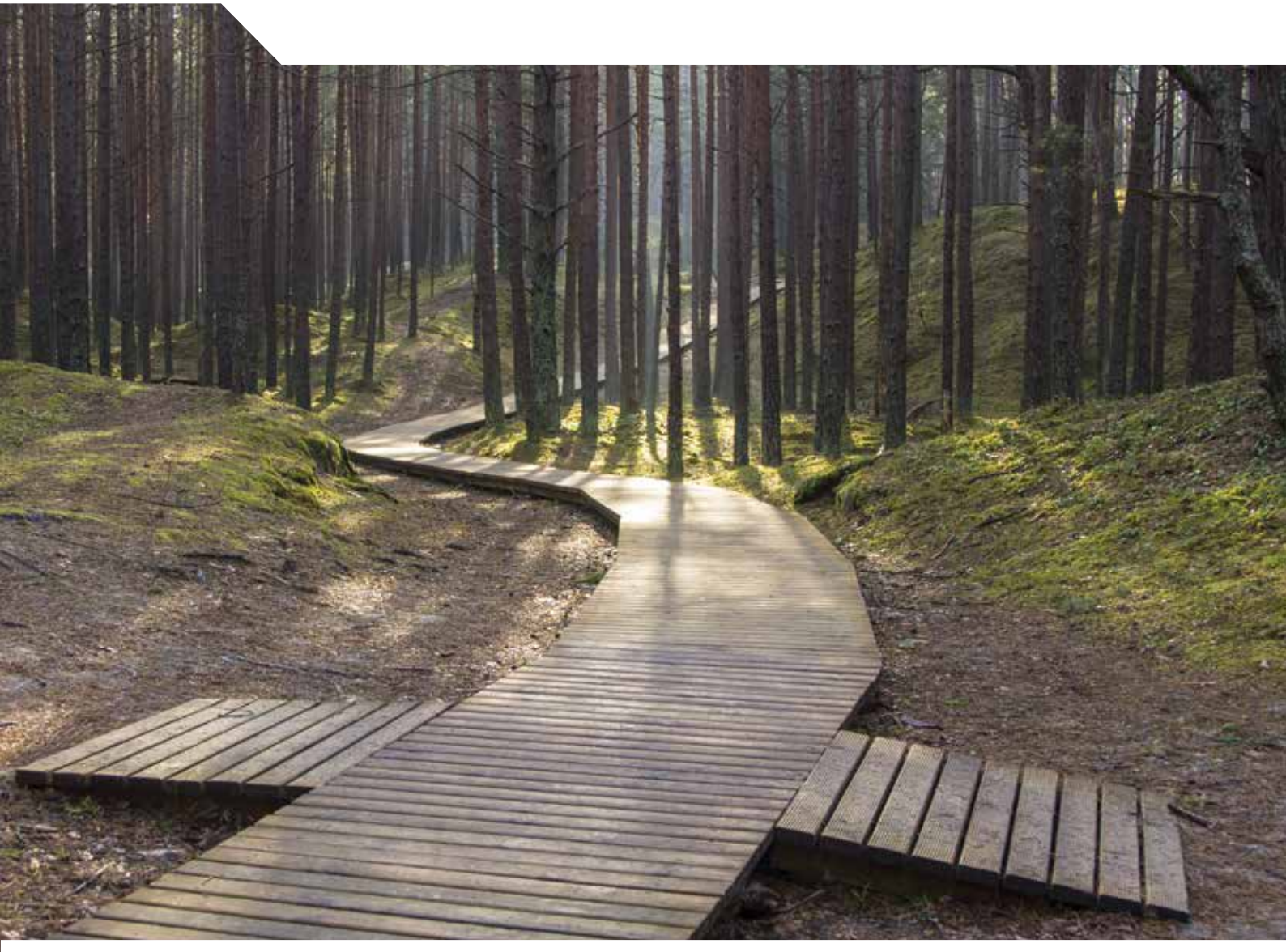
Climate Resilience in Development Planning

EXPERIENCES IN COLOMBIA AND ETHIOPIA



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BETTER POLICIES FOR BETTER LIVES

Please cite this publication as:
OECD (2014), *Climate Resilience in Development Planning: Experiences in Colombia and Ethiopia*, OECD Publishing.
http://dx.doi.org/10.1787/9789264209503-en

ISBN 978-92-64-20949-7 (print)
ISBN 978-92-64-20950-3 (PDF)

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Foreword

This report provides an overview of the current state of knowledge on how countries can achieve climate-resilient development. As climate resilience strategies are still in an early stage in most countries, it is too early for a comprehensive assessment of existing policies and measures. Rather, this report focuses on the enabling factors for integrating climate resilience and development planning. This is supported with in-depth reviews of the role of disaster risk management and the private sector. The report aims to inform both policy makers in developing countries and practitioners in development co-operation agencies.

The report draws on countries' experiences, especially through two in-depth case studies of Colombia and Ethiopia. The report was also informed by an expert workshop held at the OECD headquarters in April 2013. The report is structured as follows:

- *Chapter 1* reviews the links between climate, resilience and development.
- *Chapter 2* outlines some of the key enabling conditions for achieving climate-resilient development.
- *Chapter 3* examines how climate resilience could be applied in two areas: disaster risk management and private sector engagement.
- *Chapter 4* presents the Colombia case study.
- *Chapter 5* presents the Ethiopia case study.

The report builds on previous OECD work, including *Putting Green Growth at the Heart of Development* (2013) and the *Policy Guidance on Integrating Climate Change Adaptation into Development Co-operation* (2009). It is also guided by a number of international declarations and commitments. These include the effective development principles outlined in the *Paris Declaration on Aid Effectiveness*, the *Accra Agenda for Action* and the *Busan Partnership for Effective Development Co-operation.* The report recognises that country ownership and the use of national systems are at the heart of climate-resilient development. The report is also informed by the *Hyogo Framework for Action*, a voluntary commitment to increasing disaster risk reduction endorsed by the United Nations General Assembly in 2005. The *Cancún Adaptation Framework* recognises the need to improve the resilience of socio-economic and ecological systems to climate change, as well as to consider the *Hyogo Framework for Action* where appropriate.

The report was prepared by the OECD Environment Directorate. The drafting was led by Michael Mullan, Eva Hübner and Britta Labuhn, under the supervision of Anthony Cox. The work was overseen by the OECD Working Party on Climate, Investment and Development. The report benefited from inputs and comments from various experts. Special thanks go to the participants of the OECD expert workshop held in April 2013.

Additional comments provided by Malcolm Smart and Annika Olsson from the UK Department for International Development (DFID) and Richard Klein from the Stockholm Environment Institute (SEI) are also gratefully acknowledged.

The Colombia case study benefitted from the support of Silvia Calderón from the Department of National Planning in Colombia. The input and support provided by officials of the Environment Ministry, the Ministry of Finance, the National Unit for Disaster Risk Management, the Institute for Hydrology, Meteorology and Environmental Studies, the World Bank, the Colombian Federation of Insurance Companies, the UK Foreign and Commonwealth Office in Colombia, the National Public Purchasing Agency, the Regulatory Commission for Gas and Energy, the Colombian Institute for Rural Development, and the Transport Ministry are also gratefully acknowledged.

The Ethiopia case study benefited from the inputs of Nurmeded Jemal Abdelselam of the Ethiopian Ministry of Environment, Zerihun Getu from the Ministry of Finance and Economic Development, Tadele Ferede from Addis Ababa University, Daniel Fikreyesus from Echnoserve Ethiopia, Adam Ward and Russell Bishop of the Global Green Growth Institute in Ethiopia, Paul Watkiss, and Britta Horstmann from the German Development Institute. Nick Kingsmill conducted the initial research and supported the drafting of the case study.

Valuable feedback was provided by Jan Corfee-Morlot, Juan Casado Asensio, Stephanie Ockenden, Anna Drutschinin of the OECD Development Co-operation Directorate, as well as by Anthony Cox, Jane Ellis, Nicolina Lamhauge, Osamu Kawanishi, Takayoshi Kato, Christopher Kaminker, Rosalind Bark, and Adrien Comte of the OECD Environment Directorate. Fiona Hinchcliffe and Janine Treves provided editorial support.

This project could not have been conducted without the financial support from the UK Foreign and Commonwealth Office (FCO). Their support is gratefully acknowledged.

Table of contents

Figures

Tables

Boxes

List of acronyms

Cat DDO	Catastrophe Deferred Drawdown Option
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDKN	Climate and Development Knowledge Network
CPEIR	Climate public expenditure and institutional review
CRGE	Climate-Resilient Green Economy
CRS	Climate Resilience Strategy
DAC	Development Assistance Committee
DAC CRS	DAC Creditor Reporting System
DRF	Disaster and Recovery Fund
DRM	Disaster response mechanisms
DRR	Disaster risk reduction
FASECOLDA	Federation of Insurance Companies in Colombia
GES	Green Economy Strategy
GGGI	Global Green Growth Institute
GNI	Gross national income
GTP	Growth and Transformation Plan
HABP	Household Asset Building Program
HARITA	Horn of Africa Risk Transfer for Adaptation
HFA	Hyogo Framework for Action
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales *(Institute of Hydrology, Meteorology and Environmental Studies)*
IMF	International Monetary Fund
MAA	Multi attribute analysis
MDB	Multilateral development bank

MDG	Millennium Development Goal
MEF	Ministry of Environmental Protection and Forests
MoA	Ministry of Agriculture
MoFED	Ministry of Finance and Economic Development
MTEF	Medium-term expenditure framework
NAP	National adaptation plan
NAPA	National adaptation programme of action
NDPPF	National Disaster Prevention and Preparedness Fund
NMA	National Meteorology Agency
ODA	Official development assistance
PEER	Public environmental expenditure review
POMCAs	Planes de ordenación y manejo de cuencas *(Water Basin Designation and Management Plans)*
POTs	Planes de ordenamiento territorial *(Municipal land-use plans)*
PRECIS	Providing Regional Climates for Impacts Studies
PSNP	Productive Safety Net Programme
SISCLIMA	National Climate Change System
SRM	Sectoral Reduction Mechanism
SPIF	Strategic Programme and Investment Framework
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPME	Unidad de Planeación Minero-Energética *(Colombian Planning Unit for Mining and Energy)*

Executive summary

There is an urgent need for countries to improve their resilience to current climate variability and prepare for the consequences of future changes. Without this, climate change threatens to perpetuate poverty and slow – or even prevent – the achievement of development goals. Climate-resilient development aims to ensure that economic growth, poverty reduction and other development objectives can be sustained in a changing climate. This is more fundamental than "climate-proofing" of policies or programmes, instead re-examining the development choices that are shaping vulnerability to climate risks. This means addressing current vulnerabilities in a way that anticipates and adapts to future changes.

This book outlines the main ways in which developing countries can become more climate resilient. It draws on detailed case studies of two countries that are actively engaged in climate-resilient development planning: Colombia and Ethiopia. It has also been informed by an Expert Workshop held at the OECD in 2013.

Making climate resilience central to development planning

Development plans are a vital entry point for climate-resilient development, as they provide an overall framework for implementing policy measures and allocating resources. As such, they provide the opportunity to reconsider development pathways in the context of current and future climate risks. Development plans can include climate resilience as a broad vision, which is then implemented through specific cross-cutting and sectoral policies. The continuous engagement of sub-national and local institutions will be critical for translating national development and resilience objectives into concrete strategies and action on the ground. Strong institutional linkages and targeted capacity development are essential elements of this process.

Linking climate change adaptation and disaster risk management

Today there is often an artificial divide between disaster risk management – which deals with current climatic hazards – and climate change adaptation – which plans for future changes. This can lead to inefficiencies and duplication. In some cases, short-term measures to reduce current risks can even increase future vulnerability. Disaster risk management needs to take into account future climate changes, while adaptation can benefit from the longer-established disaster risk management institutions, regulations, infrastructure and practices. An emerging positive trend is that flows of official development assistance to developing countries are increasingly targeting disaster risk and climate change adaptation jointly.

Improving links between the two fields requires: a common definition and understanding of climate change impacts; a joint approach to assessing existing policies,

frameworks and plans for their vulnerability to climate risks; and clear and complementary mandates for each institution. Governments and development support providers all have a role to play, including facilitating finance for building climate-resilience; strengthening the link between risk-sharing and risk-reduction; and in creating a package of regulation and economic instruments that encourages risk reduction.

Supporting private sector action to build climate resilience

Ensuring that the private sector is prepared to cope with new climate risks and to seize opportunities presented by new climatic conditions will be decisive for countries' overall resilience. Public policy is essential for creating an enabling environment conducive to building climate resilience into private sector thinking. This is particularly true given the high degree of informality and prevalence of small and micro-enterprises in developing countries. Raising awareness, providing data, and increasing access to financial services will all be essential. Governments can also directly influence private sector behaviour through regulatory frameworks and spending policies. Analysing existing barriers to resilient approaches can identify opportunities for reform.

What are the building blocks for coherent action?

Integrating climate resilience into development planning requires high-level political leadership and vision. However, this needs to be combined with a strong enabling environment to translate plans into reality and to sustain progress over time. The way in which this is achieved will depend upon country circumstances, but the following building blocks are important:

- An *institutional structure* that facilitates central co-ordination and encourages the active engagement of all relevant actors. This helps to ensure that climate resilience translates into sectoral and sub-national action.
- *Building capacity* within involved institutions, especially at the local level where many adaptation measures are likely to take place but capacities tend to be weak.
- A *strong evidence base* to make the case for action and help to establish priorities. This will require good analysis and understanding of historical trends and projections of future changes.
- *Sufficient financing for the delivery of national resilience objectives*, combining the effective use of domestic and international resources.
- Mechanisms for *monitoring, evaluating, learning and adjusting approaches*. There needs to be strong feedback between lessons learned and policy design.

In moving to climate-resilient development, uncertainty about the future should not be a barrier to action; instead it should be a driver for flexibility, experimentation and learning. We need to "cross the river by feeling the stones".

PART I

MOVING TOWARDS CLIMATE-RESILIENT DEVELOPMENT

Chapter 1

Climate-resilient development

Countries have the potential to achieve a virtuous circle between climate resilience and development. Improvements in climate resilience can support development, while inclusive development can help to build climate resilience. Achieving this will not only mean climate-proofing existing development pathways, but also considering how the pathways themselves may need to change in light of the challenges posed by climate change. This chapter outlines the need for climate-resilient development, which provides a strategic approach to addressing current vulnerabilities while preparing for the effects of a changing climate.

Key messages

- Developing countries are particularly vulnerable to the effects of climate because of their economic structure, capacity constraints and insufficient mechanisms to manage risk.
- Economic development provides the resources needed to cope with and adapt to climate effects. However, it can also inadvertently increase vulnerability, for example by concentrating assets in high-risk areas.
- Countries' patterns of economic development are shaped by policy choices made at the national, local and sectoral levels. Integrating climate into these choices can enhance resilience, thereby supporting development in a changing climate.
- Achieving "climate-resilient development" demands a strategic, national approach that jointly addresses current variability and future changes. As well as climate-proofing existing development objectives, this may require changes in the objectives themselves.

Box 1.1 Definition of key terms

This report uses **climate resilience** to refer to the capacity of individuals and social, economic or environmental systems to absorb and recover from climate-induced shocks, while adapting and transforming their structures and means of living in the face of long-term stresses, change and uncertainty (Mitchell, 2013; UNISDR, 2013).

Climate-resilient development is the sustained achievement of poverty reduction, and other development objectives, under current and projected future climate conditions. Climate-resilient development thus implies a continuous and integrated process of addressing risks from current climate and preparing for future changes (Sperling et al., 2008).

Adaptation is defined as "the process of adjustment to actual or expected climate and its effects to moderate harm or exploit beneficial opportunities" (IPCC, 2012). Thus, adaptation is understood as a process, while climate resilience describes the outcome of adaptation and other, often unrelated, socio-economic trends and policy choices.

Disaster risk management is the systematic process of using administrative directives, organisations, and operational skills and capacities to lessen the adverse impacts of hazards and the possibility of disaster. It involves activities and measures for prevention, mitigation and preparedness (UNISDR, 2009).

Green growth means fostering growth and development while ensuring that natural assets continue to provide the environmental resources and services on which human well-being relies (OECD, 2011). A green growth development strategy integrates environmental considerations and the value of natural capital into economic decision making and development planning (OECD, 2013). As part of a wider agenda to integrate development and sound environmental management, climate resilience is an integral component of green growth.

There is an urgent need to strengthen developing countries' resilience to the effects of climate. Trends such as the increasing concentration of people and assets in vulnerable areas and the unsustainable use of natural resources are leading to increased vulnerability. Climate change exacerbates the costs of these socio-economic trends, while creating new challenges.

Although development can provide resources to help build resilience, relying upon "development as usual" threatens to lock in increased climate risk. The benefits of higher adaptive capacity may be eroded by increased sensitivity and exposure. "Climate-resilient development" aims to unlock a positive feedback loop between climate resilience and development goals, in which climate resilience supports development, and development choices help to build climate resilience.

1.1 The links between climate change, resilience and development are clear

Climate affects all countries, but it does not affect them all equally. This can be seen in the analysis of natural disasters, which are predominantly caused by extreme weather. Between 1970 and 2008, 95% of all deaths due to natural disasters occurred in developing countries (Handmer et al., 2012). Low and middle-income countries have also experienced higher losses as a proportion of GDP than upper-income ones (Cummins and Mahul, 2009; Laframboise and Loko, 2012). Hochrainer (2009) estimates that GDP in developing countries is 2% lower five years after a natural disaster occurs than it would otherwise have been. By contrast, disasters do not tend to have a sustained effect on growth in OECD countries (Lis and Nickel, 2010).

Extreme weather events not only slow down economic growth, but also disproportionately affect the poorest households. Efforts to cope with repeated floods or droughts can lead to "poverty traps", when households are forced to dispose of productive assets following climate shocks (Hallegatte et al., 2007; Carter et al., 2007; Hallegatte and Dumas, 2009). There can also be long-term effects on poverty if schooling is reduced or people's health is affected by a disaster (Hallegatte and Przyluski, 2010; Norris, 2005; Alderman et al., 2006).

Further action is needed to reduce emissions of greenhouse gases. Without this, average global temperatures may rise by 3 to 6°C above pre-industrial levels by the end of this century (OECD, 2012). This would represent a pace and scale of change that is unprecedented in recent experience, in a context of increasing global environmental pressures (OECD, 2013). Climate change is projected to increase the incidence of extreme weather events and change where and when they happen (IPCC, 2012). In addition, trend changes may cause significant effects over the longer-term, including changes in agro-climatic zones, loss of ecosystem services and the potential inundation of low-lying land (Dell et al., 2012; Hsiang, 2010; Kumar and Yalew, 2012).

