Climate & Development Knowledge Network

CDKN GUIDE

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About this guide

- CDKN aims to help decision-makers in developing countries design and deliver climate compatible development.
- Managing climate-related disaster risk is a high priority for CDKN's core audience: national planners and policy-makers in developing countries.
- This CDKN guide aims to support national planners and policy-makers and to strengthen their disaster risk management efforts.

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Tackling exposure:
Placing disaster risk management at the heart of national economic and fiscal policy

1. Summary

The number of disasters is increasing. When combined with upward trends in losses from economic disasters, it is clear that paying for disaster relief and recovery at such large scales is unsustainable, in both human and financial terms. Economic exposure to disasters is increasing faster than *per capita* gross domestic product (GDP), and the impacts of climate change on the severity and frequency of hazards will accentuate existing trends in disaster losses in the future. While support for effective disaster relief and recovery must remain, there should be a greater emphasis on proactive efforts to reduce risk, based on comprehensive risk assessments and the integration of risk-reduction measures into national economic and development planning.

The magnitude of losses from disasters is forcing countries to consider risk financing measures within fiscal policy. These mostly relate to: setting up national reserve funds; creating favourable and fast-disbursing credit arrangements with international financial institutions, contingent on the occurrence of disasters; and purchasing sovereign insurance to provide financial cover for emergency expenditure and losses to infrastructure and public buildings. Such risk financing strategies are widely perceived to reduce risk only if they are integrated into a wider national risk management strategy that tackles risks systematically. The ultimate goal of such strategies is to create a less risky distribution of people and assets within a country or, where people and assets are exposed, to make sure that adequate measures are in place to protect them from hazards.

Economic, fiscal and territorial planning policies can all reduce exposure to hazards, but to be successful, policies need to be based on national risk atlases and disaster risk assessments that take account of the dynamic nature of risks. This information will need to be factored into national and provincial budgets, land-use plans, infrastructure investments and poverty alleviation measures. Suitable legislation and enforcement that limits the exposure of people, critical infrastructure and other assets is also vital for putting the necessary safeguards in place. But while a number of far-sighted countries are already integrating disaster risk management into economic and fiscal planning, the majority have yet to act.

This paper aims to support decision-makers to better understand the role of national economic policy, fiscal policy and development planning in disaster risk management, and encourage more concerted action to tackle exposure to disasters. The paper contains practical examples from which others can learn, including cases from Central America, Central Asia, Mexico, Nepal and the Caribbean, involving tools and methods related to risk assessment, risk financing options, sector-level mainstreaming and legislation. The paper emphasises climate-related disasters, although the findings apply more broadly.

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2. Introduction

2011 was the costliest year on record for disasters, with estimated global losses of $380 bn. It was dominated by the disasters associated with the Japanese earthquake and tsunami, including the nuclear disaster; the earthquake in Christchurch, New Zealand; floods in Thailand; and extreme weather in the US. Not only were aggregate losses extremely high but the distributional and knock-on effects were also large. Recent data suggests that the floods in Thailand reduced Japan's industrial output by 2.6% in November 2011 compared to the previous month, due to disruption to electronics and automotive 'just-in-time' supply chains. Japanese carmakers, whose production facilities are spread across the region, lost $500 m.[i] Lloyds of London reported that the floods caused the third biggest loss – $2.2 bn – in its market's 324-year history.[ii]

The 2011 losses extend a trend that has seen global average economic disaster losses rise by 200% over the last 25 years in inflation adjusted terms (see Figure 2, page 4). The trend is predominantly the result of more people and assets being located in areas exposed to natural hazards. For example, the population exposed to flood risk in Asia in 2030 will be more than 2.5 times the figure in 1970[iii] and 0.5 times higher than in 2000.[iv] While recent data suggests disasters are already hampering economic growth in low- and middle-income countries, a continuation of the current upward trend in disaster losses poses a severe threat to both national and regional macroeconomic outlooks. Tackling this problem involves placing measures to address disaster risk at the heart of national economic and fiscal policy, as well as embedding them within sector-based economic and land-use planning. At a national level, reducing losses or even stemming their increase will require investment to reduce the vulnerability of people and infrastructure located in exposed areas, or enacting policies that over time result in a safer spatial distribution of people and assets.

While several countries have already started this process (some are highlighted in this paper), progress is highly variable. The majority of efforts focus on building budgetary reserves and establishing sovereign insurance mechanisms to bolster and speed up the flow of money to support ex-post emergency assistance and relief processes.[v] But insurance reduces the variability around outcomes – the 'rainy day' – not the expected, everyday impacts; at best it helps to protect against infrequent outcomes and thus only covers part of the loss and destruction from disasters.

Direct and indirect losses are also difficult to measure accurately. They can extend across borders, through regional and global supply chains, as well as to intangible losses such as the cultural value of historic buildings and artefacts, or the detrimental health impacts associated with stress and anxiety, which are difficult to insure against. Efforts therefore need to be focused on holistically managing risk, losses and impacts through economic and fiscal policy. But how can this be achieved?

Drawing on examples, this paper examines whether disasters genuinely inhibit economic development and whether rising disaster losses will have a greater impact on developing economies in the future. It then considers whether economic and fiscal planning at national levels can reduce exposure to disasters, before considering the necessary steps countries must take to achieve economic development in a more resilient way.

Box 1: The macroeconomic impacts of Hurricane Mitch on Honduras

Honduras is a good example of a country subject to high disaster risk (severe exposure to hurricanes, flooding, drought and earthquakes), limited economic diversification (with a reliance on cash crops such as bananas), and tight financial and fiscal constraints (due to high indebtedness and high prevalence of poverty). The country was heavily hit by Hurricane Mitch in 1998, which killed 6,000 people, left an estimated 20% of the population homeless, and caused assets losses of about $2 bn, or 18% of capital stock.

Important macroeconomic effects ensued; Figure 1 shows actual GDP in absolute terms as well as two pre-disaster projections. GDP growth in Honduras became negative during the 12 months after the event – the downward spike of GDP in absolute terms – but then rebounded due to the substantial inflow of foreign assistance, which increased by about $500 m, or from about 6% of GDP pre-disaster to close to 16% post-disaster. To determine the impact on longer-term growth, the gap to the counterfactual projections without a disaster event can be taken as one indicator

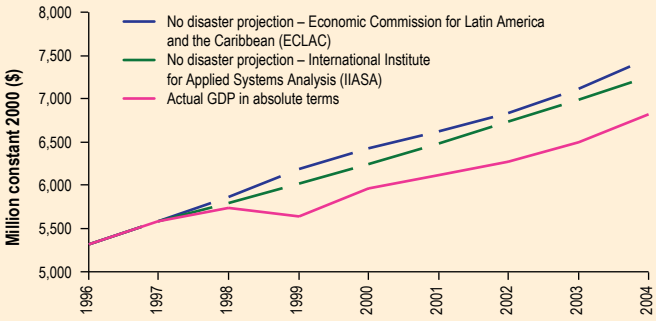

Figure 1: Observed GDP in Honduras with event vs. projected growth without event

Source: Mechler et al. (2006)

Using this approach for Honduras identifies a 'GDP gap'. For example, in 2004, six years after the hurricane, this gap can, with all other factors being the same, be considered to have amounted to about 6% of potential GDP given linear extrapolations of pre-disaster GDP with a 4-year average growth rate, and to about 9% based on another projection.

