



## Chapter 6

Opportunities and incentives  
for disaster risk reduction

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Runaway increases in exposure and risk are pushing up the costs of disasters, while at the same time, countries and communities are struggling to reduce their vulnerabilities. The link between this rapid increase in costs and certain development policies – such as liberalization of trade and financial markets, privatization of public utilities and services, and deregulation – has not been explored sufficiently.

Aside from reducing disaster mortality, existing risk governance capacities and arrangements generally fail to achieve their aims. A new paradigm for risk governance is required, one that must address the disaster risk internalized in, and sometimes generated by, development processes.

Whereas disaster risk management (DRM) has conventionally been delivered through stand-alone projects and programmes, a number of governments are now adapting development mechanisms and instruments designed to reduce risks and strengthen resilience. These include public investment planning, ecosystem-based approaches and social protection.<sup>1</sup> Although many of these innovations are still incipient, they promise to address underlying risk drivers and generate important co-benefits for the people and organizations involved. These innovations often build on existing institutional capacities and thus offer powerful incentives for governments to adopt them.

There are likely to be greater incentives for DRM when such instruments simultaneously address the needs of a number of stakeholders and competing priorities. For example, improved water management not only addresses drought risk but may also increase generation of hydroelectricity, water-storage capacity for agricultural use, and the availability of domestic drinking water. In general, these incentives are stronger when DRM contributes visibly to improved economic and social well-being and choice for each citizen. Governments often go unrecognized for reduced disaster losses, or when good risk reduction prevents extreme weather events causing a disaster. To overcome the perception that DRM budgets compete with other priorities for scarce resources, disaster risk reduction must be seen as an integral part of local development.

These innovative instruments can help define a new approach to risk governance, especially if they are supported by political commitment, policy coherence among different levels of government, competent and accountable local governments, and partnerships with civil society and low-income households and communities. At the same time, effective risk governance must become an essential component of development in general.

## 6.1 Integrating disaster risk reduction into public investment decisions

Global public investments dwarf international aid. If national public investment systems truly account for disaster risk, they can reduce potential losses at a scale impossible to achieve through stand-alone DRM.

In 2008 alone, Peru's National Public Investment System approved investment of approximately US\$10 billion, about half of which was to be executed by local governments. In comparison, official development assistance received by Peru in 2008 was US\$266 million. As such, the decision to evaluate the disaster risks internalized in public investment, and to ensure that cost-effective measures to reduce risks are included in all projects, has huge implications for whether the stock of risk goes up or down.

Public investment that is based on sound needs and risk analysis promotes growth. At the same time, investments in transport, communications and education have a particularly large effect on economic growth and poverty reduction (Barro, 1991; Easterly and Rebelo, 1993; Aschauer, 2000; Milbourne et al., 2003; Anderson et al., 2006). If public investment becomes a vehicle for DRM, not only is the quality and sustainability of public spending enhanced, but disaster-related losses and costs are also reduced and social and economic development stimulated. This can be a powerful incentive for governments. Upgrading and expanding inefficient, ageing water and drainage infrastructure, if planned from a risk reduction perspective, can reduce vulnerability to droughts

and floods while improving the quality of water and sanitation. Building earthquake-resistant schools can improve education while saving children's lives.

Public investment projects are normally shaped through a number of parallel and interconnected planning processes that include land use planning and management, development planning, sector investment planning and investment projects. Ideally, these would occur in a sequential order with one building on the other (Figure 6.1), but in reality this is rarely the case (see also Section 6.5).

In the 2009–2011 HFA Progress Review, approximately half of the reporting countries and territories stated that they use cost-benefit analyses to incorporate disaster risk reduction measures into the planning of public investment, and almost two-thirds assessed the impact of disaster risk on productive infrastructure, including dams, irrigation and transport systems. Although progress has been reported from different regions, the main impetus for formally incorporating DRM into this sequence has come from Latin America, where the modernization of public investment systems has been promoted by the Economic Commission for Latin America and the Caribbean.<sup>2</sup>

Peru was the first country to include disaster risk into its evaluation criteria for public investment projects, followed by Costa Rica and Guatemala (Box 6.1). In Peru, it is now a legal requirement that all public investment projects be evaluated for disaster risks. If the risks are not addressed, the project is not financed.

The systems developed so far, however, are only a beginning. At least three challenges must be overcome if the tremendous potential is to be realized.



(Source: adapted from Campos and Narváez, 2011)

**Figure 6.1**  
Sequential planning from broader land use systems to specific project investment

## Box 6.1 Integrating disaster risk reduction into public investment in Latin America

The use of public investment systems to reduce disaster risk reflects a new approach to planning in Latin America. In the 1990s, many countries weakened or dismantled their planning and regulation mechanisms as part of a broader wave of reforms that promoted economic deregulation and trade liberalization. Whereas these reforms may have stimulated economic growth (and hence also increased hazard exposure), weaker planning and regulation almost certainly increased vulnerability. Since the early 2000s, public investment systems anchored in finance ministries have been developed by a new generation of planners aiming for efficiency, sustainability and equity in the investment of public resources.

In Peru, the National System for Public Investment was created in 2000, and by 2008 had approved 72,000 projects. Disaster risk was formally incorporated into the system between 2004 and 2007. This was achieved by developing risk concepts and assessment methods, convening a large number of actors from different levels of government and across departments, training more than 900 professionals, implementing new standards and instruments, and developing a long-term vision of investment. These have all proved to be critical success factors.

Costa Rica has built on the lessons learned in Peru, incorporating disaster risk into its new public investment system from its inception in 2007. A comparative analysis of other public investment systems helped generate political and bureaucratic support and enabled the country to fine-tune and improve upon the Peruvian model. Unlike Peru, where planning institutions were dismantled in the 1990s, Costa Rica benefited from a 30-year-old tradition that allowed investment decisions to be aligned with strategic development plans.

Learning from one another's experiences has helped countries save time and avoid mistakes as they embark on similar processes. Added to this, strategic alliances with training and academic institutions and international support have enabled legislation, supporting regulation and planning systems to be developed in a sequential process in which one step builds on what was achieved previously.

*(Source: Campos and Narváez, 2011)*

First, although disaster risks are evaluated in the design of public investment projects, there is no analogous process earlier in the planning sequence. As a consequence, higher-level planning decisions, or a lack thereof, may actually create risks that are not evaluated and addressed until the project stage.