Many of the factors that make developing countries vulnerable to current climate variability also make them vulnerable to climate change. These include: the greater economic importance of agriculture; limited protective infrastructure; less effective land-use planning; capacity constraints that hinder risk reduction, preparedness and recovery; and limited uptake of formal risk-sharing mechanisms, such as insurance.

Economic development is one of the most effective means to build resilience against climate variability and change, providing the resources to better cope with and adapt to a changing climate. Advances in people's knowledge and skills will strengthen their adaptive capacity. However, this link is not automatic. Development trends that increase the pressure on natural resources or that encourage the concentration of people and assets in high risk areas can lock in increased vulnerability. On a global scale, unless greenhouse gas emissions are decoupled from economic growth, the rate and magnitude of climate change is likely to increase.

Policy choices affect the relationship between development and climate resilience (see Box 1.2). This relationship will be influenced by the economic sectors and geographical areas that countries choose to prioritise. It will also depend on the design of specific policy interventions. For example, the direct costs of disasters, e.g. rebuilding damaged homes, can be reduced through measures such as sound land-use management or building regulations. Improving access to credit can help individuals and businesses to offset the effect of climate shocks, minimising the risk of lasting long-term negative effects. Economic diversification can increase the resilience of the economy as a whole.

Past development trends have contributed to increased vulnerability. Socio-economic trends, such as concentrations of people and assets in coastal and other high risk areas, will exacerbate the challenge. Even without climate change, average annual global flood losses in 136 of the world’s largest coastal cities could increase from their 2005 level of approximately USD 6 billion to USD 52 billion. Under climate change (and in the absence of adaptation measures), sea-level rise and land subsidence could increase those costs significantly, with estimates in the range of USD 1 trillion a year (Hallegatte et al., 2013).

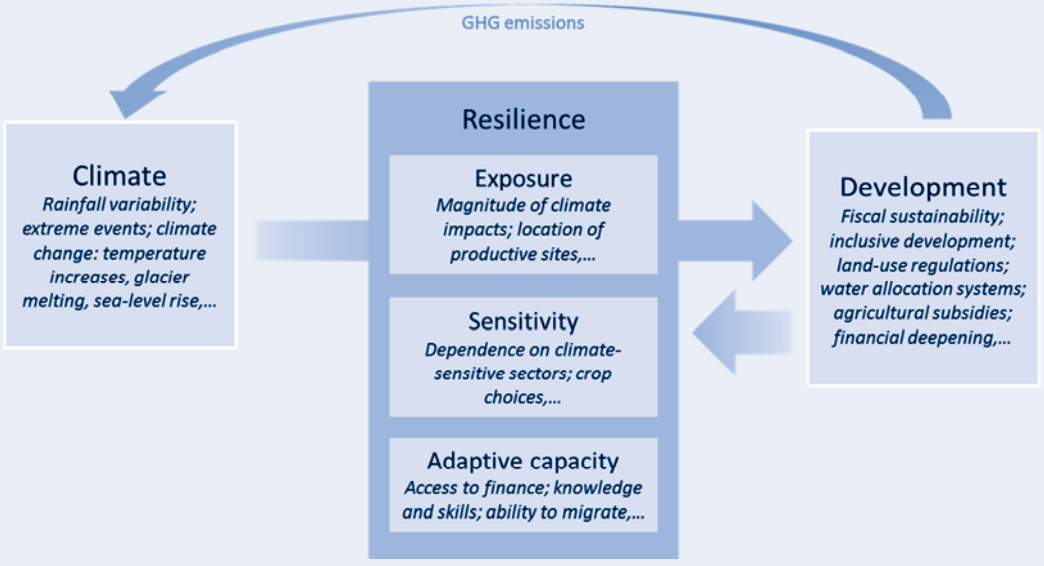
Given the scale of current and future climate impacts, there is an urgent need to integrate climate dimensions into policy-making today. This can help to ensure that development enhances climate resilience; while minimising the risk of inadvertent increases in exposure or sensitivity. Improved resilience can, in turn, support the achievement of development objectives.

Box 1.2 Climate, resilience and development

There are three channels by which development choices can affect resilience (adapted from IPCC, 2007; see Figure 1.1):

- *Exposure* is shaped by physical patterns, such as the magnitude of climate change and the geography of a country, and on the location of people and assets. Development choices can directly alter exposure by influencing how land is used and what type of infrastructure and economic activities are pursued. Decisions made through the development planning process will also have indirect effects on exposure, for example through their influence on rural-urban migration.
- *Sensitivity* is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. Development choices can affect sensitivity through the prioritisation of certain economic sectors, such as agriculture, or the protection of valuable ecosystem services such as groundwater filtration.
- *Adaptive capacity* is the ability or potential of a system to respond successfully to climate variability and change. Development can affect adaptive capacity by targeting underlying factors such as income, health and education, and through investments in capacities that are specifically aimed at supporting climate resilience.

Figure 1.1 The links between climate, resilience and development



Source: adapted from IPCC (2007), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

1.2 Climate resilience is a new context for development

"Climate-resilient development" aims to sustain improvements in economic growth, poverty reduction and other development objectives in the face of a changing climate. It systematically integrates current and future climate risks and opportunities into today's strategies for development. Climate change alters the context in which development takes place and makes different routes to achieving development goals more or less effective. Climate-resilient development recognises this reality, taking the following principles into account:

- *Development and climate are closely interconnected:* climate-resilient development aims to protect development from the impacts arising from climate variability and change. It also considers how development choices shape vulnerability to climate impacts, considering both socio-economic trends and development policies (Box 1.3).
- *Current and future climate risks need to be considered jointly:* in the short and medium term, climate change will affect development mostly through increased climate variability and extreme events. Disaster risk management and climate change adaptation need to jointly address common risks and be flexible enough to address the new challenges created by climate change in the longer term.
- *Climate resilience is an integrated aspect of green growth:* climate-resilient development is part of a wider agenda to integrate development and sound environmental management. Climate change is one of many pressures the world faces as a consequence of growing beyond our environmental boundaries. Many synergies exist between climate-resilient development and other green growth objectives. In particular, the sustainable management of natural capital, including water and forests, offers opportunities to support economic development, social inclusion, and climate resilience.

Climate-resilient development requires a systemic approach that addresses the full scale of the climate challenge. Although the effects of climate change may be most evident at the local level, the impacts and drivers of vulnerability are not confined to the area or sector that is directly affected. For example, the failure of crops in one region is likely to have spillover effects across the country (and potentially beyond), through markets and migration. Effects on agricultural productivity will depend, amongst other things, on the price of inputs such as fertilisers, availability of financial services and agricultural extension services. A co-ordinated, national approach is therefore vital for building climate-resilience into growth and development pathways.

While economic development will often increase resilience to climate impacts, climate-resilient development may require four shifts along the spectrum from "development as usual":

1. *Increase priority or urgency of taking action:* where "win-wins" are present, bringing in climate resilience could increase the urgency or priority of taking action in a given policy area. For example, the resilience benefits of education may justify greater resourcing in this area.
2. *"Climate-proof" the implementation of development strategies:* existing strategies and measures may require adjustments to avoid increases in vulnerability. For example, if the strategy aims to achieve increased agricultural output, it may be

necessary to complement this with irrigation or other measures that would increase the sector's climate resilience.

3. *Consider changing development strategy:* if the costs of "locking in" vulnerability exceed the immediate development benefits, it may be necessary to reconsider the objectives contained within the strategy. For example, the development of water-intensive industries may need to be reconsidered if drought will become an increasing risk in the future.
4. *Create new policies:* some challenges posed by climate change may be new to countries or specific regions within a country. New measures might be required to build the capacity of stakeholders to deal with shifting agri-climatic zones or respond to changes in the incidence of disease.

Countries are increasingly implementing the first two of these, but there is much less practical experience of the third and fourth approaches. As the scale and pace of climate change increases, it will become increasingly important to consider the full range of options.

Box 1.3 Channels linking climate resilience and economic growth

Inclusive growth is essential for ensuring that economic growth alleviates poverty and enhances the adaptive capacity of the most vulnerable populations.

Economic diversification is a characteristic of most high-income countries. Diversification follows from and encourages economic growth. It also reduces the dependence of the overall economy on any single climate-sensitive sector or activity.

Natural capital is vital for economic growth and welfare. It is particularly important in low-income countries, where it constitutes an estimated 26% of total wealth, compared to 2% in OECD countries. A healthy natural capital stock is an important element of climate resilience, but natural capital can be threatened by the effects of climate change.

Access to education, both in terms of general schooling and for acquiring specific skill sets, is important for long-term growth. Adapting to climate change might require investments in climate-specific knowledge to help people adapt to new challenges.

Physical infrastructure, such as transport and energy infrastructure, is vital for economic development. Climate phenomena such as flooding, storms and heat may damage existing infrastructure. Infrastructure encourages people to settle in certain areas, however, thus shaping exposure to climate change.

Institutional and regulatory frameworks that are effective and efficient encourage the long-term perspective that is required to tackle the effects of climate change. Adjustments in existing institutions and the creation of new institutions might be necessary to address new challenges arising due to climate change.

Macroeconomic stability encourages long-term investment, but can be negatively affected by climate shocks.

Access to capital, from the household up to the national level, can help to cushion the effects of shocks and allow for investment in climate resilience. Climate-related shocks in turn can reduce savings and increase the urgency to improve access to finance.

Sources: IPCC (2007), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York; Lecocq, F. and Z. Shalizi (2007), "How might climate change affect economic growth in developing countries? A review of the growth literature with a climate lens", *World Bank Policy Research Working Paper*, No. 4315, World Bank, Washington DC; OECD (2008), *Natural Resources and Pro-Poor Growth: The Economics and Politics*, DAC Guidelines and Reference Series, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264060258-en*; Vivid Economics (2010), *Promoting Economic Growth when the Climate is Changing*, Report for the UK Department for International Development.

References

Alderman, H., J. Hodditnott, and B. Kinsey (2006), "Long-term consequences of early childhood malnutrition", *Oxford Economic Papers*, Vol. 58, pp. 450-474.

Carter, M., et al. (2007), "Poverty traps and natural disasters in Ethiopia and Honduras", *World Development*, Vol. 35, pp. 835-856.

Cummins, J. and O. Mahul (2009), *Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention*, World Bank, Washington DC.

Dell, M., Jones, B. and B. Olken (2012), "Temperature shocks and economic growth: Evidence from the last half century", *American Economic Journal: Macroeconomics*, Vol. 4, pp. 66-95.

Hallegatte, S. et al. (2013), "Future flood losses in major coastal cities", *Nature Climate Change*, Vol. 3, pp. 802-806.

Hallegatte S. and P. Dumas (2009), "Can natural disasters have positive consequences? Investigating the role of embodied technical change", *Ecological Economics*, Vol. 68, pp. 777-786.

Hallegatte, S., J. C. Hourcadec and P. Dumas (2007), "Why economic dynamics matter in assessing climate change damages: Illustration on extreme events", *Ecological Economics*, Vol. 62, pp. 330-340.

Hallegatte, S. and V. Przyluski (2010), "The economics of natural disasters: Concepts and methods", *World Bank Policy Research Working Paper*, No. 5507, World Bank, Washington DC.

Handmer, J. et al. (2012), "Changes in impacts of climate extremes: Human systems and ecosystems", in Field, C. B. et al. (eds.), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: IPCC Special Report*, Cambridge University Press, New York.

Hochrainer, S. (2009), "Assessing the macroeconomic impact of natural disasters: Are there any?", *World Bank Policy Research Working Paper*, No. 4968, World Bank, Washington DC.

Hsiang, S. M. (2010), "Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America", *Proceedings of the National Academy of Sciences*, Vol. 107, pp. 15367-15372.

IPCC (2013), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

IPCC (2012), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

IPCC (2007), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

Kumar, S. and A. W. Yalew (2012), "Economic impacts of climate change on secondary activities: A literature review", *Low Carbon Economy*, Vol. 3, pp. 39 48.

Laframboise N. and Loko B. (2012), "Natural disasters: Mitigating impact, managing risks", *IMF Working Paper*, No. 12/245, International Monetary Fund, Washington DC.

Lecocq, F. and Z. Shalizi (2007), "How might climate change affect economic growth in developing countries? A review of the growth literature with a climate lens", *World Bank Policy Research Working Paper*, No. 4315, World Bank, Washington DC.

Lis, E. M. and C. Nickel (2010), "The impact of extreme weather events on budget balances", *International Tax and Public Finance*, Vol. 17/4, pp. 378-399.

Mitchell, A. (2013), "Risk and resilience: From good idea to good practice. A scoping study for the Experts Group on Risk and Resilience", *OECD Development Co-operation Working Paper*, No. 13, OECD Publishing, Paris.

Norris, F. H. (2005), *Range, Magnitude, and Duration of the Effects of Disasters on Mental Health: Review Update 2005*, Dartmouth Medical School and National Center for PTSD, Hanover and Boston.

OECD (2013), *Putting Green Growth at the Heart of Development*, OECD Green Growth Studies, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264181144-en*.

OECD (2012), *OECD Environmental Outlook to 2050: The Consequences of Inaction*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264122246-en*.

OECD (2011), *Towards Green Growth*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264111318-en*.

OECD (2008), *Natural Resources and Pro-Poor Growth: The Economics and Politics*, DAC Guidelines and Reference Series Paris: DAC Guidelines and Reference Series, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264060258-en*.

Sperling, F. et al. (2008), "Transitioning to climate resilient development: Perspectives from communities in Peru", *Environment Department Papers, Climate Change Series*, No. 115, World Bank, Washington DC.

UNISDR (2013), *From Shared Risk to Shared Value – The Business Case for Disaster Risk Reduction. Global Assessment Report on Disaster Risk Reduction*, United Nations Office for Disaster Risk Reduction (UNISDR), Geneva.

UNISDR (2009), *2009 UNISDR Terminology on Disaster Risk Reduction*, UNISDR, Geneva.

Vivid Economics (2010), *Promoting Economic Growth when the Climate is Changing*, Report for the UK Department for International Development.

Chapter 2

The building blocks of climate-resilient development

Climate-resilient development requires 1) political vision and leadership; 2) a development planning process that has climate resilience at its core; 3) an institutional structure that facilitates central co-ordination and targeted engagement; 4) a strong evidence base and methods for dealing with uncertainty; 5) sufficient financing, combining the effective use of domestic and international resources; and 6) mechanisms for monitoring, evaluating and learning including strong feedback between lessons learned and policy design. The chapter outlines experience to date in implementing these building blocks.

Key messages

- High-level political leadership, vision and commitment are vital for the move towards climate-resilient development. But without the institutional arrangements to translate vision into reality and to maintain it over time, vision alone will not be enough.
- Integrating climate resilience into national planning processes is crucial for a co-ordinated, whole-of-government approach.
- Climate resilience should ideally be the responsibility of a central ministry, rather than the environment ministry. If a different arrangement is adopted, direct linkages are essential between planning and co-ordinating institutions.
- Providers of development co-operation have a key role to play in helping to develop the evidence base, build capacity and overcome financing constraints. But these efforts must be aligned with country priorities and implemented so as to build country ownership.
- Monitoring and evaluation enables national authorities to continuously learn what approaches are effective in building climate resilience. To bring about change, the lessons learned must be fed back into policy planning and budgeting processes.

Climate-resilient development requires political leadership combined with the right enabling environment: the institutional and financial arrangements that integrate it into development planning. Countries face the key challenge of establishing institutions that 1) translate political visions into implementation strategies and action on the ground; 2) create engagement and commitment across government and public institutions; and 3) drive and sustain momentum regardless of changes in government. How this can be best achieved will depend upon country circumstances. However, some common themes are emerging from countries' experiences to date. These "building blocks" are outlined below, drawing on country case studies of Colombia and Ethiopia (Chapters 4 and 5), as well as other countries' experiences as documented in the literature:

2.1 Clear vision and strong leadership are important starting points

Many developing countries have already incorporated climate resilience into their long-term development visions, often alongside low-carbon and green growth aspirations. For example, the Rwandan government aims to become "a developed climate-resilient, low-carbon economy by 2050" (Republic of Rwanda, 2011). Others, such as Colombia and Ethiopia, also see greater resilience as a means to achieve their development goals (Government of Colombia, 2011; EPA, 2011).

High-level political leadership has been essential for establishing these development visions, and for translating them into reality. Ethiopia's late Prime Minister Meles Zenawi initiated and publicly championed the country's Climate-Resilient Green Economy Strategy (Federal Democratic Republic of Ethiopia, forthcoming). In Bangladesh, climate resilience is reflected in the ruling party's election manifesto, which has driven the mainstreaming of climate resilience into national development plans. High-level political leadership was also found to be vital in Cambodia, Kenya, The Gambia and Rwanda (Pervin et al., 2013).

The prime motivation behind the political vision and leadership varies from country to country. In Colombia, disastrous floods in 2010 prompted immediate high-level support. In Ethiopia, political action is driven by the direct link between climate and economic development, combined with the intention to become a "sustainable development leader" and the prospects of attracting international resources and investments. But while it is an important precondition, political leadership alone will not be sufficient to build climate resilience. The other building blocks also need to be in place.

2.2 Climate resilience needs to become part of national development planning

The emerging trend of integrating climate resilience into national development visions coincides with a general shift in the understanding and practice of both climate change adaptation (Box 2.1) and disaster risk management (Section 3.1).

Development plans are a natural entry point for enabling climate-resilient development, providing an opportunity to reconsider development pathways in the context of future climate risks. National development plans and similar strategic documents (e.g. poverty reduction strategies) provide the overall framework for concrete policy measures and resource allocation in most developing countries. These documents usually outline medium-term development objectives and targets, to be delivered through more detailed sectoral and sub-national plans. The choice of development objectives

within these documents aims to shape patterns of socio-economic development and, therefore, future vulnerabilities.

Several countries are recognising the importance of linking climate resilience to their national development plan. Ethiopia's current Climate-Resilient Green Economy strategy was intended to "climate-proof" the objectives that had been set in the existing development plan (2010-15). However, the government intends to reconsider development objectives alongside climate resilience when drafting the next national development plan (2015-20), and has required line ministries to integrate climate change into their inputs into the next plan (see Chapter 5). Similarly, Ghana's National Development Planning Commission has asked line ministries to consider the challenges and opportunities posed by climate when developing their contributions to the national plan (NDPC, 2013).

These examples underline how development plans not only promote climate resilience by setting out a broad vision, but also by establishing cross-sectoral and sector-specific policies for climate resilience. This is particularly important as the effects of climate change are often not limited to any specific sector. Instead, actions taken by different sectors influence each other and jointly affect a country's overall resilience to climate change. Thus strong co-ordination across sectors and levels of government – often where stakeholders do not have a history of working together – is vital.

