APEC economies, disaster coverage may be limited due to the limited scope of insurance markets. In these markets and more generally within APEC, efforts are being made to enhance the availability and penetration of disaster insurance. For example, in **Russia**, disaster insurance penetration is still very low and post-event financing is, therefore, generally required. Possible mandatory insurance schemes for extreme events have been considered, but no consensus has been reached to date, and legal and constitutional issues exist. In **Brunei Darussalam**, there is no specific disaster insurance available (i.e., no standalone products) but there are certain types of disasters that are covered such as floods and landslides for properties. Brunei Darussalam currently has no crop insurance and micro insurance available, but their development is under consideration.

In **Chile**, the main DRF tools are mandatory insurance policies for infrastructure investments awarded in concessions,[43] and voluntary, but widespread, insurance policies purchased by large industries (e.g., mining, electric and industrial sectors are heavy users in demanding coverage of natural disasters and business interruption). Earthquake and tsunami risks can also be covered by way of optional endorsements to residential property policies.

In **Mexico**, insurance policies are sold in packages with earthquake, volcano eruption, and hydro meteorological perils as extra if fire insurance is purchased. General household insurance policies have less than a 5% penetration rate for voluntary policies and loan-linked insurance penetration rate is approximately 36%. The commercial and industry penetration rates are 5% for small enterprises, increasing to 30-40% for medium sized industries and approximately 95% for big industries.

In **Japan**, earthquake insurance for dwelling covers loss or damage caused by such disasters as earthquakes, volcanic eruptions and tsunamis. This earthquake insurance is managed with the support of the government through a reinsurance scheme, while earthquake insurance for commercial business is provided solely by private insurers. In **New Zealand** private earthquake insurance is available to complement coverage provided under the Earthquake Commission (EQC) scheme.

[43] Since 1993, the Chilean government started private sector bidding for concession of infrastructure such as highways, prisons, airports, ports, and hospitals. One of the requirements for the concessions is that the bidder who is awarded the contract must have insurance coverage for natural disasters.

Australia has a well-established private insurance market that offers products that insure against losses from a wide variety of risks. In principle, its existence allows the economy to manage risk more effectively, reducing financial uncertainty in the event of a disaster and allowing for a more efficient use of capital by individuals, business, and government. In the aftermath of recent flooding, nevertheless, issues of flood insurance availability and contract wording emerged, creating risks of financial hardship for those who were uninsured or were not adequately covered, stimulating a thorough review of the situation (see **Box 12**). This led to efforts to promote: a) increased transparency, to reduce the risk of misunderstanding of covered items; and b) a uniform definition of flood, so as to overcome confusion over terminology and what types of flood events are covered.

Box 12. Australia: the Natural Disaster Insurance Review 2011

Following major floods in Queensland during the period December 2010 – January 2011[44], the Natural Disaster Insurance Review (NDIR) was launched in Australia. The NDIR focused on the availability and affordability of insurance offered by the private insurance market. The Review was stimulated by the absence of flood insurance for many policyholders, as well as by evidence of under-insurance for bushfires, cyclones and floods. The lack of flood coverage in many home insurance policies, due to coverage gaps and issues in contract interpretation, led to a community backlash against insurers during 2011 and considerable distress, financial loss and disillusionment for many insured homeowners.

The NDIR was set up primarily to explore options for the most preferable risk sharing arrangements, with the overarching premise that there was no desire to interfere with the private market whilst it was functioning satisfactorily. There was a particular emphasis on examining the extent of non-insurance and underinsurance and ways of remedying this outcome. The biggest problem was in relation to the operation of exclusion clauses.

In relation to public assets, the Terms of Reference of the NDIR specifically asked the Review Panel to consider whether the existing Commonwealth and State arrangements for dealing with natural disaster recovery and resilience require supplementation. The relationship between private market solutions and public funding mechanisms was, therefore, touched on in the course of the review.

The Australian Government was concerned to ensure that the appropriate measures are in place to foster more complete sharing of risk and equitable sharing of the cost of damage and loss resulting from floods and other natural disasters throughout the nation. The NDIR was aimed at identifying possible strategies to achieve a number of key results, including:

i. Improving the ability of individuals and communities affected by the floods and other natural disasters to recover and rebuild as quickly as possible;
ii. Giving people the opportunity to choose where they live in an informed way;
iii. Giving individuals and communities at risk the opportunity to obtain suitable protection against, both in terms of having access to insurance and benefiting from appropriate mitigation strategies.

The analysis involved consultations with the various key stakeholders that may potentially be implicated in a natural disaster. The NDIR comprised of a Review Panel and a Working Group with representation from Treasury and various government departments. Consultation was undertaken with communities, businesses, members of the public, State and Territory Governments and international expertise. The final report was handed down in September 2011.

In **Russia**, insurance against natural hazards comprises a minor proportion of the small level of total insurance premiums. Post-disaster financing dominates, while disaster insurance has a low penetration rate. For instance, only 15% of houses destroyed by fires in 2010 were insured. Disaster insurance is deemed to be most efficiently provided by being bundled with fire insurance, instead of being a stand-alone policy.

[44] The flooding was the result of a series of heavy rainfall events and several cyclones, including Tasha and Yasi. It was a La Nina year. In past years parts of Queensland had experienced severe rainfall and flooding in La Nina years. Although this is the case, 'the 2010/2011 floods have been historically unique due to their causes and wide-ranging impact.' See: World Bank and Queensland Reconstruction Authority (2011) *Queensland: Recovery and Reconstruction in the Aftermath of the 2010/2011 Flood Events and Cyclone Yasi* ,World Bank, Washington, p. 5.

In **Thailand**, the insurance sector offers property insurance for fire and business interruption to cover against losses arising from natural disaster. It also offers natural disaster coverage under automobile insurance, life and personal accident insurance and crop insurance. Issues in affordability of private flood insurance coverage recently let the government to establish the National Catastrophe Insurance Fund (NCIF).

In the **United States**, residential flood insurance has been provided mainly by the federally-run National Flood Insurance Program (NFIP) since its creation in 1968. The NFIP was developed due to the position by private insurance companies following the Mississippi floods of 1927, and continuing through the 1960s, that this peril was uninsurable. Following severe financial problems caused by the insufficient collection of premiums, in 2012 a reform was passed calling on the Federal Emergency Management Agency (FEMA), and other agencies, to make a number of changes to the way the NFIP is run. Key provisions of the legislation require the NFIP to raise rates for many policyholders to reflect true flood risk, make the program more financially stable, and change how Flood Insurance Rate Map (FIRM) updates impact policyholders.

Implementation challenges linked to private insurance markets cited by several APEC economies include:

- on the *demand side*: a weak willingness of people to take out private insurance, due to moral hazard effects (i.e., people are unwilling to pay for such insurance because they expect full compensation from government for reconstruction); an undeveloped insurance culture; a mistrust of the insurance industry due to experiences of mismanagement and unpredictable claims payments; a lack of adequate income; and high premium taxes; and,
- on the *supply side*: inadequate pricing of disaster risks due to downward undue competitive pressures or insufficiency of data for proper risk assessment (which in turn affects the scope to obtain reinsurance), a lack of promotion, lack of human capacity at the regional level, and a lack of adequate disaster risk management tools in many smaller-sized insurers.

3.3 Financial sector resilience

In many APEC economies, financial sector resilience, including capital adequacy, liquidity, and business continuity, is recognised as a key priority to ensure the sustainability of disaster risk financing, with relevant measures and initiatives in place to ensure its resilience against disasters.

For the financial sector as a whole, it is generally the case within APEC economies that no special emphasis is placed on disaster risks. Rather, all types of risks that might affect a financial institution or market infrastructure (e.g., exchange, payment system) are considered. That said, disaster risks typically raise special operational challenges, highlighting the role of business continuity planning within financial institutions and market infrastructures in addressing these risks, as well as the role of authorities in evaluating and testing these plans and ensuring proper coordination, for instance through on-going supervisory oversight and industry-wide scenario-based exercises. Also of interest is the growing role of special insurance products designed to mitigate the credit and operational risks of banking institutions, in particular against those linked to disasters (see below § 5.2.2). Moreover, and as might be expected, the regulation and supervision of the insurance sector will address the various facets of disaster risk, such as catastrophe risk models, specific capital charges or reserves, reinsurance arrangements, liquidity, and claims management.

In its guidelines for the supervision of banks, financial instruments business operators, and insurance companies, for instance, the Financial Services Agency of **Japan** requires the establishment of business continuity management strategies to cope with emergencies, as well as the development of a crisis

management manual and a business continuity plan. In **Malaysia**, extreme natural hazards are not specifically captured in the stress-testing framework for banks and insurance companies. However, guidelines have been issued for all financial institutions which outline business continuity management principles and specific requirements with regard to the formulation of a Business Continuity Plan (BCP) and Disaster Recovery Plan (DRP), implementation, testing and maintenance of the plans by the institution. As and when disaster risks may arise, the Central Bank also issues additional guidelines on necessary precautionary measures to support continuous provision of critical business services and operations. For instance, during the monsoon season in 2011, a circular was issued to all financial institutions in order to emphasise the criticality of flood preparedness scenarios under the BCP, requiring financial institutions to report affected branches/premises immediately. Other examples provided of requirements for business continuity and disaster recovery plans in the financial sector include **Brunei Darussalam**, **Hong Kong, China;** and **Indonesia**.

In **New Zealand**, the Reserve Bank of New Zealand (RBNZ) has taken a number of steps in recent years to improve the financial sector's resilience to disasters. For instance, for banks, this has involved examining operational risk within the large four banks' capital models, a review of the outsourcing policy that requires the New Zealand board of the bank to the have legal and practical ability to have control of core functions after failure, and periodic reviews of banks business continuity plans; for insurers, the RBNZ has established a new regulatory and supervisory regime and is in the process of licensing insurers. Revised capital requirements for insurers incorporate a catastrophe risk charge. As for payments systems, systemically important payments systems are required to self-assess against relevant international standards that include business continuity and to publish these self-assessments.

In **Thailand**, after the flood in 2011, the OIC reviewed the capital adequacy of all companies to ensure that companies remain strong. Since the flood caused an unexpectedly huge loss which resulted in some companies holding less capital than required but only for a short period, the OIC has allowed a waiver for such cases for a limited time. Exposure to disaster risk will later be reviewed in order for it to be included sufficiently in the risk-based capital calculation.

In **Chile**, the SVS and the insurance industry association (AACH) are planning to develop a project that establishes an earthquake and tsunami risk assessment model which would replace the current basis for calculation of the catastrophic earthquake reserve. This project aims to assess the risk of earthquake and tsunami, based on a more scientific risk mapping of the territory and a specific definition of vulnerabilities, depending on characteristic of the insured properties, through a mathematical model. This will provide more information to be used by the insurance industry that will enhance risk management, promoting more proactive risk mitigation from policyholders, especially from enterprises.

As has been highlighted by **Russia**, the business continuity plans of the nation's central bank are of great importance. The major measure directed to the preparation of the Bank of Russia for any unforeseen circumstances has been the creation of a Committee on the management of the continuity of activity of the Bank, the formation of a long-term programme of providing for the continuity of activity of the Bank, and the creation of a control system for business continuity which is integrated into the broader system of internal controls at the Bank. The current main priority of the long-term programme is the preparation of all divisions within the Bank for continuous functioning, ensuring high fault tolerance and availability of information and telecommunications infrastructure in the event of natural disasters, techno-genic accidents and large-scale emergency situations at a time when there might be interruptions in power supply and work of engineering systems, transport collapses, breaks in communications, failures in processing of financial documents and payment systems, and when employees might for various reasons be subject to significant stress. The Autoriti Monetari Brunei Darussalam of **Brunei Darussalam**, its central bank and financial regulator, has established its own crisis management plan with dedicated responsibility assigned to the offsite officers of banks for the co-ordination of bank-specific CMPs with those of the Authority.

In **Singapore**, the Monetary Authority of Singapore (MAS) prepares the industry for disasters by issuing guidelines on business continuity management and conducting supervisory inspections based on these guidelines. MAS also regularly organises industry-wide exercises (IWE) involving banks, insurers, capital market firms and financial market infrastructure. The objectives are to enhance the resilience of the financial sector and provide an opportunity for financial institutions and infrastructures to test their business continuity and communication processes, as well as enhance coordination with key industry players and civil authorities. The scenarios developed for these exercises take into account prevailing risks and concerns of MAS and the financial industry. For example, IWE I (2006) focused on terrorist attacks in the Central Business District, while IWE II (2008) was based on the outbreak of a flu pandemic. The latest IWE held in 2011, featured combined physical attacks (i.e. Mumbai-style, roving terrorist attacks across the financial sector) and targeted cyber-attacks.

Outside APEC, the case of **Italy** may be of interest, as a special working group called *Continuità di Servizio* (CODISE) has been set up in 2003 to help guarantee business continuity in the Italian financial market in the event of operational difficulties, including severe or catastrophic crisis (see **Box 13**).

Box 13. Ensuring business continuity in the Italian financial market

CODISE is a working group coordinated by the Bank of Italy in agreement with CONSOB (the Italian Securities and Exchange Commission), consisting of representatives of the leading banking groups and the companies that manage infrastructures essential to the orderly working of the financial system. CODISE is the coordinating committee for all activities, both within and outside the Bank of Italy, relating to the handling of operational crises in the national financial system.

In the event of a crisis affecting domestic operators, the CODISE coordinator must provide the necessary liaison with the Bank of Italy's crisis management units, other domestic financial operators and the European Central Bank. CODISE currently performs a number of functions:

- Coordinating the handling of operational crises involving the infrastructure and/or participants in the Italian financial system;
- Representing the Italian financial market in Eurosystem coordination activities;
- Interacting with other sectoral authorities (Civil Protection and the CONSOB);
- Serving as contact point for Italian operators in an emergency;
- Developing risk scenarios;
- Drafting business continuity rules and standards;
- Running simulations, including those coordinated by the Eurosystem, and evaluates the results and the impact on emergency management plans in terms of business continuity.

CODISE identified the financial services that were vital to the orderly functioning of the system, laid out risk levels, and evaluated the interdependence among the main participants in the domestic financial marketplace. When a crisis is declared, CODISE establishes a direct link with the Civil Protection Department.

Source: Bank of Italy - http://www.bancaditalia.it/sispaga/codise

Implementation challenges that have been identified include the need to ensure effective and timely coordination and communication among authorities charged with surveillance, the level of uncertainty surrounding the occurrence and impacts of natural disasters, human resource constraints at sub-regional government institutions, and the tendency to ignore or underestimate the importance of backup systems or recovery planning in the units that manage and supervise the budget of recovery expenditures.

One APEC economy noted that any limits regarding financial sector resilience relate in large part to the degree and adequacy of disaster preparedness within financial institutions and market infrastructures, which is a function of cost and prioritisation.

4. GOVERNMENT USE OF DISASTER RISK FINANCING TOOLS

4.1 Policy options for governments in DFR

Governments are financially impacted by disasters, due for instance to the provision of emergency relief and post-disaster aid, the repair of government assets and infrastructure and macroeconomic impacts that affect revenues.

In order to mitigate these impacts, governments may complement the investment in physical risk reduction with *ex ante* DRF tools. These *ex ante* financial tools may address short-term (emergency response), mid-term (recovery) or long-term (reconstruction) disaster impacts, and can be used in combination to cover different risk layers, based on the relative frequency and severity of the expected events. In particular, governments may employ the following *ex ante* or pre-disaster DRF tools:

(i) **Government reserves** such as dedicated contingency reserves for disasters (with allocated funds lapsing at year end), or multi-year disaster reserve funds (with allocated funds building up over time);

(ii) **Insurance**, which enables the transfer of risks and indemnifies against damage (e.g., to cover damage to government assets such as buildings and infrastructure)

(iii) **Contingent credit arrangements** with an international financial institution;

(iv) **Catastrophe bonds** or other types of catastrophe-linked securities or derivatives which provide an alternative means for risk transfer.[45]

Alternatively, governments may finance disaster risk purely on an *ex post* basis, e.g., through budget reallocations, debt financing and increased taxation. An approach blending *ex ante* and *ex post* instruments may also be adopted. See **Table 3** for options for governments in terms of the financing of disaster risk.[46]

Table 3: Approaches to financing government disaster risk

Examples of methods	
Ex ante financing	***Ex post financing***
• Dedicated reserve fund • Contingent credit facility • Insurance • Catastrophe bond, other CAT-linked security / alternative risk transfer instrument	• Budget reallocation • Debt financing / borrowing • Taxation • Multilateral / international borrowing • International aid

[45] Catastrophe-linked securities create opportunities for the transfer of disaster risks that are currently not covered by insurance markets, thus potentially broadening the overall financial coverage of such risks. See: OECD (2011), "Catastrophe-linked Securities and Capital Markets", in *Risk Awareness, Capital Markets and Catastrophic Risks*, Policy Issues in Insurance No. 14, cit.