Second, the evaluation of risks in public investments, and of the costs and benefits of reducing risks, require detailed comprehensive probabilistic risk assessments. As the HFA Progress Review highlighted, these assessments are not available in many countries, implying that there may be no objective basis for evaluation.

Third, new mechanisms for planning and budgeting at the local level, as well as stronger partnerships with civil society and local governments, are essential if public investment is to be effective, sustainable and relevant to local needs. Examples, such as participatory budgeting in Porto Alegre, Brazil (Menegat, 2002; UNISDR, 2009), Local Coordinating Councils in Peru (Venton, 2011), and the coordination of development, environmental management and disaster risk reduction in Manizales, Colombia (Velasquez, 2010), demonstrate that many countries are adopting innovative approaches to public investment.

## 6.2 Social protection: strengthening resilience to disasters

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Existing social protection mechanisms can be adapted to protect vulnerable people before, during and after crises. Conditional transfers, temporary employment programmes and micro-insurance schemes are examples of such mechanisms, which can increase household resilience and buffer against the impacts of disasters. Reaching out to the vulnerable non-poor helps avoid the creation of more poverty, and has multiple benefits in terms of asset building and protection of human capital.

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Social protection, including support payments and insurance against risk, does not reduce disaster risk in itself. Nor is it an alternative to development investments in public infrastructure and services, but there are two compelling reasons why social protection can be part of strategic DRM.

First, social protection instruments can enhance individuals' and households' disaster resilience, reduce poverty and stimulate human capital development (de Janvry et al., 2010; Siegel and de la Fuente, 2010). Successful social protection thus provides buffers that smooth consumption not only during and after, but also before disasters, and it protects household and community assets. This helps to avoid disaster losses cascading into other household impacts and outcomes, such as taking children out of school and sending them to work, or selling off productive assets (de Janvry et al., 2006; ERD, 2010; Guarcello et al., 2010) – coping strategies that have long-term negative consequences (López-Calva and Ortiz-Juárez 2009; Fernandez et al., 2011).

Second, many of these instruments are already being delivered on a large scale. They can be used to reach very large numbers of disaster-prone households and communities through relatively minor adaptations of targeting criteria and timeframes, and often with comparably low additional costs.

The countries best able to take advantage of this opportunity are those that already have social policies supported by a wide range of legislative provisions (ERD, 2010), such as labour market laws (including the regulation of unemployment benefits), workplace health and safety regulations, basic entitlements and welfare payments, and support for marginal groups. Countries that have strongly developed social legislation, corresponding regulation and up-to-date public registries find it easier to employ both targeted and universal social protection as instruments for DRM.

### 6.2.1 Conditional transfers

Almost 114 million people in Latin America and the Caribbean are receiving, or have received, conditional cash transfers as a means to reduce structural poverty over the past two decades (Table 6.1 and Box 6.2). Brazil's Bolsa Familia and Bolsa Escola, well-known examples of conditional transfers, reach more than 12 million households (as of June 2010). In these schemes, households receive a monthly payment from the government, conditional on sending children to school (Behrman et al., 2005), attending health check-ups and ensuring vaccination (Gertler, 2004; Levy and Ohls, 2007), taking children out of work (ILO, 2007), and improving nutrition (Leroy et al., 2009). Several countries, such as Bangladesh and Ethiopia, also employ food-based or combinations of food- and cash-based conditional transfers as part of their social protection systems (del Ninno et al., 2009).

These instruments potentially leverage multiple incentives. They contribute indirectly to household resilience by enabling the accumulation of assets to buffer disaster losses. In Mexico, for example, Oportunidades

Table 6.1 Structural conditional transfers in Latin America and the Caribbean

Country	Social Assistance Programme	Start year	Beneficiaries (as of)
Honduras	Programa de Asignación Familiar-PRAF I/PRAF-BID II/PRAF-BID III	1990/ 1998/2007	150,000 households (2008)
Mexico	PROGRESA/Oportunidades	1997	5.8 million households (2010)
Nicaragua	Red de Protección Social-RPS	2000	30,000 households (2006)
Costa Rica	Superémonos/Avancemos	2000/2006	165,749 persons (2009)
Colombia	Familia en Acción-FA	2001	2.5 million households (2010)
Jamaica	Program of Advancement through Health and Education-PATH	2001	341,000 persons (2009)
Brazil	Bolsa Escola/Bolsa Família	2001/2003	>12 million households (2010)
Argentina	Programa Jefes de Hogar	2002	1.5 million persons (2005)
Chile	Chile Solidario-CHS	2002	1.15 million persons (2008)
Ecuador	Bono de Desarrollo Humano-BDH	2004	1.74 million persons (2010)
El Salvador	Red Solidaria	2005	120,000 households (2009)
Dominican Republic	Programa Solidaridad	2005	463,544 households (2010)
Paraguay	Tekoporá	2005	109,692 households (2009)
Peru	Juntos	2005	420,574 households (2009)
Trinidad and Tobago	Targeted Conditional Cash Transfer Programme (TCCTP)	2005	22,000 households (2007)
Panama	Red de Oportunidades-RO	2006	63,245 households (2010)
Suriname	Suriname's Social Safety Net	2006	Unrecorded
Uruguay	Ingreso Ciudadano/Plan de Equidad	2007	74,500 households (2009)
Bolivia	Bono Juancito Pinto	2007	1.8 million persons (2009)
Guatemala	Mi Familia Progresá	2008	591,570 households (2010)
<b>TOTAL</b>			Approximately 114 million people [based on 4.8 persons per household (Bongaarts, 2001)]

(Source: Fernandez et al., 2011)

(formerly known as PROGRESA) protects education, particularly that of girls, and thus fosters the formation of human capital, offsetting shocks such as parental unemployment or illness (de Janvry et al., 2006). Similar successes have been confirmed in Indonesia (Cameron, 2002; Sparrow, 2007), Côte d'Ivoire (Jensen, 2000) and Peru (Schady, 2004). In addition, social protection that ensures income replacement during crises has a major, positive effect on the economy by stabilizing aggregate demand while having no negative effect on economic growth (ILO, 2010).