3. Do disasters affect economic development?

- Disasters can inhibit economic development at micro and macroeconomic scales
- Honduras experienced a 'GDP gap' in the years following Hurricane Mitch in 1998

Disasters directly lead to immense human suffering and loss. They may also directly and indirectly affect economic outcomes in the medium to longer term. Disasters can lead to microeconomic (household, business level) impacts, as well as macroeconomic, aggregate impacts. The latter comprise effects on GDP, consumption, savings, investment and inflation due to the effects of disasters, as well as due to the post-event reallocation of public financial resources to relief and reconstruction efforts.

Several studies over the last four decades have examined the impact of disasters on aggregate economic performance and development, based on empirical and statistical analysis as well as modelling exercises. Earlier studies addressed predominantly developed economies and focused on the sectoral and distributional impacts of disasters, while more recent studies have focused on developing countries. These studies generally find very limited aggregate macroeconomic impacts in developed countries, but important regional economic and distributional effects.[vi] In terms of developing countries, disasters have been found to lead to important adverse macroeconomic and developmental impacts, and affect the pace and nature of socioeconomic development.[vii]

For example, following Hurricane Mitch in 1998, Honduras suffered setbacks to macroeconomic performance and rural poverty (see Box 1).[viii] However, as a recent review by Handmer et al. (2012) suggests, there is only medium confidence in these findings, as a few studies have also found positive effects such as post-disaster increases to GDP.[ix] Yet it is generally argued that these 'positive' findings can be attributed to: the lack of a systematic and robust GDP counterfactual (what would have happened to GDP if the disaster had not occurred?) in these studies; a lack of accounting for informal sector effects; a lack of accounting for financial inflows (insurance and aid); and, importantly, the problem that national accounting generally measures flows rather than stocks. The last point means that the relief and reconstruction effort (measured as a flow in terms of increased consumption and investment) shows up positively in national statistics, whereas the destruction (a loss to capital stock) does not enter the accounting at all.

Despite these reservations, there is a consensus that macro effects are much more pronounced in lower-income countries.[x] Handmer et al. (2012) suggest that developing countries exhibit higher economic vulnerability due to: their reduced resilience and dependence on natural capital and disaster-sensitive activities (such as tourism and agriculture); a lack of developed assessment processes and techniques for responding to disasters, including preparedness, financing, information, and risk management; and governance shortcomings. Countries with one or more

of the following characteristics are considered particularly at risk of significant macroeconomic consequences post-disaster (see Mechler, 2004):

(i) high natural hazard exposure
(ii) economic activity clustered in a limited number of areas, with key public infrastructure exposed to natural hazards
(iii) tight constraints on tax revenue and domestic savings, shallow financial markets, and high indebtedness with little access to external finance.

4. Impact of disasters on future economic development

- The risk of economic losses from disasters is concentrated in middle-income countries with rapidly developing economies, and low-income countries particularly exposed to natural hazards
- Without a significant recalibration of economic policy to take account of rising disaster risk, disaster losses in many low and middle-income countries are likely to rise more rapidly than economic growth in the future
- Losses from climate-related disasters are doubling every 12 years

While there is high inter-annual variability in global losses (insured and uninsured) due to disasters, these have increased over the last few decades when adjusted for increases in wealth. As Figure 2 shows, recent data show that 2011 was by some margin the costliest year ever recorded for disaster losses, amplified by losses associated with the earthquake, tsunami and nuclear disaster in Japan.

However, economic exposure to disasters is not evenly distributed. The risk of economic losses, as a proportion of annual GDP, is concentrated in middle-income countries with rapidly developing economies, and particularly exposed low-income countries such as Small Island Developing States.[xi] Figure 3 shows countries with the largest monetary disaster losses as a percentage of gross national income since 1960.

The burden of losses in middle-income countries has been increasing, with average losses of 1% of GDP from 2001–2006 (compared to 0.1% for high-income countries).[xii] However, economic loss of GDP is even more concentrated, with China and countries in South Asia accounting for more than 49% of global annual losses since the 1970s.[xiii] Given the influence of the economies of China, India and other Asian countries on global growth, future trends in disaster losses in such countries are of particular concern, for the region and globally. In 2008, regarded as one of the worst years for natural and man-made disasters, Asia lost a total of $269 bn due to disasters. Emerging economies were particularly exposed due to high urban migration, intensification of natural resource use without adequate management, and population growth.[xiv]

Without a significant recalibration of economic policy to take account of rising disaster risk, disaster losses in many low- and middle-income countries are likely to rise more rapidly than economic growth in the future.[xv] This is because economic exposure to disasters is increasing at a faster rate than upward trends in wealth creation and efforts to adequately protect people and assets.[xvi]

The trend of increasing economic exposure is caused by rapid urbanisation (which concentrates exposure), the global movement of people and assets to coastal locations (where disaster risk is often greater), and degradation or loss of natural ecosystem buffers (such as mangrove forests). These are coupled with a lack of appropriate legislation and land-use planning. Figure 4 shows that this trend of increasing exposure and disaster risk is particularly pronounced in Latin America and South Asia, where risks are estimated to have risen. By contrast, risks are declining

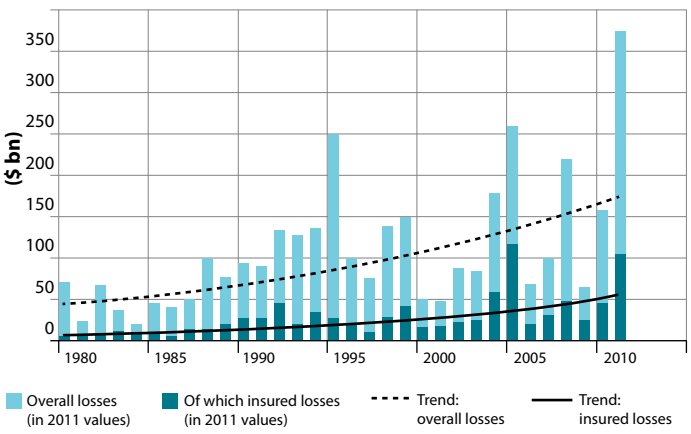

Figure 2: Increasing disaster losses
Source: Munich Re (2012)

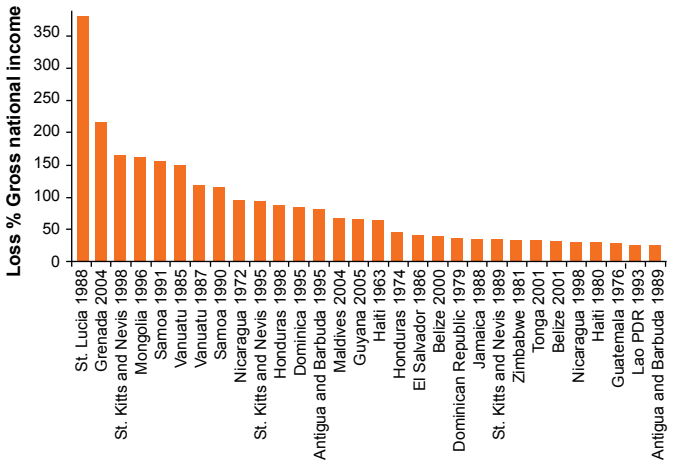

Figure 3: 30 largest monetary disaster losses since 1960 (all countries)
Source: Mechler (2009)

in East Asia and the Pacific and OECD countries, due to progress on reducing vulnerability, even though exposure is still growing.