[46] For an overview of the advantages and limitations of different financial tools see: *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing* (2012), Section II.2 and its Table 10.

With regard to the expected post-disaster government pay-outs, **timing**, among other elements, should be factored in the analysis, as different financial tools can be employed depending on the moment in which financial resources have to be deployed. For instance:

- **government reserve funds** may provide an immediate source of funding, although the level of funds obtainable may be very limited in comparison with market-based instruments;

- **market-based parametric risk transfer tools** - in the form of index-based insurance contracts, financial derivative contracts, or catastrophe-linked securities - may prove to be especially useful if the aim is to obtain financial resources as quickly as possible in the aftermath of a disaster, as the meticulous loss verification and adjustment procedure associated with insurance is not required;

- longer term financial needs, such as those for the reconstruction phase, may be better served by other types of products, including **traditional insurance and reinsurance**, depending on the circumstances.

The expected frequency and severity of disaster events also affect the choice of risk financing and transfer instruments, based on cost-benefit analysis, keeping in mind that there is always a trade-off between addressing financial vulnerabilities on the one hand and generating returns through the alternative use of funds on the other. For high-frequency events, moreover, investments in physical risk reduction are generally the most efficient use of government resources to reduce vulnerabilities.

4.2 Illustrative practices in APEC economies

4.2.1 Ex ante financing

Reserve funds are one of the mechanisms that may be used by governments to secure advance financing of disaster costs. These funds, which may be specifically dedicated to disasters but may serve a more general purpose of addressing contingencies, are financed by annual appropriations and can be drawn down in the event of a disaster. Absent a disaster or other call on the fund, they may, depending on the arrangements, lapse at the end of year, to be replenished with a new annual allocation; alternatively, the funds may be allowed to be built up over time. Reserve funds act as an explicit form of self-insurance for governments.

Governments may use reserve funds as their primary means to finance disaster risks, for instance where they face frequent but lesser impact hazards. When they face more substantive disaster risks, they may use reserve funds as part of a broader, multi-layered financial strategy; for example, reserve funds may be used to finance the first layer of disaster risk, with higher layers of risk transferred to insurance markets and/or to capital markets via catastrophe-linked securities.

Reserve funds may be used for a variety of purposes, such as emergency response and relief, recovery, and reconstruction (or for certain types of reconstruction, such as public assets and infrastructure). The types of risks covered may vary. There appears to be a trend toward enabling a portion of the reserve funds to be allocated towards investments in risk reduction.

Dedicated disaster reserve funds established in such economies as **Brunei Darussalam**, **Indonesia**, **Malaysia,** and the **Philippines** have a broad scope, whereby allocated funds can be used to cover an array of natural disasters and provide funding for different purposes. In **Brunei Darussalam**, the Ministry of Home Affairs is allocated a sum of BND 5m each year for natural disaster related purposes. In **Indonesia**, at the central level, the Rehabilitation and Reconstruction Fund is the main budget instrument to finance public post-disaster expenditures. The central government provides funding for disaster reserve funds in

state budgets. The amount of the reserve fund reflects the potential disasters that might occur and the financial capacity of the state government concerned. The reserve fund is used to perform post-disaster activities.

In **Malaysia**, a National Disaster Relief Fund provides financial aid to disaster victims to alleviate the loss of income, damaged or demolished houses, agricultural damage, livestock and aquaculture damage, as well as burial cost for fatalities due to disasters. Each year, the commercial sector and communities make contributions to help disaster victims who benefit from the Fund; these are complemented by contributions from the Malaysian Government.

In the **Philippines**, a National Disaster Risk Reduction and Management Fund not only provides a calamity fund for disaster relief and rehabilitation but has recently been made more flexible so as to be used for disaster risk reduction purposes (e.g., preparedness and mitigation programs, training and procurement of equipment, construction of evacuation centres and other facilities, payments for insurance policies, etc.) (see **Box 14**). The Department of Finance recently started the process of formalising a comprehensive DRF strategy, in order to complement the existing disaster funds and budget appropriations. Accordingly, in September 2011 the government of the Philippines entered into a special contingent credit arrangement with the World Bank, called the Disaster Risk Management Development Policy Loan with a Catastrophe Deferred Drawdown Option (CAT-DDO). This financial tool, aimed at covering disaster costs in excess to the funds allocated pursuant to *Philippine Disaster Risk Reduction and Management Act* (2010), is a contingent credit line that provides immediate liquidity up to the amount of USD 500m in the aftermath of a natural disaster. Triggered in December 2011 by President Aquino's official declaration of a State of National Calamity following the heavy losses and damages caused by Tropical Storm Sendong (Washi),[47] payment under the CAT-DDO gave the Philippine government immediate access to the necessary resources to finance the relief, recovery and reconstruction costs.

Box 14

Philippine Disaster Funds

In the Philippines, one of the most disaster-prone economies in the world, risk financing is listed as one of the priority projects by the National Disaster Risk Reduction and Management Plan 2011-2028, in keeping with the aims and objectives of the comprehensive reform enacted with the *Philippine Disaster Risk Reduction and Management Act* (2010). Prior to the passage of this Act, the focus of disaster risk reduction and management in the Philippines was on relief and reconstruction. The massive impact of Typhoons Ketsana and Parma in 2009 served as the catalyst to highlight the need to address disaster risk reduction and fiscal risks.

The reform established the National Disaster Risk Reduction and Management Council (NDRRMC) which among other duties was tasked with developing appropriate risk transfer mechanisms and revamping the National and Local Calamity funds in order to finance *ex ante* disaster risk preparedness and mitigation activities. Aside from existing budgetary appropriations for government departments and agencies, the main disaster funds that can be tapped to finance disaster relief, recovery, and reconstruction are:

- National Disaster Risk Reduction and Management Fund (National DRRM Fund)
- Local Disaster Risk Reduction and Management Fund (Local DRRM Fund).

Local governments have the primary responsibility to provide immediate relief to their constituents. Yet in many cases, local resources are not adequate and must be complemented by central government resources. Under the Department of Social Welfare and Development, various programs provide financial assistance to communities affected by a natural disaster: relief in the form of goods and services to victims of natural disasters; rice subsidies; core shelter assistance programs; food for work programs and assistance to victims of specific natural disasters. The main target population are the poorest segments of the society.

The NDRRMC is responsible for managing and mobilising resources for DRM, including the National DRRM

[47] Proclamation n.303 of 20 December 2010 declaring a State of National Calamity.

Fund, and monitoring and providing the necessary guidelines and procedures on the Local DRRM Fund releases as well as the use, accounting, and auditing of these releases. Under the new Act, a certain amount of the allocated funds are set aside for the payment of insurance premiums for the coverage of public assets, which in the past have often been uninsured or underinsured, particularly at the local government level.

Formerly known as the National Calamity Fund, the **National DRRM Fund** can, given its new-found flexibility, be employed not only for relief, recovery, reconstruction and other work or services in connection with natural or human-induced calamities, but also for disaster risk reduction or mitigation, prevention and preparedness activities such as the training of personnel, procurement of equipment, and capital expenditures.

The National DRRM Fund has seen its annual allocations, which had been around USD 46m and proved to be inadequate to meet the costs of disasters, grow dramatically: the allocation to the Fund increased by more than 200% in 2011, amounting to USD 115m, and was further increased to USD 174m in 2012, highlighting the priority attached to DRM issues.

Not less than 5% of the estimated revenue from regular sources must be allocated each year to the Local DRRM Fund to support disaster risk management activities such as pre-disaster preparedness programs, including training, purchasing life-saving equipment, supply and equipment for post disaster activities and for payment of premium on calamity insurance.

A share equal to 30% of both the National DRRM Fund and the Local DRRM Fund are to be allocated for Quick Response Fund (QRF) or Stand-by Fund for relief and recovery programs. This strengthens the legal and institutional capacities of local government units for self-determination through devolution and decentralisation of responsibilities and authority that have been bestowed upon them by the Local Government Code of 1991.

The Local Disaster Risk Reduction and Management Council (LDRRMC) monitors and evaluates the use and disbursement of the Local DRRM Fund. Under certain conditions, the LDRRMC may transfer resources from its Fund to support disaster risk reduction activities of other LDRRMCs which are declared under state of calamity. Unexpended resources in the Local DRRM Fund accrue to a special trust fund for the sole purpose of supporting disaster risk reduction and management activities of the LDRRMCs within the following five years. Any amount still not fully utilised after five years reverts back to the general fund and can be made available for other social services identified by the local *sanggunian* (council).

Disaster reserve funds set up in other APEC economies - such as **Mexico**, **Russia**, **Chinese Taipei**, and the **United States** - have more specific purposes. In **Mexico**, a Fund for Natural Disasters (FONDEN) provides a tool to finance the costs of recovery and reconstruction of damaged public assets and infrastructures. Its main purpose is to provide the 32 Mexican States and the Federal Agencies in charge of federal infrastructure with the necessary resources to cover the losses and damages caused by natural hazards, whose magnitude may exceed their financial capacity. Funds from FONDEN can also be used for the rehabilitation and reconstruction of low-incoming housing and certain components of the natural environment (e.g., forestry, protected natural areas, rivers, and lagoons). Mexico has constructed reinsurance and catastrophe bond programmes to augment the financial capacity of FONDEN and limit the financial exposure of Mexico to disaster risk (see **Box 15**).

In **Russia**, the federal budget provides for expenditures of the reserve fund of the Government of the Russian Federation for the prevention and elimination of emergency situations and natural disasters for housing of the individuals as a result of natural disasters. Budget allocations from the fund are made in accordance with prescribed rules, namely that repayment can be made for state housing certificates issued to Russian citizens who lost their homes as a result of emergencies, natural disasters, acts of terrorism or suppress terrorist acts. Accordingly, citizens who have lost premises as a result of natural disasters can, with the help of the mechanism of the state housing certificates, purchase new premises or rebuild destroyed at the expense of budgetary provisions. In **Chinese Taipei**, provisions are made for disaster reserve funds in the annual budgets of both central and local governments. If these resources prove to be insufficient to address disaster needs, the so-called "Secondary Reserve Fund" can be accessed.

In the **United States**, federal funding for disaster events may only be provided when the President declares a major disaster or state of emergency. In these situations, the Budget Control Act supports a cap adjustment exclusively for disaster relief, providing a budget vehicle for disaster requirements and

facilitating a shift from a reliance on supplemental appropriations. Among other resources, a dedicated amount of funding is also set aside every year – in the form of a Capital Fund, monitored by the Department of Housing and Urban Development – that serves to assist government departments and housing authorities to pay for reconstruction costs to public housing when their insurance coverage has been exhausted or there is no other federal assistance. The Fund can be used for damage from a presidentially declared disaster or in some instances a non-presidentially declared disaster for damage arising from an extraordinary event (earthquake, flood, tornado or hurricane). A public housing authority may apply for assistance from the Fund by providing the requisite documentation with a cost estimate.

Box 15

Mexico: A layered approach

In Mexico, a **Fund for Natural Disasters (FONDEN)** was established in 1996 as a tool to finance the costs of recovery and reconstruction of damaged public assets and infrastructures and coordinate the actions of intergovernmental and inter-institutional entities. The creation of FONDEN was linked to the development of an integrated DRM framework involving risk assessment, prevention, reduction and transfer tools. Both the Ministry of Finance and the Ministry of Interior appoint members of the FONDEN Board.

The main purpose of FONDEN is to provide the 32 Mexican States and the Federal Agencies in charge of federal infrastructure with the necessary resources to cover the losses and damages caused by natural phenomena, whose magnitude may exceed their financial capacity. FONDEN is made up of three main financial components:

- *The FONDEN Program for Reconstruction*. Designed to provide financial support to rehabilitate and reconstruct public assets, it has a budget line within the Federal Budget of every year and works mostly as a cash transfer to the Trust. It focuses on

  (i) The reconstruction of public infrastructure at level of government (federal, state, and municipal);

  (ii) The reconstruction of low-incoming housing; and

  (iii) The restoration of forestry, protected natural areas, rivers, and lagoons.

- *The FONDEN Trust*. Established to provide resources for the activities of the FONDEN Program, it is the financial tool through which the reconstruction costs are paid and the acquisition of risk transfer tools is financed, including insurance and CAT bonds.

- *The Revolving Fund*. A tool designed to provide the financial means to respond to the immediate needs of the affected population in the post-disaster phase.

The reconstruction costs of infrastructures belonging to States and Municipalities are covered by FONDEN up to 50%, while the remaining portion of the loss is sustained by local governments, which have access to a credit line provided by the Reconstruction Fund for local entities.

Originally created as a budgetary tool to allocate funds on an annual basis, in 1999 it was transformed into a multi-year reserve fund, the FONDEN Trust, accumulating the unspent disaster budget of each year. Moreover, the government encouraged and provided incentives to the local states to insure their assets and infrastructure, in order to gradually reduce the impact on federal and local budgets when a major event occurs.

In 2006 FONDEN issued a USD160m parametric catastrophe bond against earthquake risks in three zones for a three year duration; in addition, it secured USD290m of parametric reinsurance coverage for the same three zones for three years, bringing its total protection to USD450m. In October 2009, it issued a USD290m multi-peril parametric catastrophe bond covering both earthquake and hurricane risks with a three-year maturity. After the 2009 bond matured, a third issuance was made in October 2012. MultiCat 2012 is a three-tranche catastrophe bond, for an overall value of USD315m, covering earthquake and hurricane risks in multiple regions with a parametric trigger. Starting from 2011, moreover, FONDEN secured a USD400m indemnity-based excess of loss reinsurance treaty that will cover the losses sustained by the Federal government for government assets and low-income housing, limited to replacement costs.

The approach adopted by Mexico is sophisticated. It shows that a strong legal and institutional framework, created in this case through FONDEN (including through its board of directors, which is composed of key government stakeholders), can be critical to coordinating the efforts of central and local authorities in the various

phases of DRM, from risk assessment to risk financing and transfer. Such framework is also crucial to support public decision making on how different risk layers should be managed. In Mexico a wide range of financial tools is employed, selected on the basis of the frequency and severity of disaster events: recurring events are covered by the annual budget line (also available to finance the purchase of insurance by government dependencies); a multi-year reserve fund, the FONDEN Trust, is aimed at covering less frequent event; deviations from the assessment of future potential reconstruction costs are covered by the indemnity-based non proportional reinsurance program; finally, catastrophe-linked securities are employed to finance emergency response costs triggered by major disaster events.

In other economies, such as **Hong Kong, China; and Japan**, general fiscal reserves may be used as a cushion against unforeseen events. In **Japan**, the Contingency Reserve can be secured for addressing unexpected situations and was used to address the needs arising from the Great East Japan Earthquake. In **Chile**, the Economic and Social Stabilisation Fund, which is used to manage external shocks to Chile's economy, could potentially be used to meet disaster costs in the future.

In regard to the use of insurance by governments for the coverage of public assets, the picture is mixed across APEC economies. In **Australia**, a key principle of the Natural Disaster Relief and Recovery Arrangements (NDRRA) under which the Australian Government provides financial assistance to State and Territory governments is that the support provided is not to supplant or operate as a disincentive for insurance or disaster mitigation. States are required to explore a range of insurance options in the market place and assess available options on a cost–benefit basis. Similarly, in **New Zealand**, individual government departments are not required to insure against all their risks; instead, they are required to systematically assess all risk management options available to them, of which insurance is one option. The Minister of Finance retains an interest in the insurance arrangements of departments given their relevance for the government's overall financial position and ownership interests in departments. Departments are encouraged to share best practice in relation to insurance and risk management. This may also involve the development of shared services schemes where practicable. In **Chinese Taipei**, the government has to date not purchased insurance for public infrastructure based on its evaluation of the costs and benefits.