Box 2.1 The international context for climate adaptation: National adaptation programmes and plans

In 2001, the United Nations Framework Convention on Climate Change (UNFCCC) called for least developed countries to develop National Adaptation Programmes of Action (NAPAs). The NAPA process aimed at enabling least developed countries, with support from the Least Developed Countries Fund, to identify and address their most urgent and immediate adaptation needs on a project-by-project basis. More recently, international discussions have shifted from this project-based approach towards promoting national, strategic responses. This includes the recent establishment of the National Adaptation Plan (NAP) process under the UNFCCC, which aims to support developing countries in developing strategic, national-level responses to climate change. The NAP process aims to "facilitate the integration of climate change adaptation, in a coherent manner, into relevant new and existing policies, programmes and activities, in particular development planning processes and strategies, within all relevant sectors and at different levels" (LDCEG, 2012). The NAP process aims to support countries in considering development and resilience priorities in parallel. Rather than necessarily being a stand-alone document outlining medium to long-term action, national adaptation or resilience plans can also be a process or tool for capturing and creating coherence in countries' adaptive and resilience-building processes. This process is intended to build upon existing institutions where possible.

2.3 Implementing climate resilience requires strong institutions

Although the details of institutional arrangements will vary depending on context, the integration of climate resilience into development planning requires sustained engagement by all actors relevant for adaptation and development at national, sectoral and sub-national level, as well as good administrative capacity.

Co-ordination mechanisms should facilitate climate resilience

There are significant advantages to placing responsibility for climate resilience within a powerful central ministry. Central ministries or co-ordination bodies that have cross-sectoral responsibilities for economic planning, such as the finance ministry or the prime minister's office, can ensure the active engagement of sectoral ministries (OECD, 2009; IEG, 2012). These institutions may also be better suited to mobilise and co-ordinate development partners, promote information sharing and influence development planning and the budget in the short and long term (World Bank, 2013a). Colombia shifted the responsibility for co-ordinating climate change adaptation from the Ministry of Environment to the Department of National Planning (Chapter 4). This powerful central body has established links with sectoral ministries, and is responsible for co-ordinating Colombia's national development plans. This shift makes co-ordination easier with development planning and other national policy processes. Several other countries – including Kiribati, Mexico, Mozambique, Morocco, Samoa and Zambia – have opted for similar arrangements, placing the co-ordinating agencies for climate resilience under their planning and finance ministries, or their offices of the President or Prime Minister (World Bank, 2013a).

In many countries, however, it is the Ministry of Environment that is responsible for co-ordinating climate change adaptation policies (Pervin et al., 2013). Experience suggests that this can lead to weak inter-sectoral co-ordination (OECD, 2009). Environment ministries may have less power and authority than central ministries to impose the necessary co-ordination among ministries and to maintain the political will to make climate resilience a cross-sectoral priority. Nevertheless, countries can still strengthen the profile and political weight of their co-ordinating institution. Cambodia, for example, upgraded the institutional status of its climate change team within the Ministry of Environment to a Climate Change Department. Ethiopia gave ministerial status to its co-ordinating institution (the former Environmental Protection Agency). In Bangladesh, the Minister of Environment has been made a state minister to enhance the ministry's role in co-ordinating climate-resilient planning.

Countries can also create direct linkages between planning and co-ordinating institutions. Such linkages can take the form of cross-sectoral committees at different levels of government, permanent secretariats or dedicated teams within line ministries (Box 2.2). The most appropriate institutional design clearly will depend on the country context. There are advantages to working with well-established institutional frameworks. However, if new institutional mechanisms are being established, this provides an opportunity to design features that encourage and maintain political engagement across the government, taking into account existing roles and responsibilities, formal and informal co-ordination mechanisms and power relations across public institutions. Establishing adequate institutions or institutional linkages may be a dynamic "learning-by-doing" process, adjusting to capacities and needs as they become apparent.

Box 2.2 Upgrading the political profile of climate resilience: Lessons from Colombia and Ethiopia

Both Colombia and Ethiopia are building a broad-based coalition of stakeholders to support the development of a policy for climate resilience. In Colombia, climate change adaptation policy has been led by the National Planning Department in close collaboration with the Environment Ministry, the National Disaster Risk Management Unit, and a governmental institute for climate-related research. A draft decree foresees a new institutional co-ordination mechanism that involves a broader range of stakeholders in financial, sectoral, regional, international and scientific committees. This will bring together public officials who work on adaptation, and stakeholders whose decisions are relevant for development planning, including the ministries of finance, agriculture, energy and mining. Broader engagement in the future might also extend to the private sector and civil society.

In Ethiopia, a new permanent steering committee has been established to support the development of the country's Climate-Resilient Green Economy strategy. The committee comprises high-level representatives from all relevant sectoral institutions and is chaired by the Chief Economic Advisor to the Prime Minister. This is intended to ensure that climate resilience remains a cross-governmental concern that can be more easily linked to development planning. The strategy's implementation will be overseen by a permanent secretariat that comprises staff from both the Ministry of Environment and the Ministry of Finance. In addition, all federal ministries and regional governments are planning to establish Climate Units to support the development and implementation of regional and sectoral resilience strategies. These units might become "agents" for climate resilience in ministries, building commitment and helping to secure the necessary resources for implementation of the national resilience strategy.

Climate resilience needs to be built at the sectoral and sub-national levels

National development plans provide a framework for building climate resilience, but successful implementation requires building climate resilience into sectoral and sub-national development processes. This occurs through two linked but separate channels:

1. the "bottom-up" flow of information and policy recommendations into national development planning and budgeting, and into national adaptation policy processes; and
2. the sectoral and sub-national planning processes.

There is a range of potential approaches to incorporating climate resilience into sectoral and sub-national planning. Colombia has established dedicated committees to co-ordinate matters related to sectoral, sub-national and international policies, in addition to a co-ordination mechanism at the national level. In addition, a legal requirement to incorporate climate change impacts into at least five sectoral strategies by the end of 2014 has greatly enhanced planning for climate-resilient development (Government of Colombia, 2011). Another approach is to screen major projects for climate risks. Disaster risk management is legally required to be integrated into land-use planning and watershed management plans. Ethiopia is establishing permanent teams in each ministry, which will be responsible for integrating climate resilience into all policies and programmes. Such provisions for mainstreaming resilience into sectoral practices, however, will need to take technical and administrative capacities into account.

Sequential efforts, starting with a few sectors, can help to make the most effective use of available administrative capacity. This is particularly the case given that budgets and policy responsibilities relevant to climate resilience are often concentrated in a few ministries (Miller, 2013). In Ethiopia, the development of the Climate Resilience Strategy initially focused on the agriculture sector. The social and economic importance of this sector, combined with its sensitivity to climate, means that action in this area will make a major contribution to Ethiopia's resilience. Ethiopia is now extending the work to other key sectors, such as water and energy. If a sequential approach is adopted, additional mechanisms might need to be put in place to ensure that remaining ministries do not continue to operate under business-as-usual conditions in the short to medium term. In Ethiopia, each ministry is expected to include climate resilience objectives into its next sectoral development plan for 2015-2020.

The local level plays a vital role in climate resilience. Decisions taken locally can have consequences for the resilience of society overall, as many adaptation policies are implemented locally. Yet local administrative capacities tend to be weaker than those at the national level. In Colombia, while disaster risk management is legally required to be integrated into land-use planning and watershed management plans, similar requirements for integrating climate risks at sub-national level do not yet exist, mainly due to capacity constraints. Legislative requirements are likely to be most effective when carefully designed and targeted at the areas of highest risk. Pilot projects have been used to encourage action across regions or municipalities. The Colombian government, city authorities and development co-operation providers are working towards aligning the development, disaster risk, land-use and adaptation planning in the coastal city of Cartagena de las Indias. The project has published guidelines to facilitate similar processes in other municipalities (INVEMAR et al., 2012). Peer learning between cities, for instance through strategic city alliances, can be used to enhance capacities at the local level.

Building capacity and encouraging learning are key

Capacity building is required to support the implementation of climate-resilient development. Capacity development needs to engage, and be tailored towards the needs of, relevant stakeholders. These are likely to include multiple levels of government and extend to businesses and civil society (OECD, 2012). Technical training may be required for the core co-ordination team and focal points in key ministries. This will include learning how to adequately communicate the main issues and needs for action to other stakeholders. The decentralised nature of much adaptation means there can be particular value in peer-learning mechanisms, allowing decision makers to benefit from the experiences being gained in other areas or sectors.

There is also value in learning between countries. As climate change may lead to a whole new climate in some countries, learning from regions that are used to a similar climate might be helpful. Climate "analogues" have been used to inform research on how European cities can adapt to climate change (Kopf et al., 2008). A global forum for developing climate analogues has been launched by a research programme of the Consultative Group on International Agricultural Research (CGIAR). This climate analogue tool aims to inform medium-term agricultural adaptation options and strategies by mapping similar climates over space and time.[1] For example, climate analogues for the climatic conditions in a region in Ghana in 2030 recommended choosing crops that are currently used in other regions in Africa and Asia (Ramírez-Villegas et al., 2011).

The OECD guidance on *Greening Development: Enhancing Capacity for Environmental Management and Governance* identifies five steps for developing the capacities required to integrate environmental issues across government planning, policy making and implementation (OECD, 2012; Box 2.3). These five steps apply to the specific context of climate-resilient development. Capacity building calls for a long-term approach that requires regular monitoring of progress and revision of activities to respond to changing needs. These steps can therefore be considered as part of an iterative process.

Box 2.3 Five key steps for building the skills for climate-resilient development

Step 1: Assess the political and institutional context

Understand how decisions are made in a particular political and institutional context, for example how national development plans are formulated or how budget decisions are made. This analysis can be applied both for a national approach to a capacity-building strategy, and for sectoral or sub-national approaches.

Step 2: Identify key actors and their capacity development needs

Key actors and capacity needs will vary greatly across government agencies. Depending on the process, capacities for climate change adaptation include: awareness of the links between climate risks and development, data collection and analysis capacity, capacities to conduct vulnerability assessments and knowledge of adaptation options, the capacity to frame climate risks and adaptation issues in the language of policy makers and other stakeholders, and the capacity to monitor and evaluate progress towards climate resilience.

Step 3: Identify opportunities to shape organisational incentives

Identify suitable entry points, set priorities and outline appropriate timescales, targets and resource needs for capacity building, emphasising the need to build co-ordination capacity for cross-sectoral issues such as adaptation.

Step 4: Identify awareness/knowledge needs and existing analytical tools

Climate-resilient development will mean raising awareness across government ministries, creating a need for effective communication tools that are targeted to specific audiences (such as the finance ministry and other sectoral ministries, regional entities and municipalities). The uncertainty associated with climate projections calls for training in specific analytical tools for analysis and decision making.

Step 5: Identify options for policy responses

Officials working to build climate resilience need to have the capacity to suggest feasible and convincing policy measures, often in areas where climate change has not been taken into account in the past. At the institutional level, capacity requires that officials working on adaptation are involved in important policy-making processes, or consulted at an early stage. At the individual level, this requires the capacity to negotiate and formulate convincing arguments for integrating measures to improve climate resilience in policy packages.

Source: OECD (2012), *Greening Development: Enhancing Capacity for Environmental Management and Governance*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264167896-en*.

The OECD guidance also summarises lessons learned from capacity development support (OECD, 2012):

- *Start small, learn and adapt:* capacity development can be most effective if it is scaled up gradually. In the implementation of the Ethiopian Climate-Resilient Green Economy Strategy, capacity development by a range of development co-operation providers focused on two of the key ministries before being rolled-out more widely (Chapter 5).
- *Target "pockets of energy":* areas where there is already willingness to change should be prioritised first.
- *Be transparent and engage key stakeholders:* capacity development interventions should involve dialogue with a wide range of relevant stakeholders (e.g. parliamentarians, media and NGOs), as well as the immediate target of the intervention.
- *Gradually remove constraints:* there will always be capacity constraints and data limitations. Focusing on capacity constraints that are both urgent (where the costs of delay are high) and important (greatest potential to undermine improved outcomes) can help to maximise the benefits of interventions.

Recent experience from Ethiopia suggests that close collaboration between development co-operation providers and domestic actors can do much to build skills. Ethiopia's Climate Resilience Strategy was developed by hybrid teams made up of external experts and Ethiopian government officials. Where capacity gaps became apparent, training and workshops were held with local officials to build knowledge and necessary skills (Chapter 5).

2.4 The risks and uncertainties surrounding climate change need to be understood

Development planning is an inherently uncertain process, with the achievement of development objectives being affected by factors ranging from fluctuating commodity prices to disruptive technological changes. The effects of climate change are also uncertain. The magnitude and sometimes even the direction of climate changes are not yet known for many developing countries, often because historical climate data and the technical expertise to develop climate models are limited. The most vulnerable countries also tend to face significant gaps in relevant data, such as socio-economic statistics and reliable estimates of past economic impacts from climate phenomena. Improvements in data collection and capacity to interpret that data should reduce, but will not eliminate, some of these uncertainties.

These sources of uncertainty are also interrelated: future climate impacts will depend on the development choices countries make today, as well as on the interplay between the climate and socio-economic changes. For example, the impact of decreasing rainfall on agricultural output and livelihoods will depend on technologies used by farmers, including irrigation and crops, the availability of climate information, farmers' education and knowledge for dealing with specific climatic conditions, access to markets, credit, etc. Uncertainty about the future patterns of these characteristics can make it difficult to decide how best to respond. Yet, uncertainty is no reason for inaction; instead it is a driver for building in flexibility, experimentation and learning (Box 2.4). Instigating

monitoring and evaluation of resilience-building efforts right from the start can help to identify promising approaches or where it may be necessary to change course.

Nevertheless, improvements to the evidence base are vital to understand the links between climate resilience and development, to make the case for taking policy action and to establish priorities. Efforts to improve the evidence base can build on the progress that has already been made to date, for example through the National Adaptation Programmes of Action (NAPA) process. Developing the evidence base for climate-resilient development will entail improvements in the quality, analysis and accessibility of climate data. Climate-resilient development will further benefit from projections of future climate change and mapping of the links between climate and the economy.

Improving climate data and projections is essential

Historical and current climate data provide an important starting point for informed climate-resilience planning. The systematic analysis of past climate data will uncover trends in temperature or rainfall, whilst also providing the basis for advanced modelling activities for medium to long-term projections. In addition, early warnings of extreme events based on meteorological data have the potential to reduce casualties, human suffering and economic losses. Improving the reliability of existing weather networks and capacity to manage and process climate data, for example within national meteorological agencies, should therefore be a priority for improving the evidence base.

Where climate data are available, access both for public institutions and the private sector is vital. Accessibility should go hand-in-hand with capacity building to ensure the data is understandable and useful for users. Various partnerships between research institutions and government agencies have been established to provide data and build capacity (Webster, 2013). For example, the Africa Adaptation Programme led by the United Nations Development Programme (UNDP) is co-ordinating several global initiatives to increase access to climate data and information, including the Africa Monsoon Multidisciplinary Analyses and the Coordinated Regional Climate Downscaling Experiment (UNDP, 2011a).

More needs to be done to improve the availability and quality of climate projections for developing countries; there is wide variability in the coverage, quality and usability of climate projections (OECD, 2009). In many countries, resource constraints and data limitations lead to great uncertainty and inability to capture spatial variation. Average changes over wide areas can be a poor guide to the specific impacts that are likely to occur, particularly for mountainous and coastal areas. Regional climate models and "statistical downscaling" techniques can be used to provide higher resolution estimates of changes in climatic conditions (Ranger et al., 2009). For instance, the UK Met Office's Providing Regional Climates for Impacts Studies (PRECIS) model provides results at spatial resolutions as fine as 25 x 25 km (Jones et al., 2004). Some countries, such as Colombia, are using such models to downscale climate projections to similar resolutions, or even finer for particularly vulnerable areas.

Box 2.4 Dealing with uncertainty

The challenge of dealing with uncertainty is not unique to climate change. Various tools have been developed and adopted to support decision making where the probabilities and/or full range of potential outcomes are not known in advance. The common element of these approaches is that instead of seeking an optimal policy or investment option, they seek to identify options that perform well under a range of different scenarios. Hallegatte et al. (2012) identify four strategies that can be used to address uncertainties related to climate change adaptation:

1. *No-regret strategies* yield benefits even without climate change. Such measures aim to target situations that are sub-optimal both under current and future climate conditions, such as excessive leakage from water pipes. The potential benefits of no-regret strategies can be significant. For example, research suggests that the economic benefits of introducing new crops in just one region in Mali could be large enough to exceed the estimated costs of climate change for the entire country (ECA, 2009).
2. *Reversible and flexible strategies* are adjustable in the future. For example, insurance or early warning systems can be adjusted over time. In some cases, further evidence on the implications of certain development measures for climate resilience might be necessary to avoid an irreversible outcome. This can create an opportunity cost in the short term.
3. *Safety-margin strategies* can reduce vulnerability at no or low cost if they are applied in the design phase of an investment or policy. For example, specifying road surfaces that can cope with wider temperature ranges. Incorporating climate projections in the design phase can also mean building cost-effective multi-purpose infrastructure, such as reservoirs that can also act as flood defences.
4. *Favouring options with shorter time-horizons*, for example planting tree species with a faster rotation time.

Specific tools for making decisions in uncertain conditions include:

- *Sensitivity analysis*, which can be used within the framework of traditional tools such as cost-benefit analysis or multi-criteria analysis.
- *Real options analysis*, which follows the same underlying principles as cost-benefit analysis, but incorporates the value of delay and flexibility. This enables irreversible measures to be compared with more flexible ones. Its use requires knowledge of the probabilities of different outcomes and involves modelling how probabilities respond to new information (Ranger et al., 2010).
- *Robust decision making* has been developed to explicitly include the effects of uncertainty when comparing different policy options. This can be applied to situations where the probabilities of different outcomes occurring are unknown. Its use requires detailed quantitative information on other indicators, expert knowledge and high computing power to model a large range of scenarios. Robust decision making was used to assess strategies to deal with flood risk in Ho Chi Minh City. The analysis found that the city's current infrastructure strategy may not be sufficiently robust to withstand the likely impacts of climate change (World Bank, 2013b).

Research is needed to understand how climate change is affecting development

Integrating climate resilience into development planning requires understanding of the links between climate and development. Quantitative evidence and expert judgement on the type and scale of potential interactions can inform the choice of measures and objectives in the development planning process. Understanding of climate-development interactions can be established using information on the economic and social effects of extreme events, as well as more detailed case studies. The type of studies that countries can undertake will largely depend on available climate and socio-economic data, and their financial, technical and human capacities. Research is likely to be better targeted if policy makers engage with researchers to make sure that results are relevant to policy making. This is an area where providers of development support are playing a central role in informing the development of adaptation responses, both in Colombia and Ethiopia.