The models used do not capture endemic or extensive risks well, particularly those associated with food security and slow-onset disasters (such as those commonly associated with drought). This means that the accuracy of assessments for sub-Saharan Africa is limited. More research is needed to understand the point at which disaster losses and economic growth decouple, and the key drivers of this, but deployment of the type of tools introduced in Section 5 (page 6) are likely to be important, along with greater progress in reducing poverty and upgrading infrastructure.

4.1 Impact of climate change-related disasters on future losses

Although we do not know the full effects of climate change on disaster risk, it is estimated that losses from weather-related disasters are doubling globally every 12 years.[xvii] While the recent rises in economic losses are mainly attributed to changes in exposure and asset values, natural climate variability and anthropogenic climate change could significantly impact future disaster-related losses. Therefore future predictions cannot be based solely on historic patterns, but need to consider future trends (see Box 2, page 6).

Many global projections of estimated future disaster losses are based on analysis from insurance and reinsurance companies, who are concerned that the changing frequency and intensity of climate extremes, alongside increases in exposure, will dramatically affect the industry. In 2007, the Association of British Insurers estimated that worldwide annual losses from hurricanes and windstorms will increase by two thirds by 2080, in inflation adjusted terms.[xviii] However, the industry is starting to adjust to these trends, warning about future uninsurability if risks remain unmanaged. As Clarence Wong, chief economist at Swiss Re Asia, stated in 2009, 'ex-post risk financing is unsustainable. Investing in disaster risk management is the only way to reduce the burden on public budgets and build the foundation for more sustainable risk financing arrangements'.

The European Environment Agency raised concerns in 2008 that uninsured disaster losses are likely to rise as obtaining insurance gets more difficult in places experiencing increased disaster risk. They also stated that the people likely to experience uninsured disaster losses are those from socially deprived groups and, increasingly, those in countries where insurance markets will not operate or where premiums are too high. In such cases, public–private partnership insurance and risk financing is attracting increased attention as a means to develop the insurance industry and support both public and private investments.[xix]

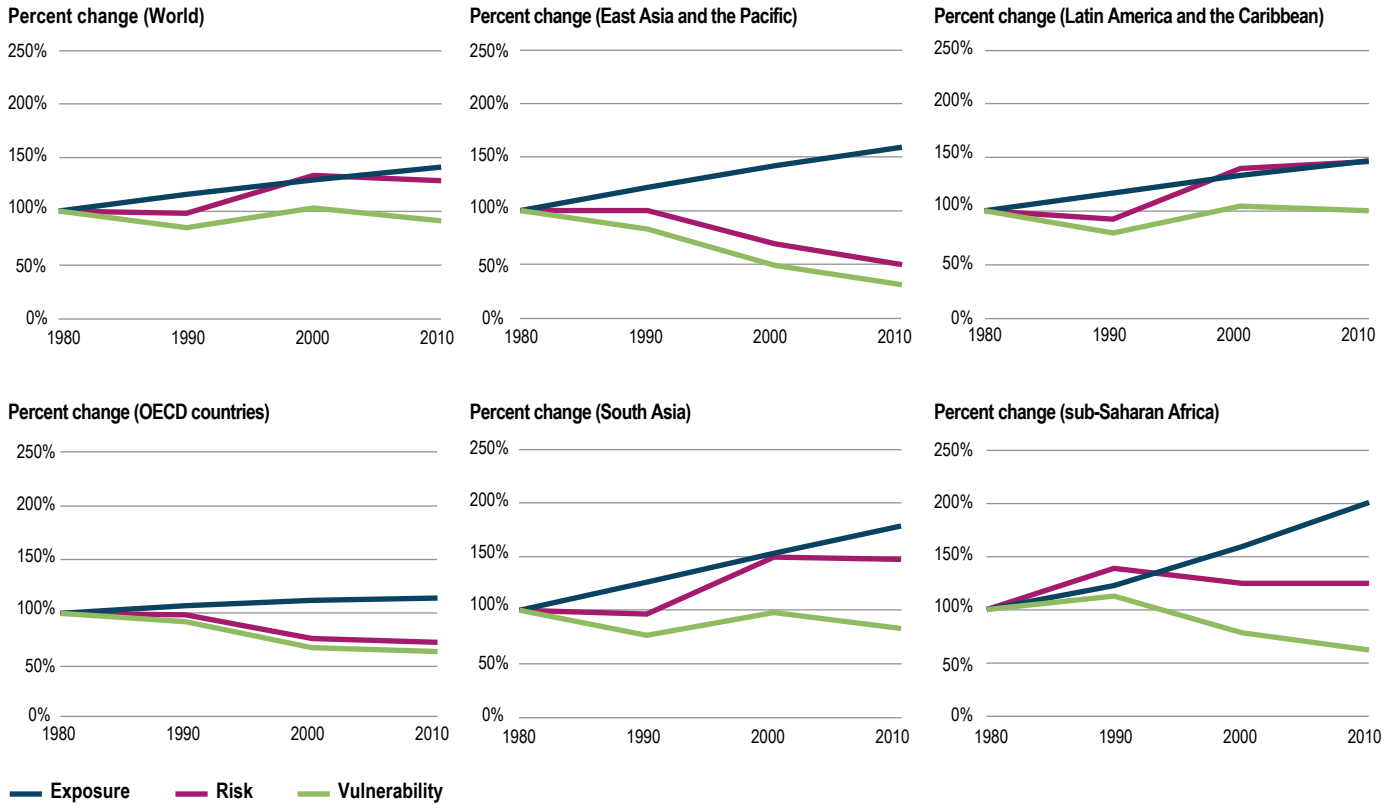

Figure 4: Trends in disaster risk, exposure and vulnerability, 1980–2010

Source: UNISDR GAR (2011)

Box 2: Changing pattern of disaster losses in El Salvador

El Salvador is one of the world's most exposed countries, along with the rest of Central America and the Caribbean (see Figure 3, page 4). Just over 20,700 km^2 of its land area (88.7%) is considered to be at risk of disasters, and 95.4% of its population lives in exposed areas. Its location means the country experiences increasingly frequent climate extremes. In just three years, El Salvador was affected by five extreme climatic events: Tropical Storm Ida in 2009; Tropical Storms Agatha, Alex and Matthew in 2010; and Tropical Depression Twelve-E in 2011.

As a result of Twelve-E, 181 municipalities were affected to a greater or lesser degree and nearly 2000 km^2 (practically 10%) of the country's territory was flooded. A total of 1.5 m of rain fell over 10 days (recorded at Huizuca Station, La Libertad); such an occurrence had not been recorded for 40 years, since the country has had reliable measurements. This was more than twice the rainfall during Hurricane Mitch. It is estimated that the consequences of Twelve-E caused GDP growth to drop from 2.1% to 1.4% in 2011, and accelerated inflation from 6.8% to an estimated maximum of 8% in one year.