In the **Philippines**, insurance of public assets is mainly provided by the Government Service Insurance System (GSIS) through the Property Insurance Fund, which was established in 1951 to indemnify or compensate the Government for any damage to, or loss of, its properties due to fire, earthquake, storm, or other casualty. The Fund was later renamed the General Insurance Fund in 1973. Notwithstanding the GSIS, government assets, particularly those of local governments, were in the past often uninsured or underinsured. This issue may now be addressed given that government reserve funds must now set aside a certain amount for the payment of insurance premiums for coverage of public assets. In **Indonesia**, several local governments have made use of insurance to protect these assets against disasters. Almost all local governments are owners of PT Bangun Askrida, an insurance company through which insurance is usually provided. In **Russia**, insurance of critical infrastructure is present. For instance, all nuclear power plants are governed by a single company "Rosenergoatom", which selects an insurer to provide protection against catastrophic risks.

Implementation challenges highlighted by APEC economies include the lack of financial resources to be committed *ex ante*, both at central and local levels of government, to DRF tools, the lack of information sharing among government divisions and communities to identify funding needs, the lack of proper documentation to demonstrate the credibility of risk assessments, and the unavailability of a proper legal and regulatory framework for the design and implementation of market-based sovereign risk transfer mechanisms. One economy cited some obstacles related to specific DRF instruments: for contingent credit, it was believed that such arrangements are of less value where the government has a strong fiscal position and has regular access to capital markets; for catastrophe bonds, their complexity and pricing challenges were seen as problematic.

4.2.2 Ex post financing

Although there can be great utility in making use of *ex ante* disaster risk financing tools, there are significant opportunity costs involved, especially in terms of investment potential. Holding a hypothecated cash fund in the expectation that it may be drawn upon at some stage in the future to finance disaster responses, for instance, is not typically a costless exercise.

In this perspective, the concept of holding a cash fund to finance disaster recovery is ultimately a question of cash management and when the government chooses to raise its finance. The government can choose to borrow for disaster recovery - if necessary - and set cash aside *ex ante*, or it can finance disaster recovery after a disaster. It is for this reason that those economies that are well placed to access the international financial markets and have the ability to create fiscal resources quickly when needed opt against establishing reserve funds or purchasing insurance, preferring instead to utilise *ex post* disaster financing mechanisms. Such mechanisms include in-year budget reallocations, longer-term realignment of investment budgets, taxation, deficit financing and international assistance.[48]

In **Australia**, the Australian government's contributions to disaster recovery costs under the NDRRA provide *ex post* funding support to Australia's state and territory governments. For an economy like Australia that is well placed to access the financial markets, raising cash as and when needed to finance disaster recovery measures is consistent with efficient balance sheet and cash management.

In **New Zealand**, there are special legislative arrangements that facilitate *ex post* funding of disaster losses. As has been noted, the New Zealand *Public Finance Act* allows for expenses or capital expenditures to be incurred in emergencies without further authority from Parliament when certain conditions are met.

4.3 Regional risk pooling initiatives within and beyond APEC

Experience shows that the pooling of disaster risks at the regional level may allow smaller economies to benefit from mutual risk sharing and economies of scale when accessing the international reinsurance marketplace.

A notable recent example is offered by the **Pacific Disaster Risk Financing and Insurance** (PDRFI) **Program**. PDRFI provides the Ministries of Finance of PICs with advisory services to help improve their macro-economic planning against extreme natural events and develop a disaster risk financing strategy.[49] Based on catastrophe models developed in the context of PCRAFI (see **Box 7**), in January 2013 a pilot catastrophe risk transfer program was launched to provide the governments of five PICs with immediate funding if a major natural disaster occurs. The participants in this pilot program, supported by a grant of the Government of Japan, are: the Marshall Islands, Samoa, Solomon Islands, Tonga and Vanuatu.

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[48] See: *G20/OECD Methodological Framework for Disaster Risk Assessment and Risk Financing* (2012), Section II.2 and its Table 11; see also: World Bank & GFDRR (2012), *Advancing Disaster Risk in ASEAN Member States: Framework and Options for Implementation*, Washington, DC, 31 ff.

[49] The technical assistance focuses on three core aspects: (i) the development of a public financial management strategy for natural disasters, recognizing the need for *ex ante* and *ex post* financial tools and acknowledging the different financial requirements associated with the different layers of risk; (ii) post-disaster budget execution process, to ensure that funds can be accessed and disbursed easily and effectively post disaster; and (iii) the insurance of critical public infrastructure, to reduce the much larger funding requirements for recovery and reconstruction needs.

Coverage of the emergency response costs – up to USD 45m in aggregate for the year 2013 - is provided by the private (re)insurance market[50] under this regional risk pooling scheme against the risk of losses due to earthquakes, tsunamis and tropical cyclones, based on a parametric trigger formula. More specifically, pay-outs under the catastrophe swap transaction are triggered by modelled government emergency response costs, calculated using physical parameters for the event derived from the Joint Typhoon Warning Centre and the US Geological Survey (USGS).

The five derivative contracts specific to participant members have been placed on the international reinsurance market as a single, diversified portfolio of risks, which allowed for significant price reduction. To this end, the World Bank, through the International Development Agency (IDA), acted as the intermediary and entered into back-to-back catastrophe swap transactions.

The aim of this innovative financial tool is not to replace post-disaster international donor assistance, rather to increase the budget flexibility and reduce the contingent liabilities of participating PICs governments, thereby strengthening the ability of these economies to withstand a disaster event from a financial viewpoint.

PDRFI was inspired by the Caribbean Catastrophe Risk Insurance Facility (CCRIF), a mutual insurance company controlled by participating Caribbean islands governments.[51] CCRIF was initially capitalised by the participating members, with support from donor partners. A portion of the pooled risks is retained through reserves, which reduces the cost of insurance premiums. The residual risk is transferred by purchasing reinsurance and catastrophe swaps.

CCRIF helps to mitigate the short-term cash flow problems small developing economies suffer after major natural disasters. A critical challenge is often the need for short-term liquidity to maintain essential government services until additional resources become available. CCRIF represents a cost-effective way to pre-finance short term liquidity to begin recovery efforts for an individual government after a catastrophic event, thereby filling the gap between immediate response aid and long-term redevelopment. As a result, members benefit from: (i) the ability to transfer a portion of their hurricane and earthquake risk to the CCRIF at a price lower than what they would pay if they were able to obtain coverage individually in international insurance markets or the cost of the capital they would need in order to self-insure; and (ii) the financial protection of prompt cash pay-out, within two weeks or less, following a covered event.

Since its establishment, CCRIF rapidly built its capital and risk bearing capacity. As CCRIF's financial strength has improved, it has lowered the premiums charged, in order to make its coverage more affordable. Since its first year of operations, CCRIF has lowered its pricing various times for a total reduction of about 30 per cent.

Another regional disaster risk financing initiative inspired by CCRIF is the African Risk Capacity (ARC).[52] The ARC is an extreme weather insurance scheme designed to help African Union (AU) member

[50] Participating insurers are: Sompo Japan Insurance, Mitsui Sumitomo Insurance, Tokio Marine & Nichido Fire Insurance and Swiss Re.

[51] Sixteen governments are currently members of the Facility: Anguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St. Kitts & Nevis, St. Lucia, St. Vincent & the Grenadines, Trinidad & Tobago and Turks & Caicos Islands.

[52] The original signatories of the Establishment Treaty on 23 November 2012 are: Burkina Faso, Burundi, Central African Republic, Chad, Republic of Congo, Djibouti, Gambia, Guinea, Liberia, Libya, Malawi, Mozambique, Niger, Rwanda, Sahrawi Arab Democratic Republic, Senegal, Togo and Zimbabwe. Kenya and Mauritania joined on 28 January 2013, Ivory Coast on 6 February 2013 and Comoros on 15 February 2013.

economies resist and recover from natural disasters. This entity will use advanced satellite weather surveillance and software - developed by the UN World Food Programme (WFP) - to estimate and disburse immediate funds to African economies hit by severe drought, with other hazards to follow in the coming years. Economies that participate in ARC will benefit from in an index-based insurance mechanism for infrequent, severe drought events.

The concept for ARC is roughly based on the CCRIF, modified for the special features of African multi-seasonal weather risk in its financial design and based on Africa RiskView (see **Box 11**), the pool's governance structure mirrors the CCRIF as an African-owned stand-alone entity.

The purpose of the two entities is, nevertheless, quite different: the CCRIF was established to provide contingent funds to governments in the case of a hurricane or earthquake thereby allowing public facilities to continue their operations. Payments from the pool go directly in to the general budget of the affected economies and is not earmarked or monitored thereafter. To the contrary, pay-outs from the ARC are meant to finance early and timely responses to food insecurity caused by extreme weather events. Participating members need to develop contingency plans in the event of a pay-out and the ARC governing body needs to develop a process for ensuring that funds in the pool are protected and spent in a way that best addresses the pressing issues facing the most vulnerable populations. By bringing together the concepts of insurance and contingency planning, ARC aims to create a new way of managing weather risk by transferring the burden away from African governments, and their vulnerable populations who depend on government assistance, to international financial markets that can handle the risk much better.[53]

Reportedly, up to a 50% saving can be obtained from diversification of drought-related losses across Africa, that is to say a 50% reduction in the contingent funds needed if the risk is pooled among nations and managed as a group rather than borne by each economy individually. These are savings that can then be invested in longer term development projects and disaster risk reduction activities.

Solvency and sustainability objectives can be achieved using a variety of different financing approaches and instruments, including the coordinated use of risk retention, risk transfer and contingent financing from international financing entities to create a layered financing structure within the pool and also within participating economies themselves:

- **Retention by participants in the scheme**: Members retain a portion of risk, using existing resources to manage the impact of less severe, localised or frequent events;

- **Risk pool reserves (ARC retention)**: Reserves layer of the pool are based on contributions of participating members in the form of annual premiums, in addition to initial donor capitalisation.

- **Risk pool contingent financing (ARC risk transfer)**: The ARC risk pool transfers extreme drought risk that it believes it would be inefficient to hold as reserves within the pool to international carriers via reinsurance, derivative contracts and/or catastrophe-linked securities.

To be effective, pooled risk transfer programs and schemes – such as PDRFI, CCRIF and ARC – need to be linked to defined contingency plans within a domestic disaster risk management framework.

[53] Donors are: Rockefeller Foundation, Department for International Development (DFID) of the Government of the United Kingdom, Swedish International Development Cooperation Agency (SIDA), International Fund for Agriculture Development (IFAD), and the Swiss Agency for Development and Cooperation (SDC).

5. PRIVATE MARKET SOLUTIONS FOR DISASTER RISK FINANCING AND INSTITUTIONAL ARRANGEMENTS

5.1 Key policies and measures

Promoting financial protection within the economy can serve to better protect populations against disasters, reduce government exposures, and provide signals regarding needed risk reduction measures.

Following the assessment of financial vulnerabilities and possible financing gaps, targeted policies and measures can be established to support the development and sustainability of private sector solutions for DRF and to promote widespread access to such markets. These measures may include:

a) Strengthening the legislative and regulatory framework for the financial sector (especially the insurance sector) or amending this framework to facilitate and encourage the development of specific instruments or the coverage of specific risks (e.g., enacting special regulatory regimes for parametric products, micro-insurance schemes or catastrophe-linked securities; introducing tax incentives for private insurance coverage; enabling the use of insurance as a risk management tool for public entities)[54];

b) Establishing a financial scheme by industry, government or both.

Institutional arrangements – or the frameworks, systems, organisations, instruments, rules, and processes established to promote the financial management of disaster risks – may be necessary to support private-sector development of products designed to provide needed financial tools for identified vulnerable populations or sectors of the economy, such as micro-insurance or parametric insurance products, often marketed through innovative distribution channels (see below § 5.2). Institutional arrangements may also facilitate the coordination between public and private sector efforts in various fields, such as data collection, risk modelling and assessment, risk reduction and risk awareness.[55]

These arrangements may be complemented by special subsidies or tax incentives. In **Korea**, partial premium subsidies are offered by central and local governments to support a special insurance scheme for storms and flooding, controlled by NEMA but operated by a private insurance company. Government support is also provided to crop disaster insurance and fisheries disaster insurance programmes operated under the authority of the Ministry of Agriculture, Food and Rural Affairs and the Ministry of Oceans and Fisheries. In **Chinese Taipei**, for instance, tax relief measures are available to those who have suffered from a disaster and to those who provide donations in support of disaster aid. Concerning fiscal measures, in **Japan** income tax deductions for earthquake insurance premiums have been introduced, in order to incentivise the purchase of coverage.

In response to the unusually severe monsoon floods in 2006, the central bank of **Malaysia** (BNM) allocated RM500m to a Special Relief Guarantee Facility (SRGF), to aid in recovering small businesses and rebuilding damaged infrastructure in areas affected by disasters, through commercial and other banks.

[54] In **Singapore**, for instance, a regulatory framework governing Special Purpose Reinsurance Vehicles (SPRVs) was introduced in 2008 to facilitate the setting up of insurance securitisation as an alternative risk management tool to reinsurance – insurers can transfer insurance risk directly to the capital markets.

[55] The Caribbean Catastrophe Risk Insurance Facility (CCRIF) and the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) are good examples of effective coordination. See: **Box 7** and § 4.3 above.

The facility is an example of public-private partnership in which the commercial banks provide the financing with 2.5% interest to the borrower while BNM covers an additional 2.45% of interest and 80% guarantee of the financing obtained.

5.2 Promoting innovative risk transfer tools

In economies where private DRF markets and infrastructures are not yet developed, where government resources are severely constrained, or the paying capacity of the most vulnerable layers of the population is extremely low, the promotion of risk financing and transfer tools requires the introduction of innovative products, instruments and solutions.

Several innovative insurance and micro-insurance solutions, including weather index-based products and portfolio protection tools aimed at strengthening the resilience of rural banks, credit cooperatives, microfinance lenders and other financial institutions against disaster risk, have been the subject of experimentation and been tested in various economies, with the support of the international donor community. Some of these tools have been introduced only recently, so that it may be too early for an assessment. Yet, a presentation of their structure and basic features may provide useful guidance for the identification of possible solutions targeted to APEC economies where the financial and insurance markets are still in the initial stages of development.

5.2.1 Linking risk transfer to risk mitigation

A first group of innovative tools promote investment in the mitigation of disaster risks by introducing special features into the structure of the risk transfer product.

A notable example within APEC is offered by the "Forecast Insurance" recently developed in **Peru** in the context of an international cooperation project launched by Germany in 2010, within the scope of the International Climate Initiative (ICI).[56] The purpose of the project is to make available innovative weather insurance products to producer associations, agro-export companies, fisheries,[57] and financial and governmental institutions along Peru's northern coast.[58] Studies in this field have been conducted since 2004 with the support of other donors.[59]

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[56] The initiative was commissioned by the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) and managed by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

[57] The agricultural and fishery sectors constitute a significant component of Peru's economic activities.

[58] The project specifically targets northern coastal regions that are most affected by the El Niño (Piura, Lambayeque, and La Libertad). 'The project strategy is divided into four action lines. The first is performing a demand and risk analysis in order that the population and public and private institutions (target group) in the pilot region have a clear idea of the need and advantages of purchasing weather insurance as a means of lowering weather-related risks. The second is weather insurance product development tailored to the target group's needs. The third is institutionality and legal framework strengthening on the matter of weather insurance in both the government and private spheres. Furthermore, national institutions are supporting the respective adaptation of the legal framework so that weather insurance is endorsed. Finally, the fourth action line is knowledge management for spreading information on weather insurance products nationally and internationally, for promoting experience sharing, and for evaluating their reproducibility in other Peruvian regions and throughout Latin America.' *Lessons learned from the "Insurance for Climate Change Adaptation" Project in Peru* (July 2012), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Lima (Peru), p. 5.