Given that in many countries disasters undermine the effectiveness of conditional transfers in addressing structural poverty, enhancing these instruments to strengthen

disaster resilience increases their power to reduce poverty. Although such transfers were not designed to deal with disaster impacts, experience shows that they can be adapted to reach those at risk of losing their assets in a disaster, which prevents significant medium- to long-term increases in the number of recipients after disasters (Siegel and de la Fuente, 2010; Fernandez et al., 2011). The advantage of using conditional transfers in this way is that social protection for disasters can be built into existing large-scale programmes without the need to construct a new administrative structure. Whereas conditional transfers have been used this way in Latin America and the Caribbean, the HFA Progress Review indicates that only a handful of countries in Africa and Asia have them in place.

## Box 6.2 Using structural conditional transfers to strengthen disaster resilience – experience from Latin America and the Caribbean

Chile and Ecuador have made provisions in their conditional transfer programmes that allow for supplemental payments in exceptional circumstances. For example, the Chilean Government extended payments from the country's social assistance programmes, Chile Solidario and Programa Puente, to households affected by the February 2010 earthquake. This came in the form of a lump-sum transfer of 40,000 Chilean pesos (approximately \$US73 at the time), which went to all affected households regardless of wealth or whether they were previous members of the programmes.

In Nicaragua, *Atención a Crisis* was implemented from 2005 to 2006 as part of the national *Red de Protección Social* to provide short-run social safety payments to households in six municipalities repeatedly affected by drought. The short-term objective was to protect human capital and physical assets of affected households (through cash transfers). The long-term objective was to create productive assets through conditional cash transfers coupled with scholarships for vocational training or productive investment grants for small-scale non-agricultural activity. The programme's evaluation revealed that after nine months, participating households had not only protected but also improved their asset base, and subsequently they were better able to engage in productive activities.

Two other countries, Jamaica and Mexico, have also introduced protective buffers to their respective programmes in response to the 2008 global economic downturn in an effort to safeguard beneficiaries' purchasing power. Together, these experiences show that existing conditional transfers can be adapted to efficiently accommodate timely additional payments to disaster-affected households.

(Source: Fernandez et al., 2011)

The use of conditional transfers to strengthen disaster resilience also poses challenges, because transfers are sometimes used in a way that undermines their principal objective to reduce structural poverty (Box 6.3). Furthermore, in many low- and middle-income countries, the poverty line is deliberately set very low, to reduce the cost of poverty reduction programmes and to broaden the tax base as much as possible (Box 6.4). As such, many non-poor but risk-prone households are not included in such transfer programmes.

Another issue is to what extent conditional transfers and other social protection instruments should be targeted. On the one hand, the high cost of targeted programmes may reduce the impact of each individual transfer (ERD, 2010), reinforcing the argument for a universal minimum level of social protection. However, the example of community-led identification of beneficiaries in Rwanda (Box 6.5) shows that targeting can be effective when organized in partnership with risk-prone households

and communities. Evidence to date suggests that Rwanda's approach has been successful, particularly for households dependent on the informal economy (i.e., the part of an economy that is not taxed or monitored by governments) for their income (ERD, 2010). Such examples show that even low-income countries can set up fairly simple, non-contributory programmes that are administratively feasible and fiscally sustainable. These programmes can then serve as a first step to developing more complex and coordinated packages.

### 6.2.2 Temporary employment programmes

Employment strengthens individual and household resilience through secure income and gives households the opportunity to build assets. As such, employment is closely linked to disaster risk reduction (Krishnamurty, 2011). The ability of households to recover to pre-disaster income levels is higher when their pre-disaster income is higher



### **Box 6.3 Conditional cash transfer programmes in Mexico**

The conditional cash transfer programme PROGRESA was introduced by the Government of Mexico in 1997 and re-launched as Oportunidades in 2002. With the basic objective of improving the education, health and nutrition of poor families, it provides cash transfers to families in exchange for regular school attendance and visits to health clinics. It reaches six million poor households nationwide and payments are provided directly to mothers or female heads of households.

In addition to its designed goals, Oportunidades has reduced household vulnerability through asset accumulation and more stable income flows. This allows households to better plan expenses and pay debts, and more easily access credit, resulting in increased consumption of goods and services. Other studies have also found that Oportunidades performs an unofficial safety-net function through its cash transfers (de Janvry et al., 2006), though sometimes imperfectly and at the expense of its designed objectives (de la Fuente et al., 2008). The transfers are often used to address small-scale losses that occur around the dates that the cash transfers arrive. Although this protects household assets, such safety-net functions may divert resources from their primary goal. For example, parents may use the cash earmarked for educational expenses to buffer the failure of a maize harvest. The programme is currently being evaluated with a view to reinforcing its function in strengthening resilience to disasters and other shocks without losing its principal focus on structural poverty reduction.

*(Source: Arnold and de la Fuente, 2010)*

### **Box 6.4 Are poverty lines too low?**

A low poverty line means that a significant percentage of the people just above it may have high enough income and consumption levels to qualify as non-poor, but may not generate enough surplus income during relatively good periods, and so quickly fall under the poverty line following disasters.

There is a strong case for raising poverty lines or replacing them with a 'vulnerability line' based on individual and household resilience, and the likelihood that they will fall below the poverty line due to a disaster. Although in most cases, this would mean a substantial increase in the scope and cost of social protection programmes, they would subsequently reach those households at risk of becoming poor as a result of unmanaged disaster impacts.

Such a vulnerability line could be flexible, adjusted according to the reserves households need to meet contingencies arising from disaster impacts. Measures that reduce disaster risk and household losses would allow governments to lower the vulnerability line, as would the existence of far-reaching social safety nets.

*(Source: Krishnamurty, 2011)*

(Muqtada, 2010). Furthermore, when growth in employment is accompanied by social protection, it is possible to avoid sharp declines in income following disasters.

Unlike conditional transfers, temporary employment programmes are intended to help individuals and communities smooth consumption in times of disaster

by supplementing income. This is usually achieved through labour-intensive public service and infrastructure programmes, such as building rural roads, street cleaning and reforestation (Fernandez et al., 2011). Where these programmes are focused on building community assets that reduce risk, they have the potential to contribute to risk reduction (del Ninno et al., 2009). Examples from

## Box 6.5 Community-led identification of beneficiaries in Rwanda

Rwanda's highly decentralized administrative structure has allowed the country to develop an innovative community-led system for targeting social protection programmes. Rwanda has a good track record in social protection, including the provision of universal health insurance to 91 percent of the population, free education and several social transfers, including pension benefits. The new targeted approach, based on a traditional practice of collective action known as *ubudehe*, allows communities to identify beneficiaries of social protection based on locally relevant criteria, such as the size of land holding. Communities also suggest and lead area-specific programmes. Preliminary evidence shows that poor households can be directly involved in the planning and execution of social protection instruments and that even those usually without access to formal support can participate.