In recognition of the severe impact of disaster risk on growth, El Salvador's government, with support from CDKN, is developing a National Climate Change Strategy. Climate change adaptation will be facilitated through guidelines in key sectors, including water, agriculture, education, health and infrastructure. Climate and disaster risk is being factored into development plans and budgets, in an attempt to develop climate compatible development strategies and reduce exposure to changing climate-related hazards. This involves a major reconstruction commission to review exposure on El Salvador's Pacific coast, in response to the apparent switch in the sources of storm tracks and heavy rainfall from the Atlantic to the Pacific side.

The Caribbean sovereign insurance scheme (Boxes 3 and 6, pages 8 and 11) is one example, and Mexico is another interesting case. The Mexican government insured its disaster liabilities in international markets, using traditional and alternative insurance products. This arrangement built heavily on Mexico's' far-reaching expertise in modelling and managing risk, as well as technical assistance from the World Bank and expertise provided by a large reinsurer, who acted as a joint bookrunner (see Box 4, page 8).

The United Nations Framework Convention on Climate Change is considering such approaches under its Work Programme on Loss and Damage (2010–2012), which recognises that climate change mitigation and adaptation is sometimes not enough to avoid losses associated with climate change. Among other issues, the Work Programme is considering whether some form of insurance mechanism can be developed to ensure developing countries are 'compensated' for such losses. The public investments necessary to support such insurance markets could come from countries with higher historical greenhouse gas emissions.

5. Tools and approaches for integrating disaster risk management into economic and fiscal policy

- Governments need regular and reliable risk assessment data for economic and fiscal planning
- Disaster risk assessment tools and methods, such as GIS-based platforms, are being used in different regions to inform decisions on risk management investments
- Some countries are developing risk financing mechanisms to reduce the financial burden of disasters

Given the concepts discussed, what tools and approaches are available to countries, non-governmental organisations and the international community? This section considers tools and approaches that can integrate disaster risk management into national economic and fiscal policy, with the goal of reducing economic exposure to disasters and ultimately reversing the trend of rising disaster losses, especially in low- and middle-income countries. A recent OECD assessment (2012) on economic growth in the context of climate change finds that 'building in resilience to climate change impacts by integrating adaptation to climate change in development planning and infrastructure design is critical to the growth prospects of low-income countries'.

5.1 Comprehensive risk assessments as part of economic policy decisions

The first key step in managing risk is to assess and characterise it. Disaster risk is commonly defined by three elements: the hazard, the exposure of elements, and vulnerability.[xx] Thus, understanding risk involves observing, recording and analysing hazards; studying exposure and drivers of vulnerability; vulnerability assessment; and arriving at an estimate of probabilistic risk. The next step is to factor disaster risk assessments into national development strategies, sector plans, budgets, regulations, programmes and projects (see Figure 5, page 7).

Comprehensive disaster risk assessments depend on having a clear baseline and strong time-series information covering hazard, exposure and vulnerability data; these make it easier to see what is changing.[xxi] Given the dynamic nature of disaster risk, underlined by the possible effects of natural climate variability and anthropogenic climate change and uncertainties, regular information updates are necessary.[xxii] For national-level assessments, it is particularly important to have data on the distribution of national assets and their values (derived from inventories and census data) and on institutional and organisational capacity at different scales (see Table 1, page 7).

While considerable advances have been made in terms of data availability, including in developing countries, many countries lack relevant data sets and assessments are not regular. Nonetheless, a variety of disaster risk assessment

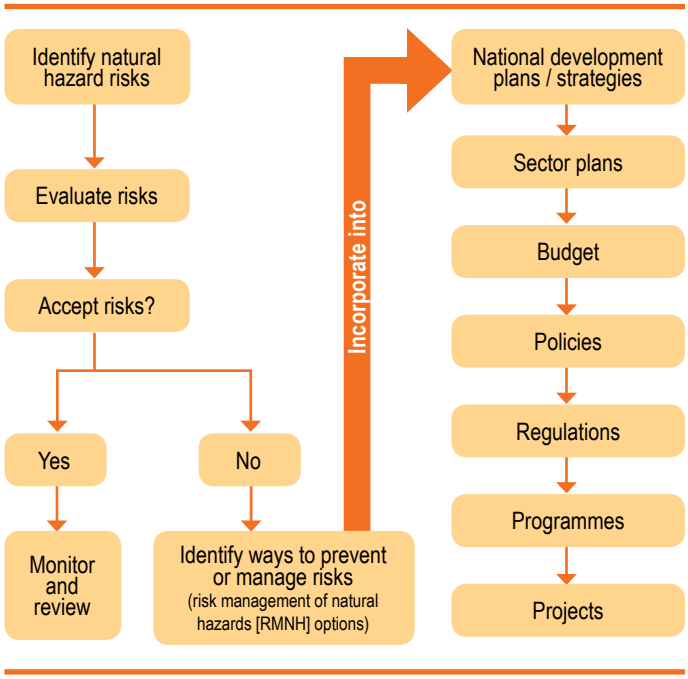

Figure 5: Incorporating disaster risk assessments into strategies and plans

Source: Bettencourt et al. (2006)

tools and methods have been developed, including the Comprehensive Approach for Probabilistic Risk Assessment (CAPRA). CAPRA is a geographic information system (GIS) platform in which probabilistic assessments of hazards are made and then combined with exposure and vulnerability data, enabling users to examine multiple hazards and different risks simultaneously. Since its inception in 2008, CAPRA has faced problems of building the necessary capacity to use the tool, and collecting enough data on national assets to ensure the exposure module is accurate.[xxiii] CAPRA has been applied in Central America and has been designed to facilitate decision-making, including of risk transfer instruments and the evaluation of cost–benefit ratios for risk reduction strategies. CAPRA is now being rolled out in South Asia.[xxiv] The example in Box 3 (page 8) describes a similar risk assessment platform used to support the Caribbean Catastrophe Risk Insurance Facility.

5.2 Integrating disaster risk management into fiscal policy and budget planning

Using such comprehensive risk assessments, a key entry point for governments to better deal with disasters is to budget for disaster risk and include strategies for managing disaster risk in wider fiscal policy.