[59] Including USAID, Bill and Melinda Gates Foundation and UNDP.

The Extreme El Niño Insurance Product (EENIP) is an index "forecast" insurance product, designed to provide a wide range of stakeholders with the financial means to prepare for the consequences of imminent extreme natural events. These consequences include the extra costs and losses associated with catastrophic rainfall and flooding that follow a build-up of extreme levels of sea surface temperatures (SSTs) in the Pacific. "El Niño" is cyclical climate phenomenon characterised by complex interactions between the ocean and the atmosphere across the eastern and western tropical Pacific, caused by a disruption in El Niño Southern Oscillation (ENSO).[60]

Pay-outs of the EENIP are triggered by extreme increases in Pacific SST that occur during an El Niño year.[61] The SST indicator is observed months before the onset of heavy rainfall on land, triggering pay-outs that enable the insured persons to finance and to implement loss prevention and risk management strategies well before the catastrophic flooding reaches full force.

From a technical viewpoint, it is worth noting that the EENIP for Piura makes payments based on average November-December Niño 1+2 SST measurements, thus enabling rapid payouts in January before the onset of flooding. Based on series of studies, a relationship between such values and precipitation levels in the region was established.[62] The analysis was then refined to determine an appropriate SST value for triggering payment under the insurance contract. Reportedly, logistic regression was used identify Nino 1+2 values that correspond to rainfall events with return periods of 10 and 20 years respectively, representative of a strong El Niño event.[63] Limiting insurance coverage to the less frequent yet strongest El Niño events allowed for affordable pricing of the product, while providing protection against more severe losses. Because the weather index is based on predictions for determining the pay-out, the insurance must be purchased one year in advance before any index confirms the occurrence of an extreme El Niño phenomenon.

The EENIP can reduce exposure to unexpected losses and costs for vulnerable households, enterprises, and public sector entities, while facilitating disaster mitigation and planning. As such, the EENIP appears to be an innovative insurance product that could facilitate risk mitigation through payouts based on forecasting, thereby allowing for *ex ante* loss prevention.

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[60] Trade winds and ocean currents in the equatorial Pacific change course, thus causing SST to increase and convection to shift from the western to the central Pacific. El Niño (the warm phase) and La Niña (the cool phase) refer to the two extremes on this spectrum as indicated by changes in SSTs. See: GlobalAgRisk (2012), *Extreme El Niño Insurance for Climate Change Prevention and Adaptation in Peru (Technical Note 2)*, Deutsche Gesellschaft für Internationale Zusammenarbeit, Lima (Peru).

[61] The U.S. National Oceanic and Atmospheric Association (NOAA) maintains a public database of historic and current SST measurements from four regions in the Pacific. SSTs have become the standard scientific benchmark for monitoring changes in geophysical processes that signal an El Niño year. Sustained SST elevation occurring in specific regions of the Pacific Ocean is one of the primary indicators of El Niño, as monitored by meteorological institutions around the world. The time series of monthly average SST measurements maintained by NOAA span from 1950. NOAA also synthesises a number of ENSO indices, using recorded and reconstructed SSTs, available at monthly resolution dating back to 1856. See: www.cpc.ncep.noaa.gov/data/indexes/sstoi.indexes; see also: GlobalAgRisk (2012), *Extreme El Niño Insurance for Climate Change Prevention and Adaptation in Peru (Technical Note 2)*, cit.

[62] See: Khalil, A. F., H. H. Kwon, U. Lall, M. J. Miranda, and J. R. Skees. (2007) "El Niño Southern Oscillation-based Index Insurance for Floods: Statistical Risk Analyses and Application to Peru." Water Resources Research, p. 43; Lagos, P., Y. Silva, E. Nickl, and K. Mosquera. (2008) "El Niño-related Precipitation Variability in Peru", Advances in Geosciences Vol. 14, pp. 231–237.

[63] The current version of the Niño 1+2 (November and December) insurance contract starts paying at 24 ºc with a maximum payment at 27 ºc. Studies are currently being conducted to anticipate the payouts using Niño 3 measurements.

Outside APEC, the Weather Index-Based Livelihood Protection Policy experimented in **Santa Lucia** is an innovative risk transfer product aimed at improving the credit worthiness of insured persons in the long-term, facilitating their access to loans and other financial services that may drive disaster risk reduction investments and economic growth (See **Box 16**).

Box 16

Saint Lucia: Weather Index-Based Livelihood Protection Policy

In October 2012, an innovative weather index-based micro insurance product, developed by a consortium of partners named Climate Risk Adaption and Insurance in the Caribbean Programme (CRAICP),[64] and called the Livelihood Protection Policy (LPP) was launched in Saint Lucia.

The aim of the product is to provide livelihood protection for low-income populations against adverse weather risks, offering a safety net for those whose incomes are affected by severe climatic events, such as strong winds and heavy rainfall during hurricanes and tropical storms. A wide range of beneficiaries is envisaged: from fishermen whose core activity may be negatively affected by storms, to farmers whose harvest depends on rain levels.

From a technical viewpoint, the territory of the island of Saint Lucia was divided into 39 grid cells and each insured person is assigned to the cell in which he or she is domiciled. Pricing of coverage is based on a fixed 8% rate on the sum insured across the entire island, without any differentiation from cell to cell. The maximum sum that can be insured is approximately USD 3,700 and customers may decide the amount of coverage required in 10 segments of equal value.

Rainfall levels and wind-speed at the centre point of each grid cell are monitored on a daily basis by satellite technology and insured persons receive early warnings and emergency advice via mobile phone SMS, allowing them to anticipate a storm and take precautionary measures. If coverage is triggered by the severity of a weather event, there is no need for the beneficiaries to lodge a claim with the insurer, as pay-outs are directly credited to the insured persons' bank account.[65]

While extremely promising, these examples show that developing weather insurance capacities is a long term, difficult process. To develop weather insurance, one must generate reliable information and data, which often proves to be a challenge. Strengthening the financial literacy of potential users of innovative instruments is also crucial. Financial instruments, such as weather insurance, can be part of a comprehensive risk management and transfer strategy, helping to ensure that small holders have a wide range of financial products, such as savings, credit, and insurance, to manage weather risks.

5.2.2 Using lending institutions as risk aggregators

As many APEC economies are highly exposed to extreme weather events like torrential rain and strong wind, microfinance institutions operating there face significant financial risks related to natural hazards. The cash flow of credit cooperatives in the **Philippines**, for instance, can be suddenly interrupted if member borrowers lose their livelihoods and assets in a storm and become unable to fulfil their debt obligations.

[64] CRAICP is financed by the German Ministry of the Environment and Nuclear Safety (BmU) and implemented by the Munich Climate Insurance Initiative (MCII) through a partnership with MicroEnsure and CCRIF.

[65] The policy is underwritten by EC Global Insurance Company Limited and distributed via several local distribution channels, including the St. Lucia Development Bank and the Credit Union League.

Similarly, the banking and financial sectors in **Indonesia** face severe earthquake exposures, especially those firms that have limited capacities to diversify geographically.[66] Local credit institutions, such as rural banks and microfinance lenders, dominate the financial landscape in this economy and have the most comprehensive outreach to small and medium enterprises, which in turn represent the backbone of Indonesia's growing economy. Liquidity issues, capital base erosion, poor loan performance, limited access to second-tier financing and extra-costs are some of the key areas of concern for these financial institutions facing earthquake risk; supporting them in the management of their exposures, therefore, has important social and economic implications.

Starting from the end of 2010, a group of partners[67] working in support of the Cooperative Life Insurance and Mutual Benefit Services (CLIMBS)[68] have been implementing a weather-index-based micro-insurance product in the **Philippines**. This product is employed as a hedge for credit portfolios, enabling the cooperatives to limit their loan defaults and meet their social commitments in the event of a catastrophe. This extreme weather event insurance tool is based upon a parametric index for each municipality, developed by private sector partners, categorising wind speed and rainfall into 10-, 15-, and 20-year recurrence events. Using these benchmarks as pay-out triggers, CLIMBS compensates local cooperatives based on a pre-determined percentage of the value of their portfolios of loans, depending on the event intensity and corresponding category class. Shortly after a trigger event, the institution concerned receives a reinsurance payment which is then disbursed to its members in the form of emergency loans granted on favourable terms, according to the specific needs. The insured cooperatives must make a commitment to pass on the insurance benefits to their members and each of them establishes a Natural Catastrophe Fund.

The micro-insurance product CLIMBS Catastrophe Protection Policy appears to be beneficial to the cooperatives, by helping them manage their exposure to the default risk, but also to the member borrowers or shareholders of these cooperatives, by protecting their equity and investments in the cooperatives and by enabling them to rebuild their livelihoods after an extreme weather event. From an operational viewpoint, CLIMBS acts as an aggregator of individual cooperatives and provides a distribution network.

In **Indonesia**, a group of partners in collaboration with PT. Asuransi MAIPARK Indonesia is developing index-based earthquake insurance to strengthen the resiliency of the financial sector that serves lower income households and SMEs. The "Earthquake Index Insurance" product (EQII) is designed to transfer portfolio risks of financial institutions, such as banks, financial services firms and credit unions, enabling them to expand access to financial services in vulnerable, under-served areas and to aid in local recovery through continued lending after an earthquake event. An intensity index of geographically-mapped earthquake-induced ground motion is used as a trigger for EQII: in order to obtain the pay-out, this index is calibrated to the insured entity expectation of loan non-performance across its portfolio. Payment rates increase with the event intensity, and are weighted to reflect the geographic spread of the portfolio as well as population density. Secondary lenders, providing long term capital for on-lending, are also protected by EQII insofar as their clients acquire an improved credit profile. Earthquake risk insurance constitutes an important component of DRM strategies. Using EQII to protect financial institutions,

[66] "Geographically concentrated FIs have limited institutional protection against earthquake risk and limited ability to access new capital following a disaster". See: GlobalAgRisk (2013), *Portfolio Protection against Earthquake Disaster for Second-Tier Financial Institutions in Indonesia*, Concept note, http://globalagrisk.com/Pubs/2013%20MFI%20Concept%20note%20for%20Secondary-Tier%20Banks.pdf

[67] Including Munich Re and the German Gesellschaft für Internationale Zusammenarbeit (GIZ).

[68] CLIMBS is an umbrella organisation and a grassroots insurance owned by over 1,700 primary cooperatives and federations in the Philippines. It is registered with the Cooperative Development Authority (CDA) and it was issued a licence to operate as a composite insurance cooperative by the Insurance Commission.

increasing their resilience to earthquake risk may have positive effects, including lower interest rates on loans, availability of credit in the aftermath of a disaster event and broader financial inclusion.

Along the same lines, as the threat of extreme El Niño significantly constrains the provision of financial services to the poor, the EENIP (see § 5.2.1.) was made available to financial institutions, with a view to covering the risk of portfolio deterioration in the aftermath of an extreme weather event.[69]

One of the major hurdles to be overcome in implementing a sustainable market for index micro insurance products is the lack of financial literacy: knowledge transfer and communication to the cooperatives and microfinance institutions – and, more generally, to all potential users – is, therefore, required. Another challenge is to move beyond financial support provided by international donors for these products and make the schemes commercially viable.

5.2.3 Agricultural insurance schemes

The agricultural sector occupies an important place in many APEC economies. Moreover, agriculture stands out as one of the economic sectors most affected by natural hazards, especially climate-related perils such as droughts, floods, excessive rain, cold waves, and hail.

In **Viet Nam**, for instance, around 20% of the economic output is within the agricultural sector, which is highly exposed to natural hazards, including tropical cyclones (typhoons), tornadoes, landslides and droughts. Having heavily invested in improving irrigation, pest and disease control, and flood defences, the government of Viet Nam decided in 2011 to implement an agriculture insurance scheme starting with a subsidised pilot programme. The programme provides cover for rice, livestock and aquaculture farming against storm, flood, drought, cold, frost, tsunami and other perils. It also provides cover against named pests and diseases and epidemics specific to rice, livestock and aquaculture. During the pilot, the programme is being implemented in 20 provinces throughout Vietnam. The rice insurance scheme is index based, the livestock and aquaculture schemes are indemnity based. The Ministry of Finance and the Ministry of Agriculture and Rural Development provide guidance and support for the programme implementation. The Vietnam National Reinsurance Corporation, Vina Re, and Vietnam's two largest insurers, Bao Viet and Bao Minh were appointed by the Ministry of Finance to participate in the design and implementation of the pilot programme. Swiss Re was asked to provide actuarial services in calculating insurance premium rates as well as reinsurance capacity.[70]

In **Malaysia**, there is an on-going effort to explore the development of a paddy takaful[71] scheme to provide protection to small-scale paddy farmers against natural disasters such as floods, droughts, pests and diseases. Initially proposed to be funded by the government, the greatest challenge in designing the scheme has been the availability of good and comprehensive data in addition to the limited funding available yet meet the expectation that the scheme would provide the best and maximum benefits.

In **Thailand**, the Rice Disaster Relief Top Up Crop Insurance Scheme is a government-based micro-insurance product provided by eight local insurance companies and nine reinsurance companies. Each of

[69] Excess rainfall in the north of Peru during the last two extreme El Niño events (1982–83 and 1997–98) was nearly forty times the normal level and created significant economic disruption, destroying irrigation infrastructure, bridges, roads, homes, and crops.

[70] Information provided by the Swiss Re Centre for Global Dialogue: http://cgd.swissre.com/features/Agricultural_reinsurance_in_Vietnam.html.

[71] Based on principles of mutuality and co-operation, takaful is an Islamic form of insurance characterized by elements of shared responsibility, joint indemnity, common interest and solidarity, in which each participant contributes into a fund that is used to cover expected claims.

the insurance and reinsurance companies cover a portion of the risk based upon a quota share arrangement. The scheme was set up to provide additional compensation to top up the amount which a farmer may already receive as compensation from the Thai Government's Disaster Relief Program. Coverage will be provided for damage that occurs to the rice in the growing or harvest stage where it is affected by flood, drought, windstorm, front, hail and bushfire. In order to assist farmers with the financial cost of obtaining coverage the Thai Government will pay 50% of the premium and the farmer will pay the remaining cost. The system is index based. If damage does occur there is a simple process for recovery which encompasses the farmer showing that his farm was located in the affected area and that loss had occurred to the rice he/she was growing. The significance of this micro insurance product derives from the importance of rice as a staple agricultural product of Thailand. In **Chile**, agricultural micro-insurance policies are made available to small and medium-sized domestic farmers. The government supports farmers for a total of 50% of the cost of insurance as well as an additional amount of 1.5 UF (approximately USD 60). Some small farmers may be able to qualify for subsidies amounting to 90% of the premium. Products such as wheat, potatoes, tomatoes and rice, among others, are insured against droughts, floods and other natural disasters.

In **Korea**, micro-insurance products are available to cover crops against disaster and there is also the availability of fisheries disaster insurance. For the crop disaster insurance this is governed by the Ministry of Agriculture, Food and Rural Affairs and is offered for named perils and multi-peril crop insurance. The named peril coverage is for crops including apples, pear, peach, grape, sweet persimmon and tangerine for damage arising from hail and typhoon. Famers who utilise this insurance can also utilise insurance coverage for freezing, torrential rain. Given the private support available to farmers to assist them in obtaining insurance coverage, the insurance penetration rate is reasonable. The Ministry of Oceans and Fisheries offers an optional fisheries disaster insurance which provides coverage to the fisheries industry for losses arising from natural disasters.

Beyond APEC, in **India** a large proportion of rural households are dependent on agriculture for their livelihoods. Due to limited irrigation infrastructures, yields are strongly affected by climatic events, monsoon in particular, leading to significant financial vulnerability to weather risks. The protection of farmers from harvest variability is, therefore, a key concern for Indian governmental authorities (see **Box 17**).