Understanding the economic effects of past climate events can provide important information on climate-economy linkages. As part of the *Hyogo Framework for Action*, countries have committed to improve their collection and monitoring of disaster data. Progress remains uneven and continued improvements are needed to understand vulnerabilities, strengthen the case for investments in disaster risk management and identify priority sectors for intervention (UNISDR, 2011). The creation of national disaster databases can help to fill some of the evidence gaps. The *2013 Global Assessment Report for Disaster Risk Reduction* compares data from some existing national databases with internationally reported figures based on the EM-DAT[2] database, as well as data estimated by combining insurance losses and estimates of insurance market penetration (UNISDR, 2013). It concludes that disaster losses are likely to be at least 50% higher than internationally reported figures.

There are few examples of economy-wide modelling, due in part to resource constraints. Economy-wide models are useful because they capture indirect effects of climate change and extreme events that do not become apparent in sectoral analyses, or relate to sectors that are not typically prioritised for sectoral vulnerability studies. Colombia is currently developing a general equilibrium model that estimates the overall effects of climate change on the economy. It is based on sectoral inputs and estimates derived from a baseline socio-economic development trajectory. The modelling process is resource-intensive, and relies on data on the linkages within the economy and climate impacts in the sectors covered. Where suitable quantitative data are not available, the use of qualitative approaches such as systems mapping can help to identify key links.

Sectoral analyses of the risks and opportunities of climate change can help to inform policy priorities, while being less resource intensive than economy-wide modelling. Sectoral estimates can provide important information for policy action, and also provide the necessary inputs needed to understand cross-sectoral linkages. Many countries have completed national-level studies of some of the direct economic impacts of climate change and likely adaptation needs for selected sectors. For example, Ethiopia undertook detailed analysis on climate impacts in the agricultural sector, and calculated potential adaptation costs. The World Bank's Economics of Climate Change Adaptation project analyses the detailed effects of climate change and adaptation needs in each sector for seven countries, as well as providing data by sector for all developing countries (World Bank, 2010). Analyses conducted to date have tended to focus on sectors that are particularly vulnerable to climate change, such as agriculture, transport infrastructure, water or energy.

Case studies can further inform understanding of climate-economy linkages. They can, for example, shed light on the implications of behavioural responses to adverse weather and climate conditions. To access this information more systematically, some countries, are considering adding questions on climate vulnerability to their regular household surveys. For example, Mozambique has included climate change questions in its household survey to examine whether if households have suffered food, asset or income losses due to climate change, what their sources of information are on disaster and weather risks, approaches households have taken to minimise the impact from such shocks, and sources of support when they have suffered from climate change (INE, n.a.). Acquiring such information can help to understand both the socio-economic effects of climate variability as well as the underlying causes of vulnerability. It can also help to identify some of the channels by which extreme events lead to long-term decreases in growth rates, such as key infrastructure needs or insufficient access to credit for the private sector. Micro-level data in Bangladesh, for instance, have shown that farmers who manage rainfall variability by diversifying their economic occupations sacrifice higher returns on labour (Bandyopadhyay and Skoufias, 2013).

A continuous dialogue between policy makers and researchers is needed to increase the policy-relevance of climate information. Without this dialogue there can be a disconnect between the demand and supply of climate information in terms of the types of data produced and the format in which they are presented. The UNDP has developed guidance for policy makers who work with scientific and technical experts for discussing climate scenarios for climate-resilient development (UNDP, 2011b). Institutionalised discussions can improve the policy relevance of climate-economy research. For example, Colombia is establishing a Committee for Scientific Research, Generation and Communication of Climate Change Information. This brings the main governmental research institutions and institutes analysing climate-relevant data together with the Environment Ministry and the National Planning Department – Colombia's lead institutions for climate change policy and adaptation planning. Part of the committee's functions includes defining research priorities and plans that meet the needs of policy makers.

Prioritising among adaptation options is critical

The number of potential adaptation options far exceeds the resources available to implement them; prioritisation is essential. Three types of sectors are likely to be most important for building climate resilience:

1. those that are highly sensitive to climate change;
2. those that have a negative impact on the climate resilience of ecosystems or communities; and
3. those that are important for economic development because they make a significant contribution to GDP, are growing very quickly, or sustain a large group of poor populations.

Agriculture, forestry and infrastructure are all examples of sectors that may be both economically significant and climate-sensitive.

Not all sectors that affect overall climate resilience are necessarily highly exposed themselves. Negative effects of economic activities on ecosystems can have important implications for future climate resilience, even if they appear marginal today. For example, the cumulative effect of small-scale land-use changes, such as deforestation, can

significantly affect flood risks. Sectors that are crucial for the livelihoods of poor people are likely to need particular attention because even small changes in productivity can have large impacts on vulnerability. Fast-growing sectors still have time to avoid choosing new activities and infrastructure that could be vulnerable to future climate change.

The evidence gathered through the NAPA process provides countries with a starting point for prioritising adaptation measures, but climate-resilient development planning will require additional analysis to go beyond climate-proofing of existing development objectives. Guidance produced by the Least Developed Countries Expert Group on developing NAPs recommends complementing the analysis of urgent needs with a focus on structural and longer-term vulnerabilities (LDCEG, 2012). An important step is to review adaptation options in light of national development policies and identify overlaps and/or tensions between adaptation and development goals or priorities. Some countries are currently undergoing this process and are developing tools and approaches to put this into practice. Box 2.5 provides an overview of the prioritisation process used by Ethiopia in the development of its plan (and see Chapter 5).

It is vital that the process of prioritising adaptation measures is inclusive, ensuring that it brings in the voice of affected communities. Vulnerability to climate change can be different according to age, gender and ethnicity, and these perspectives need to be brought into the decision-making process.

Development co-operation providers are playing a key role in supporting countries in improving their evidence base. This applies for the entire chain of activities necessary for achieving climate-resilient development: collecting, processing and interpreting climate data; climate forecasting and projections; using the data to identify sector and local climate vulnerabilities; and identifying priority areas for policy action. Development co-operation providers can help establish regional partnerships to pool resources and support national governments in incorporating regional forecasts into national disaster-mitigation programmes to provide warnings. For example, the Regional Integrated and Multi-Hazard Early Warning System works with governments across South and East Asia to incorporate regional forecasts into national disaster-mitigation programmes (Webster, 2013).

2.5 Climate-resilient development will need sufficient finance and investment

If efficient options for climate resilience are chosen, the benefits should exceed the costs over time. However, options vary in terms of their immediate budgetary implications (Box 2.6). In some cases, they will entail additional resources to cover the higher initial costs. In others, the priority will be to implement projects differently rather than necessarily at higher cost. There are also opportunities, such as with the reform of environmentally harmful subsidies, to both reduce demands on public finances and improve climate resilience. Estimating needs and identifying funding sources is an essential element of the planning process, and for successful implementation. Options may require mobilising sufficient funding, or ensuring the effective use of existing resources. Domestic and international funding sources, both public and private, all have a role to play.

Box 2.5 Prioritisation in Ethiopia's Climate Resilience Strategy for agriculture

Ethiopia's vision is to become a low-carbon and climate-resilient middle-income country by 2025. A first step in increasing its climate resilience is its Climate Resilience Strategy for its agricultural sector. Agriculture is a strategically important sector, accounting for 41% of GDP and 85% of employment in 2012. It is also highly sensitive to climate change. The Climate Resilience Strategy was developed by reviewing existing national and regional adaptation plans. This generated a list of almost 1 000 potential adaptation options for building resilience in the agricultural sector. This was consolidated into 350 options that were then prioritised.

The first prioritisation was undertaken at a high political level with expert advice, and resulted in a list of 41 priority options for inclusion in the final strategy. The prioritisation asked the following four questions:

1. Does the option pass an initial assessment of relevance and feasibility to be implemented in the local context?
2. Does the option make a positive contribution to reaching the targets of the Growth and Transformation Plan (Ethiopia's national development plan)?
3. Does the option help to alleviate poverty, and address distributional and equity issues, and ensure food security?

Does the option provide significant reductions to the current costs of weather variability and future climate change? The second prioritisation analysed the options in more detail to decide when and where they would be implemented. A wide range of criteria was chosen and evaluated through a literature review and a stakeholder workshop. The prioritisation looked at the following attributes:

- *institutional feasibility,* including an evaluation of the potential lead stakeholder, the practicality and scale of the option;
- *climate risk and opportunities addressed, and the robustness of the option to different climate scenarios*, including temperatures, drought or floods, or its contribution to building general resilience;
- *synergies and co-benefits* with sustainable land-use and ecosystem services protection, conservation and biodiversity, economic growth and agricultural transformation, and low-carbon development;
- *economic cost and finance,* evaluated through the cost per person or per hectare, the total cost of the project/programme, the benefits achieved per person or hectare, the total number of beneficiaries and the nature of economic benefits;
- *the urgency of the measure* in terms of cost of inaction and benefits of action, finance available, the nature of benefits and numbers of beneficiaries; and
- *distributional effects and gender,* including possible co-benefits in these areas.

Source: Federal Democratic Republic of Ethiopia (forthcoming), *Ethiopia's Climate-Resilient Green Economy Climate Resilience Strategy. Agriculture*, Addis Ababa.

Box 2.6 How much finance is needed for adaptation?

Estimates of global financing needs for adaptation by 2030 are highly uncertain. They range from USD 48 to 171 billion per year (in 2005 USD), according to the UNFCCC. The World Bank's Economics of Climate Change Adaptation report estimates that it would cost developing countries USD 70 to 100 billion a year by 2050 to adapt to a 2°C increase in temperature. These figures do not include the costs of adapting to current variability, only cover some of the potential impacts and do not account for the effect of uncertainty in increasing costs. The estimate equals about 80% of all official development assistance (ODA) currently disbursed, but corresponds to only 0.2% of the projected GDP of all developing countries in the current decade.

There are considerable variations in the likely costs depending on the region and type of climate impact. According to the World Bank, costs as a share of GDP will be highest in sub-Saharan Africa. This is partly explained by their lower average GDP, but also by costly measures required to secure water supply in a scenario of highly variable precipitation patterns. Infrastructure and coastal zones will account for the bulk of global adaptation costs, especially in East Asia and the Pacific, South Asia, Latin America and the Caribbean.

Although requiring increased upfront investment, adaptation will pay off. Ethiopia for instance might experience losses in the magnitude of 2-10% of GDP by 2040 due to climate change, primarily through extreme weather events that will damage the country's agricultural sector and infrastructure. Losses could be reduced by 50% if adaptation measures were adopted, at a cost of between 1.2 billion and 5.8 billion per year. Net benefits from adaptation are estimated to be significant. For example, those adaptation projects considered in the study had cost-benefit ratios of between 5 and 13.

Sources: UNFCCC (2007), *Investment and Financial Flows to Address Climate Change*, Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), Bonn; World Bank (2010), *Economics of Adaptation to Climate Change: Synthesis Report*, World Bank, Washington DC.

The sources of public international climate finance are growing

Public international climate finance is expected to become an increasingly important source of funding for building climate resilience. The UNFCCC *Cancún Adaptation Framework*[3] commits developed countries to the goal "of mobilizing jointly USD 100 billion per year by 2020 (…) from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources" to assist developing countries in meeting their climate change adaptation and mitigation needs.

A variety of international funding mechanisms are currently available for financing climate resilience measures:

- dedicated climate funds established under the UNFCCC;
- resources from multilateral development banks; and
- bilateral development co-operation.

Accessing these sources will be critical for building climate resilience, given the scale of the climate-resilience challenge and financial constraints affecting domestic funding sources. Most developing countries rely at least partly on international development finance to fund climate-resilience investments (Pervin et al., 2013), and its role can be substantial in many countries. In Bangladesh, 23% of climate-relevant expenditure was financed by external grants or loans in 2010/11. In Cambodia, official development

assistance (ODA) contributed 87% of climate-related finance when including off-budget expenditures; 70-80% of that spending was related to climate change adaptation (Miller, 2013).

Several dedicated climate funds exist under the UNFCCC to support adaptation in developing countries. The Adaptation Fund provides finance for the implementation of priority adaptation projects and funds, using resources from a levy on Clean Development Mechanism projects, supplemented with other funding sources. The Global Environment Facility is tasked with supporting adaptation under the UNFCCC through the Least Developed Countries Fund and Special Climate Change Fund. More recently, the establishment of the Green Climate Fund offers the potential to scale-up finance for adaptation activities.

Multilateral Development Banks (MDBs) are also a significant source of finance for climate resilience. Seven of the largest MDBs reported providing a total of USD 21 billion to support action on climate change in 2012, of which USD 6 billion was identified by them as supporting adaptation (AfDB et al., 2013).

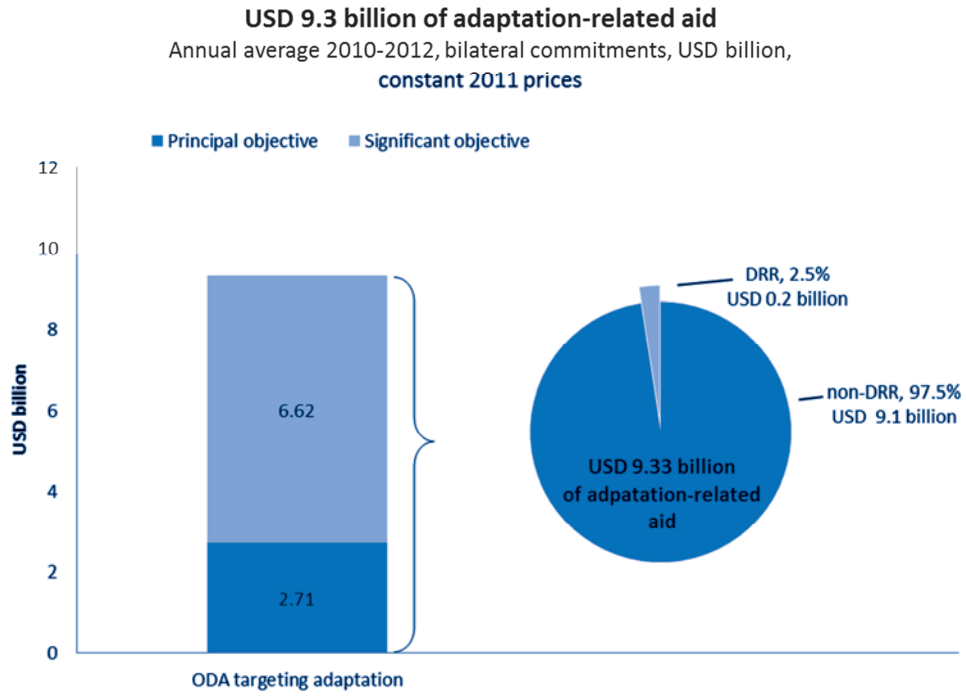
The OECD's Development Assistance Committee (DAC) collects data from its members on bilateral ODA supporting adaptation.[4] These are recorded using a similar methodology but on a different basis to the MDB joint approach, such that figures are not comparable and there may be some overlap between the estimates of bilateral ODA identified in DAC statistics and finance reported separately by the MDBs. Total bilateral adaptation-related aid commitments by members of the OECD's DAC reached USD 9.3 billion on average per year between 2010 and 2012[5]. This compares to USD 16.1 billion of bilateral ODA targeting climate change mitigation-related objectives on average per year in 2010-2012 (OECD, 2014). A share of climate-related aid (18%, USD 4 billion) targets both climate adaptation and mitigation objectives, such that total climate-related aid reached USD 21.5 billion per year in 2010-2012. The majority (71%) of adaptation-related bilateral ODA targets adaptation as a significant objective (Figure 2.1). This means that the intervention has other prime objectives but has been formulated or adjusted to consider the effects of climate change.

Equivalent data are not available for bilateral ODA intended to reduce risks related to current climate variability. However, the OECD DAC Creditor Reporting System (DAC CRS) database includes data on the volume of ODA allocated to Disaster Risk Reduction (DRR). These figures also include financial flows targeting risks unrelated to climate, but the overall trends are informative. In the past five years, ODA allocated to DRR increased from about USD 270 million in 2007 to USD 820 million in 2012 (OECD, 2014). Although funding for risk reduction is increasing, it remains substantially less than that allocated to addressing the consequences of disasters. Between 2010 and 2012, for every USD 1 allocated to DRR there were USD 19 allocated to emergency response, reconstruction and relief.

There is some overlap between bilateral finance targeting adaptation and finance allocated to DRR. Based on the OECD DAC CRS database, 37% (USD 234 million) of funding allocated to DRR sectors was marked as targeting adaptation-related objectives. A recent report on disaster risk financing from the Global Facility for Disaster Risk Reduction and the Overseas Development Institute detected a similar trend. They found that an increasing number of DRR projects are funded from climate change adaptation sources, and often coincide with the publication of a NAPA and an initial focus on the development of early warning systems (GFDRR and ODI, 2013). However, from the

USD 9.3 billion of total adaptation-related bilateral ODA, the large majority is not focused on DRR (see figure 2.1; OECD, 2014).

Figure 2.1 Bilateral ODA towards climate change adaptation



Source: OECD (2014), "Creditor Reporting System: Aid activities", *OECD International Development Statistics* (database), March 2014, *http://dx.doi.org/10.1787/dev-cred-data-en*.

Guidance from the United Nations Environment Programme (UNEP) on *Accessing International Funding for Climate Change Adaptation* proposes four principles to help developing countries access both public and private international finance (Christiansen et al., 2012):

1. ensure a return on investment by demonstrating the project's or programme's effectiveness in reducing vulnerability;
2. establish collaborative action by engaging with private investors, NGOs and local institutions;
3. demonstrate an adaptation rationale; and
4. ensure a stable policy and institutional framework to reduce uncertainty and transaction costs.

Taking a programmatic approach to adaptation planning will help strengthen these aspects, by setting clear objectives for climate resilience both in the short and long term.

Climate resilience needs to be built into public expenditure frameworks

International climate finance will need to be complemented by, and used to leverage, domestic finance. Investments – from both internal and external sources – related to climate resilience currently constitute a significant part of government budgets in many

developing countries. The governments of Thailand, Nepal and Bangladesh spent between 2.7% and 7.2% of their budgets on climate-related activities in 2011; 70-80% of those funds were dedicated to climate change adaptation (Bird et al., 2012). According to the same study, Cambodia and Samoa spent between 15% and 17% of their budgets on climate change activities (both mitigation and adaptation) when development co-operation support was included in the calculation.

Systematically integrating climate resilience into the budgeting process is essential for ensuring that planning decisions translate into priority actions for climate resilience. Integrating climate-related spending into existing country systems can help to reduce transaction costs and enhance transparency and budgetary accountability. International climate finance could be channelled through existing systems, where appropriate.