Table 1: Information requirements for selected disaster risk management and climate change adaptation activities

Source: Lal et al. (2012), adapted from Wilby (2009)

	Activities	Examples of information needs
Cross-cutting	Climate change modelling	Time-series information on climate variables – air and sea surface temperatures, rainfall and precipitation measures, wind, air circulation patterns, and greenhouse gas levels
	Hazard zoning and 'hot spot' mapping	Georeferenced inventories of landslide, flood, drought and cyclone occurrence and impacts at local, sub-national and national levels
	Human development indicators	Geospatial distribution of poverty, livelihood sources, access to water and sanitation
	Disbursement of relief payments	Household surveys of resource accesss, social well-being, and income levels
	Seasonal outlooks for preparedness planning	Seasonal climate forecasts; sea surface temperatures; remotely sensed and *in situ* measurements of snow cover/depth, soil moisture and vegetation growth; rainfall-runoff; crop yields; epidemiology
	A system of risk indicators reflecting macro and financial health of nation, social and environmental risks, human vulnerability conditions, and strength of governance (Cardona et al. 2010)	Macroeconomic and financial indicators (Disaster Deficit Index); measures of social and environmental risks; measures of vulnerability conditions reflected by exposure in disaster-prone areas, socioeconomic fragility, and lack of social resilience in general, measures of organisational, development and institutional strengths
Flood risk management	Early warning systems for fluvial, glacial and tidal hazards	Real-time meteorology and water-level telemetry; rainfall, stream flow and storm surge; remotely sensed snow, ice, and lake areas; rainfall-runoff model and time series; probabilistic infromatoin on extreme wind velocities and storm surges
	Flooding hot spots, and structural and non-structural flood controls	Rainfall data, rainfall-runoff, stream flow, floods, and flood inundation maps; inventories of pumps, stream gauges, drainage and defense works; land-use maps for hazard zoning; post-disaster plans; climate change allowances for structures; floodplain elevations
	Artificial draining of proglacial lakes	Satellite surveys of lake areas and glacier velocities; inventories of lake properties and infrastructure at risk; local hydrometerology
Drought management	Traditional rain and groundwater harvesting and storage systems	Inventories of system properties including condition, reliable yield, economics, ownership; soil and geological maps of areas suitable for enhanced groundwater recharge; water quality monitoring; evidence of deep-well impacts
	Long-range reservoir inflow forecasts	Seasonal climate forecast models; sea surface temperatures; remotely sensed snowcover; *in situ* snow depths; multi-decadal rainfall-runoff series
	Water demand management and efficiency measures	Integrated climate and river basin water monitoring; data on existing systems' water use efficiency; data on current and future demand metering and survey effectiveness of demand management

Historically, losses in developing countries have been financed by diverting funds from the national budget, or by loans and donations from the international community. Yet these sources are often insufficient and countries frequently encounter ex-post gaps in the financing necessary to compensate disaster losses. When stimulus is most needed, this lack of timely funding can lead to follow-on losses. In Honduras after Hurricane Mitch, aid measured in terms of GDP almost tripled from 6% to 16% (from $0.3 bn to $1 bn), yet this was still well below what was necessary for effective relief and recovery. In contrast, Mexico has been one of the first countries to recognise these liabilities and integrated disaster risk with fiscal planning. Box 4 describes Mexico's approach to fiscal planning for extreme events.

Box 3: Experience of risk assessment in economic policies of Central Asia and Caribbean

Central Asia is one of the most vulnerable regions to climate change. While prone to extreme temperatures and rainfall-related landslides, recurrent drought in the first decade of the 21st century has affected hydropower generation, water supply for irrigation, rain-fed cropland and pasture productivity. Electric power generation shortages in Kyrgyzstan and Tajikistan stalled industrial growth and deprived millions of people of heat and electricity in severe winter conditions, resulting in a humanitarian crisis.[xxv]

A new partnership between the United Nations Development Programme's Central Asia Climate Risk Management Programme and CDKN focuses on improving capacity and methodologies for comprehensive and integrated climate risk assessment tools. The partnership has found that systematic risk assessments require a broad range of expertise, given the range of data needs. A successful process depends on adequate capacity to conduct assessments, interpret results and identify appropriate actions.

In the Caribbean in 2009, Caribbean Community (CARICOM) leaders established the Liliendaal Declaration, which recognises that countries in the region need to take decisive and potentially transformative action to build disaster-resilient, low-carbon economies. A risk assessment approach to disaster risk management in macroeconomic planning is a central component of its implementation plan.

The Caribbean Catastrophe Risk Insurance Facility (CCRIF), discussed further in Box 6 (page 11), is supporting the development of country risk profiles and their integration with economic and fiscal planning. The country risk profiles offered via the Multi-Peril Risk Evaluation System (MPRES) catastrophe risk modelling platform provide a systematic basis and entry point for more detailed information. These data have been generated and used to underpin CCRIF policies since the policy year 2010–11 and represent a valuable regional public-good resource to inform holistic disaster risk management.[xxvi]

Box 4: Fiscal planning for extreme events in Mexico

Mexico lies within one of the world's most active seismic regions and in the path of hurricanes and tropical storms, meaning its population and economy are highly exposed to natural hazards. The country has been a pioneer in planning for disaster risk and using sovereign risk financing instruments to reduce the public costs of bearing risk. Severe natural disasters (the type likely to occur infrequently but at great cost) imply large fiscal liabilities for the Mexican Government. For example, more than 9,000 people lost their lives in the 1985 Mexico City earthquake, and estimates put the direct economic cost of the disaster at about $8 bn (in 2010 prices).

In the case of a disastrous event, the Mexican Government is responsible for providing emergency aid and economic support for its low-income population. According to Mexican law, public assets are insured and thus reconstruction is financed by insurance claims. In the past, severe disasters have created large fiscal liabilities and imbalances. Given its financial vulnerability, the Mexican government has been working to improve its fiscal and debt management to reduce the costs imposed by natural disasters and other shocks.

Alerted by the Mexico City catastrophe, in 1996 the Mexican Government created a budgetary programme called FONDEN (Fund For Natural Disasters) to enhance the country's financial preparedness for natural disasters. FONDEN is established as a budget item at the start of each fiscal year by Parliament, as part of the federal government budget plan. It provides last-resort funding for uninsurable losses, such as emergency response, and disaster relief. In addition to the budgetary programme, in 1999 a reserve trust fund was created, which is filled with the surplus of the previous year's budget item. FONDEN's objective is to prevent imbalances in the federal government finances derived from outlays caused by natural catastrophes.

But the recent series of natural disasters forced the Government to look at alternative risk management strategies. From 2000 the Government began collecting data to assess the exposure of its assets to losses from earthquakes, and to analyse different financial instruments that could transfer the risk. In 2006 it became the first emerging economy to transfer part of its public-sector natural catastrophe risk to the reinsurance and capital markets – and thus out of the country. This decision came 21 years after the 1985 Mexico City earthquake had highlighted the shortcomings of after-the-event approaches for coping with disasters and associated losses. Mexico's public sector risk management strategy is strongly informed by risk analysis, including modelling and economic assessment.

Mexico's experience shows that data collection over a long time horizon is crucial to inform good planning. Building research and analytical capacity domestically has also paid off, with universities leading data collection and modelling efforts.

Governments are right to consider financial mechanisms, including reserve funds and insurance products, that offer financial protection against different parts of their residual disaster risk portfolios. But with rising disaster risk, it is crucial that they take further ex-ante measures (such as physical infrastructure, building codes and improved preparedness) to protect lives and livelihoods and to increase the affordability of insurance. Taking disaster risk assessments as a starting point, it is crucial that decision-makers are well informed about the relative costs and benefits of investing in risk reduction measures compared to preparing for and financing residual risk. Further, it is desirable that disaster risk financing strategies incentivise investments in risk reduction, by explicitly costing risk and providing for cost savings on insurance premiums after the further implementation of risk reduction strategies. Figure 6 highlights the risk management policy options open to decision-makers.

However, the process of evaluating policy choices to manage the disaster risk portfolio can be complicated. There are considerable uncertainties associated with the frequency and severity of hazards, challenges in projecting the distribution of vulnerability into the future, and a competing range of budgetary and investment priorities. Box 5 (page 10) describes a model to support decision-makers navigate these challenges, particularly with regard to fiscal policy.