Box 17

Crop insurance in India

Traditional crop insurance in India is provided by the Agriculture Insurance Corporation of India Ltd. (AIC) under the National Agricultural Insurance Scheme (NAIS). Insurance coverage is normally bundled with crop financing and it is subsidised by central and state governments. The NAIS operates on an area-yield indexed basis, whereby claim payments to farmers depend on the average yield of the insured crop measured across the insurance unit, typically an administrative block, in which they live. NAIS financing is based on *ex post* funding by the government.

As soon as the Indian insurance market was opened, at least in part, to private and foreign insurers, the Insurance Regulatory and Development Authority (IRDA) required all private insurers to reserve a certain portion of their portfolios in the rural and social sectors. In response to this requirement, private insurance companies - but also AIC - started offering Weather Based Crop Insurance Schemes (WBCIS), as a substitute or complement to crop insurance supplied by the government.

Similar to other weather-index insurance products, WBCIS pay-outs are triggered by excess or shortfall from a predetermined threshold level of rainfall, temperature or humidity. Coverage provided by the WBCIS is "area based", assuming average risk and average loss characteristics for an entire cultivation area. In this context, basis risk may arise because the trigger value is the average yield calculated for a larger area, which may not represent the actual yield of a smaller unit. Basis risk may also arise on account of distance of the village from the automated weather station, as data generated may not represent that of the localities which are far away from the

station. On the other hand, the individual farm level approach (indemnity-based) requires *ex ante* and *ex post* assessments, which are costly and may be affected by moral hazard.

The minimisation of basis risk through a well-planned network of automated weather stations has been identified as a key priority goal in India. The location of weather stations, in fact, has the greatest bearing on the basis risk in a weather insurance contract once the key parameters of the contract have been set.

Aimed at providing a more accurate basis for calculating the threshold yield for triggering pay-outs, the Modified National Agricultural Insurance Scheme (MNAIS) was introduced in 2010-2011. A hybrid of the area-yield and weather-index schemes, it is being tested by the Indian government across 34 districts in 12 States.

India is a global leader in micro-insurance innovation. This is due, in part, to the huge number of rural households, offering the potential for achieving economies of scale. Another factor is the interplay between roles of different stakeholders: the public sector has a clear mandate to assist the poor and it dominates a significant portion of the insurance market, while the private sector contributes technological solutions and innovations in product design and distribution channels.

Another interesting micro-insurance scheme outside APEC is offered by the Kilimo Salama Index-Based Crop Insurance developed in **Kenya**. Kilimo Salama, meaning "safe agriculture" in Swahili, is a crop index-based micro-insurance product launched in 2008 to protect farm inputs of wheat growers against drought and excess rain. Under the auspices of the Agricultural Index Insurance Initiative,[72] it is reportedly the largest program of its kind in Africa. In addition to the investment in farm inputs (e.g., seed, fertilizer), farm output value, i.e. an estimate of the expected harvest value, can also be covered by a second parametric micro-insurance product offered under the scheme. Payouts are determined based on the actual amount and distribution of rainfall over the crop season, measured at the weather station nearest to the insured farm.

From a technical viewpoint, existing index insurance contracts have been adapted to the Kenyan climatic characteristics and planting practices: reference is made, in particular, to historical data sets, consisting of between 20 to 30 years of weather data, combined with agronomical data on crop development. Pricing of the risk is then made on this basis by international reinsurers. Complex agronomical models, relying on weather data, are used to simulate crop growth at various locations. The Food and Agriculture Organisation of the United Nations (FAO) Water Requirement Satisfaction Index (WRSI),[73] capturing the impact of timing, quantity, and distribution of rainfall, comparing the amount of water available throughout the season to how much a plant needs in its different stages of growth, is employed as an agronomical model to quantify rainfall deficiency.

Distribution channels include local agro-dealers and mobile phone networks. A mobile money platform is used to process premiums and claims payments: the success and growth of this product is largely due to technical innovation particularly in using this mobile technology. However the spread of the product is also attributable to an increased understanding of the need for micro-insurance and trust amongst farmers that the insurance product will deliver on its promises.[74]

[72] A partnership between UAP Insurance and the Syngenta Foundation for Sustainable Agriculture (SFSA).

[73] The WRSI is defined as the ratio of actual evapotranspiration (ETa) to maximum evapotranspiration (ETc); see also: Doorenbos J. and W.O. Pruitt, (1977) *FAO Crop Water Requirements*, cit.; Frère, M. and Popov, G.F. (1979) *FAO: Agrometeorological crop monitoring and forecasting* cit.; Frère, M. and Popov, G.F. (1986) *FAO, Early Agrometeorological Crop Yield Forecasting. FAO Plant Production and Protection Paper*, cit.

[74] Burke, Marhall; de Janvry, Alain and Quintero, Juan (May 2010) "Providing Index Based Agricultural Insurance to Smallholders: Recent Progress and Future Promise", http://siteresources.worldbank.org/EXTABCDE/Resources/7455676-1292528456380/7626791-1303141641402/7878676-1306270833789/Parallel-Session-5-Alain_de_Janvry.pdf

Another factor attributable to its success is that it does not make assessments at an individual farm level but rather based upon criteria. This is achieved through the use of automatic weather stations which are employed to prevent the need to visit each affected farm. The use of electronic weather stations and automatic measurement, therefore, greatly reduces the costs of operations.[75] A significant investment was required to upgrade and renovate weather stations in cooperation with the Kenya Meteorological Department. The use of this technology is very open and transparent so that farmers can be fully aware when they are covered and when they are not covered.[76]

Affordability of the product is achieved through an innovative partnerships or 'premium sharing arrangement' with agri-businesses, who sponsor 50% of the premium's price, leaving the farmers to pay 5% on top of the cost of the inputs. Basically each party to the agreement pays part of the premium according to his vested interest. The distributors of the agricultural inputs have a commercial interest in paying a portion of the premium, as this increases their total sales volume. Following adverse weather events, in fact, without insurance protection farmers do not have the necessary financial means to buy new agricultural inputs for the next season. Evidence that the manner in which Kilimo Salama operates is successful can be seen from the upward trend in premium revenue that was collected over the past few years.

Concerning ***implementation challenges***, the establishment of index-based agricultural insurance schemes requires significant investments in technology, as well as extensive and high-quality data sets to model the hazard and quantify loss probabilities. Risk market infrastructures, including legal and regulatory framework and delivery channels, are also critical to scale up these programs. Strengthening the financial literacy of potential users of these types of products is also a crucial component

5.3 Establishing disaster insurance schemes

In economies with more developed insurance markets and infrastructures, different forms of disaster insurance schemes have been established to encourage widespread coverage of catastrophic risks. The key features of these schemes include (see also **Table 4**):

- *Legal framework, governance and operational structure* (including servicing of insurance contracts and complaints-handling mechanisms);
- Nature of *government intervention* (e.g., government as provider of liquidity support, direct insurer, reinsurer, guarantor of last resort) and role of the private sector;
- Extent of *compulsion* (i.e., extent to which there is an obligation for insurers to offer disaster coverage, or alternatively for households and firms to purchase coverage);
- The *type of hazards* (natural and/or man-made, depending on the disaster risk profile of the territory) against which coverage is provided;

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[75] Syngenta Foundation for Sustainable Agriculture, (2012) "Agriculture Index Insurance: Kilimo Salama", www.syngentafoundation.org/index.cfm?pageID=562

[76] Kilimo Salama operates such that those selling the indexed crop insurance products would register a farmer for cover using a simple mobile phone application. Confirmation of the insurance policy will then be received by sms message. Technology is used in the sale of the product, in claims processing and in assessing when damages are paid out. Pay-outs are transferred through a mobile payment system called "M-Pesa", developed by a local telecommunications services provider. In line with the use of technology and with a view to linking risk transfer to risk reduction, if farmers have any questions about their coverage or if they would like advice about how to make their farms more resilient they have the option of calling a toll free number.

- The *type of losses* (e.g., property damage, business interruption, life, accident, liability) that are covered by the scheme;
- The *segments of the population and the economy* for which coverage is made available by the scheme (e.g., households in urban areas, households in rural areas, farmers and herders, small business enterprises, large commercial and industrial corporations, local governments);
- The *contractual mechanism* by which disaster coverage is made available by the scheme (e.g., stand-alone policies, optional endorsements to other policies);
- The *pricing* mechanism;
- Possible government commitment to undertake *specific risk reduction measures* (e.g., flood defences, enforcement of strong building codes, enhanced use regulation).

Table 4: Key elements of disaster insurance schemes

1) Hazards covered	• Single • Pre-selected group • Multi-peril
2) Scope of coverage	• Damage to property, e.g.: - Residential / commercial - Private / public (buildings and infrastructures) • Damage to motor and transport vehicles • Business interruption • Life, accident • Liability
3) Segments of the population and economy covered *(policyholders)*	• Households (e.g., urban, rural) • Corporate (e.g., large commercial, SMEs, agriculture) • Government (e.g., economy-wide, subnational)
4) Role of government	• Backstop liquidity provider • Reinsurer • Direct (primary) insurer • Guarantor
5) Key features of policies under schemes for insurance markets	***a) Extent of compulsion***
	• Mandatory offer • Mandatory extension • Mandatory purchase
	b) Contractual mechanism
	• Stand-alone policy • Extension / endorsement
	c) Pricing
	• Flat • Risk-based
	d) Other policy features
	• Deductibles • Co-insurance

Examples of state-sponsored direct insurance and reinsurance programs are presented and discussed in the following subsections.

5.3.1 State-sponsored direct insurance programs

In economies where a private insurance market exists, but is unwilling or unable to provide coverage due to local conditions or the peculiar risk profile of the territory, primary insurance to cover certain disaster losses is provided by a *special purpose entity set up by the government to act as direct insurer*. Basically, the government provides insurance and responds to claims either to the fullest or up to a certain limit. The private insurance sector often contributes to the institutional arrangement by providing operational capabilities, such as marketing of the policies, collection of the premiums, and/or adjustment of the claims.

In **New Zealand**, for instance, the Earthquake Commission (EQC) is the primary provider of seismic disaster insurance to residential property owners. The EQC is a Crown Entity, wholly owned by the government of New Zealand and controlled by a board of commissioners.

EQC administers the Natural Disaster Fund. The government guarantees that this fund will meet all its obligations. It does this by securing New Zealand residential property owners against the cost of these disasters and by helping organise repair and replacement after the event. The main mechanism for this is the provision of seismic disaster insurance to property owners who insure against fire. All residential property owners who voluntarily buy fire insurance from private insurance companies automatically acquire EQC cover, the Commission's seismic disaster insurance cover. Perils insured by the EQC catastrophe coverage are: earthquake, natural landslip, volcanic eruption, hydrothermal activity, tsunami and, in the case of residential land, also storm or flood. EQC premiums are added to the cost of the fire insurance and passed on to EQC by the insurance company.

A review of the EQC is pending in New Zealand, where the crown entity was put under scrutiny after the 2010-2011 Canterbury earthquake sequence. Interestingly the Canterbury earthquake sequence represented the first major test of the EQC model since its inception. In particular, the government of New Zealand seeks to achieve a series of objectives through the review, including:

- To support the contribution of a well-functioning insurance industry to economic growth opportunities;
- To minimise the fiscal risk to the Crown associated with *private property damage* in natural disasters (a contingent liability);
- To support an efficient approach to the overall management of disaster risk and recovery; and
- To minimise the potential for property-owners to experience socially unacceptable distress and loss in the event of a disaster.

Matters covered by the review include the structure and extent of EQC cover, the pricing of insurance coverage, the institutional design, and the financial management strategy. A consultation document and legislative measures will follow.

In the **Philippines**, with support from the ADB, the Insurance Commission is leading the effort on the design of an earthquake insurance scheme for households and small and medium scale enterprises, which seek to complement existing products independently offered by the private sector. The project is in a stage of data gathering and household survey. The effort is expected to be completed in 2013.

Outside of APEC, an illustrative example is offered by the **Turkish** Catastrophe Insurance Pool (TCIP). Following the 1999 earthquake disasters that occurred in the Marmara Region and Duzce, earthquake insurance was made compulsory primarily for dwellings through an Earthquake Insurance Program. TCIP was launched by the Turkish government in cooperation with the World Bank in

September 2000. Earthquake insurance premiums are ceded to the TCIP, which is managed by the Natural Disasters Insurance Council, DASK in the Turkish abbreviation. The pool provides earthquake coverage up to certain limits for a premium which varies across the territory depending upon seismicity, local soil conditions, and the type and quality of construction. The compulsory scheme covers only residential buildings that fall within municipality boundaries. Industrial and commercial risks as well as residential buildings in small villages (with no municipality established) can be insured on a voluntary basis.

The compulsory earthquake insurance is a stand-alone product sold separately from fire (or homeowner's) insurance. It covers building damages for the following risks: earthquake; fire related to earthquake; explosion related to earthquake; and landslide related to earthquake. The aim of the TCIP is to provide an adequate level of protection with affordable premiums. Therefore, the maximum coverage limit of compulsory insurance is currently NTL 150,000 (since 2012). This limit is adjusted annually according to changes in the construction price index. Policyholders are free to buy additional coverage in excess of this limit from insurance companies if the value of their dwelling is more than this amount. When assessing claims, the TCIP takes into account market reconstruction prices at the date of the event for each type of building. The TCIP has a simple pricing matrix accounting for seismicity and construction type. Prices range from 0.4 per mille at the lowest to 5.5 per mille at the highest. A reform enacted in 2012 allowed the government to provide reinsurance protection to the scheme and introduced additional checks for compliance with the mandatory insurance requirement in order to increase penetration.

5.3.2 State-sponsored reinsurance programs

In other economies, the government provides reinsurance protection to private insurance companies writing disaster risk. Basically, the government protects the private insurance sector by offering special reinsurance arrangements of different types (proportional and non-proportional). Government sponsored reinsurance programs may be mandatory or optional for primary carriers. The option to provide special reinsurance arrangements is aimed at limiting private sector exposure to peak risks.

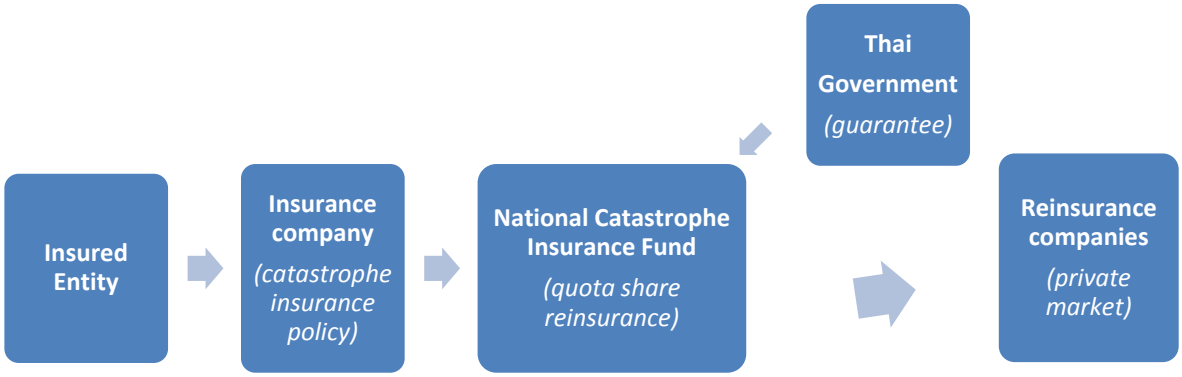
This solution can be justified if the primary insurance carriers are financially able to retain a portion of the risk, but there is not enough reinsurance capacity on the private market to provide the required excess of loss arrangements. The provision of such a limitation to private-sector exposure may also be part of an institutional arrangement in which mandatory offer, purchase, or extension of disaster risk coverage is introduced by law. In this respect, this option is aimed at protecting the insurers' solvency and, therefore, the stability of the whole system.

Within APEC, this option has been implemented, among other economies, by **Japan**, **Thailand** and **Chinese Taipei**.

In **Thailand**, for instance, following the devastating floods in 2011, many business operators and individuals were no longer able to obtain affordable insurance policies to cover flooding and other natural hazards. As a response and a measure to restore public confidence, in January 2012 the government has created a National Catastrophe Insurance Fund (NCIF) with a view to making disaster insurance coverage available to businesses and individuals alike.