Medium-term expenditure frameworks (MTEFs) can help integrate climate resilience into development planning when implemented as part of an overall package of activities to improve the management of public expenditure (Le Houerou and Taliercio, 2002). MTEFs are intended to link the allocation of resources to development priorities, within a realistic budget envelope extending over three years. Their objective is to overcome some of the weaknesses of annual budgeting by providing greater predictability, flexibility and fiscal discipline (World Bank, 1998). Variations of MTEFs are used across developed countries and in many developing countries. Although they are not specifically an environmental measure, MTEFs can nonetheless make a valuable contribution to building climate resilience (OECD, 2012):

- MTEFs reflect shifting priorities and encourage collaboration. They also provide greater flexibility to redirect funding to new priorities, such as climate resilience.
- MTEFs are intended to provide a longer-term, integrated perspective. The budgeting process provides a mechanism for considering both the upfront and recurrent costs of policies, thereby favouring longer-term decision making.
- Some countries, such as Bangladesh, have aligned their MTEF with effectiveness indicators. Climate-related finance can build on such frameworks to monitor and improve the effectiveness of spending.

MTEFs can be complemented with public environmental expenditure reviews (PEERs) or climate public expenditure and institutional reviews (CPEIR) to identify the extent to which current spending is aligned to environmental and climate resilience priorities. CPEIRs have been carried out in Bangladesh, Cambodia, Nepal, Samoa and Thailand (Miller, 2013). They can assess whether money is spent according to priorities in national development plans and climate resilience strategies. They can also estimate costs of climate vulnerability, such as the losses from extreme events. This can support the case for changes in the overall budget envelope for activities in this area, and for reallocating spending if necessary.

National climate funds are being used to build coherence

National climate funds are designed to attract, blend, co-ordinate and monitor domestic and international climate finance from public and private sources. They are intended to increase policy coherence by directing various sources of financing to national climate priorities. Coherence with national policies can be achieved through institutional mechanisms (Box 2.7). They can also reduce the transaction costs of administering climate finance, while strengthening associated capacities and national ownership.

National climate funds can seek finance from a wide range of sources. For example, Rwanda's Fund for Environment and Climate Change is financed partly by domestic environmental fees and fines, environmental impact assessment fees, proceeds from forestry and water funds, other environmental revenue and financing from ministries. The fund had initially been set up to enforce compliance with environmental impact laws and started with funding from local taxes only (CDKN, 2013). Aligning the fund with existing private sector regulations and incentive structures can create more commercially viable projects that attract additional private investment (Flynn, 2011). They can also be funded by bilateral and multilateral development finance and international environment and climate funds as long as they meet the requirements of development co-operation providers on administration and transparency.

National climate funds are a relatively new development and there is a need for more evidence on their effectiveness. As experience with them grows, it will be important to assess their contribution to improving co-ordination and alignment between funding sources and domestic priorities.

Box 2.7 National climate funds in practice

Bangladesh's Climate Change Resilience Fund provides direct support for the implementation of its Climate Change Strategy and Action Plan for 2009-2018. The governing council and management committee both include representatives from the key ministries for adaptation – environment, finance, agriculture and disaster management – as well as representatives from development co-operation agencies, civil society and the World Bank, which acts as the trustee. The governing council ensures that the fund's objectives align with the country's strategies and objectives, and the management committee reviews grant requests, work programme and budget allocations to ensure compliance with these objectives and to avoid duplication of work carried out by the ministries (Flynn, 2011). A number of other countries, including Ethiopia, Indonesia and Nepal, have also opted for a national climate fund to support their strategic climate goals.

2.6 Progress towards climate resilience needs to be continually monitored

Monitoring and evaluation are essential for climate-resilient development planning. Climate change is a long-term and uncertain phenomenon, which means that outcomes can deviate markedly from expectations – some anticipated risks can fail to materialise, while unforeseen issues may emerge. Iterative monitoring and evaluation can review the validity of underlying assumptions and the effectiveness of policies and programmes. However, to bring about change, lessons learned through monitoring and evaluation need to feed into subsequent planning and implementation cycles.

Climate resilience is the outcome of a large number of individual and collective economic decisions and natural responses. An effective monitoring and evaluation system must therefore assess the overall picture instead of looking only at specific adaptation projects. A forthcoming OECD report synthesises national approaches to monitoring and evaluation in developing countries and proposes tools to help countries develop (or strengthen) their domestic frameworks for adaptation (Lamhauge, forthcoming). These include risk and vulnerability assessments, the tracking of prioritised climate risks and vulnerabilities, and the use of national audits to review climate policy approaches.

Evaluations of large or innovative adaptation initiatives can complement these mechanisms, providing important lessons for national monitoring and evaluation despite their different sizes and timescales.

Monitoring and evaluation can also strengthen accountability by tracking how resources are spent and whether the policy or project is delivering as expected. The nature of this accountability will be influenced by the funding mechanisms in place. When countries rely on domestic resources to implement national development plans, their accountability is to their taxpayers. This accountability can in part be met through standard government auditing mechanisms (Lamhauge, forthcoming). Spending relevant to climate resilience concerns many sectors and is so far rarely tracked by governments. Nepal has introduced a climate change marker in the 2012/13 budget to track climate-relevant spending in its development budget (Miller, 2013). In the future, the marker could also be applied to climate-relevant recurrent costs and investments made by the private sector and NGOs.

Policies and programmes implemented with financial support from providers of development co-operation may have their own sets of reporting requirements. In Nepal, for instance, 50% of all climate relevant activities in 2011/2012 were funded by development co-operation providers (Bird, 2011). Development co-operation agencies have often created separate indicators and data collection mechanisms to comply with their own reporting requirements. In addition, providers of financial flows are often fragmented and implementation responsibility resides in different institutions (Miller, 2013). Systems to monitor climate resilience and the success of large-scale adaptation projects should be accompanied by a consultative process across government and the provider community to ensure that both domestic and provider requirements are met (Lamhauge, forthcoming).

Efforts to improve data availability and quality can support monitoring and evaluation. Reporting on climate change and climate resilience is relatively new compared to the more established assessments of social and economic trends, for example those feeding into the Human Development Index and the Millennium Development Goals. In this context, development co-operation providers can play an important role in working with government officials to collect key data (Lamhauge, forthcoming). This may entail improving the collection of meteorological data and the incorporation of a few climate resilience questions in household surveys that tend to be conducted on a four to five-yearly cycle in many developing countries. However, it is important that the complexity of the monitoring and evaluation is proportionate and does not exceed administrative capacity.

Notes

1. See *http://analogues.ciat.cgiar.org/climate*.
2. EM-DAT is a database containing information on the occurrence and effects of about 18 000 emergency events in the world from 1900 to today. It is maintained by the World Health Organization Collaborating Centre for Research on the Epidemiology of Disasters (CRED), see *www.emdat.be/database*.
3. UNFCCC Decision 1/CP.16, The Cancun Agreements, 2010, see *http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2*.
4. Since 1998, the OECD DAC has monitored aid targeting the objectives of the Rio Conventions, through its Creditor Reporting System using the "Rio Markers". Every aid activity reported to the DAC CRS should be screened and marked as either 1) targeting the Conventions as a "principal objective" or a "significant objective", or 2) not targeting the objective. There are four Rio markers, covering: biodiversity, desertification, climate change mitigation, and climate change adaptation. The adaptation marker was introduced in 2010.
5. Note that this figure includes only bilateral ODA flows. Information on adaptation-specific other flows within the DAC CRS is partial, e.g. those from multilateral funds, and non-concessional official development finance flows. For more information on the Rio markers, see *http://www.oecd.org/dac/stats/rioconventions.htm*.

References

AfDB et al. (2013), *Joint Report on MDB Climate Finance 2012*, African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank (IDB), the World Bank (WB) and the International Finance Corporation (IFC), available at *http://www.ebrd.com/downloads/sector/sei/climate-finance-2012.pdf*.

Bandyopadhyay, S. and E. Skoufias (2013), "Rainfall variability, occupational choice, and welfare in rural Bangladesh, *Review of Economics of the Household*, Vol. 11/2.

Bird, N. (2011), *The Future for Climate Finance in Nepal*, Overseas Development Institute, London.

Bird, N. et al. (2012), *The Climate Public Expenditure and Institutional Review (CPEIR): A Methodology to Review Climate Policy, Institutions and Expenditure*, United Nations Development Programme, Overseas Development Institute.

Cartwright A. et al. (2013), "Economics of climate change adaptation at the local scale under conditions of uncertainty and resource constraints: The case of Durban, South Africa, *Environment and Urbanization*, Vol. 25, pp. 139-156.

CDKN (2013), "Rwanda: Pioneering steps a climate-resilient green economy, *Climate and Development Outlook*, No. 8, Climate and Development Knowledge Network (CDKN), London.

Christiansen, L. et al. (2012), *Accessing International Funding for Climate Change Adaptation: A Guidebook for Developing Countries*, TNA Guidebook Series, UNEP Risø Centre on Energy, Climate and Sustainable Development, Roskilde.

ECA (2009), *Shaping Climate-Resilient Development: A Framework for Decision-making,* Economics of Climate Adaptation Working Group, ECA, available at *http://mckinseyonsociety.com/downloads/reports/Economic-Development/ECA_Shaping_Climate Resilent_Development.pdf*.

EPA (2011), *Ethiopia's Vision for a Climate-Resilient Green Economy,* Federal Environmental Protection Authority of Ethiopia (EPA), Addis Ababa.

Federal Democratic Republic of Ethiopia (forthcoming), *Ethiopia's Climate Resilient Green Economy Climate Resilience Strategy. Agriculture*, Addis Ababa.

Flynn, C. (2011), *Blending Climate Finance Through National Climate Funds: A Guidebook for the Design and Establishment of National Funds to Achieve Climate Change Priorities*, United Nations Development Programme, New York.

GFDRR and ODI (2013), *Financing Disaster Risk Reduction. A 20 year Story of International Aid*, Global Facility for Disaster Reduction and Recovery (GFDRR) at the World Bank and the Overseas Development Institute (ODI), London and Washington DC.

Government of Colombia (2011), *Plan Nacional de Desarrollo 2010-2014: Prosperidad para Todos [National Development Plan 2010-2014: Prosperity for All]*, Bogotá.

Hallegatte, S. et al. (2012), "Investment decision making under deep uncertainty: Application to climate change", *World Bank Policy Research Working Paper*, No. 6193, World Bank, Washington DC.

IEG (2012), *Adapting to Climate Change: Assessing World Bank Group Experience, Phase III of the World Bank Group and Climate Change*, Independent Evaluation Group (IEG) – World Bank, IFC, MIGA, Washington DC.

INE (n.a), Climate change questions added to the Mozambique Household Survey, Personal communication with the Instituto Nacional de Estatística de Moçambique, Maputo.

INVEMAR et al. (2012), "Lineamientos para la adaptación al cambio climático de Cartagena de las Indias" [Guidelines for climate change adaptation ind Cartagena de las Indias], in Rojas, G.X., J. Blanco and F. Navarrete (eds.), *Proyecto Integración de la Adaptación al Cambio Climático en la Planificación Territorial y Gestión Sectoral de Cartagena de Indias [Integration of Climate Change Adaptation in Land-use Planning and Sectoral Management in the Cartagena de Indias Project]*, Cartagena.

Jones, R. G. et al. (2004), *Generating High Resolution Climate Change Scenarios Using PRECIS*, Met Office Hadley Centre, Exeter.

Kopf, S., M. Ha-Duong and S. Hallegatte (2008), "Using maps of city analogues to display and interpret climate change scenarios and their uncertainty", *Natural Hazards and Earth System Sciences*, Vol. 8, pp. 905-918.

Lamhauge, N. (forthcoming), *National Monitoring and Evaluation of Climate Change Adaptation in Developing Countries*, OECD Publishing, Paris.

LDCEG (2012), *National Adaptation Plans: Technical Guidelines for the National Adaptation Plan Process*, Least-Developed Countries Expert Group (LDCEG), United Nations Climate Change Secretariat, Bonn.

Le Houerou, P. and R. Taliercio (2002), "Medium term expenditure frameworks: From concept to practice. Preliminary lessons from Africa", *Africa Region Working Paper Series*, No. 28, World Bank, Washington DC.

Miller, M. (2013), *Climate Public Expenditure and Institutional Reviews (CPEIRs) in the Asia-Pacific Region. What Have We Learnt?*, Asia-Pacific Regional Center United Nations Development Programme, Bangkok.

NDPC (2013), *Guidelines for the Preparation of Medium-Term Development Plans by Ministries, Departments and Agencies 2014-2017*, National Development Planning Commission (NDPC) Ghana, Accra.

OECD (2014), "Creditor Reporting System: Aid activities", *OECD International Development Statistics* (database), March 2014, *http://dx.doi.org/10.1787/dev-cred-data-en*.

OECD (2012), *Greening Development: Enhancing Capacity for Environmental Management and Governance*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264167896-en*.

OECD (2009), *Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264054950-en*.

Pervin, M. S. et al. (2013). "A framework for mainstreaming climate resilience into development planning", *IIED Working* Paper, November 2013, International Institute for Environment and Development (IIED), London.

Ramírez-Villegas, J. et al. (2011), "Climate analogues: Finding tomorrow's agriculture today", *CGIAR Working Paper*, No. 12, Research Program on Climate Change, Agriculture and Food Security, Cali.

Ranger, N. et al. (2010), *Adaptation in the UK: A Decision-making Process*, Policy Brief 2010, Grantham Research Institute on Climate Change and the Environment, Centre for Climate Change Economics and Policy, London.

Ranger, N., R. Muir-Wood and S. Priya (2009), *Assessing Extreme Climate Hazards and Options for Risk Mitigation and Adaptation in the Developing World*, World Development Report 2010 Background Note, World Bank, Washington DC.

Republic of Rwanda (2011), *National Strategy for Climate Change and Low Carbon Development*, Kigali.

UNDP (2011a), "Africa adaptation programme: Capacity building experiences – Improving access, understanding and application of climate data and information", *Discussion Paper Series*, No. 2, United Nations Development Programme (UNDP), New York.

UNDP (2011b), *Formulating Climate Change Scenarios to Inform Climate-Resilient Development Strategies: A Guidebook for Practitioners*, UNDP, New York.

UNFCCC (2007), *Investment and Financial Flows to Address Climate Change*, Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), Bonn.

UNISDR (2013), *From Shared Risk to Shared Value – The Business Case for Disaster Risk Reduction. Global Assessment Report on Disaster Risk Reduction*, United Nations Office for Disaster Risk Reduction (UNISDR), Geneva.

UNISDR (2011), "HFA Priority 2, core indicator 2.2: Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities", *Compilation of National Progress Reports on the implementation of the Hyogo Framework for Action (2009-2011)*, UNISDR, Geneva.

Webster, P. J. (2013), "Meteorology: Improve weather forecasts for the developing world", *Nature*, Vol. 493, pp. 17-19.

World Bank (2013a), *Building Resilience: Integrating Climate and Disaster Risk into Development – The World Bank Group Experience*, International Bank for Reconstruction and Development / World Bank, Washington DC.

World Bank, (2013b), *Risk and Opportunity: Managing Risk for Development*, International Bank for Reconstruction and Development and World Bank, Washington DC.

World Bank (2010), *Economics of Adaptation to Climate Change: Synthesis Report*, World Bank, Washington DC.

World Bank (1998), *Public Expenditure Management Handbook*, World Bank, Washington DC.

Chapter 3

Implementing climate-resilient development

Disaster risk management and private sector involvement are both important for climate resilience. Improved integration of disaster risk management and climate change adaptation is needed to address current risks while preparing for future challenges. The chapter suggests ways of integrating the two approaches into development planning, focusing on institutions, risk reduction, and financial instruments to reduce the long-term impacts of disasters. The private sector is another important piece in the climate resilience puzzle, given its fundamental role in securing economic growth, and its potential for investing in resilience measures. The second part of the chapter examines how public policy can support private sector climate resilience. Priorities for this include raising awareness, providing data, and ensuring that regulatory frameworks and spending policies are conducive to building resilience.

Key messages: Disaster risk management

- Current and future climate risks need to be considered jointly. In the short to medium term, climate change will affect development through increased frequency and magnitude of weather variability and extreme events. Disaster risk management and climate change adaptation need to jointly address these risks and allow for flexible adjustments for climate change in the longer term.
- Priorities for achieving institutional synergies include a common definition and understanding of climate change adaptation; the joint examination of existing policies, frameworks and plans that aim to reduce exposure and vulnerability to current risks; and clearly defined mandates for each relevant institution.
- Increased investment in ex-ante risk reduction measures is needed to address current climate variability, with climate change leading to an increased urgency and need to scale up activities. This should be complemented with the increased use of mechanisms for sharing residual risks, matched to countries' circumstances.

Key messages: Private sector engagement

- The actions of the private sector will be pivotal in determining countries' efforts to build resilience to climate change. Developing countries tend to have a high degree of informality and prevalence of small and micro-enterprises, which create particular challenges for building climate resilience.
- Public policy has an essential role to play in creating an environment that is conducive to building climate resilience by the private sector. Priority areas include: raising awareness, providing data, and increasing access to financial services.
- Weaknesses in the design or enforcement of key regulations, such as building codes, can act as a barrier to climate resilience. Analysis of potential barriers is needed to identify priorities for reform and target efforts to strengthen implementation.

Chapter 2 has outlined important features of a strategic and coherent approach to climate-resilient development. This chapter now focuses in on two areas – disaster risk management and private sector involvement – both of which will be important for implementing climate resilience. There are close and inherent links between managing current and future climate risks, but integration between disaster risk management and climate change adaptation is currently insufficient in many countries. Better integration provides a chance to future-proof current disaster risk management and ensures that adaptation policies build on the experience gained in disaster risk management.

The private sector's response to climate risk is essential for climate resilience, given its fundamental role in securing economic growth and its potential for investing in resilience measures. Decisions which do not consider future climate changes can have significant impacts on overall resilience. For example, the development of Bangkok as a manufacturing hub meant that the 2011 floods disrupted the global supply chains for computers. While private sector actions that positively influence resilience are often not labelled as adaptation, the cumulative consequences of these decisions will be critical for countries' resilience to current and future climate (UN Global Compact and UNEP, 2011; Agrawala et al., 2011).

3.1 Climate change adaptation and disaster risk management need to be better linked

Current and future climate risks have much in common, yet most countries are still not co-ordinating disaster risk management and climate change adaptation sufficiently. At the international level, discussions under the UNFCCC Work Programme on Loss and Damage and on a follow-up agreement to the *Hyogo Framework for Action* (Box 3.1) have acknowledged that coherence between disaster risk management and climate change adaptation needs to be enhanced (UNISDR, 2013a). This is a good start, but there is a need for further progress in implementation at the national and sub-national levels.

There are clear links between climate hazards and economic development

Climate hazards are variations and extremes in precipitation and temperature that result in flooding, droughts and storms. Between 1980 and 2012, 87% of reported disasters (18 200 events), 74% of losses (USD 2 800 billion) and 61% of lives lost (1.4 million) globally were caused by extreme weather events (Munich Re et al., 2013). In the future, warmer temperature extremes, more frequent heavy precipitation and stronger tropical cyclones are some of the main climate-related risks envisaged (IPCC, 2012). In addition, sea-level rise will render coastal areas more vulnerable to storms, flooding and salt water intrusion.