Risk financing products are becoming increasingly popular, but in 2011 the Intergovernmental Panel on Climate Change (IPCC) concluded that there is only medium confidence in the findings that 'risk sharing and transfer mechanisms at local, national, regional and global scales can increase resilience to climate extremes'. Such mechanisms provide a means to finance the relief and recovery of livelihoods and reconstruction, reduce vulnerability, and provide knowledge and incentives for reducing risk (see Box 6, page 11). But the IPCC also concedes that such mechanisms – if not well integrated with risk reduction and economic planning and policy – can actually provide disincentives for reducing disaster risk, by focusing money and effort on the more infrequent risks covered under the policies and providing a feeling of safety, while drawing attention away from frequent and dynamically increasing risk.

5.3 Mainstreaming disaster risk management in sector planning

To reduce disaster losses, the balance of effort needs to shift towards reducing exposure, through national and sector-based economic planning that takes detailed account of risk assessments. Such strategies benefit from being part of national strategic risk management processes.

In Kiribati, the Kiribati Adaptation Program (KAP) is designed to 'develop and demonstrate the systematic diagnosis of climate-related problems and the design of cost-effective measures, while continuing the integration of climate risk awareness and responsiveness into economic and operational planning'.[xxix] On the basis of extensive consultations and detailed risk assessments, risk management has been integrated across national development strategies and ministry operational plans for all relevant sectors. All of the KAP's investments are tied directly to priorities and activities identified in government planning documents, guided by a National Strategic Risk Management Unit in the Office of the President.

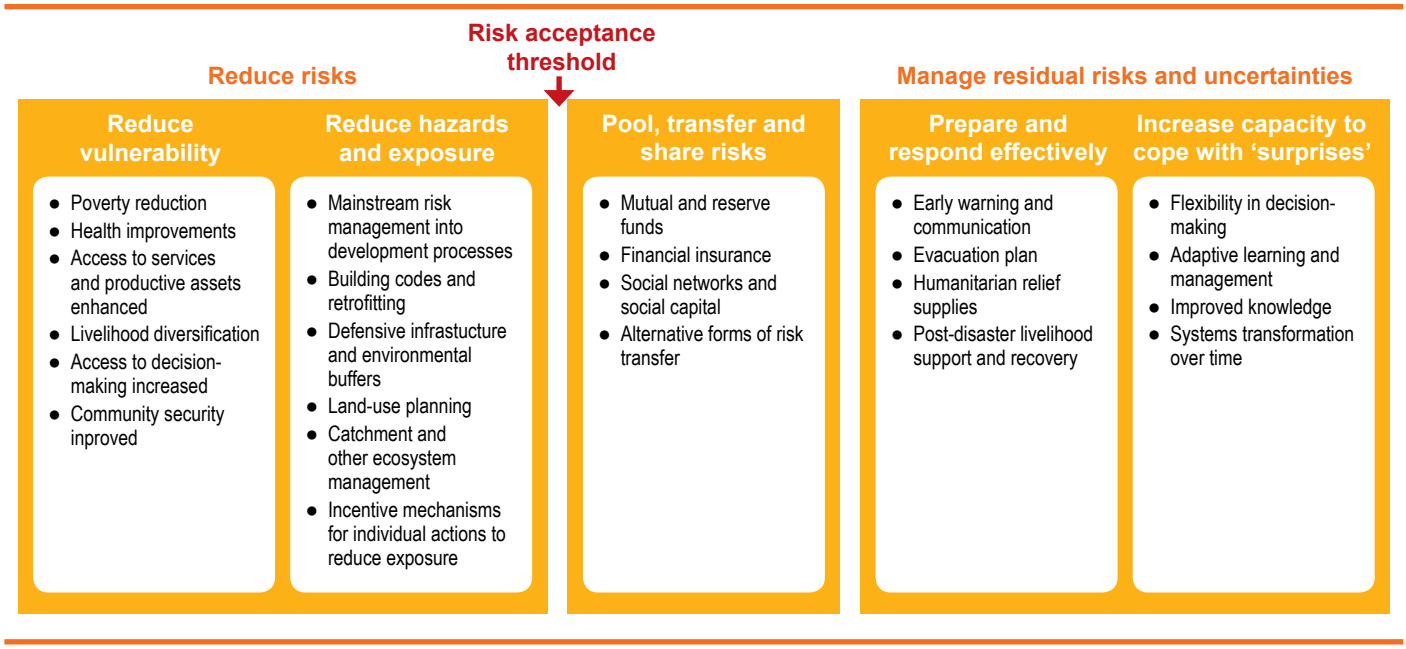

Figure 6: Complementary policy options for managing disaster risk portfolios at national level
Source: Lal et al. (2012)

Box 5: Modelling fiscal vulnerability: the liquidity gap and risk

The CATastropheSIMulation (CATSIM) model, developed by the International Institute for Applied Systems Analysis, is a risk-based economic framework for evaluating the impacts of economic disasters, and the costs and benefits of measures for reducing those impacts. CATSIM uses stochastic simulation of disaster risks by randomly and repeatedly generating disaster events in a specified region, and examining the ability of the government and private sector to finance relief and recovery. The model is interactive; the user can change parameters and test different assumptions about hazards, exposure, vulnerability, general economic conditions and the government's ability to respond.

As a capacity-building tool CATSIM can illustrate the trade-offs and choices confronting governments about increasing their economic resilience to the impacts of catastrophic events. The model can support policy-planning processes for the allocation of resources between ex-ante spending on disaster risk management (such as prevention, national reserve funds, sovereign insurance) and ex-post spending on relief and reconstruction.

CATSIM and other tools are now being used to support a multi-sector steering committee in Madagascar to simulate the impacts of hazards and disasters on the budget, and to assess the costs and consequences of financial solutions adopted in terms of important indicators such as economic growth or debt. These tools will allow the development of comprehensive funding strategies for disaster risk. This project, called 'Mainstreaming Disaster Risk Management and Climate Change in Economic Development', was stimulated by the 2008 cyclone season, which saw economic losses of 4% of GDP through impacts on housing, agriculture, trade, tourism and transport. The project is financed by the Global Facility for Disaster Reduction and Recovery.

The CATSIM model compares asset loss distribution with fiscal resilience, defined as the total of ex-post and ex-ante risk financing (see Figure 7). Using this approach, it is possible to identify countries that exhibit high fiscal and economic vulnerability, and it can help quantify the 'fiscal gap'.[xxvii]

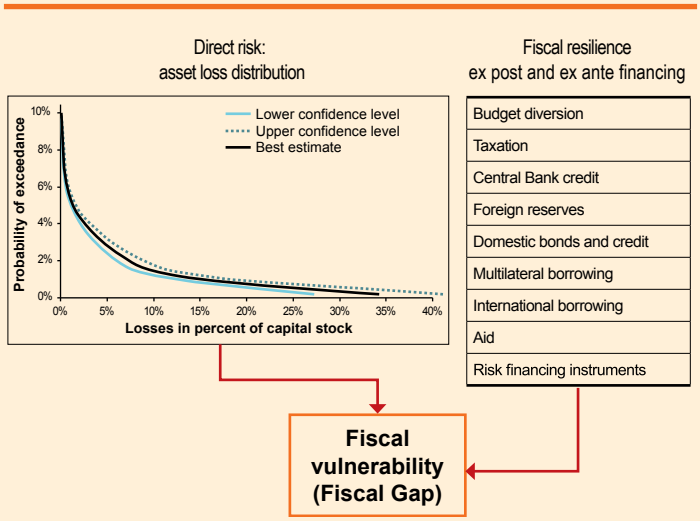

Figure 7: Modelling fiscal vulnerability and resilience to natural hazards

Source: Mechler et al. (2010)

Applied globally, the model highlights the following as particularly fiscally vulnerable:

- some Small Island Developing States in the Caribbean and Pacific
- Bolivia, El Salvador, Honduras and Nicaragua (Latin America)
- Madagascar, Mauritania, Mozambique, Nigeria, Sudan and Zimbabwe (Africa)
- Nepal (Asia).