Prohibitive costs of community-led or universal programmes are often cited as a barrier to implementation, though this is determined by political priorities. The Rwandan Government allocated 4.7 percent of its total budget to the social protection sector in 2009–2010. This amount is expected to increase to 4.9 percent and 5.1 percent of the total budget in 2010–2011 and 2011–2012, respectively, with support from international donors.

*(Source: ERD, 2010)*

Bangladesh, Ethiopia, India and Malawi demonstrate how food- or cash-for-work programmes can significantly improve flood control, water conservation and irrigation infrastructure, and reverse land degradation (del Ninno et al., 2009; Pelham et al., 2011).

When conditional transfers cannot be adapted to target non-poor households before a disaster, temporary employment programmes may offer a way of providing additional or substitute income, though such schemes are not widely used. In the HFA Progress Review, only 18 out of 82 countries reported having employment guarantee schemes, but examples from Ethiopia, India and South Africa show that temporary employment programmes can have positive impacts if adapted to target risk-prone households and communities (see Box 6.6 for examples from Latin America).

Many existing employment programmes, though originally designed as temporary measures, have developed into permanent schemes with millions of people participating annually. The Mahatma Gandhi National Employment Guarantee Scheme, for example, reached around 68 million people in 41 million households in the 2009–2010 financial year alone, providing each of the employed with

an average of 24 days work. The public works component of Ethiopia's Productive Safety Net Programme covered approximately 7.6 million people by early 2011, almost 10 percent of the entire population. South Africa's Expanded Public Works Programme, in operation since 2004, provides work for roughly 11 percent of the country's unemployed, and by 2013–2014 it aims to create 1.5 million jobs that will each provide 100 days of work while ensuring minimum wages (Krishnamurty, 2011).

The 2008 crisis in Ethiopia, precipitated by drought, food shortages and high food prices, provided a testing ground for the Productive Safety Net Programme, which became a major part of the government's response in rural areas. Using the programme's contingency budget of US\$40 million, urgent assistance was provided to almost 1.5 million individuals who had not previously participated in the programme (Krishnamurty 2011).

Apart from challenges related to targeting, temporary employment and conditional transfer programmes also struggle with corruption and bureaucracy. However, the potential of these instruments to reduce disaster risks is enormous if they are explicitly linked to strengthening disaster resilience and supported by governance



## Box 6.6 Temporary employment programmes in Latin America

Temporary employment schemes exist in Mexico, Bolivia, Argentina and Chile to help people buffer macroeconomic crises or disasters, but with mixed results. In general, targeting has been successful. In Argentina for example, the majority of beneficiaries in several programmes (A Trabajar and Programa Jefes) are from the country's poorest families.

Such schemes also increase income for women and reduce extreme poverty, at least in the short term. For example, in Argentina's Programa Jefes y Jefas de Hogar, the proportion of participants considered to be living in poverty dropped from 82 percent to 70 percent, while the proportion living in extreme poverty fell from 51 percent to 29 percent. In Mexico, 60 percent of the participants in the Programa de Empleo Temporal have moved out of extreme poverty.

Temporary employment schemes have had mixed success in improving infrastructure. After four years of operation (1988–1991), Bolivia's Special Emergency Fund completed 3,300 projects at a cost of US\$194 million. The programme constructed and refurbished 550 schools and 417 health centres, improved 8,800 kilometres of roads, built 9,974 houses, and serviced 980 kilometres of sanitary sewerage networks and 320 kilometres of potable water system networks (Fernandez et al., 2011). The fund generated approximately 60,000 direct jobs and 45,000 indirect jobs during the four years of operation. In 1990, the number of jobs created was equivalent to nearly a third of the number of unemployed people in the country. The investments contributed 1.1 percent to GDP growth in 1990, thus without the Special Emergency Fund, GDP growth in Bolivia in 1990 would have been only 1.5 percent rather than 2.6 percent.

*(Source: Fernandez et al., 2011)*

arrangements based on local partnerships and community participation.

### 6.2.3 Micro-insurance

Government-led social protection schemes increasingly work together with market-based micro-credit and insurance. By providing timely capital following disasters, such instruments can also help protect households from losses and subsequently recover. By pricing risk, insurance-related instruments also raise awareness and may act as an incentive for disaster risk reduction. By buffering losses in a predictable way, insurance can also enable risk-prone households to take on higher-risk and higher-return activities that increase these households' chances of moving out of poverty (Suarez and Linnerooth-Bayer, 2011).

At the micro level, households and businesses in low- and middle-income countries are gaining access to new index-based insurance instruments that link payouts to a measurable

hazard event, for example a particular amount of rain or cyclone strength, thereby reducing transaction costs. These schemes can also reduce the danger of moral hazards (when guaranteed compensation for losses encourages risk-taking behaviour, leading in turn to higher premiums), and adverse selection (when only high-risk households sign up for the insurance, while insurers cannot compensate for their increased overall risk by increasing the price of the premium).

Micro-insurance can support DRM in a variety of ways. One approach is to bundle the insurance with loans to promote investments in risk reduction. In Saint Lucia, for example, a programme offering home improvement loans aimed at reducing risks required owners to join a micro-insurance scheme. Bundling micro-insurance with a loan package can also promote productive investments that help the most vulnerable escape disaster-related poverty traps. In Malawi, farmers taking part in a drought-indexed insurance scheme can access loans for

improved seeds, thus increasing agricultural productivity and reducing their vulnerability. If the premiums in such schemes were set to reflect long-term climate forecasts, they would also provide signals for planting crops suited to expected rainfall conditions (Suarez and Linnerooth-Bayer, 2011).

Index-based micro-insurance can also be linked not only to observed hazard events, but also to forecasts, providing timely funds for risk reduction activities before disasters occur. The Ethiopia Disaster Insurance programme, piloted in 2006, is now developing an Early Livelihood Protection Facility based on a sequential combination of contingency funds for very mild droughts, contingent debit and credit for mild droughts, and insurance for severe droughts (see Chapter 5). Interestingly, the target group for this new scheme comprises transiently food-insecure households, defined as food secure yet subject to acute but temporary food shortages. It was estimated that 4.5 million people would be at risk of transient food insecurity during another drought in Ethiopia, and based on this, the total cost of the facility was estimated at US\$113 million in a severe drought year (ERD-EUI, 2010). Finally, micro-insurance can be adapted to the specific needs of risk-prone communities. For example, the HARITA pilot project in Ethiopia allows cash-constrained farmers to pay the micro-insurance premium with disaster risk reduction-oriented labour.