Whether climate hazards become disasters largely depends on factors linked to economic and social development, such as the existence of well-functioning early warning systems and public institutions, or levels of household income and savings. Another important aspect is where people, assets and infrastructure are located (IPCC, 2012; 2013). For example, as in many other countries, flood risk in Colombia is exacerbated by uncontrolled economic development that changes the natural flow of rivers, promotes agricultural expansion into sensitive ecosystems, and allows the construction of housing in high-risk areas (ECLAC and IADB, 2012; and see Chapter 4).

Box 3.1 The Hyogo Framework for Action and climate resilience

The *Hyogo Framework for Action 2005-2015* (HFA) is a 10-year plan to make the world safer from natural hazards. It was endorsed by the UN General Assembly following the World Disaster Reduction Conference in 2005 and was signed by 168 countries. To date, 144 countries are working towards improved disaster risk management under the HFA. The HFA focuses on five priorities for disaster risk management (Table 3.1). Climate change is considered an underlying risk factor for disasters under Priority 4.

Table 3.1 The five priorities of the Hyogo Framework for Action

Priority 1	Priority 2	Priority 3	Priority 4	Priority 5
Ensure that disaster risk reduction is a national priority with a strong institutional basis for implementation	Identify, assess and monitor disaster risks and enhance early warning	Use knowledge, innovation and education to build a culture of safety and resilience at all levels	Reduce the underlying risk factors	Strengthen disaster preparedness for effective response at all levels

Sources: United Nations (2005), "Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters", extract from the final report of the World Conference on Disaster Reduction, United Nations International Strategy for Disaster Reduction, Geneva.; UNISDR (2013a), *Towards the Post-2015 Framework for Disaster Risk Reduction – Tackling Future Risks, Economic Losses and Exposure*, United Nations Office for Disaster Risk Reduction, Geneva; and UNISDR (2013b), *Implementation of the Hyogo Framework for Action. Summary of Reports 2007-2013*, UNISDR, Geneva.

Disaster risk management strategies need to build in a climate change perspective

Building resilience to current climate risks often contributes to or facilitates adaptation to future climate change. For example, adapting Mumbai's drainage systems to a 1-in-100 year flood event could reduce future flood damage projected by climate models by up to 70% (Ranger et al., 2011). Similarly, addressing underlying drivers of vulnerability, such as a lack of access to education or healthcare, will strengthen the adaptive capacity of people and businesses to current and future climate. Investing in disaster risk management provides benefits in the near future, while also protecting against climate change.

This is why an awareness of future risks and trend changes in climate conditions is imperative for good disaster risk management. Without this awareness, short-term risk reduction activities could increase vulnerability to future events (IPCC, 2007; Box 3.2). For example, dams and levees to prevent frequent flooding may encourage development on low-lying lands, but future sea-level rise might render their protection ineffective. Such trends need to be understood early on to avoid costly investments that are unsustainable in the long term, and to give time to build infrastructure and undertake any necessary policy reforms.

Dealing with climate change will require changes to current disaster risk management practices. Yet few countries have started to systematically build likely changes in

exposure and vulnerability to climate extremes into their disaster risk management strategies (IPCC, 2012). This may be because countries need:

- *More information:* as disaster risk is altered by climate change, historical experience will become a less reliable guide to the future. Disaster risk management needs to be underpinned by climate projections. This will require building a knowledge base of climate effects on disaster risk, and increasingly co-operating across regional and national borders to learn about adaptation and risk management approaches that have worked elsewhere.
- *More investment:* estimates of climate change impacts on disaster losses vary considerably, but the average increases in losses predicted are 65% for river and local flooding, 30% for tropical storms, and 15% for extra-tropical storms up to 2040 (IPCC, 2012). These estimates mostly apply to developed countries, but losses in developing countries could increase rapidly due to their higher economic growth rates and so additional investment is likely to be required. The World Bank (2011a) estimates that by 2050, Bangladesh would need an additional USD 5.7 billion in investment solely for the infrastructure required to protect the country from the additional effects of climate change on inland monsoon floods and coastal storm surges.
- *More effective, integrated risk management strategies and instruments:* shifts in the frequency, intensity and uncertainty of climate extremes may mean that current risk management strategies and instruments become less effective over time. There may need to be a greater emphasis on risk reduction, as well as reforms to risk sharing arrangements to ensure their continued financial viability.

Box 3.2 Accommodate, protect, or retreat?

Disasters can require three types of responses:

1. *accommodate risks:* people may decide to live with a hazard. They can reduce their vulnerability by retrofitting infrastructure or buildings;
2. *protect livelihoods:* protective infrastructure or ecosystem-based adaptation such as coastal vegetation or wetlands can reduce climate risks; and
3. *retreat:* move existing buildings, infrastructure and people to a low-risk location.

If urban planners only consider current risks in their decision making, they might authorise development in areas that later require protection or even become uninhabitable. Yet avoiding development or choosing a flexible approach can often be a more cost-effective approach to building resilience.

Source: World Bank (2013), *Building Resilience: Integrating Climate and Disaster Risk into Development - The World Bank Group Experience*, World Bank, Washington DC.

Disaster risk management and climate change adaptation need institutional links

Approaches to disaster risk management have evolved over many decades. As a result, the relevant institutions, policies and plans can have a deeper institutional basis than newly established institutions for climate change adaptation. Many countries have built separate institutional structures to tackle disaster risk management and adaptation. In Colombia, disaster risk management is overseen by a dedicated body under the authority of the President, while adaptation policy and planning are the responsibility of the National Planning Department. In Bangladesh, a similar divide between the Ministry of Environment and Forests and the Ministry of Disaster Management and Relief constitutes a major challenge for integration (Shamsuddoha et al., 2013).

Linking institutions and processes for disaster risk management and climate change adaptation can help to share information and develop joint policies. The details of the institutional set-up will depend on the specific political, administrative and social context of each country. However, a common element is the need to develop a shared understanding and definition of climate resilience and the links between current and future risks and economic and social development. Translating between different terminologies used in disaster risk management and climate change adaptation, and moving towards a common understanding can facilitate collaboration.

A second important step is to examine the various policies, frameworks and plans that aim to reduce exposure and vulnerability to current risks for coherence with projected climate impacts. A review of existing and planned policies and projects will also help to identify low-regret measures: measures that provide benefits under current climate and a range of future climate scenarios (see Box 2.4 in Chapter 2). Prioritising low-regret measures can be a suitable starting point for a dialogue and joint work between disaster risk management and adaptation practitioners. In parallel, vulnerability assessments under future climate scenarios can maximise the likelihood that projects undertaken today can withstand or adapt to future climate risks.

In Colombia, public officials from the National Planning Department, the National Disaster Risk Management Unit, the Environment Ministry, and the Institute of Hydrology, Meteorology and Environmental Studies have together defined how adaptation will take place in the country (DNP et al., 2012). This has provided the basis for future co-ordination between these bodies and helped to identify potential challenges in the process of linking disaster risk management and climate change adaptation policies and projects. As a second step, the institutions are jointly developing a national adaptation plan as a framework for national, sectoral and sub-national planning.

Climate resilience strengthens the case for risk reduction measures

Reducing the risk of hazards is often the most cost-effective approach to dealing with current climate-related risks (Mechler, 2012). However, current investment in disaster risk reduction is insufficient to protect countries against current climate variability (UNISDR, 2013b; Kenny, 2012). Disaster response finance greatly exceeds finance for disaster risk reduction. Between 2010 and 2012, only 5.5 % of total humanitarian ODA (USD 628 million) was spent on DRR per year on average (OECD, 2014).

Scaling-up finance for risk reduction will be vital, as climate-resilient development may involve additional upfront costs. Rebuilding or retrofitting damaged infrastructure so that it is climate resilient can increase immediate reconstruction costs in the aftermath of

a disaster by 10% to 50% in sectors such as housing, agriculture, or health services (GFDRR, 2010). Additional costs in the water and sanitation, transport and electricity sectors could be significantly more expensive, but are hard to quantify as they vary significantly with the exact choice of reconstruction.

Public policy has a key role to play by providing regulatory and financial incentives, as well as direct finance, for risk reduction measures (Christiansen et al., 2012). Many governments provide tax exemptions for reconstruction – extending coverage to include risk reduction efforts could increase the incentives to invest in climate resilience. Governments should also examine whether their land-use regulations and enforcement reduce risk, particularly when coastal areas or large infrastructure projects are concerned.

Risk-sharing tools can provide incentives for efficient risk reduction. For example, risk-based insurance premiums encourage the accumulation of assets and economic activity in lower-risk areas and reward risk reduction measures in an economically efficient way (IPCC, 2012). Governments and development co-operation providers alike have a role to play in facilitating such arrangements. To date, the majority of insurance arrangements in developing countries with links between risk sharing and risk reduction have involved such support (Surminski and Oramas-Dorta, 2011).

Risk reduction measures should be designed and targeted to ensure they reach the poorest households, such as those in informal urban settlements. These households are often concentrated in the highest-risk areas, but are faced with barriers to reducing those risks. These include: having a limited and insecure asset base, inadequate income and political marginalisation. Overcoming these will involve strengthening representation and providing finance and investment to improve access to services and infrastructure (IFRC, 2010).

Climate change has implications for the fiscal management of extreme events

Weaknesses in the fiscal management of extreme events exacerbate the effect of shocks by leading to prolonged reductions in growth over time. Largely due to capital constraints, extreme events have a statistically significant negative effect on fiscal balances in developing countries (Lis and Nickel, 2010). Negative impacts on growth can often be measured even a decade after the event (McDermott et al., 2013). In Mozambique, there have been three occasions in the past two decades where direct losses from weather-related disasters have exceeded that year's total gross fixed capital formation (UNISDR, 2013c). In other words, the financial cost of a single disaster has overshadowed all of Mozambique's physical investment made in that year.

Countries need to improve access to capital for emergency relief and reconstruction to limit the indirect impacts of climate extremes on economic development. This will be particularly important where disasters become more frequent or severe due to climate change. Traditionally, developing countries have heavily relied on ex-post mechanisms, mainly budget reallocations (Benson, 2012; World Bank, 2012). However, taking measures before a disaster strikes can not only shorten the time before emergency finance is available, but can also reduce the negative side-effects of heavy spending after a disaster, such as inflation, increased interest rates, and exchange rate appreciation. More frequent climate hazards are likely to increase the need for emergency relief financing, creating a greater need for pre-planned arrangements to access emergency capital. Colombia has developed a financial strategy to reduce the state's fiscal vulnerability to natural disasters (Box 3.3).

Box 3.3 Colombia's strategy to reduce the state's fiscal vulnerability to natural disasters

Colombia is frequently affected by climate-related problems, particularly flooding. A period of heavy rainfall linked to La Niña in 2010/11 cost the country almost 2% of its GDP. Raising sufficient funds for emergency response and reconstruction proved challenging. In response, Colombia developed a *Financial Strategy to Reduce the State's Fiscal Vulnerability in the Case of a Natural Disaster* (Ministry of Finance and Public Credit, 2012). This is intended to reduce contingent liabilities on the state and to facilitate access to finance in the case of a natural disaster. Even though the strategy has not been specifically designed to address future climate risk, it foresees the introduction of instruments that can be adapted to new challenges from climate change.

The strategy envisages the use of three risk management strategies: *risk reduction* through preventive measures, *risk retention* through reserves and contingent credit, and *risk transfer* through insurance. Several instruments are planned to be introduced under each of these strategies:

- *Risk reduction* is intended to reduce potential damages and subsequent liabilities on the state. Measures include the integration of disaster risk into land-use and watershed management plans. The strategy also foresees that infrastructure projects shall take account of disaster risks.
- *Risk retention* uses three instruments to ensure access to finance in the case of an extreme event: a National Disaster Risk Management Fund, a contingent credit line with the World Bank, and an increase in budget flexibility. Some of these measures relate to risk reduction activities. The National Disaster Risk Management Fund includes a budget line for risk reduction activities, and the World Bank's contingent credit line is granted under the condition that a disaster risk management programme is being implemented.
- *Risk transfer* instruments include an expansion of public and private insurance and the possible use of capital markets, for example through risk bonds. The government is planning to collectively insure public buildings and primary state-owned roads. There is a goal to expand private insurance cover beyond the 7% of assets that were covered out of losses incurred in 2010/11. Current efforts have focused on increasing the private insurance market in the agricultural sector.

See Chapter 4 for details

There are four types of instruments that can be useful for improving fiscal preparedness for disasters (G20/OECD, 2012):

1. *Savings or reserves:* domestic resources earmarked for disaster risk response can be rapidly deployed following a disaster. There is an opportunity cost to maintaining a liquid reserve and capital needs to build up following the initial set-up and any depletion of funds. This approach is better suited for smaller and more frequently occurring risks.
2. *Contingent credit facilities:* external sources of risk financing such as contingent credits may be preferable for larger risks with high expected disaster costs. Contingent credit also has the benefit of being available shortly after a disaster

occurs. However, these facilities are likely to be best suited to countries with a track record of sound macroeconomic management.

3. *Insurance:* governments can transfer risks using sovereign insurance, with prices depending on market conditions and expected losses. They can also indirectly improve their fiscal resilience by encouraging businesses and households to hold insurance. Simplified risk sharing tools such as micro-insurance and parametric insurance where traditional insurance markets are not well developed or have low coverage.
4. *Capital market instruments:* these instruments enable transfer of risks directly to capital markets through the issuance of catastrophe-linked securities, such as bonds. Instruments linked to parametric triggers can be rapidly paid out, but these payments may not match the actual losses incurred ("basis risk").

The following sections examine risk sharing through private and sovereign insurance, and capital market instruments. These instruments can increase fiscal resilience to disasters, but there are barriers that need to be overcome for this potential to be achieved. They can be complemented with social protection schemes, which provide a safety net for the poorest households.

Encouraging uptake of insurance by households and businesses

Insurance can increase the resilience of households and businesses to climate-related extremes by providing them with the financial means to rebuild their asset base and operations. Governments have a key role to play in removing barriers to uptake of insurance by households and businesses. Innovative approaches can help to reach the poorest and most vulnerable households.

Recent research suggests that the macroeconomic costs of extreme events are exacerbated by low insurance coverage (von Peter et al, 2012). Currently insurance coverage is limited in developing countries. On average, less than 10% of losses from natural disasters in middle-income countries, and less than 5% of losses in low-income countries, are insured. This compares to over 40% insurance coverage of losses in high-income countries (Cummins and Mahul, 2009).

There are inherent barriers to the uptake of insurance in developing countries. These include: a lack of risk awareness, limited demand due to low incomes, and a lack of capacity for designing and pricing insurance (Cummins and Mahul, 2009). Transaction costs for contracting insurance and for verifying losses tend to be high in developing countries, particularly relative to the size of the sums insured. For this reason, there is increasing interest in expanding coverage using innovative approaches to insurance, such as index-linked insurance (Box 3.4). By reducing transaction costs and speeding-up payments, these can expand the reach of insurance to non-traditional markets.

Governments can reduce encourage insurance provision by improving information on climate risks. The provision of relevant climate data, such as historical records, can help insurance schemes to more accurately set premiums for coverage (MCII, 2010; ClimateWise et al., 2010). It is also important for governments to establish clear rules about their liabilities in the case of a disaster to provide a signal about who will bear which risks (Heipertz and Nickel, 2008).

Government policies should be carefully designed to expand insurance coverage in a financially sustainable way. If climate change makes some risks very expensive to insure

through insurance markets, the public sector can support provision by taking on responsibility for exceptionally high damages through public-private risk-sharing arrangements (Mills, 2008; OECD, 2008). Such arrangements should be designed to achieve a fair and efficient share of the burden between those suffering losses, insurance providers and taxpayers.

Subsidies have been used to support the establishment of insurance markets as well as enabling people with limited resources who live in high-risk areas to get insurance cover. However, they can also distort incentives to reduce risks, ultimately increasing vulnerability and threatening the financial stability of insurance provision (Botzen and Van den Bergh, 2008). It is essential that risk transfer measures are integrated with risk reduction measures.

Box 3.4 Private weather insurance in Ethiopia

The Horn of Africa Risk Transfer for Adaptation (HARITA) scheme in Ethiopia combines several innovative aspects to provide farmers with insurance against drought risk. Payments are linked to a weather index, which is intended to speed up insurance pay-out, reduce administrative costs and retain farmers' incentives to reduce risks. Farmers can purchase insurance by contributing to risk-reduction activities such as developing an irrigation network, rather than in cash. This has the dual benefit of helping to reduce future risk while also reaching beneficiaries who would otherwise lack the financial resources to buy policies. The scheme is currently reliant on funding from development co-operation providers. However, households are increasingly opting to make monetary payments for the crop insurance component of the scheme, thus increasing the programme's financial sustainability.

See Chapter 5 for more details on HARITA

Social protection schemes can help to fill gaps and reach the poorest

Social protection schemes can be an important instrument for increasing resilience of the most vulnerable households. Instruments of social protection programmes, such as social cash transfers, cash-for-work programmes, or insurance and credit schemes, provide households with assets that can cushion them in times of climate shocks. More than that, these resources may stimulate a virtuous cycle of improved access to credit and investments in productive assets or risk-reduction measures. Cash transfers, for example, have been shown to encourage a diverse array of profitable investments, including in human capital and in micro-enterprise activities (Gertler et al., 2006; Plaas et al., 2009). Cash transfers that are combined with livelihood promotion elements (e.g. training and credit provision) are found to be even more promising (Béné et al., 2013).

Several initiatives exist to make existing social protection schemes climate resilient. Tanzania, for instance, intends to incorporate climate change into the next phase of the Tanzania Social Action Fund, which has been operating since 1998. Similarly, Ethiopia is planning to further integrate climate resilience into its Productive Safety Net Programme and the related Household Asset Building Programme (Box 3.5).

Box 3.5 Climate smart social protection in Ethiopia

Ethiopia's Productive Safety Net Program (PSNP) is the largest social protection scheme in Africa outside of South Africa. It provides predictable cash and food transfers to almost 8 million chronically food-insecure households in exchange for working on community projects. Households who cannot undertake public works receive direct support. In times of climatic shocks, the PSNP expands to also cover transitory food insecure households.

A specific component under the PSNP umbrella intended to help develop micro- and small-scale enterprises is the Household Asset Building Program (HABP). The HABP aims to help chronically food insecure populations to improve their risk management, diversify their income sources, and to build up household assets. This is to be achieved by 1) providing access to microfinance and 2) strengthening agricultural extension services to provide households with better technical and business advice. A key component of the HABP-supported activities is the development of business plans to guide households' investments. Other activities include training for improving input sources, marketing and supporting off-farm activities. Credit is provided through microfinance institutions and Rural Savings and Credit Cooperatives; yet is not linked to agricultural extension services.