The National Catastrophe Insurance Fund is employed as a reinsurance reserve. Local insurance companies that issue the policies retain part of the risk underwritten and transfer the rest to the NCIF, which in turns retrocede a portion to international carriers operating on the global reinsurance market (see **Figure 3**).

Figure 3: Thailand's National Catastrophe Insurance Fund



The "Catastrophe Insurance Policy" offers coverage for damages caused by three perils: flood, earthquake and windstorm. Coverage is triggered by a "catastrophe", according to the following conditions:

- Upon the advice of the Department of Disaster Prevention and Mitigation, a declaration of the Cabinet of Ministers is issued, stating that a particular event has escalated to a 'catastrophe';
- The total claim for catastrophe damages exceeds five billion baht per event that is within a 60-day duration and with a minimum of two claimants;
- Earthquake with the magnitude at least 7 on the Richter scale; or
- Windstorm with the wind speed at least 120 kilometres per hour.

Catastrophe coverage can be purchased by business entities, including SMEs, only on top of a fire insurance policy or an Industrial All-Risk (IAR) policy. Coverage does not apply to the loss of properties located in the floodway, otherwise compensated by the Thai government.

Indemnity payments are made following loss adjusting and based on an evaluation of the actual loss sustained, within the sublimit. For flood events, a simplified Water Level Criterion has been set up to expedite the loss assessment process for residential properties; according to such criterion, indemnity payments are determined as follows:

- THB 30,000 if water level reaches the floor of the household, less than 50 cm;
- THB 50,000 if the water level reaches 50 cm;
- THB 75,000 if the water level reaches 75 cm;
- THB 100,000 if the water level reaches 100 cm.

The policy covers on a "first loss" basis and is limited to property damage, without business interruption.

The Thai government also defined and implemented *strategies to prevent future flooding*. Under the short-term risk management program, they studied the topography along Chao Phraya River and constructed floodgates to retain in or direct flood water to designated zones, whose owners have been

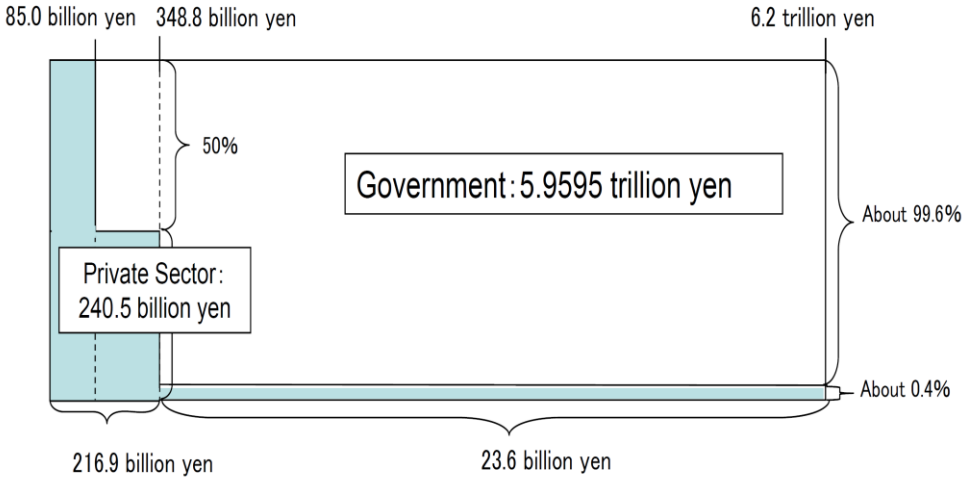
compensated. Under the long-term risk management program, the government plans to expand forests in the northern mountain area of the territory. Water management and continued involvement of the government in the National Catastrophe Insurance Fund are key components of the sustainability of the scheme.

In **Japan**, the earthquake insurance system on dwelling risks was introduced by the Act on Earthquake Insurance in 1966 - enacted after the Niigata earthquake in 1964 – and the Japan Earthquake Reinsurance Co., Ltd. (JER) was established. The JER acts as the sole earthquake reinsurer for the private insurance market. The JER can be seen as an earthquake reinsurance pool, retaining a portion of the liability and ceding the rest back to private insurers (based on their market share) and to the Japanese government through reinsurance treaties. The reinsurance program is designed such that the liability of private insurers and the JER itself does not exceed the accumulated reserves from earthquake insurance premiums.

Under this scheme, earthquake insurance is automatically attached to fire insurance and arranged as an optional rider to fire insurance which covers buildings for residential use and/or personal property. The scope of earthquake coverage includes loss or damage of buildings for residential use and personal property through fire, destruction, burial or flooding caused directly or indirectly by any earthquake, volcanic eruption or resulting tsunami.

At present, the aggregate limit of indemnity for earthquake insurance liabilities (JPY 6,200bn) is shared by the private and public sectors as follows: for earthquake insurance liabilities up to JPY 85bn: the JER is liable for 100% of insurance claims; over JPY 85bn and up to JPY 348.8bn, the government is liable for 50% while the JER and private insurers (due to retroceded risk from the JER) are liable for 50%; and from JPY 348.8bn to JPY 6,200bn, the government is liable for approximately 99.6% and private insurers (including the JER) are liable for approximately 0.4%. Under the Act on Earthquake Insurance, where earthquake insurance liabilities for one event exceeds the indemnity cap of JPY 6,200bn, residential policyholders' claims are reduced proportionately. Under the Japanese earthquake reinsurance program, therefore, primary carriers sell earthquake coverage with large deductibles on the voluntary market (insurers are obliged to offer the optional earthquake extension with all residential fire insurance policies, but policyholders may decide not to purchase it) and then fully reinsure their risk with the JER, which, in turn, retrocedes part of the risk to the Japanese government, and part of it to the private insurance market (see **Figure 4** below).

Figure 4: Risk Allocation under Japan's Earthquake Insurance Scheme



As part of the implementation of a comprehensive disaster prevention and risk management program, the competent authority of the government of **Chinese Taipei** introduced the Residential Earthquake Insurance Program (TREIP), originally managed by Central Reinsurance Corporation (Central Re), a government owned reinsurance company. Since 2006, after privatisation of Central Re, the management of the scheme has been entrusted to the Residential Earthquake Insurance Fund (TREIF), a governmental entity established in 2002. The program was designed to share earthquake risk between private insurance companies and the government and to diversify such risk through a combination of local co-insurance, a non-profit fund (TREIF), international reinsurance, capital markets and government funds.

In the risk spreading structure, private insurers retained the first tier of risk, and the government acted as a backstop, assuming the risk above that level and up to a total limit of NT$ 50bn, then raised in 2007 to NT$ 60bn. Since 2009, the limit has been raised to NT$ 70bn.

Box 18: Risk spreading structure of TREIP

Since 2012 TREIP has NT$ 70bn in capacity arranged as follows:

- **1st tier** of NT$ 3bn – Co-insurance pool.
- **2nd tier** of NT$ 67bn – TREIF of which:
  - Up to NT$ 53bn - spread in domestic, and/or overseas reinsurance markets and/or capital markets and/or retained by TREIF in accordance with business needs and/or market costs;
  - Top portion of NT$ 14bn – retained by the government.

The scheme caps losses at NT$ 70bn. In the event that losses exceed the capped amount, the losses paid to policyholders will be proportionally reduced (proration).

Prior to the creation of TREIP, earthquake insurance was provided as an endorsement to a long-term residential fire policy. Since 1 April 2002, new residential fire policies have been issued on an annual (rather than long-term) basis, and have been changed to cover earthquake risk automatically. Existing long-term policies can also be voluntarily endorsed at any time to provide annual cover for the earthquake peril. As of 30 June 2013, the take-up rate was about 30% of total estimated 8.37m households in Chinese Taipei. The new policies provide indemnity on a replacement cost basis for buildings. Effective 1 January 2012, the maximum insured amount is NT$ 1.5m; in addition, a further NT$ 200,000 of reimbursement is provided per household for Contingent Living Expenses. No deductible applies. TREIP coverage is provided for an annual flat premium per household (starting from 1 April 2009 the annual flat premium was reduced from NT$ 1,459 to NT$ 1,350). For the small number of houses valued at less than NT$ 1.2m, the premium is calculated on a pro-rata basis. Insurers will pay the indemnity to insured parties only for total loss.[77]

TREIP's portfolios are written by domestic and foreign insurers in Chinese Taipei. Perils covered include: earthquake shock, fire or explosion caused by earthquake, landslide, land subsidence, earth movement and rupture caused by earthquake and, since 2006, tsunami, sea surge and flood caused by earthquake.

[77] The definition of "total loss" has also been revised and refers to any of the following conditions: (1) the insured property is demolished upon order of a government agency; or (2) the insured property has been declared uninhabitable and in need of demolition and rebuilding by a qualified adjuster, or by an association of professional architects, structural engineers, civil engineers, or geotechnical engineers; or the assessment established that the insured property could be inhabitable after repairing and the repair cost equals or exceeds 50% of the replacement cost at the time when the insured event occurred.

Box 19. Hong Kong, China: Facility for Terrorism Risks

To address the problem arising out of the withdrawal of reinsurance coverage for terrorism risks in workers compensation (WC) business following the 9/11 attacks on the United States, the Government has since January 2002 provided direct WC insurers with a facility up to HKD 10bn in aggregate to cover claims arising out of terrorism under their WC insurance policies (Facility). Participation in the Facility is voluntary. Participating insurers are required to pay a monthly charge of 3% on the gross premiums written for the month of their WC policies to the Government. With this Facility, insurers can continue to provide cover for employment-related claims for death and bodily injury caused by terrorist acts and the protection of both employers and employees can be maintained.

Table 5: Roles of government in disaster insurance schemes in selected APEC and non-APEC member economies

Backstop liquidity provider
NON-APEC **United Kingdom** (*Pool Re*)
Reinsurer
APEC **Australia** (*Australian Reinsurance Pool Corporation or ARPC*) **Japan** (*Japan Earthquake Reinsurance Co., Ltd. or JER*) **Chinese Taipei** *(Residential Earthquake Insurance Fund or* EQ- TREIF*)* **Thailand** *(National Catastrophe Insurance Fund)* **United States** (participation in *Terrorism Risk Insurance Program*)
NON-APEC **Belgium** (*Caisse nationale des calamites* + participation in *Terrorism Reinsurance and Insurance Pool*) **Denmark** (participation in *Terrorism Insurance Pool for Non-Life Insurance*) **France** (*Caisse Centrale de Réassurance or CCR*) **Germany** (participation in Extremus AG) **Netherlands** (participation in *Nederlandse Herverzekeringsmaatschappij voor Terrorismeschaden or NHT*)
Direct Insurer
APEC **New Zealand** (*Earthquake Commission or EQC*) **United States** (*California Earthquake Authority*, *National Flood Insurance Program or NFIP*)
NON-APEC **Iceland** *(Iceland Catastrophe Insurance or ICI)* **South Africa** (*SASRIA Limited*) **Spain** (*Consorcio de compensacion de seguros*)
Guarantor
APEC **Australia** (*Australian Reinsurance Pool Corporation or ARPC*) **New Zealand** (*Earthquake Commission or EQC*) **Thailand** *(National Catastrophe Insurance Fund)* **United States** (*National Flood Insurance Program or NFIP*)
NON-APEC **Denmark** (storm surge - *Danish Storm Council*) **France** (*Caisse Centrale de Réassurance or CCR*) **Spain** (*Consorcio de compensacion de seguros*) **Turkey** *(Turkish Catastrophe Insurance Pool or TCIP)*

Regarding ***implementation challenges***, one APEC economy noted that, in the context of its deliberations as to whether to impose compulsory insurance in order to promote disaster insurance coverage, the main obstacle to implementation of any such a scheme is the lack of insurance culture in the population, which moreover considers insurance to be too expensive and is sceptical regarding the operations of insurance companies. This particular economy has sought to improve this situation through the recent adoption of a law on insurance contracts, which better protects the interests of the insured.

Table 6: Scope of coverage under disaster insurance schemes in selected APEC and non-APEC member economies			
Residential property damage	**Commercial property damage**	**Infrastructure**	**Business interruption**
APEC **Japan** (earthquakes, volcanic eruptions and resulting tsunami - *JER*) **New Zealand** (natural perils - *Earthquake Commission or EQC*) **Chinese Taipei** (EQ- TREIF) **United States** (flood – *National Flood Insurance Program*) **NON-APEC** **Denmark** (storm surge – *Danish Storm Council*) **France** (natural perils, technological accidents – *under two different insurance programs*) **Iceland** (natural perils - *Iceland Catastrophe Insurance*) **Netherlands** (terrorism - *NHT*) **Norway** (natural perils –*Natural Perils Pool*) **Spain** (all extraordinary risks – *Consorcio* or CCS) **Turkey** (earthquake – *Turkish Catastrophe Insurance Pool*)	**APEC** **Australia** (terrorism - *ARPC*) **Thailand** (flood, EQ, windstorm - NCIF) **United States** (terrorism – *Terrorism Risk Insurance Program*) **NON-APEC** **Denmark** (storm surge - *Danish Storm Council* - and terrorism – *Terrorism Insurance Pool for Non-Life Insurance*) **France** (natural perils, terrorism – *under two different insurance programs*) **Germany** (terrorism – *Extremus AG*) **Iceland** (natural perils - *Iceland Catastrophe Insurance*) **Netherlands** (terrorism - *NHT*) **Norway** (natural perils – *Natural Perils Pool*) **Spain** (all extraordinary risks – *Consorcio* or CCS) **United Kingdom** (terrorism - *Pool Re*)	**NON-APEC** **Iceland** (natural perils - *Iceland Catastrophe Insurance*) **Spain** (all extraordinary risks – *Consorcio* or CCS)	**APEC** **Australia** (terrorism - *ARPC*) **United States** (terrorism – *Terrorism Risk Insurance Program*) **NON-APEC** **Denmark** (terrorism – *Terrorism Insurance Pool for Non-Life Insurance*) **France** (natural perils, terrorism – *under two different insurance programs*) **Germany** (terrorism – *Extremus AG*) **Netherlands** (terrorism - *NHT*) **Spain** (all extraordinary risks – *Consorcio* or CCS) **United Kingdom** (terrorism - *Pool Re*)

6. GOVERNMENT COMPENSATION AND FINANCIAL ASSISTANCE ARRANGEMENTS

6.1 The rationale for *ex ante* arrangements

Government compensation or financial assistance arrangements are intended to address financial vulnerabilities where private coverage by DRF tools may be lacking or unobtainable at an affordable price. The schemes may cover basic living expenses and losses linked to disaster impacts (e.g., property damage, temporary relocation) and may be coordinated with other levels of government or sources of funding (e.g., international aid).

These schemes or programmes may be designed to ensure timely appropriations or release of funds within pre-specified parameters, thereby ensuring timely disbursement of disaster funds for emergency assistance, social protection, recovery and reconstruction. The financing of such schemes may be *ex ante*, taking the form of a governmental reserve fund financed internally through annual appropriations and possibly leveraging international risk financing and risk transfer markets to augment financial capacity (see above § 4.1); alternatively, they may be funded *ex post*, with appropriations made upon the occurrence of a disaster.

Compared with *ad hoc* post-disaster financial assistance, *ex ante* governmental compensation arrangements have important advantages in terms of efficiency and clarification of disaster assistance, helping to ensure prompt assistance and reduce moral hazard and variability in unplanned post-disaster assistance. Also, in the absence of well-defined parameters surrounding this assistance, individuals and businesses may come to develop strong expectations of post-disaster aid, thereby affecting incentives for self-protection and reducing demand for other sources of financial coverage such as insurance.

6.2 Illustrative practices in APEC economies

Within the **Australian** federal system, constitutional responsibility for natural disaster planning, mitigation and recovery sits with State and Territory governments. Local governments own a large proportion of essential public infrastructure, including roads, bridges, and sewerage and water treatment. The Australian Government also has a role both in assisting with the burden of relief and recovery after major disasters and in collaborating with all levels of government to strengthen communities' resilience to natural disasters and to minimise the impact of them.