Although these developments are promising, micro-insurance currently reaches only a very small fraction of risk-prone households, and reviews of micro-insurance pilot initiatives have highlighted substantial obstacles to scaling up these systems. Therefore, micro-insurance can complement, but not substitute for, other social protection measures. There are also other important mechanisms by which low-income households increase their capacity to cope with stresses or shocks. In many nations in Africa and Asia, community-based savings groups formed mostly by women living in informal settlements have particular importance, and in some countries, federations of such savings groups have developed city or national funds on which they can draw (Mitlin, 2008).

## 6.3 Planning for risk reduction and climate change adaptation

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Efforts to adapt to climate change must be aligned with disaster risk reduction objectives and strategies. For such integration to succeed, institutions must focus on prospective and corrective risk management, as well as building new partnerships at the local level, rather than on compensatory mechanisms.

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Climate change adaptation represents a new opportunity to advance DRM using another set of policy, programme and funding instruments. Regardless of the current or future impacts of climate change, adaptation has become a perceived need that has generated a politically important set of mechanisms. In December 2010, for example, the United Nations Framework Convention on Climate Change (UNFCCC) Parties agreed to the Cancún Adaptation Framework, which calls for “climate change-related disaster risk reduction strategies” and consideration of the HFA in particular (UNFCCC, 2010). Asian leaders agreed to develop joint frameworks for the integration of disaster risk reduction and climate change adaptation as part of national and regional sustainable development policies (AMCDRR, 2010). A few years earlier, in 2007, the Arab Ministerial Declaration on Climate Change also linked adaptation to risk reduction. At the national level, the Government of the Philippines has adopted climate change legislation that specifically links adaptation and DRM, recognizing the fact that successful DRM increases adaptive capacity (Philippines, 2009).

It has been suggested that the momentum to develop country-level adaptation programming owes more to the perceived opportunity to access climate change funding mechanisms, than to social demand for adaptation (Williams, 2011). Nonetheless, given that in practice

most adaptation projects address disaster risks, such mechanisms offer an additional means of implementing DRM (Box 6.7). Through December 2010, the Kyoto Protocol's Adaptation Fund had considered project proposals from 24 countries, of which 22 were DRM-related.<sup>3</sup> The Cook Islands, for example, proposed to implement the Joint National Action Plan on Disaster Risk Management and Climate Change Adaptation (Cook Islands, 2010).

As with DRM, the effectiveness of adaptation measures depends on their integration into mainstream development planning and public investment decisions by national and local governments (ECA, 2009). Unfortunately, many climate change adaptation initiatives are still conceived and implemented as stand-alone projects. In addition, the key role of local governments in implementing locally appropriate adaptation receives insufficient attention. Governments' failure to bring DRM and climate change adaptation into national and local development planning and investment perpetuates the misconception that climate change adaptation is purely an environmental issue, and that DRM is limited to early warning, insurance and disaster preparedness and response (Mercer, 2010).

The inability to recognize the links between adaptation, DRM and development processes leads to an inaccurate understanding of climate-

related risks. As a result, adaptation can become too reliant on compensatory risk management to be able to deal with extreme events. Preferable to this is a comprehensive approach that seeks to reduce the extensive risks, which will increase in the short term as a result of climate change.

There is, however, a growing effort to factor adaptation into mainstream planning. Eight of the Adaptation Fund project proposals include provisions for fiscal and planning capacity development and for integrating adaptation into development plans. In Mozambique, for example, an integrated approach to coastal zone development in Govuro District combines risk identification for current and future climate-related hazards with the development of income opportunities for local communities and sub-district land use plans (Olhoff, 2011). In Benin, a number of municipalities have successfully integrated risk reduction and climate change adaptation into annual development and investment plans (Olhoff, 2011), thereby strengthening technical capacity within municipal governments and establishing a system for climate risk and disaster management. At the national level, Uganda has begun to integrate climate risk management into a comprehensive development and investment plan (Olhoff, 2011).

Adaptation initiatives have also struggled to address the challenge presented by climate-

### **Box 6.7 Reducing risk through biodiversity conservation and climate change adaptation in Rwanda**

Rwanda has lost 60 percent of its forest cover since 1978. As a result, ecosystems have been severely compromised, with an observed increase in the frequency of landslides, floods and torrential rains, and corresponding increases in loss of life, damage to infrastructure and human settlements, and degradation of forests and farmland.

Rwanda now sees environmental degradation as an obstacle to its national growth objectives. The country's Vision 2020 Programme promotes adequate land, water and environmental management techniques and sustainable forestry development together with a sound biodiversity policy, including a detailed land use plan that takes future climate change into consideration. The outputs of the programme have already helped Rwanda secure US\$15.9 million for adaptation activities from the UNFCCC Least Developed Country Fund.

*(Source: Olhoff, 2011)*

related risks in urban areas, particularly in cities in low- and middle-income countries, where low-income households are often concentrated in informal settlements in areas prone to weather-related hazards. Integrating adaptation into conventional land use planning and building regulations is unlikely to reduce the risks faced by such households (also see Section 6.5). Instead, partnerships between risk-prone households and communities, local governments and the central government should be constructed to address deficits in infrastructure and service provision and in access to safe land. Such linkages can facilitate the scaling up of investment necessary to address risks that are rapidly escalating even without climate change (Dodman, 2010).

## 6.4 Ecosystem-based disaster risk management

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Examples from around the world show how ecosystem-based DRM can reduce disaster risk. In the absence of other forms of evidence, these cases act as a reminder of the urgent need for global and national investment in risk-sensitive environmental management.

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The vital role of regulatory ecosystem services in managing disaster risk was highlighted in GAR09 (UNISDR, 2009). Although their value is difficult to measure in economic terms, estimates indicate that regulatory services may form the largest proportion of the total economic value of ecosystem services (PEDRR, 2010; TEEB, 2010). For example, a study by the World Resources Institute found that healthy coral reefs in the Caribbean provide US\$0.7–2.2 billion of coastal protection from erosion and storm surges to 18,000 km of beaches<sup>4</sup> (Burke and Maidens, 2004). In the United States of America, coastal wetlands absorb wave energy and act as ‘horizontal levees’, providing US\$23.2 billion per year in protection from storms (Costanza et al., 2008).