The Climate Smart Initiative aims to explore how the next phases of the PSNP and HABP can improve risk management related to climate change and how asset-building measures can be redesigned to better encourage resilience-building activities, while avoiding maladaptation and unproductive coping mechanisms such as asset depletion.

Source: Berhane et al. (2011), *Evaluation of Ethiopia's Food Security Program: Documenting Progress in the Implementation of the Productive Safety Nets Programme and the Household Asset Building Programme*, International Food Policy Research Institute, available at *http://essp.ifpri.info/files/2013/05/ESSPII_EDRI_Report_PSNP.pdf*.

Sovereign insurance and capital market instruments are emerging tools

As climate change and economic growth jointly threaten to increase the scale of potential losses, governments may consider alternative risk-sharing arrangements. Mexico has piloted catastrophe bonds covering earthquakes and hurricanes with the support of the World Bank's MultiCat Program (World Bank, 2011b). Their use is triggered by certain parameters, such as the Richter scale for earthquakes and central pressure for hurricanes. Initial oversubscription indicated that the catastrophe bonds were well received by the financial markets. There is currently little evidence available about the longer-term performance of the mechanism, including potential changes in investor confidence after a disaster occurs and the implications for their value if more countries offer catastrophe bonds in the market. Catastrophe bonds require good data and statistics on the severity and probability of the catastrophic event. They are better suited to middle-income countries which tend to have stronger legal and institutional frameworks for risk financing, and better statistics on the severity and probability of catastrophic events (World Bank, 2011b).

Transnational risk-pooling arrangements allow several countries to share their liabilities. Such an arrangement can be attractive for small states with diverse risks, because this diversification can reduce the overall cost of reinsurance (IPCC, 2012). A key requirement for risk-pooling arrangements is that risks are not correlated between the different members of the pool, as the capitalisation of the facility would be insufficient to cover several major disasters that occur at the same time across several states. Risk-

pooling arrangements also require reliable information about risks covered, as well as regular monitoring. Risk-pooling arrangements are promising instruments, but only work under specific conditions.

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) was set up as a public-private partnership in 2007 and provides parametric insurance to 17 member states. Each insurance contract specifies the level of coverage, the parameter that triggers the pay-out, and an annual premium dependent on each country's risk exposure. Part of the risk is covered through reserves; another part is transferred to reinsurers and through capital swaps. The CCRIF encourages risk reduction as premiums are calculated based on the estimated risk exposure and potential compensation under the parametric scheme does not cover all potential damages. The process of establishing this facility has enhanced discussions about disaster risk management more generally (World Bank, 2011c).

3.2 An enabling environment is needed to link climate resilience to the private sector

The private sector will play a fundamental role in building climate resilience. In most economies, 70% to 85% of disaster risk investments are made by the private sector (UNISDR, 2013c). The cumulative effect of decisions made by companies, often for reasons unrelated to climate, will determine the resilience of the economy as a whole.

In developing countries, large parts of the private sector are concentrated in climate-sensitive sectors such as agriculture, fisheries or nature-based tourism. The private sector is characterised by a high degree of fragmentation and a large number of small and informal businesses. On average, micro, small and medium-sized enterprises account for 45% of employment and 33% of GDP in developing countries (IFC and McKinsey, 2010). More than 40% of value added in Africa and Latin America is generated by the informal sector, compared with 13.5% in OECD countries (OECD, 2007).

The structure of the private sector in developing countries means that many companies have short planning horizons, and high operating flexibility. This can reduce their incentives to prepare for the medium and long-term effects of climate change. In many cases adapting to changes as they occur will be an efficient strategy, but there are important exceptions. Some resilience measures have long lead-times before they can be implemented, for example the development of crop varieties that are suited to an altered climate. Decisions with long-term implications, such as where buildings or infrastructure are located, also risk locking-in vulnerability if they neglect to consider climate change.

Overall, there is a gap between the perceived need to act and the implementation of adaptation activities. Many companies are already affected by drought or excessive precipitation, or expect negative impacts in the next five years (CDP, 2013). Although the majority of companies perceive climate change as a risk or a business opportunity, only a minority has taken action (Agrawala et al., 2011). A survey by the Carbon Disclosure Project found that businesses in developing countries tend to be much less aware or reactive in response to climate risks than businesses in OECD countries (CDP, 2013).

Public policies can support private sector efforts to build resilience. This can include providing information on climate risks; institutional arrangements that facilitate private-sector engagement; policies and regulations that support risk reduction; economic incentives; and access to communication, technology and external knowledge (Stenek et al., 2013). The following sections look at policies that regulate economic activities or encourage certain behaviour; and the role of communication, technology and knowledge.

The government can build awareness of climate risks and opportunities

Governments have an important role to play in increasing companies' awareness of climate risks by providing information on the effects of climate change.

Framing climate resilience as a potential commercial opportunity instead of a risk can help to motivate action (Agrawala et al., 2011). Potential benefits of climate resilience include reduced losses from extreme events, improved business continuity, financial benefits, reputational benefits, competitive advantages and expansion into new markets (UN Global Compact and UNEP, 2011). When developing policy, stakeholder dialogues with businesses can help to target the most relevant information and capacity gaps for policy to address. This can encourage both adaptation and business activities that aim to develop solutions to climate risks.

Climate information and disaster warnings are increasingly disseminated via mobile phones or the internet, in addition to traditional channels. Growing internet and mobile phone coverage provides an opportunity for low-cost and easily accessible information sharing. For example, governments can enhance access to data through public-private partnerships between mobile companies, and meteorological services can transfer weather information and warnings to farmers and fishermen (WMO, 2012).

Stronger capacities for climate resilience are required

Capacity constraints can prevent companies from taking action to manage the effects of climate variability and climate change. Skills will be needed for accessing finance for adaptation activities, connecting to markets and understanding how to deal with climate risks. Linking capacity-building strategies with existing programmes and services can increase efficiency. For example, several countries have adapted the remit of their agricultural extension services to integrate climate change adaptation.

Capacity constraints are a particular challenge for small and medium-sized companies. Those small and medium-sized companies that proactively manage their disaster risk tend to focus on emergency preparedness, rather than on the prospective management of future risks (UNISDR, 2013c). There is some emerging evidence that access to national and international markets, often accompanied by an involvement in supply chains, can significantly increase the private sector's capacity to cope with climate change (Bandyopadhyay and Skoufias, 2013; Ahmed et al., 2012). While policies for increased market access are usually promoted for economic development, climate change might strengthen the case for action in climate-sensitive sectors.

Public policy can also play a role in ensuring the supply of workers who are trained in understanding, assessing and responding to climate risks. This includes integrating climate change into the standard academic and vocational training undertaken by relevant professions in climate-sensitive sectors. This can be complemented with supporting research institutions to find solutions relevant to countries social, economic and environmental context.

Regulation and economic incentives can be important

Regulations affect where and how economic activities take place and assets are built. Currently, land-use planning, permitting and building codes are rarely based on future climate projections, and often do not even take current climate risks into account (Stenek et al., 2013; IEG, 2012). However, some countries or even cities are changing their

regulations, providing early lessons learned on how land-use and building regulations can enable private-sector adaptation (Box 3.6).

Regulatory measures can be implemented or reformed to encourage companies to take action to manage risks and exploit opportunities. This can include requiring large companies to identify and report on their climate risks; specific requirements for environmental licensing; enacting building codes; and improving regulation on key assets such as transport and energy infrastructure. The use of regulatory tools should be proportionate and be backed with a sound rationale for government intervention (Cimato and Mullan, 2010). However, regulatory measures are only useful insofar as they are put into practice. Improving the enforcement of relevant regulations can encourage private action to build resilience.

Economic incentives can also promote climate change adaptation by the private sector. For example, well-designed water and energy pricing arrangements can encourage efficient use of these resources (Stenek et al., 2013). There may be a case for additional incentives to encourage private adaptation actions, if those actions would give rise to wider public benefits. For example, grants, concessional loans and guarantees or public-private partnerships could be used to cover political, regulatory and some environmental and market risks (Naidoo et al., 2012).

Adaptation-specific finance may require additional policy action because of its long-term nature and specific risk structure. In Bangladesh, it has been noted that commercial banks rely on short-term deposits and lack the technical skills required to offer financing that is suitable for long-term adaptation projects (Asian Tiger Capital Partners, 2010). To improve access to capital, governments could establish programmes that lower transaction costs, establish risk-sharing arrangements with banks that have a climate-sensitive loan portfolio, and encourage banks to offer long-term financial products for climate adaptation investments.

Box 3.6 Land-use planning for climate change: Examples from Colombia and India

The city of Cartagena in Colombia is the first coastal city in South America to develop guidelines to integrate climate projections into future municipal land-use plans (CDKN, 2013). India is currently creating hazard maps for 100 year coastal flood events and 100 year erosion lines for the entire coastline, taking into account sea-level rise projections up to 2110 (IEG, 2012). Supported by the World Bank, the hazard maps will be publicly available, thus enabling private sector actors to take future risks into account. Incorporating these hazard maps into future land-use regulations might be a second step towards climate-resilient development.

References

Agrawala, S. et al. (2011), "Private sector engagement in adaptation to climate change: Approaches to managing climate risks", *OECD Environment Working Papers,* No.39, OECD Publishing, Paris, *http://dx.doi.org/10.1787/5kg221jkf1g7-en*.

Ahmed, S.A. et al. (2012), "Agriculture and trade opportunities for Tanzania: Past volatility and future climate change", *Review of Development Economics*, Vol. 16/3, pp. 429-447.

Asian Tiger Capital Partners (2010), "A strategy to engage the private sector in climate change adaptation in Bangladesh", prepared for the International Finance Corporation, available at *www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/IFC_pres_CC_PS_V8_Sep12010-_IFC_%20sk.pdf*.

Bandyopadhyay, S. and E. Skoufias (2013), "Rainfall variability, occupational choice, and welfare in rural Bangladesh", *Review of Economics of the Household*, Vol. 11/2.

Béné et al. (2013), "Social protection and climate change", prepared for the OECD-DAC Task Team on Social Protection, available at *http://search.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DCD/DAC/ENV(2013)2&docLanguage=En*.

Benson, C. (2012), "Indirect economic impacts from disasters", report produced for the Government Office of Science, Foresight project 'Reducing Risks of Future Disasters: Priorities for Decision Makers, available at *www.bis.gov.uk/assets/foresight/docs/reducing-risk-management/supporting-evidence/12-1296-indirect-economic-impacts-from-disasters.pdf*.

Berhane, G. et al. (2011), *Evaluation of Ethiopia's Food Security Program: Documenting Progress in the Implementation of the Productive Safety Nets Programme and the Household Asset Building Programme*, International Food Policy Research Institute, available at *http://essp.ifpri.info/files/2013/05/ESSPII_EDRI_Report_PSNP.pdf*.

Botzen, W. J. and J. C. Van den Bergh (2008), "Insurance against climate change and flooding in the Netherlands: Present, future and comparison with other countries", *Risk Analysis*, Vol. 28/2, pp. 413-426.

CDKN (2013), "Embedding climate change resilience in coastal city planning: Early lessons from Cartagena de Indias, Colombia", Climate and Development Knowledge Network (CDKN), available at *http://cdkn.org/resource/embedding-climate-change-resilience-in-coastal-city-planning-early-lessons-from-cartagena-de-indias-colombia/*.

CDP (2013), *Reducing Risk and Driving Business Value: CDP Supply Chain Report 2012-13*, Carbon Disclosure Project (CDP), New York.

Christiansen, L. et al. (2012), *Accessing International Funding for Climate Change Adaptation: A Guidebook for Developing Countries*, TNA Guidebook Series, UNEP Risø Centre on Energy, Climate and Sustainable Development, Roskilde.

Cimato, F. and M. Mullan (2010), *Adapting to Climate Change: Analysing the Role of Government*, Defra Evidence and Analysis Series, available at *http://archive.defra.gov.uk/environment/climate/documents/analysing-role-government.pdf*.

ClimateWise et al. (2010), *Global Insurance Industry Statement on Adapting to Climate Change in Developing Countries*, ClimateWise, International Association for the Study of Insurance Economics, Munich Climate Insurance Initiative, United Nations Environment Programme, available at *www.unepfi.org/fileadmin/documents/insurance_climatechange_statement.pdf*.

Cummins, J. and O. Mahul (2009), *Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention*, World Bank, Washington DC.

DNP et al. (2012), *ABC: Adaptación Bases Conceptuales - Plan Nacional de Adaptación al Cambio Climático [ABC: Adaptation Conceptual Bases - National Climate Change Adaptación Plan]*, Departamento Nacional de Planeación (DNP) [National Planning Department], Bogotá.

ECLAC and IADB (2012), *Valoración de Daños y Pérdidas – Ola Invernal en Colombia 2010-2011 [Valuation of Damages and Losses - Winter Floods in Colombia 2010-2011]*, Economic Commission for Latin America and the Caribbean (ECLAC) and Inter-American Development Bank (IADB), Bogotá.

G20/OECD (2012), *Disaster Risk Assessment and Risk Financing. A G20/OECD Methodological Framework*, available at *www.oecd.org/gov/risk/G20disasterriskmanagement.pdf*.

Gertler, P., S. Martinez and M. Rubio-Codina (2006), "Investing cash transfers to raise long term living standards", *World Bank Policy Research Working Paper,* No. 3994, World Bank, Washington DC.

GFDRR, (2010), "Damage, loss and needs assessment: Guidance notes", Global Facility for Disaster Reduction and Recovery (GFDRR) of the World Bank, Washington DC.

Hallegatte, S. et al. (2013), "Future flood losses in major coastal cities", *Nature Climate Change*, Vol. 3, pp. 802-806.

Heipertz, M. and C. Nickel (2008), *Climate Change Brings Stormy Days: Case Studies on the Impact of Extreme Weather Events on Public Finances*, European Central Bank.

IEG (2012), *Adapting to Climate Change: Assessing World Bank Group Experience, Phase III of the World Bank Group and Climate Change*, Independent Evaluation Group (IEG) – World Bank, IFC, MIGA, Washington DC.

IFC and McKinsey (2010), *Two Trillion and Counting: Assessing the Credit Gap for Micro, Small, and Medium-size Enterprises in the Developing World*, International Finance Corporation (IFC) and McKinsey&Company, available at *www.mspartners.org/download/Twotrillion.pdf*.

IFRC (2010), *World Disasters Report 2010 – Focus on Urban Risk*, International Federation of Red Cross and Red Crescent Societies, Geneva, available at *www.ifrc.org/Global/Publications/disasters/WDR/WDR2010-full.pdf*.

IPCC (2013), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

IPCC (2012), *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

IPCC (2007), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

Kenny, C. (2012), "Disaster risk reduction in developing countries: Costs, benefits and institutions", *Disasters*, Vol. 36, pp. 559-588.

Lis, E. M. and C. Nickel (2010), "The impact of extreme weather events on budget balances", *International Tax and Public Finance*, Vol. 17, pp. 378-399.

McDermott, T., F. Barry and R. Tol (2013), "Disasters and development: Natural disasters, credit constraints and economic growth", *CEDI Discussion Paper Series*, No. 13-03, Centre for Economic Development and Institutions (CEDI), London.

MCII (2010), "Solutions for vulnerable countries and people: Designing and implementing disaster risk reduction and insurance for adaptation", *MCII Policy Brief*, Munich Climate Insurance Initiative (MCII), United Nations University Institute for Environment and Human Security, Bonn.

Mechler, R. (2012), "Reviewing the economic efficiency of disaster risk management", *Geophysical Research Abstracts*, Vol. 15, European Geosciences Union General Assembly held 7-12 April, 2013 in Vienna, Austria, available at *http://meetingorganizer.copernicus.org/EGU2013/EGU2013-12728.pdf*.

Mills, E. (2008), "The role of U.S. insurance regulators in responding to climate change", *UCLA Journal of Environmental Law and Policy*, Vol. 26, pp. 129-168.

Ministry of Finance and Public Credit (2012), *Estrategia Financiera para Disminuir la Vulnerabilidad Fiscal del Estado ante la Occurencia de un Desastre Natural [Financial Strategy to Reduce the State's Fiscal Vulnerability in the Case of a Natural Disaster]*, Ministerio de Hacienda *[Ministry of Finance and Public Credit]*, Bogotá.

Munich Re, Geo Risks Research, & NatCatSERVICE (2013), "Natural and weather catastrophes worldwide 1980-2012", available at *http://www.munichre.com/app_pages/www/@res/pdf/natcatservice/focus_analyses/1980_2012_paket_welt_fokus_analysen_touch_en.pdf* (accessed 13 November 2013).

Naidoo, T., K. Vaz and L. Byaba (2012), *An Introduction to Adaptation in View of Developing a Private Financing Approach for Adaptation-Related Projects Using the CTI PFAN model*, Climate Technology Initiative Private Financing Advisory Network (CTI PFAN) Background Paper on Adaptation, February 2012, available at *http://cti-pfan.net/upload/event/file/CTIPFAN_AdaptationPaper.pdf*.

OECD (2014), "Creditor Reporting System: Aid activities", *OECD International Development Statistics* (database), March 2014, *http://dx.doi.org/10.1787/dev-cred-data-en*.

OECD (2008), *Economic Aspects of Adaptation to Climat e Change: Costs, Benefits and Policy Instruments*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264046214-en*.

OECD (2007), *Promoting Pro-Poor Growth: Policy Guidance for Donors*, DAC Guidelines and Reference Series, OECD Publishing, Paris. *http://dx.doi.org/10.1787/9789264024786-en*.

Plaas, D. N. et al. (2009), *The Use and Effectiveness of Social Grants in South Africa*, Economic Policy Research Institute (EPRI) and Institute for Poverty, Land and Agrarian Studies (PLAAS), Cape Town, available at *http://www.wahenga.net/sites/default/files/library/Use%20and%20effectiveness%20of%20social%20grants_0.pdf*.

Ranger, N. et al. (2011), "An assessment of the potential impact of climate change on flood risk in Mumbai", *Climatic Change*, Vol. 104, pp. 139–167.

Shamsuddoha, M. et al. (2013), *Establishing Links between Disaster Risk Reduction and Climate Change Adaptation in the Context of Loss and Damage – Policies and Approaches in Bangladesh*, UK Department for International Development and Climate and Development Knowledge Network.

Stenek, V., Amado, J.-C. and D. Greenall (2013), *Enabling Environment for Private Sector Adaptation: An Index Assessment Framework*, International Finance Corporation, Washington DC.

Surminski, S. and D. Oramas-Dorta (2011), *Building Effective and Sustainable Risk Transfer Initiatives in Low- and Middle-Income Economies: What can we Learn from Existing Insurance Schemes?*, Centre for Climate Change Economics a Centre for Climate Change Economics and Policy, Leeds and London.