The Australian Government provides financial assistance directly to State and Territory governments through the Natural Disaster Relief and Recovery Arrangements (NDRRA) to help alleviate the financial burden of responding to natural disasters and to facilitate the early provision of emergency assistance to disaster-affected communities (see **Box 20**). The burden on State and Territory budgets of dealing with recovery from natural disasters, including the cost of restoring or replacing essential public assets, is also shared between the States and Territories through the allocation process for Australia's Goods and Services Tax (GST). The Intergovernmental Agreement on Federal Financial Relations (IGA), which provides the framework for fiscal equalisation within Australia's federal system, requires that the GST be distributed among the States on the basis of horizontal fiscal equalisation. The Australian Government also provides a range of additional assistance, primarily focused on payments to individuals and businesses.

Box 20

Australia: the Natural Disaster Relief and Recovery Arrangements (NDRRA)

The NDRRA Determination 2012 sets out the arrangements under which the Australian Government provides support to State and Territory governments. The NDRRA Determination 2012 establishes a 'self-adjusting' program that is automatically triggered once eligible State or Territory government expenditure exceeds a specified small disaster criterion. Under the arrangements, the Australian Government contribution increases with the scale of disaster spending, with a maximum reimbursement of 75 per cent payable to the State or Territory for eligible relief and recovery measures. States and Territories are reimbursed a proportion of expenditure that exceeds certain thresholds, which are calculated by reference to their annual general government sector revenue and grants.

Once the small disaster criterion has been exceeded, the proportion of the costs reimbursed by the Australian Government is determined by two thresholds. The Australian Government funds 75% of the cost of all eligible relief and recovery measures for all eligible events in a financial year assessed above the higher of two thresholds and 50% of the cost of all eligible relief and recovery measures between the two thresholds.

These thresholds are calculated as a proportion of State or Territory revenue. Linking the thresholds to government revenue helps link the level of support to the capacity of State and Territory governments to meet the costs of disasters within their own means.

A range of other measures are also available under the NDRRA, including support for personal hardship and distress assistance; counter disaster operations; loans for small businesses and primary producers; transport freight subsidies for primary producers; loans and grants to churches, voluntary non-profit organisations and sporting clubs; and the cost of restoring or replacing essential public assets (of State or Territory and local governments) damaged or destroyed by a natural disaster. Following severe disaster events, additional packages to support communities for clean-up and recovery and grants for small businesses and primary producers may be activated.

State spending on natural disasters in excess of that funded by the Australian Government through the NDRRA is taken into account in determining a State's GST share.

In **Canada**, provinces and territories (P/Ts) have primary responsibility for disaster response and recovery costs within their jurisdictions, as the majority of emergencies are local in nature. However, when their capacities are exceeded, or when an event is of economy-wide interest or impacts in an area of federal or shared jurisdiction, local authorities may request assistance from the federal government. Depending on the conditions, P/Ts may request financial assistance from the federal government under several disaster assistance programs, including the *Disaster Financial Assistance Arrangements* (DFAA). The DFAA is a cost-sharing reimbursement program between the federal government and Canadian provinces and territories, sharing in the costs of eligible provincial expenditures arising from natural disasters. Federal reimbursements are made on a progressive scale, with the thresholds defined by per capita eligible expenditures:

Table 7: Funding formula for Canada's DFAA

	P/T Share	Government of Canada Share
First CAD 1 per Capita*	100%	Nil
Next CAD 2 per Capita	50%	50%
Next CAD 2 per Capita	25%	75%
Remainder	10%	90%

The DFAA Program is intended to support a disaster-affected province or territory in order to assist with costs that might otherwise place a significant burden on the provincial economy and would exceed

what the province or territory might reasonably be expected to bear on its own. In 2008 the Government of Canada revised the DFAA Guidelines to include the sharing of cost for mitigative improvements to damaged infrastructure in order to better protect against future disasters: under this provision, up to 15% of the estimated cost of repairs to damaged infrastructure to pre-disaster conditions can be allocated for mitigative enhancements.[78]

In **Hong Kong, China**, the Emergency Relief Fund Ordinance set up the Emergency Relief Fund to provide prompt assistance to persons who are in need of urgent relief as a result of fire, flooding, tempest, landslide, typhoon or other natural disasters. Grants from the Fund are intended for relief rather than compensation. The Fund consists of an annual allocation from the General Revenue and donations received from the public from time to time. It is vested in the Director of Social Welfare Incorporated as Trustee. There are five major types of grants under the Fund namely (i) grants in respect of death or personal injury; (ii) domestic re-accommodation, re-equipment, site formation and repair grants and grant for extensive damage to home appliances; (iii) grants to repair or replace vessels and fishing gear; (iv) primary producer grants; and (v) special grants. The responsibility for approving grants and making payments is in most cases vested in the Agriculture, Fisheries and Conservation Department, the Marine Department, the Social Welfare Department and the Lands Department, while the Home Affairs Department is responsible for overall co-ordination at the district level. To be eligible for relief from the Fund, a person must be in need to an extent which merits relief as set out in the law.

The Government of **Malaysia** established a National Disaster Trust Fund in 2006 to provide financial aid to disaster victims. The types of financial assistance provided are for loss of income, damaged or demolished houses; agricultural damage; livestock and aquaculture damage; and burial cost for fatalities due to the disasters. During the last decade, allocation from this fund - under the Operation Budget - has been mostly channelled to victims of flood disasters. In 2010, the allocation totalled RM 10m , 2011 – RM 60m, 2012 – RM1 00m and 2013 – RM 100m. Furthermore, the establishment of a cooperative in the form of *Amanah Ikhtiar Malaysia* (The Endeavour Trust of Malaysia) in 1987 has improved the resilience of communities previously vulnerable to disasters. Currently, the trust fund provides services to more than 180,000 families in Malaysia. The services provided include micro-financing, compulsory savings and welfare funds for the poor and marginalised. The Department of Social Welfare is also involved in providing disaster assistance and managing disasters in the following areas: (i) providing and maintaining relief centers; (ii) distributing food supplies, clothing and other basic needs to disaster victims; and (iii) providing advice and counseling to disaster victims. Flood relief operation costs including repairing infrastructure are undertaken by other agencies through their respective budgets.

In the **Philippines**, local governments have the primary responsibility to provide immediate relief to their constituents. In many cases, local resources are not adequate and are such complemented by central government resources. Under the Department of Social Welfare and Development, various programs provide financial assistance to communities affected by a natural disaster: (i) relief goods and services to victims of natural disasters, (ii) rice subsidies, (iii) core shelter assistance programs, (iv) food for work programs and (v) assistance to victims of specific natural disasters. The main target population for most of these programs are the poorest segments of the society. Livelihood support in the form of farming inputs are likewise provided by the Department of Agriculture to farmers affected by disasters.

Implementation challenges identified by individual APEC economies include establishing disbursement procedures for a timely yet accountable process for providing aid (see also Section 7 below) and criteria to fairly allocate limited available financial resources among different categories of disaster victims.

[78] Examples of improvements to damaged public infrastructure include enlarging a culvert beside a road in a flood prone area, raising a bridge to prevent it from being washed away, or extending a dike.

7. FAIR AND EFFICIENT DEPLOYMENT OF FUNDS

7.1 Key challenges and operational solutions

Securing a fair, timely and efficient disbursement of funds for disaster relief, recovery and reconstruction is a key component of effective DRF strategies. Not only must financial resources for disaster response and reconstruction efforts be available, they must also be deployed in a well-timed and targeted manner.

Many obstacles can be encountered along the way, from the lack of clear and streamlined administrative procedures aimed at securing transparency and accountability at the public sector level, to the risk of inefficiencies or even opportunistic conducts on part of the insurance companies tasked with the payment of indemnities to victims of disasters.

From an operational viewpoint, experience shows that this objective can be achieved by establishing *ex ante* specific procedures for the disbursement of public and/or international donors' funds in the aftermath of an event, as well as by monitoring the performance of private sector players (e.g., insurance companies) in claims management, with a view to ensuring fairness in the treatment of claims (in accordance with contractual terms) and speed in compensation.

In securing a timely payment of insurance funds, the availability of loss adjusters can help facilitative efficient claims handling and claims payments. In **Chile** in the aftermath of 27-F one of the problems which arose in settling insurance claims in a timely manner centred on the limited availability of loss adjusters. In order to prevent a recurrence of this problem should a similar future event occur it was determined that a forward looking policy of entering into an agreement with the international subsidiaries of insurance firms operating in Chile would be essential. A similar problem arose in **New Zealand** in the aftermath of the Canterbury earthquakes due to limited availability of loss adjusters. In New Zealand, the optimal solution was to sub contract loss adjusters from Australia.

7.2 Illustrative practices in APEC economies

Following the extensive 2010-11 Queensland floods, to ensure value for money, the **Australian Government** established the Australian Government Reconstruction Inspectorate, an independent body tasked with reviewing reconstruction spending. To advance its mandate, the inspectorate has created a value-for-money framework and a process for evaluating reconstruction projects. The inspectorate assesses value for money on a sample of reconstruction projects across Queensland and inspects damage and reconstruction in disaster-affected areas. To guide recovery and reconstruction activities, the Australian Government entered into the Natural Disaster Reconstruction and Recovery National Partnership Agreement with the Queensland Government on February 24, 2011. The agreement established additional reporting requirements for Queensland and oversight arrangements that reflected the scale and severity of the disaster. The agreement provided a greater level of scrutiny to the use of disaster recovery funding and allowed the Australian Government to make payments to Queensland in advance of incurring recovery costs. On 8 February 2013 the Australian Government signed a new National Partnership Agreement with Queensland which supersedes the earlier agreement and covers the damage caused by floods and cyclones in Queensland between November 2010 and January 2013.

The Australian Government is also working with the insurance industry to strengthen its Code of Practice to improve the handling of claims. Key changes include requiring that insurers resolve claims stemming from most natural disasters in the same time frame as other claims.

In **Chile**, the need to handle a massive amount of claims received in a short timeframe - more than 230,000 in just a few months - was one of the biggest operational challenges that the local insurers had to face in the aftermath of 27F.[79] The SVS confirmed that by August 2010 almost all residential properties damaged by the earthquake and covered by insurance were inspected and by the end of December 2010 approximately 99.8% of the residential property insurance claims were settled. The SVS conducted its own review of the impact of 27F on the insurance industry; in a recent report entitled "*Terremoto 2010: Análisis e impacto del 27-F en el mercado asegurador"* the SVS gives an ample overview of the performance of the private insurance sector, identifying critical areas and lessons learned from the experience, including improvements in the loss adjustment procedures.

In **Japan**, after the Great East Japan Earthquake, the Minister for Financial Services and the Governor of The Bank of Japan immediately made a request to the financial institutions and the insurance industry to take appropriate measures to assist the victims. Upon these requests, the insurance industry promptly resolved insurance claims. In order to create a quick and efficient processing of claims there was a simplification of insurance receipt procedures. Insurers worked together utilising cumulative efforts to facilitate industry wide loss adjustment mechanisms. Insurers completed 98% of insurance claims within 6 months after the occurrence of the earthquake. The earthquake resulted in the enactment of the Disaster Countermeasures Basic Act and establishment of an emergency management scheme for serious disasters. The Disaster Countermeasures Basic Act saw the Financial Services Agency revise the "Supervisory Guidelines". Under the new legislation in the aftermath of a disaster, insurers are required to take appropriate measures such as industry cooperation to achieve efficient payment of insurance claims.

In the aftermath of the 2011 floods in **Thailand**, the OIC cooperated with the General Insurance Association, the surveyors and network organisations in order to facilitate the claims handling process.

In **Hong Kong, China**, the Government has established procedures for handling payments under a centralised web-based Enterprise Resource Planning system. The design of the system enables a timely and effective disbursement of payment, including those arising from disasters. Also, the Social Welfare Department prepares an annual report of the Fund and the report is to be tabled at the Legislative Council for public scrutiny. Investigations are made by the District Officer to determine whether the applicants are eligible for the grant, in accordance with the guidelines. As far as the insurance sector is concerned, the performance of insurers in claims management is monitored by the competent authority. Insurers are encouraged to establish a Claims Settlement Committee to assist the Board of Directors to oversee the claims settling policy and position of the company. Particular attention is also drawn to any significant claims cases or events, e.g. typhoons, floods, which might give rise to a series of claims.

In **Mexico**, the FONDEN operating guidelines are designed to ensure the time-efficient disbursement of appropriate levels of reconstruction financing while balancing accountability and transparency concerns. The process for accessing and executing reconstruction financing can be broken into four phases: (i) declaration of a natural disaster; (ii) damage assessment and request for FONDEN resources; (iii) disbursement of resources and implementation of reconstruction activities; (iv) public reporting on post-disaster activities. FONDEN continues to innovate to improve its operations throughout these phases; for example, it has been an early mover in adopting information technology to streamline the damage

[79] The insurers belonging to multinational groups had contingency plans in place and were able to successfully handle the crisis with the aid of dedicated teams of experts promptly sent from abroad. The shortage of loss adjusters was another major issue that companies had to deal with, with mixed results.

assessment process and has adopted a "build back better" approach to reconstruction financing. FONDEN's Program for Reconstruction, with its resources allocated through the FONDEN Trust, forms the cornerstone of building back (and building back better) in a timely manner following a disaster in Mexico. The Program's operating guidelines are intended to ensure time-efficient disbursement of financial resources for reconstruction of federal and state assets, with cost-sharing between federal and state governments for state assets, while prioritising accountability for the execution of funds. As is true for the broader FONDEN system, this process continues to evolve; over the years, new features have been incorporated such as innovative information technology for damage assessment and the Immediate Partial Support Mechanism for urgent reconstruction needs, among others, to improve the efficiency, effectiveness, and transparency of this process.

Moreover, the financial arrangements for Mexico's FONDEN provide for some flexibility in the disbursement of funds, allowing for the acceleration of funding for certain purposes. The main mechanism for financing reconstruction is the FONDEN Program for Reconstruction, FONDEN's primary budget account which channels resources to specific reconstruction programs; after a disaster, funds committed to a specific reconstruction program will be transferred to a dedicated sub-account in the FONDEN Trust and will be held until reconstruction programs are implemented. However, FONDEN also has a Revolving Fund that can be used to provide resources for immediate response and for the acquisition of emergency supplies. It allows FONDEN to provide humanitarian assistance before, during, and after a disaster. While the Revolving Fund is financed by the FONDEN Trust, it operates under its own rules, ensuring that funding requests meet certain conditions. Further, a new financing mechanism, known as 'Immediate Partial Support', exists that provides partial financial support immediately after a disaster to finance urgent post-disaster needs and actions until the full damage assessment and fund approval process is completed.

In the **Philippines**, as discussed (see above, **Box 14**), the NDRRMC is responsible for managing and mobilising resources for DRM, including the National DRRM Fund, and monitoring and providing the necessary guidelines and procedures on the Local DRRM Fund releases as well as the use, accounting, and auditing of these releases. Moreover, the LDRRMC monitors and evaluates the use and disbursement of the Local DRRM Fund.

In the **United States**, all agencies that disburse federal funds to disaster survivors are required to abide by applicable regulations. The Federal Emergency Management Agency (FEMA) conducts a close-out process with all Public Assistance grantees to reconcile estimates and obligations, and to recover funds that were spent on disallowed costs. Additionally, the Department of Homeland Security Inspector General regularly audits Public Assistance projects to determine if waste, fraud, or abuse has occurred.

Concerning ***implementation challenges***, the main obstacles identified by APEC economies are the lack of resources, the lack of specialised personnel and the practical difficulties in establishing procedures that allow for speedy compensation while guaranteeing transparency and accountability.

8. PUBLIC AWARENESS OF THE FINANCIAL IMPACTS OF DISASTERS AND THE NEED FOR FINANCIAL PREPAREDNESS

8.1 Key challenges and operational solutions

Disaster risk awareness is a key element of DRM strategies. Human-induced factors greatly contribute to the costs of disasters. Changes in patterns of human behaviour, perception and decision-making at all levels of government and society, therefore, can lead to a substantial reduction in disaster risk. Improving the level of risk awareness and the quality of disaster risk reduction education tools clearly stands out as an essential feature of effective DRM strategies.[80] Moreover, promoting awareness of the financial impacts of disasters and the need to plan for - and mitigate - these impacts through the development of financial strategies, including investment in physical risk reduction and financial tools, can boost financial resilience.