The forest in Andermatt, Switzerland, provides US\$2.5 million of avalanche protection each year (Teich and Bebi, 2009). At the same time, ecosystems not only provide regulatory services, they also sustain livelihoods, provide drinking water and energy, and provide a host of other benefits, from soil formation and nutrient cycling to cultural services.

The protection, restoration and enhancement of ecosystems, including forests, wetlands and mangroves thus has two important benefits for DRM. First, healthy ecosystems serve as natural protective barriers and buffers against many physical hazards. Second, they increase resilience by strengthening livelihoods and increasing the availability and quality of goods and resources. Given these important co-benefits, ecosystem-based DRM often realizes highly attractive cost–benefit ratios compared with conventional engineering solutions.

There are clear limitations to the protection that natural buffers can offer against extreme hazards such as tsunamis. However, the examples highlighted in Table 6.2 indicate that ecosystem-based disaster risk management is an increasingly attractive option for addressing problems as varied as river-basin and urban flooding, drought and wildfires.

Ecosystem-based DRM has the advantage of building on existing ecosystem management principles, strategies and tools, including a range of methodologies for environmental, risk and vulnerability assessments, protected area management, integrated ecosystem management and community-based sustainable natural resource management (PEDRR, 2010).

Experience to date shows that ecosystem-based DRM has a greater chance of success when it is based on a number of core elements (PEDRR, 2010):

- recognizing the multiple functions and services provided by ecosystems, including natural hazard protection or mitigation;
- linking ecosystem-based risk reduction with sustainable livelihoods and development;
- combining investments in ecosystems with other effective DRM strategies, including hard engineering options;



- addressing risks associated with climate change and extreme events and reducing their impact on ecosystem services;
- expanding governance capacities for ecosystem-based DRM through multi-sector, multidisciplinary platforms; and
- involving local stakeholders in decision-making and using existing ecosystem management instruments.

However, the monetary undervaluation of ecosystem services remains an important obstacle to the adoption of ecosystem-based DRM. As a consequence, relatively few countries are taking advantage of tools such as ‘payments for ecosystem services’. During the HFA Progress Review, for example, only 25 countries reported its use. Whereas undervaluation of natural capital and ecosystem services is not the only issue (TEEB, 2010), it can also highlight instances where ecosystem degradation and exploitation create public risks while producing private benefits.

## 6.5 Land use planning and building regulation

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Conventional approaches to land use planning and implementation have failed. Affected communities must be allowed to participate in decision-making in planning, which drives disaster risk, particularly in urban areas.

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The global population living in informal settlements is currently estimated at approximately 1 billion people, many of whom live in hazard-prone areas, and this population is growing at a rate of 40 million people per year (IFRC, 2010). How land is used in cities and how buildings, infrastructure and networks are designed and constructed all influence exposure to physical hazards and the rise or fall of a country’s stock of risk. As such, land use planning and building regulation should be

included in any list of development instruments that can be adapted for DRM.

Decisions on land use and building can push up risk significantly, especially in cities where much of the population can find accommodation only in informal settlements and where there is little willingness or capacity of local governments to manage city expansion and land use change in the public interest. Once investments in infrastructure, housing and other facilities have been made in hazardous locations, the risk is locked in place for decades or more, and once in place, it is far more expensive to correct it than it would have been to avoid its creation in the first place.

Unfortunately, land use planning and management in low- and middle-income countries have excluded a large proportion of the urban population from legal land and housing markets (Dodman, 2010), thus driving an increase in urban risk. Given their low status and lack of secure tenure, households in informal settlements are generally excluded from public investments in vital risk-reducing infrastructure and services.

Most local governments in low- and middle-income countries have no functioning land use planning or management system or have lost control over managing land use changes. Land set aside for public use is not protected, cities expand without provision for infrastructure, and powerful vested interests are engaged in land speculation and profitable but unauthorized land use changes (Satterthwaite, 2011). Many countries have established national policies for land use planning and have passed legislation assigning specific responsibilities to local governments, but many others either lack the technical capacities to plan their territory or fail to take hazards into account. For example, in Costa Rica, a small middle-income country with relatively strong governance capacities, only 20 of 89 municipalities had their own land use plans as of 2009 (Berti and Ferrufino, 2009). Although legislation exists to include risk considerations in land use planning, it is not mandatory. As a consequence, much development in hazard-prone sites has been legally authorized.