These countries are prime candidates for stepping up activities to plan, reduce and manage risks. This will reduce serious human and financial loss burdens to exposed populations, business and wider macroeconomic health.

Box 6: Containing the fiscal costs of disasters: the Caribbean Catastrophe Risk Insurance Facility

Disaster risk is high and prevalent in the Caribbean. Annual losses from disasters can reach up to 6% of GDP, when these direct asset losses are measured in terms of GDP (see Figure 8). In most scenarios, climate and socioeconomic changes are projected to increase this risk, despite and because of economic development.

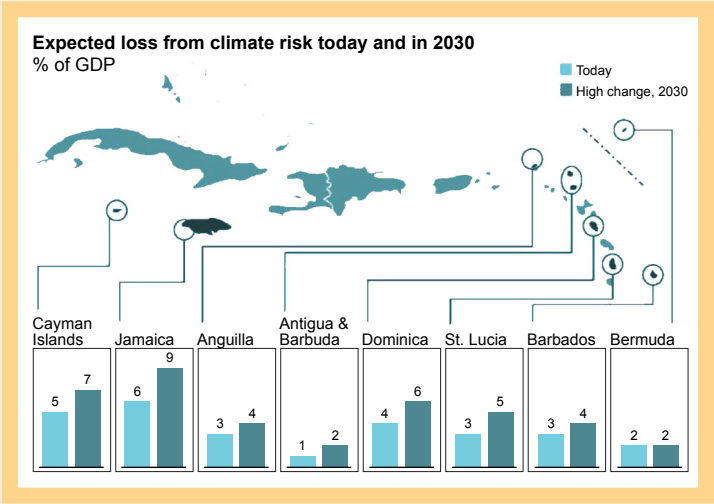

Figure 8: Current and future disaster risk in the Caribbean, measured as a share of GDP

Source: CCRIF (2010)

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) was established in 2007 as a regional mechanism to contain the fiscal costs of disasters and bridge the liquidity gap in the immediate aftermath (see Figure 9). It is the world's first regional catastrophe insurance pool, reinsured in the capital markets, to provide governments with immediate liquidity in the aftermath of hurricanes and earthquakes. Sixteen Caribbean countries contribute resources ranging from $200,000 to $4 m, depending on their exposure to earthquakes and hurricanes.[xxviii]

The CCRIF requires comprehensive and sound risk analysis, and several Caribbean countries have started budgeting for disaster risk. This represents a shift in mindset, with Caribbean governments treating risk pre- rather than post-event.

The next step for the CCRIF is to tackle its key gaps, in terms of providing stronger linkages and incentives for risk reduction and economic policy. The CCRIF is investing further in developing country risk profiles, which could be used to study the reduction of risk over time, and thus provide information for reducing insurance premiums. Also, few Caribbean countries currently price risk in terms of a budget for disasters, and thus the benefits of the CCRIF remain intangible and it difficult to make a robust economic case for risk management.

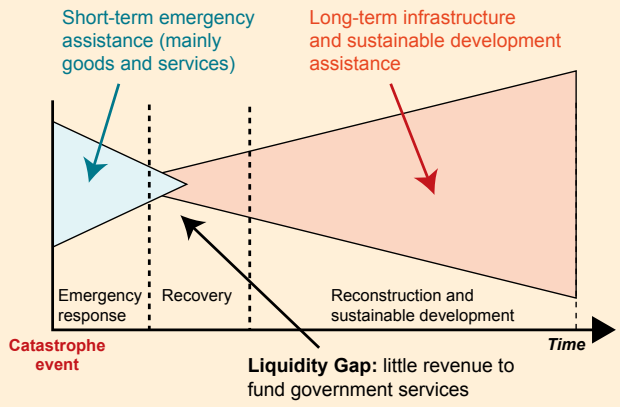

Figure 9: Tackling the disaster liquidity gap

Source: Young (2010)

But there are few other documented, detailed examples in developing countries of where sector-based investments and planning have been systematically shaped by comprehensive disaster risk assessments and national-level strategic risk management plans. In this regard, CDKN is supporting early-stage work on risk management tools and methods in the energy sector in Central Asia and West Africa (see Box 7).

One of the most critical implementation issues surrounds the extent to which disaster risk assessments influence the location of critical infrastructure and other important economic assets. As UNISDR (2010) states, 'reducing climate-related risk will involve protecting critical infrastructure, such as schools and health facilities, retrofitting buildings, relocating settlements and restoring ecosystems, or better yet, avoiding risky development in the first place'.

The majority of countries now have some form of disaster risk management legislation,[xxx] but few developing countries have the capacity (or political will) to develop disaster risk zones and then implement the necessary regulatory and compliance processes. This is because of competing pressures, lack of incentives, a common practice of unplanned development, and the difficulties associated with blocking access to areas that often offer rich livelihood resources, such as flood plains, volcanic slopes or coastal strips. Based on Llosa and Zodrow's 2011 assessment of disaster risk management legislation, the most effective ways to reduce risk are those that: (i) are coherent with other legislation and policies across scales and sectors; (ii) allocate sufficient finance across levels of government; (iii) clarify institutional arrangements; (iv) are based on up-to-date risk assessments and mandate periodic reassessments and; (v) establish regulatory and accountability mechanisms and associated penalties.[xxxi] Reducing exposure will require legislation that either blocks building on exposed areas or ensures building standards are commensurate with current and future risk profiles. This will require clear communication, mechanisms to integrate this into planning, and comprehensive enforcement and penalties. Box 8 (page 13) describes the current situation in Nepal.

Box 7: Managing disaster and climate risk in the energy sector in Central Asia

Central Asia remains the most energy-inefficient region in the world, in terms of both energy consumption and production. Energy and carbon intensity are high and electricity and heat production account for a large proportion of the region's CO_2 emissions. For example, Kazakhstan ranks among the top 25 global greenhouse gas emitters, and Uzbekistan is the most energy-intensive country in the Europe and Central Asia region. Demand on the energy sector is expected to rise in the period to 2030, which means it is imperative to find ways to meet the demand in climate-sensitive ways. Much of the current generation capacity is outdated and will be rehabilitated, upgraded or replaced over the next 20 years.