Enhancing awareness and financial preparedness may include communication on the expected allocation of disaster costs, e.g., clarifying public and private responsibilities for assuming disaster costs or the respective responsibilities of different levels of government in this respect (through e.g., government policy statements, targeted messages), as well as information about the availability and main characteristics of DRF tools.

Many APEC economies have launched campaigns seeking to raise public awareness about the importance of preparing for emergencies of all kinds, but only some of them focus specifically on the financial impacts of disasters and the need for financial preparedness.

8.2 Illustrative practices in APEC economies

In 2009, through the FONDEN rules; the federal government of **Mexico** launched a new initiative to improve states' understanding of disaster risks and to increase their involvement in the design of financial risk transfer schemes. This initiative was enhanced in the 2011 FONDEN's Operational Guidelines with an increase in financial support. It aims to assist state governments in developing inventories of public assets and low-income housing (including attributes such as type of construction, year of construction, replacement cost, location, and past damage) that are eligible for insurance and in conducting studies to identify and quantify these assets' vulnerability to natural hazards. FONDEN provides state entities with technical and/or financial support for the development of integrated risk management systems. Once a state files a formal request and the FONDEN Technical Committee approves it, financial support is available through the FONDEN Trust for several activities.

The government of **Indonesia**, in collaboration with local authorities, the insurance industry and research institutes, has performed a variety of outreach activities and seminars to raise public awareness of disaster. The **Korean** government has used websites, mass media and promotional materials to enhance public awareness of financial impacts and highlight the importance of financial preparedness. The Office of Insurance Commission of **Thailand** regularly hosts seminars and join many events nationwide regarding

[80] Principles and good practices drawn from experiences within the OECD are presented in the OECD *Policy Handbook on Natural Hazard Awareness and Disaster Risk Reduction Education* issued in 2010 under the auspices of the OECD High-Level Advisory Board on the Financial Management of Large-Scale Catastrophes: OECD, *Policy Handbook on Natural Hazard Awareness and Disaster Risk Reduction Education*, 2010. Available at: http://www.oecd.org/daf/fin/catrisks

insurance products and the National Catastrophe Insurance Fund in order to promote insurance to the public which are intended to boost up the penetration rate.

As regards ***implementation challenges***, some APEC economies recognised that improving financial literacy and the financial culture is a complex process, requiring substantial investment of time, resources and organisational capacities.

9. CONCLUSIONS AND KEY PRIORITIES FOR STRENGTHENING FINANCIAL RESILIENCE IN APEC ECONOMIES

The concentration of catastrophic risks in the Asia-Pacific region, the high economic losses inflicted by natural hazards and man-made threats in the recent past, together with the expected impacts of future potential events, make ***financial resilience*** against disasters a key policy objective for APEC economies.

Policies and measures aimed at reducing financial vulnerabilities at all levels of government and society reinforce the inclusive growth strategy established by APEC Leaders, who recognised the need to "*develop more effectively the human and natural resources of the Asia-Pacific region so as to attain sustainable growth and equitable development of member economies*".[81]

Against this backdrop, in their Joint Ministerial Statement of 30 August 2012, APEC Finance Ministers highlighted the importance of *strengthening resilience against disasters* in the region through the introduction or expansion of *risk sharing and risk transfer markets and products* and also called for the *exchange of knowledge and practices on financial strategies* among APEC member economies.

This report responds to such a call.

Prepared by the OECD in cooperation with the ADB, the UNISDR and the World Bank, it complements an inventory of APEC illustrative practices in DRF that comprises the responses of several APEC economies to an APEC-OECD questionnaire circulated in 2013. It constitutes the first step towards promoting effective and widespread implementation of the G20/OECD Methodological Framework in the APEC region and beyond in the area of disaster risk financing.

While the G20/OECD Framework underscores the central role played by financial policymakers in DRM and provides a general framework for action, this report provides practical illustrations of the concrete ways in which the step-by-step action items can be implemented in different economies, including those with scarce financial resources and limited insurance markets. This report shows that relevant actions can be taken even in economies where the paying capacity of the most vulnerable layers of the population is severely constrained.

The specificities of local disaster risk exposures, the historical development of private insurance, reinsurance and financial markets, the legal and administrative frameworks, the level of economic development and financial capacities within the economy among other factors contribute to shape domestic and regional risk financing strategies across the APEC region. Given the diverse economy profiles that collectively comprise APEC, policies designed to manage the financial impacts of disaster risks are not fully replicable from one economy to another.

Keeping this in mind, illustrative practices – such as those presented and discussed in this report – facilitate learning across economies and can help to identify viable risk financing options for the different segments of the economy and population that can be adapted to different types of economies and thus implemented.

As highlighted by the G20/OECD Methodological Framework, *disaster risk assessment and risk modelling* provide the starting point for the development of disaster risk financing strategies. Important initiatives have been undertaken in this area within APEC in the recent years. In some member economies,

[81] APEC Economic Leaders' Declaration of Common Resolve, Bogor, Indonesia, November 15, 1994.

risk assessment of financial and economic impacts is built on a comprehensive risk assessment, following an approach that evaluates the impacts of specified worst-case scenarios. In other APEC economies, probabilistic risk assessment and modelling has been employed, or is currently under development, as part of a strategy to develop risk financing options for government. This report also presents examples of tailored efforts within APEC to develop pre-disaster impact analysis and risk modelling to address specific DRM purposes, such as emergency management, urban planning and zoning.

Efforts have been made to strengthen the *foundations for risk assessments*, such as the elaboration of risk maps and the collection of data on hazards, exposures, vulnerabilities and losses. Research institutions and the private sector are contributing to these efforts in some APEC economies. Furthermore, a number of APEC economies have developed systems, tools, and databases in order to track disaster impacts and losses. These may be in place in the public sector or private sector, particularly the insurance sector. This information provides input for future disaster risk assessment but is also critical for the provision of compensation for disaster response and recovery. In order to improve the estimation of damages and post-disaster needs, methodologies have been developed to ensure rigour and consistency. .

A number of APEC members are making significant efforts to *identify financial vulnerabilities* within the population and economy and promote the development of *adequate and affordable risk financing and transfer tools* to address these vulnerabilities, particularly among households and small-scale agricultural enterprises. The cost of DRF tools becomes increasingly important in economies where a significant proportion of the population is low income, with limited financial capacity to pay for these instruments. In this regard, public and private investments in disaster risk assessment, quantification, reduction and mitigation enable the development of more affordable market-based products, reducing the need for public subsidies. For governments, notwithstanding important progress being made, developing an accurate risk assessment based on quantitative approaches remains a challenge and a weak link in the DRM cycle.

A comprehensive and integrated approach is required for financial strategies, following an assessment of the availability, adequacy and efficiency of different types of financial tools available to the population and within the economy, as well as of their relative costs and benefits, in comparison with possible further disaster risk reduction. Private insurance provides one of the main risk financing tools for businesses and households to strengthen their financial resilience against disasters. Innovative financial products developed in the capital markets may also be accessed by large corporations, insurers, and governments.

In a very limited number of APEC economies the availability and affordability of disaster insurance is not considered problematic, due to a relatively low level of risk. In other member economies, the situation is different, with disaster risks being more material, which has led governments in markets where insurance is more developed to provide support for disaster insurance through subsidies or guarantees, for instance through disaster insurance schemes. In other APEC economies, disaster coverage may be limited due to the limited scope of insurance markets. In these markets and more generally within APEC, efforts are being made to enhance the availability and penetration of disaster insurance.

Ensuring the *capacity of the financial sector to manage disaster* risk is a key priority within APEC, forming part of a broader strategy to ensure financial sector resilience, including through capital adequacy, liquidity, and business continuity. In many APEC economies, financial institutions are required to establish business continuity management strategies to cope with emergencies, as well as to develop crisis management manuals and business continuity plans. Other initiatives have also been undertaken by financial authorities within APEC to ensure that the financial sector – and in particular the insurance sector – is sound and resilient, capable of delivering promised payments and financing in the event of a disaster.

Some APEC governments are *employing DRF tools* to mitigate the financial impacts of disasters on public budgets and complement investments in physical risk reduction. These *ex ante* financial tools may address short-term (emergency response), mid-term (recovery) or long-term (reconstruction) disaster impacts, and may be used in combination to cover different risk layers, based on the relative frequency and severity of the expected events. Reserve funds have been used within a number of APEC economies for a variety of purposes in relation to DRM, such as emergency response and relief, recovery, and reconstruction. The funds ensure that resources can be rapidly secured and disbursed in the event of a disaster event. There appears to be a trend toward enabling a portion of the reserve funds to be allocated towards investments in risk reduction. In addition, some APEC governments have used insurance for the coverage of public assets. By contrast, other APEC governments are currently financing disaster risk on an *ex post* basis – e.g., through budget reallocations, debt financing, increased taxation and international aid – or by adopting an approach that blends *ex ante* and *ex post* instruments.

Regional initiatives involving some APEC economies have demonstrated how economies can join their forces to share the costs of developing and implementing financial strategies, including risk assessment and the pooling of risks, which may enable enhanced access to the international reinsurance marketplace. Regional risk assessment and quantification efforts, moreover, can have multiple applications: from risk reduction, to early warning and emergency management, to disaster risk transfer and financing. To be effective, pooled risk transfer programmes and schemes need to be linked to defined contingency plans within a domestic disaster risk management framework.

Efforts are being made in APEC economies to promote the *development of innovative risk financing products, instruments and solutions* where insurance markets are weakly developed. The development of micro-insurance has been one avenue through which governments have sought to enhance financial protection among the financial vulnerable, such as small-scale farmers. Non-traditional products using parametric or index-based structures have also been developed, for instance in the areas of crop insurance, weather insurance and earthquake insurance. Parametric structures, however, require reliable data and technology to monitor hazard levels, which may be costly to acquire, manage and maintain, presenting relevant implementation challenges. On the other hand, existing technological and financial networks can be exploited to improve accessibility and lower transaction costs for financial tools: for instance, mobile phone technology can enhance access to micro-insurance while the purchase of portfolio protection against disasters by credit cooperative or rural banks and micro-finance institutions can enhance access to finance.

In some APEC economies with more developed insurance markets and infrastructures, but where insurance coverage for disaster risks may not be sustainable given the scale of the risks and/or level of capital in the insurance industry, different forms of disaster insurance schemes have been established to encourage widespread coverage of catastrophic risks, with the government acting as primary insurer, as reinsurer and/or as guarantor.

Government financial assistance programmes have also been established by some APEC governments to cover basic living expenses and losses linked to disaster impacts. These programmes are financed either *ex ante* or *ex post* and are designed to ensure timely appropriations or release of funds within pre-specified parameters, thereby ensuring timely disbursement of disaster funds for emergency assistance, social protection, recovery and reconstruction. Some member economies have experienced difficulties in establishing criteria to fairly allocate limited available financial resources among different categories of disaster victims.

Securing a *fair, timely and efficient disbursement of funds* for disaster relief, recovery and reconstruction is a key component of effective DRF strategies. Not only must financial resources for disaster response and reconstruction efforts be available after an event, they must also be deployed in a well-timed and targeted manner. Timely availability of funding can reduce the indirect impacts and

secondary consequences of a disaster significantly. From an operational viewpoint, some APEC economies improved transparency and accountability: by establishing *ex ante* clear and streamlined administrative procedures and guidelines for the disbursement of public and/or international donors' funds in the aftermath of an event; by appointing an independent body tasked with reviewing public spending for disaster relief and reconstruction; by monitoring the performance of private sector players (e.g., insurance companies) in claims management, with a view to ensuring fairness in treatment of disaster victims.

Disaster risk awareness is a key element of DRM strategies. Promoting awareness of the financial impacts of disasters and the need to plan for – and mitigate – these impacts through the development of financial strategies, including investment in physical risk reduction and financial tools, can boost financial resilience. In some APEC economies, awareness and financial preparedness have been enhanced by communicating information on disaster impacts and providing information about the availability and main characteristics of DRF tools. Many APEC economies have launched campaigns seeking to raise public awareness about the importance of preparing for emergencies of all kinds; meanwhile, some economies have launched campaigns specifically focussed on the financial impacts of disasters and the need for financial preparedness.

Among the ***top priorities for strengthening financial resilience*** in the APEC region, the improvement of the *availability and quality of data* on hazards, exposures, vulnerabilities and losses was highlighted by several member economies. At the international level, existing discrepancies have led to calls for in-depth reviews of data collection and dissemination practices. Finance Ministers and other public and private institutions concerned would greatly benefit from the promotion of regional and international co-operation and synergies in the collection and sharing of data on disaster risks,[82] as well as in the modelling of the nature of these risks.[83] The development of an international risk assessment platform which amalgamates the risk assessments of economies within proximity to one another, for instance, was identified as a tool that could prove useful for developing a common regional perspective of risk.

Key priorities also include the strengthening of *financial sector resilience*, including *business continuity planning*, and the enhancement of *technical and institutional capacities*, involving the development of multidisciplinary technical skills and expertise, and *coordination* among the various governmental authorities in charge of DRM at the central and local levels. Promoting *awareness of the financial impacts of disasters* and *the need for insurance protection* is yet another priority area. APEC economies are also seeking to *foster the development of DRF markets* and *enhance insurance market penetration*. In this respect, for one economy, there is interest in better understanding parametric insurance and how a reasonable premium can be determined. For another economy, promoting a *more robust operating procedures for the disbursement of public funds* remained a challenge and priority.

Many APEC economies have stressed the value of strengthened cooperation and knowledge and information exchange among member economies on topics related to DRF. Such cooperation and exchange of knowledge and information should focus on addressing APEC member economy priorities.

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[82] Efforts towards common understanding and possible harmonisation, when relevant, of basic definitions and classification criteria, including for the quantification of total economic losses caused by a disaster on a global scale, should also be enhanced further. See OECD, *Recommendation of the Council on Good Practices for Mitigating and Financing Catastrophic Risks*, 16 December 2010, available at: http://www.oecd.org/daf/fin/catrisks

[83] A notable example concerning geophysical hazards is constituted by the Global Earthquake Model (GEM) initiative, promoted by the OECD. At present, GEM is established as a foundation, a public-private partnership that drives a collaborative effort aimed at developing and deploying tools and resources for earthquake risk assessment worldwide, based on uniform global databases, methodologies and open-source software. See: http://www.globalquakemodel.org

Strengthened cooperation can support capacity building and enhance understanding of different DRF strategies and tools and their potential benefits and limitations, including necessary preconditions, and thus support the development and evaluation of DRF strategies and policies within member economies.

Table 8	
KEY PRIORITIES	
Disaster data	• Improving the availability, consistency, and quality of data on hazards, exposures, vulnerabilities and losses for a full range of applications: from domestic and regional risk assessment, to zoning, risk reduction investment, and emergency preparedness, to risk modeling and financing
Technical and institutional capacities	• Strengthening technical and institutional capacities in disaster management, risk assessment, and risk financing, which requires developing multidisciplinary expertise, • Building proper capacities within Ministries of Finance
Domestic and regional coordination	• Enhancing coordination among the various domestic stakeholders in disaster management • Supporting international risk assessment, which can enhance regional perspectives on risks and risk reduction and recognition of interlinkages and interdependencies among economies
Financial capacities and DRF markets	• Enhancing the financial capacity to deal with disasters by promoting the development of DRF tools and markets
Financial sector resilience	• Ensuring financial sector resilience, including through business continuity planning
Deployment of funds	• Securing a fair, timely and efficient disbursement of funds for disaster relief, recovery and reconstruction, while ensuring transparency and accountability in the process
Risk awareness and financial preparedness	• Promoting awareness of the financial impacts of disasters and the need for insurance protection
APEC Finance Minister and officials network	• Promoting cooperation and the exchange of knowledge and information on best practices and challenges regarding DRF strategies among APEC Member economies

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PRACTICES AND CHALLENGES

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