Table 6.2 Ecosystem-based disaster risk management

Risk addressed	Examples
<b>River basin flooding</b>	<p>In Hubei Province, China, a wetland restoration programme reconnected lakes to the Yangtze River and rehabilitated 448 km<sup>2</sup> of wetlands with a capacity to store up to 285 million m<sup>3</sup> of floodwater. The local government subsequently reconnected a further eight lakes covering 350 km<sup>2</sup>. Sluice gates at the lakes have been re-opened seasonally, and illegal aquaculture facilities have been removed or modified. The local administration has designated lake and marshland areas as nature reserves. In addition to contributing to flood prevention, restored lakes and floodplains have enhanced biodiversity, increased income from fisheries by 20–30 percent and improved water quality to potable levels (WWF, 2008).</p> <p>In 2005, the Government of the United Kingdom launched the programme Making Space for Water, an innovative strategy that uses ecosystems instead of costly engineered structures for flood and coastal erosion risk management along river banks and coastlines. The programme, triggered by severe floods in 1998, 2000 and 2005, consists of 25 nationwide pilot projects at the catchment and shoreline scales, and involves collaborative partnerships between local governments and communities. Since April 2003, the Government has invested between US\$4.4 and US\$7.2 billion as of March 2011.</p> <p>One such project covered an area of approximately 140 km<sup>2</sup> of the Laver and Skell Rivers west of Ripon in North Yorkshire. Activities included planting trees as shelterbelts, establishing vegetative buffer strips along riverbanks, the creation of woodland, fencing off existing woodland from livestock, hedge planting, and creation of retention ponds and wetlands for increased flood storage capacity. These activities reduced surface flow during floods by trapping, retaining or slowing down overland flow and provided other benefits such as protection of wildlife habitats and improved water quality (PEDRR, 2010).</p>
<b>Urban flooding</b>	<p>Urban development replaces vegetated ground that provides a wide range of services, including rainwater storage and filtration, evaporative cooling and shading, and greenhouse gas reduction, with asphalt and concrete, which do not. Although the functions of green spaces in urban areas are easily overlooked, local governments have started reinstating 'green infrastructure' (Gill et al., 2007) as a viable component of urban water management and as a means of combating urban heat.</p> <p>In New York, for example, untreated storm water and sewage regularly flood the streets because the ageing sewerage system is no longer adequate. After heavy rains, overflowing water flows directly into rivers and streams instead of reaching water treatment plants. The US Environmental Protection Agency has estimated that around US\$300 billion would need to be invested over the next 20 years to upgrade sewerage infrastructure across the country. In New York city, alone, it is estimated that traditional pipe and tank improvements would cost US\$6.8 billion (New York City, 2010).</p> <p>Instead, New York City will invest US\$5.3 billion in green infrastructure on roofs, streets and sidewalks. This promises multiple benefits. The new green spaces will absorb more rainwater and reduce the burden on the city's sewage system, air quality is likely to improve, and water and energy costs may fall.</p>
<b>Drought</b>	<p>Two different but almost simultaneous agro-ecological restoration processes that started 30 years ago in southern Niger and the central plateau of Burkina Faso have increased water availability, restored soil fertility and improved agricultural yields in degraded drylands. With very little external support, local farmers experimented with low-cost adaptations of traditional agricultural and agroforestry techniques to solve local problems. Three decades later, hundreds of thousands of farmers have replicated, adapted and benefited from these techniques, transforming the once barren landscape. In Burkina Faso, more than 200,000 hectares of dryland have been rehabilitated, producing an additional 80,000 tonnes of food per year. In Niger, more than 200 million on-farm trees have been regenerated, providing 500,000 additional tonnes of food per year, as well as many other goods and services. In addition, women have particularly benefited from improved supply of water, wood fuel and other tree products (Reij et al., 2010).</p>
<b>Fire</b>	<p>Aboriginal people in northern Australia have a long history of using fire to manage habitats and food resources. Due to changes in settlement patterns and marginalization, traditional fire management was fragmented over vast areas, leading to an increase in destructive fires in fire-prone savannahs. Traditional fire management practices, such as early dry-season prescribed burning, have been revived and combined with modern knowledge, such as using satellite technology to locate fires. Aboriginal fire rangers have considerably reduced large-scale fires through fire management across 28,000 km<sup>2</sup> of western Arnhem Land, with subsequent reductions in greenhouse gas emissions of more than 100,000 tonnes of CO<sub>2</sub>-equivalent per year. The Darwin Liquefied Natural Gas plant compensates aboriginal communities with approximately AU\$1 million (US\$1 million) per year for offsetting carbon, generating important income in disadvantaged communities. Additional fire management benefits include protection of biodiversity and indigenous culture (PEDRR, 2010).</p>

Land use laws and regulations that prohibit or limit development in hazard-prone areas are often misused to exclude low-income households from well-located land (Box 6.8). At the same time, low-income households may be more likely to secure tenure in hazard-prone areas that should never have been occupied for housing. In other cases, regulations exist but have been bypassed to facilitate land speculation in well-located but hazardous areas.

Even when it is implemented, land use planning may be ineffective for DRM when a given risk crosses municipal or regional boundaries. National-level planning tends to be based on standards that are not designed to address specific local problems. Local planning, on the other hand, has no influence over risks that may be constructed outside of its jurisdiction. However, intermediate-level planning frameworks that could fill the gap are often missing. In the Oshana region of Namibia, for example, the lack of regional-level planning is an obstacle to flood risk reduction. The towns of Ondangwa and Oshakati each have their own flood risk management plans, but each is designed solely to reduce risks in its own locality. A proposed channel to manage

floodwaters in Ondangwa drains directly into a village south of the town and worsens flooding there (Johnson, 2011).

Critically, planning is often disconnected from realities on the ground. Long, slow planning cycles are inconsistent with the rapid growth of many cities in low- and middle-income countries. Planning cycles of three years or more mean that plans, when adopted, may have already been overtaken by development. And without enforcement, even the best land use planning cannot change land use practices. Balancing the needs of low-income groups for well-located land with disaster-reduction objectives remains a difficult task (Box 6.9).

The design and enforcement of building legislation, regulation, codes and standards<sup>5</sup> presents similar issues, because requirements are often inappropriate for national and local conditions (Johnson, 2011). In post-disaster contexts in particular, overly complicated codes and standards that cannot be maintained over time are often introduced. The codes can be prohibitively costly for low-income households, ultimately increasing the incidence of unregulated construction. Inhabitants

### **Box 6.8 The unintended consequences of hazard zoning**

In 1957, as a consequence of severe floods, the state of Buenos Aires, Argentina, enacted a strict law on the Conservation of Natural Drainage. The law prohibited construction within 50 metres of rivers, streams and canals and 100 metres around the perimeter of lagoons, and also prevented urban development in all areas below 3.75 metres above sea level. A 1977 law reinforced the 1957 law by prescribing that houses must be built above a certain elevation to obtain planning approval. It also established a minimum plot size of 300 square metres and provided specific regulations for urban infrastructure projects. Both laws prevent the construction of new flood risk, and their detailed specifications facilitate local implementation. However, the laws are inflexible in that they do not consider alternative solutions to flood risk reduction, and after they were introduced, the cost of urban land increased, excluding many low-income households from the land market.

By contrast, a recently amended Turkish law from 1985 requires that land use plans are informed by hazard assessments and need to address risks, without the sort of detailed specification required in Buenos Aires. This approach offers flexibility in factoring risks into planning and construction, and takes into account local-level social and environmental conditions and needs. On the downside, the flexibility can mean that municipal decisions could allow development in unsafe areas or at higher densities than the law intended.

*(Source: Johnson, 2011)*

### Box 6.9 The ring road settlement in Cuttack, India

A settlement of approximately 1,200 households in Cuttack, in the Indian state of Orissa, is located on a flood-prone river bank with no protection against river level rises in heavy monsoon years when the area can be flooded for 10–15 days. Plans to relocate the settlement to an alternative site 20 km away, have been opposed by residents who cope with the flooding by moving their possessions onto the ring road when the waters rise. A more recent offer by the municipality to relocate the settlement to a site 7 km away is still awaiting approval by the national government, but for many inhabitants of this settlement, the housing offered is inappropriate (small apartments in five-storey blocks) and the move would increase commuting costs. Despite the risks, inhabitants would prefer to stay in their current location and cope with flooding when it happens. Meanwhile, the municipality is constrained in what it can offer the community for relocation. Moreover, this is just one of over 300 informal settlements in the city, all of which are also seeking infrastructure, services, tenure or alternative sites.