Climate and disaster risk assessments will need to shape investments into efforts to change and reform energy infrastructure, as the sector is sensitive to changing weather patterns and extremes. These can affect the supply of energy, impact transmission capacity, and disrupt oil and gas production. Efforts are being undertaken by CDKN partners to model future risks to the sector, based on vulnerabilities and climate change projections. This will inform decisions on existing and planned infrastructure. These models are highlighting the need to consider the capacity of energy systems to sustain cumulative or cascading impacts, as well as showing how to develop redundancy/additional capacity during peak periods and how to enhance efforts on demand management and energy conservation strategies.

CDKN is working alongside the United States Agency for International Development and the World Bank to provide risk assessment information. This will guide current and future energy investment options to promote climate and disaster risk management in government-led energy sector planning.

5.5 Challenges of managing risk through economic and fiscal policy

There are entry points for reducing exposure through risk-sensitive economic and fiscal planning. But experience suggests that reducing risk via this mechanism remains challenging. Few countries budget for risk and contingent liabilities and their capacity is often limited, requiring major efforts in terms of training and building knowledge and skills. The ongoing global financial crisis has shown that it is unaffordable to continue leaving risks unattended in countries exposed to high risk (disaster, fiscal and financial). Turning these hidden and unrecognised liabilities into explicit budget items (and costs) is a first step to being better prepared and managing potential shocks more effectively. As most governments do not deal with risk directly, significant effort is needed to generate the additional capacity required to assess and effectively manage risks.

A related challenge is integrating economic and fiscal risk planning with comprehensive disaster risk management. Although both efforts lead in a similar direction, as they identify and manage risks, the framing of risk management by various experts differs importantly. Economic planning is, by definition, a top-down effort involving macroeconomists and public finance experts, whereas disaster risk management experts are predominantly working on local scales (villages and communities) and employ more bottom-up processes to identify vulnerable households and communities. Bridging the gaps between these discourses, and integrating risk management expertise across layers of government decision-making, requires considerable effort.

Beyond these technical and procedural challenges, a systemic challenge remains in terms of the political economy of disaster response. Effective disaster risk reduction requires engagement, empowerment and leadership across layers of government and in ways that support marginalised people. This is difficult to achieve given the political capital attached to 'heroic action' in disaster response; the media focus on this element of a disaster and the considerable increase in funding flows both provide a disincentive to significantly invest in ex-ante action.

Box 8: Disaster risk management legislation to reduce exposure in Nepal

Recent work has demonstrated Nepal's high vulnerability to disasters, and the potentially large economic and development losses should a major disaster affect the country.[xxxii] One factor behind this high vulnerability is insufficient uptake of building codes. While national building codes exist, there is currently no clear mechanism for implementing them. This means that high-risk buildings continue to be constructed, including in heavily populated, seismically active zones. Even where implementation of codes has started, no city administration has managed to implement building regulations through prior approval, inspection and enforcement. Land-use planning is not clearly regulated and its responsibility is split between the Ministry of Physical Planning and Public Works and the municipal authorities. New developments occur without approval and there is no clear mechanism for ensuring these meet safety standards or are not on land at high risk from natural hazards. There is no legal mechanism to relocate individuals or communities from highly exposed land, though this has been implemented ad hoc, mostly following a disaster.

It is hoped that a new national Disaster Management Act, currently under development, will address some of these issues by improving coordination between those responsible for implementing building codes, and by strengthening the enforcement mechanisms, via improved capacity and clearer penalties. It will supersede the 1982 Natural Calamity (Relief) Act, which focused on response and relief. The Act will establish new and more broadly representative disaster management institutions at national, regional, district and local levels, as follows: [xxxiii]

- a National Commission for Disaster Risk Management, chaired by the Prime Minister
- a National Authority for Disaster Risk Management as the implementation authority
- specialist committees on rescue and relief, preparedness and mitigation, resourced by the Ministries of Home Affairs, Local Development, and Physical Planning and Works respectively
- regional, district and local disaster management committees involved in both planning and implementation.

This paper demonstrates that making the economic case for disaster risk management is possible, but difficult. Although many entry points and improved data and technologies are being made available, these difficulties will not easily go away. Innovation in the field of disaster risk financing is currently outpacing demand. Responding to risk, even when quantified, remains a hard sell for politicians, particularly in resource-constrained environments. It remains tempting for policy-makers to rely on a retroactive and myopic 'wait and see' approach, and provide relief and reconstruction assistance after an event. This is when it can be easily and effectively promoted through the mass media and be highly visible to potential voters.

6. Conclusion: Promoting disaster resilience for climate compatible development

This review has demonstrated that disaster losses are rising and threaten future economic development, especially given the associated threat of climate change. A policy solution is to integrate risk management into economic and fiscal policy, with the goal of reducing exposure and vulnerability over time. To be successful, it will be necessary to:

- ensure disaster risk assessments are included in economic projections and economic planning across key sectors. Tools and indicators are available to support such exercises, including ways to include assessments and scenarios in growth-diagnostic and economic-competitiveness tools. However, examples of detailed sector-based approaches are limited.
- create a frequently updated and accessible national risk atlas, which includes probabilistic assessments of natural hazards, current and projected distributions of assets and people, and their associated vulnerability and capacity. This atlas needs to inform economic decisions at all levels through inclusion in impact assessments for new investments and in countrywide, provincial and local development planning. Such assessments need to consider how the investment will influence the distribution of people and other assets; for example, a new road is likely to attract people and services, magnifying potential losses if the road passes through highly exposed areas.
- enact suitable legislation and adequate enforcement measures that seek to carefully manage exposure; for example, by establishing suitable building codes and in some cases prohibiting development in flood plains or low-lying coastal areas.
- integrate government risk financing schemes with risk reduction and economic planning. Bridging the gap in government insurance with risk reduction and economic planning would provide incentives for monitoring and reducing risk, as well as adequately put a cost on risk in economic planning, which will incentivise investment in risk management.

More broadly, integrating risk management into economic and fiscal policy will require a shift in focus from ex-post relief and reconstruction financing to ex-ante investment at national and sub-national levels, and recognition that ex-post relief is unsustainable.

How can uncertainties associated with dynamic hazards, catalytic events and complex system-wide responses, such as impacts through international supply chains, be factored into economic models and cost–benefit analysis? How can remote disasters that disrupt supply chains and affect prices be factored in? Can models of society accurately predict future patterns of exposure and vulnerability? Is a 'green' economy inherently more resilient to disasters (and other shocks and stresses) than a more traditional model of economic development? These questions need to be taken up by researchers, decision-makers and the private sector in particular, who would all benefit from improved national data collection. Further, it is important to link disaster risk reduction, climate change adaptation, development, and

climate change mitigation, both institutionally and analytically, through a climate compatible development approach. This offers a promising avenue to better calculate the trade-offs and benefits of action, and may help with political buy-in and longer term fiscal and economic development planning.

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v From an insurance perspective, Surminski and Oramas-Dorta (2011) found 123 disaster risk transfer schemes in developing countries. Of these, 12 could be classed as sovereign schemes, with seven of those operational and five under development.
vi See Okuyama (2009)
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The Climate and Development Knowledge Network (CDKN) aims to help decision-makers in developing countries design and deliver climate compatible development. We do this by providing demand-led research and technical assistance, and channelling the best available knowledge on climate change and development to support policy processes at the country level.

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