*(Source: Livengood, 2011)*

of informal settlements in particular find it impossible to implement codes. In other contexts, authorities may use the enforcement of strict codes as a pretext for evicting low-income households.

For example, more than half of Kenya's urban population lives in informal settlements in houses made mostly of timber and earth-based materials. Most settlements in the rapidly growing cities breach building codes, as local bylaws stipulate the use of cement, mortar and steel, in addition to electrical and sanitary installations, beyond the reach of most households (Yahya et al., 2001). In the Bangladeshi capital of Dhaka, the many families living in one-room dwellings suspended over water and with no outside space cannot hope to meet the Bangladesh National Building Code. The code defines a minimum housing size of about three times the average dwelling size in informal settlements such as Mohammadpur (Figure 6.2) and does not allow for incremental upgrading.

Even where appropriate, building codes are often inadequately supported by legislation and enforcement. Before the 2001 earthquake in Bhuj, in the Indian state of Gujarat, compliance with existing codes was not required by law except for government buildings. In Turkey, only after the devastating 1999 earthquake did the supervision of building standards become

a legal requirement. However, even when building control becomes mandatory, local governments often do not have the required expertise or manpower to monitor and enforce the regulations (Johnson, 2011).

Overly lengthy processes to obtain building permits can be another serious impediment to adherence to building codes in low-income areas. Obtaining building permits in the historical centre of Lima, for example, requires an average of 222 working days under optimal conditions (Johnson, 2011). Delays and difficulties in the processing of land and



**Figure 6.2**  
This informal settlement in Mohammadpur, Dhaka, does not conform to the Bangladesh National Building Code

*(Photo: Huraera Jabeen)*

housing permits in the Philippines mean that inhabitants of informal settlements and communities living in vulnerable locations may have no choice but to remain outside formal processes. Recent studies recommend that an important step towards helping communities to adopt building codes is to develop fast-track and one-step processes that are simple to follow and quickly realized (Rayos Co, 2010). For example, familiarizing the local masons who actually build housing in informal settlements with simple but effective techniques for improving building safety (Aysan and Davis, 1992), or adopting simple but achievable standards (Box 6.10), can be far more effective than adopting complex but ultimately unenforceable codes and regulations.

Innovations in local governance from around the world are showing that a new approach to planning and urban development is possible when participation from citizens, community

organizations and other civil society groups is supported by a new generation of mayors and civil servants. There are now many examples of low-income communities negotiating reasonably safe and well-located land, adapting rigid zoning and building standards to local needs and possibilities, upgrading vulnerable settlements in ways that reduce risks, and participating in planning and budgeting processes (Bicknell et al., 2009; UNISDR, 2009; Satterthwaite, 2011). The governance arrangements needed to underpin such approaches are discussed further in Chapter 7.

These practices certainly contribute to reducing risks, but they also have much wider benefits, from planned urban development, enhanced citizenship and social cohesion, and greater investment. In this way, building and planning regulations can drive DRM instead of impeding it (Table 6.3).

### **Box 6.10 Pragmatic approaches to safety: ensuring compliance through appropriate standards**

The 2001 earthquake in Bhuj, in the Indian state of Gujarat, caused the collapse of both traditional dwellings built with low-strength masonry, and modern, reinforced concrete buildings. Destruction of buildings was the major cause of death and damage. India had a long-established seismic code, first published in 1962 and periodically updated. Before the 2001 earthquake, however, applying the seismic code to private building construction was left to the discretion of owner, builder or engineer (but was compulsory for public buildings). Unsurprisingly, most of the private buildings did not conform to the code. Following the earthquake, compliance with the code has become mandatory in areas with the highest seismic risk.

However, the two worst-affected municipalities, Bhuj and Anjar, simplified the rules for reconstruction, prohibiting all construction higher than two stories (Spence, 2004). In the long term, this kind of standard may not be realistic given required urban densities, but it does illustrate the point that simple and achievable standards may be better at reducing risk than those that are too complex to be implemented properly.

*(Source: Johnson, 2011)*

Table 6.3 Do building and planning regulations drive or impede DRM?

Building and planning regulations facilitating DRM	Building and planning regulations impeding DRM
<ul style="list-style-type: none"> <li>• Recognition on the part of the (local) government of the needs of the poor, and motivation to be accountable to them.</li> <li>• Mandates coming from national government, giving responsibility to local government for safe building and planning while also enabling them with the technical expertise and resources to make and implement plans and enforce building codes.</li> <li>• Plans, codes and standards that are developed with and include the perspectives of businesses, residents and diverse communities.</li> <li>• Flexible regulatory frameworks that accommodate the changing realities of economies, environments and building densities over time.</li> <li>• Recognition of informal building processes and encouragement of safe building practices through education and advocacy.</li> </ul>	<ul style="list-style-type: none"> <li>• Safe construction or secure land tenure is unaffordable or unobtainable by the poor.</li> <li>• Inequalities in access to land or housing are reinforced.</li> <li>• Inhabitants of informal settlements are subject to forced evictions or reduced tenure security.</li> <li>• Regulations fail to account for realities on the ground, e.g., existing densities in urban areas are ignored, or construction of small dwellings or workspaces, or use of more affordable alternative building materials, are prohibited.</li> </ul>

(Source: Johnson, 2011)

## Notes

- 1 This chapter focuses only on the application of such instruments in selective areas of public administration. Other areas, such as rural livelihoods, were discussed in GAR09. There are also similar instruments in other sectors (e.g., health), which have not been documented here and which have the potential to be adapted for DRM. For more information, see Kirch et al., 2005; WHO, 2007; IFAD, 2010; and Wisner et al., 2011.
- 2 For more information on how to integrate disaster risk management into public investment, refer to [www.comunidadandina.org/predecan](http://www.comunidadandina.org/predecan).
- 3 Based on UNISDR analysis of Adaptation Fund project proposals considered through December 2010.
- 4 The value depends upon the amount of development protected by the reef.
- 5 Whereas the difference between statutory building regulations and legislation on the one hand, and supporting building codes and technical standards on the other, is an important one, the overall term 'building codes' will be used in this report to cover both technical and functional standards and control.