UN Global Compact and UNEP (2011), *Adapting for a Green Economy: Companies, Communities and Climate Change – A Caring for Climate report*, United Nations Global Compact, United Nations Environment Programme, Oxfam and the World Resources Institute.

UNISDR (2013a), *Towards the Post-2015 Framework for Disaster Risk Reduction – Tackling Future Risks, Economic Losses and Exposure*, United Nations Office for Disaster Risk Reduction (UNISDR), Geneva.

UNISDR (2013b), *Implementation of the Hyogo Framework for Action. Summary of Reports 2007-2013*, UNISDR, Geneva.

UNISDR (2013c), *From Shared Risk to Shared Value – The Business Case for Disaster Risk Reduction. Global Assessment Report on Disaster Risk Reduction*, UNISDR, Geneva.

United Nations (2005), "Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters", extract from the final report of the World Conference on Disaster Reduction, United Nations International Strategy for Disaster Reduction, Geneva.

Von Peter, G., S. Von Dahlen and S. Saxena (2012), "Unmitigated disasters? New evidence on the macroeconomic cost of natural catastrophes", *BIS Working Papers*, No. 2094, Bank for International Settlements (BIS), Basel.

WMO (2012), "Reaching the last mile with mobile weather alert. The user-interface platform in action", *World Meteorological Organization (WMO) Bulletin – Weather, Climate, Water*, Vol. 61/1.

World Bank. (2013). *Building Resilience: Integrating Climate and Disaster Risk into Development - The World Bank Group Experience*, World Bank, Washington DC.

World Bank (2012), *Advancing Disaster Risk Financing and Insurance in ASEAN Countries: Framework and Options for Implementation Volume 1: Main Report*, World Bank, Washington, DC.

World Bank (2011a), "The cost of adapting to extreme weather events in a changing climate", *Bangladesh Development Series*, No. 28, World Bank, Washington DC.

World Bank (2011b), *Mexico MultiCat Bond: Transferring Catastrophe Risk to the Capital Markets*, Global Facility for Disaster Reduction and Recovery, World Bank, Washington DC.

World Bank (2011c), "Caribbean Catastrophe Risk Insurance Facility (CCRIF) - Pooling risk to protect against natural disasters", *Disaster Risk Financing and Insurance Case Study*, Global Facility for Disaster Reduction and Recovery, World Bank, Washington DC.

PART II

LEARNING FROM COUNTRY EXPERIENCES

Chapter 4

Climate-resilient development in Colombia

Colombia is vulnerable to climate change and extreme weather. Most of the country's priority sectors for economic growth are sensitive to climatic changes. The country is still counting the human and economic costs of severe flooding in 2010/11. This chapter describes how these factors have prompted the government to mainstream climate resilience into national, sectoral and sub-national plans. Colombia has already taken important steps towards climate-resilient development, including substantive research on its vulnerability to climate change and the design of an institutional co-ordination framework. The Colombian government has driven policy making, but has benefitted from technical and financial assistance from development co-operation providers to support priority areas of its work.

Key messages

- Colombia's efforts to achieve climate-resilient development have a legal mandate in the National Development Plan 2010-2014 and the forthcoming national adaptation plan. This includes clear targets for building climate resilience into key growth sectors. The legally binding nature of the climate challenge will support the mainstreaming of climate resilience into policy planning.
- Colombia has created direct institutional links between climate change adaptation and development. The National Planning Department plays a strong role in adaptation policy, which is helping to promote a climate-resilient vision of development planning and encourage engagement across sectors. The institutional arrangements being developed should support existing informal co-ordination, while also encouraging collaboration with ministries that have not engaged in adaptation activities to date.
- Capacity constraints are a barrier to integrating climate resilience into development planning, particularly at regional and sub-national level. Identifying priorities for sub-national activities could help to overcome some of these capacity constraints. This might also involve scaling up existing pilot projects at sub-national level. It is important that sub-national authorities take ownership of this process.
- As a middle-income country, the government will need to develop sustainable financing mechanisms that channel both domestic and external resources in a way that is aligned with the broader government agenda on climate-resilient development. This includes considering how to expand the role of the private sector. Tools like the Climate Public Expenditure Review can help track investments in climate resilience, assign resources more strategically, and set up mechanisms to monitor and evaluate the effectiveness of climate finance.
- Colombia is undertaking analysis of the climate risks to development. It will be important to continue building capacity for decision making under uncertainty. Planning and implementation will benefit from a flexible approach to policy making, as well as a focus on structural vulnerabilities and socio-economic conditions in highly uncertain scenarios. The involvement of a broad group of stakeholders, including the private sector, will help support this process.
- Providers of development co-operation have played an important role in supporting the analysis of climate risks, development of adaptation plans, and implementation of policies and pilot projects. A close alignment with Colombia's political strategy for climate change adaptation will be essential to maximise the impact of these interventions.
- There is scope for better alignment of climate resilience and disaster risk management, given the country's legal mandate for joint articulation of current and future climate risks. Disaster risk management currently has a different (and stronger) legal basis and institutional standing than adaptation. Learning from these arrangements will facilitate the implementation of climate-resilient development measures. This may require further strengthening of the institutional links between disaster risk management and climate change adaptation.

Colombia started mainstreaming climate risks into national, sectoral and sub-national plans after being hit by a major climate-related disaster in 2010/11. Severe flooding cost the country dearly in terms of human life and economic damage. The government responded by making climate change adaptation a priority. It developed a national adaptation plan and integrated climate risks into sectoral planning. Colombia's main political planning document, the National Development Plan 2010-2014, warns of the risks that climate change and variability pose to development. Yet it also acknowledges that past development patterns have increased Colombia's vulnerability to climate risks.

The shift to climate-resilient development is timely: most priority sectors driving economic growth will be affected by climate change. Colombia has taken important steps towards climate-resilient development, including substantive research on its vulnerability to climate change and the design of an institutional co-ordination framework. The country has also laid the foundations for the progressive integration of climate risks into sectoral and sub-national planning. Future challenges include fostering a holistic vision of development that incorporates climate change risks and in translating the efforts undertaken so far into concrete resilience-building measures. In this context, it is important that future development plans reiterate the mandate to make development climate-resilient.

4.1 Colombia is vulnerable to climate change

The cost of climate change could be significant in Colombia if no adaptation measures are taken. A partial cost estimate based on a variety of studies indicates that climate change is likely to cost the country at least 1.9% of its GDP every year by 2050 (ECLAC, 2013a). This section explores how a combination of climatic and socio-economic patterns leads to high climate vulnerability in Colombia. Box 4.1 maps Colombia's vulnerability based on data on the three channels determining climate resilience – exposure, sensitivity and adaptive capacity (IPCC, 2007; and see Box 1.1 in Chapter 1 for definitions).

Geography and topography leave Colombia highly exposed

Colombia's geography and topography make it particularly exposed to climate hazards. In the past, the economic losses caused by flooding have exceeded those of earthquakes, the second most expensive natural hazard, by almost four times (Ministerio de Hacienda y Crédito Público, 2012). The last major flood, an event linked to the La Niña phase of the El Niño-Southern Oscillation, lasted from October 2010 to April 2011 and affected more than 3 million people, or 7% of the population (ECLAC, 2012). Losses and damage amounted to about 2% of Colombia's GDP in 2010. Some provinces experienced damage of up to 15% of their annual GDP (ECLAC, 2012).

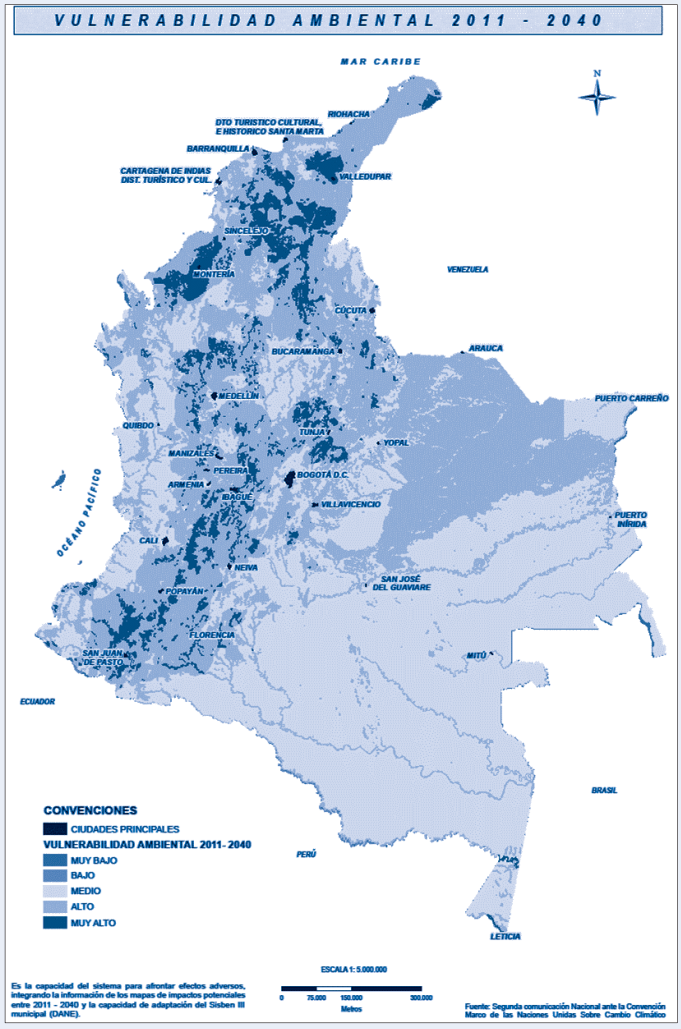
Climate change will expose Colombia to new risks. Average temperatures are projected to increase by around 2.4°C by 2070 and 3.2°C by 2100 (IDEAM, 2010). Annual precipitation is likely to shift the already drier Caribbean and Andean regions towards the Pacific coast and Amazon regions. As a result, the Caribbean region may change from its current semi-humid to a semi-arid climate; and even become arid by the end of the 21st century. As temperature increases are likely to be more marked in the Andean region, a transition from a semi-humid to a semi-arid climate is expected for some areas. This might reduce the Andean *páramo* ecosystem, important for freshwater storage and filtering, by 60%-70%. The Andean forest cover could be reduced by 40% by 2050, and Colombia's glaciers could disappear by 2040 (DNP et al., 2012). In addition,

coastal zones will be exposed to gradual sea-level rise. Sea levels are projected to increase by 40-60cm by 2060 (IDEAM, 2001). The impact of climate change on year-to-year variability of precipitation is still uncertain, but disasters related to rainfall variability are projected to become more frequent (IDEAM, 2010).

Climate risks and economic development coincide spatially to a large degree, thus jointly increasing exposure. Colombia's main economic centres are located in the Andean and coastal regions, often close to rivers and the coast. These areas are also particularly exposed to flooding, landslides, projected temperature increases and sea-level rise (DNP, 2012). Economic development has been identified as an important driver of disaster risk in the context of flooding. Drivers of exposure include the construction of housing and infrastructure in vulnerable areas. Also, land-use change from urban development and agriculture has reduced resilience by diminishing forest cover, diverting the course of rivers and damaging wetlands and other natural flood protection areas (SNPAD, 2010; ECLAC, 2012).

Box 4.1 Climate change vulnerability in Colombia, 2011-2040

Colombia's Second National Communication to the UNFCCC mapped the country's vulnerability to climate change using data on exposure, sensitivity and adaptive capacity. The vulnerability map combines maps of potential impacts (based on precipitation variation, an index of environmental sensitivity and an index of relative climate change impact) and data on the capacity of municipalities based on socio-economic information. The vulnerability mapping for 2011-2040 illustrates medium to very high levels of vulnerability across most of the country.



Source: IDEAM (2010), *Segunda Comunicación Nacional de Colombia ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático [Second National Communication by Colombia to the UNFCCC]*, IDEAM, Bogotá.

Exposure is also increasing due to the joint pressure of economic activities and climate change on ecosystems and natural resources. A significant share of economic activities in Colombia is carried out in vulnerable areas. For example, 85% of productive systems in the agricultural sector are located in areas that are vulnerable to desertification. In a context of potential water scarcity in the Caribbean and Andean regions, this could have important implications for climate resilience. The opening up of the agricultural frontier, mainly driven by an extension of inefficient livestock farming into formerly forested areas, has also affected ecosystems such as forests, wetlands and the Andean *páramos*. It is estimated that 60% of land in the Andean region is used for agriculture or consists of degraded vegetation (Suárez et al., 2011). This also reduces the capacity of ecosystems to adapt to change (Rodríguez Becerra et al., 2012).

Colombia's dependence on vulnerable economic sectors increases its sensitivity

Agriculture and fisheries are expected to be the sectors most badly affected by climate change (ECLAC, 2013a). Although Colombia generated only 6% of its GDP from agriculture in 2011, it is important for the economy and rural livelihoods in particular. Preliminary estimates suggest that climate impacts on the agricultural sector alone might lower overall GDP in 2050 by 2.5% compared to a baseline scenario without climate change (ECLAC, 2013a). Colombia's transport and energy infrastructure are also vulnerable. Colombia has less transport infrastructure than many other countries with a similar level of development (OECD, 2013a). This means that there is limited spare capacity to exploit in the event of disruption, making road and rail damages particularly costly. Hydropower represents over 70% of the country's electricity generation capacity (IEA, 2012), yet increasing aridity is likely to affect it by reducing water storage volumes in water reservoirs (Ospina Noreña et al., 2011). Preliminary estimates suggest that the resulting electricity price increases might cost Colombia 0.7% of its GDP in 2050, assuming stable demand and infrastructure stock (ECLAC, 2013a).

Inequality and poverty are challenges for adaptive capacity

A country's adaptive capacity is determined by factors such as society's ability to learn, reorganise, and mobilise social capital, and the economy's inherent flexibility to adjust. These factors are closely linked to inclusive economic development, such as improved access to resources, poverty reduction, good education and infrastructure, and high levels of institutional capacity (IPCC, 2001). In Colombia, high income inequality and prevailing poverty are challenges for building adaptive capacity, particularly in rural areas. In order to combat income inequality, the OECD's 2013 *Economic Survey of Colombia* recommended increasing the effectiveness of the tax and transfer system (OECD, 2013a). "Prosperity for All", Colombia's National Development Plan 2010-2014, aims for inclusive economic development, social inclusion, and for regional inequalities to be tackled (Government of Colombia, 2011). The government has also identified targeted adaptation measures for poor populations as a priority (DNP et al., 2012).

Climate change in Colombia is expected to affect poor households the most, potentially increasing the risk of extreme poverty (DNP et al., 2012). Columbia's average per capita income reached USD 7 104 in 2011, but the income distribution remains one of the most unequal in the world (OECD, 2013b). In 2011, 7% of Colombians lived on less than USD 1.25 a day (in purchasing power parity) (World Bank, 2013c). Some impacts of climate change will directly affect the rural poor. These include reduced access to freshwater, increased disease and other health problems, and a reduction in agricultural

productivity. There will also be repercussions for the urban poor in terms of increased food prices.

One reason why the poor will be more exposed to climate change is that a disproportionately high number of them live in zones at risk from climate extremes. Lower average levels of income, skills and access to markets in poorer regions also undermine the adaptive capacity of the households living there. The OECD has suggested three main actions to boost productivity: promoting access to financial markets through better regulation and enhanced competition, encouraging private sector investment, and constructing more and better infrastructure (OECD, 2013a). Implementing these recommendations is an opportunity to also improve the private sector's resilience to climate change, as long as incentives for investment do not encourage harmful activities and support is directed to important growth sectors and vulnerable populations alike.

4.2 The Colombian government is enabling climate-resilient development

What steps have the Colombian government taken to mainstream climate change adaptation into national, sectoral and sub-national policies, programmes and projects, and what challenges remain? This section gives an overview of adaptation planning; the institutional framework for climate resilience; work undertaken to increase the evidence on the links between climate, development and resilience; efforts to secure sufficient financing for adaptation activities; and the role of development co-operation providers.

Colombia has a strong policy framework for climate resilience

Colombia's decision to develop a national adaptation policy was triggered by the severe flooding in 2010/11. The flooding occurred shortly after the election of a new government and thus coincided with the formulation of the governmental programme for the following four years, the National Development Plan 2010-2014. Influenced by the experience of the floods, the plan explicitly recognises that climate change may constitute an obstacle to economic and social development, and that the patterns of Colombia's economic development will determine its vulnerability to the effects of climate change (Government of Colombia, 2011). Coping with climate change was introduced as one of the development plan's four key objectives, alongside consolidating peace, eliminating poverty and reducing unemployment. The high profile accorded climate resilience is particularly important because objectives and indicators included in national development plans are legally binding in Colombia. Climate change adaptation thus became subject to monitoring by the Office of the General Comptroller, which has the power to undertake a disciplinary investigation if objectives are not met.

The incorporation of adaptation in the National Development Plan 2010-2014 marked a significant shift in policy. Before this, adaptation had largely been confined to the environmental sector and was predominantly financed by development partners. Mitigation was the main focus of domestic climate policy. Adaptation activities aimed primarily at improving the evidence on the effects of climate change and at learning through pilot projects. Since 2010, Colombia has taken strong ownership of adaptation issues, and is extending the scope of adaptation interventions beyond the environmental sector.

The National Development Plan mandates that a National Adaptation Plan be developed, and that the effects of climate change and adaptive measures be mainstreamed into sectoral planning (Government of Colombia, 2011). The National Development Plan

set the target of completing five sectoral plans by the end of 2014. To implement this, the government has designed an institutional system to integrate climate change across sectors and levels of government. Simultaneously, research will inform sectoral and national adaptation plans. The forthcoming National Adaptation Plan (to be completed by the end of 2014), is intended to provide a policy framework for action, but will not give a detailed blueprint for implementation. The government has also published a guidance document detailing the conceptual bases for adaptation (DNP et al., 2012).

Colombia's adaptation policy is intended to be long-lasting, but there is no institutional mechanism to guarantee that adaptation will be considered in future development policies and plans. The forthcoming National Adaptation Plan will encourage continuity, provided that it receives sufficient institutional and legal backing to influence policy making over time. For example, the plan is expected to outline priority policies and projects that could be included in the next national development plan. The National Adaptation Plan is conceived as a continuous process that consists of four phases:

1. Developing a conceptual framework for adaptation and to increase coherence in adaptation planning. This has now been published (DNP et al., 2012).
2. Formulating sectoral and sub-national adaptation plans.
3. Implementing, monitoring and evaluating adaptation policies and measures.
4. Monitoring, reporting, and verifying progress, lessons learned and remaining weaknesses to feed back into policy.

A mechanism for monitoring and evaluating climate will assist policy learning once established. Evidence of changes in resilience may also help to ensure continued political support for work in this area. Discussions are still on-going, but the mechanism is intended to be integrated into the broader national systems for monitoring public investments and progress on the national development plan.

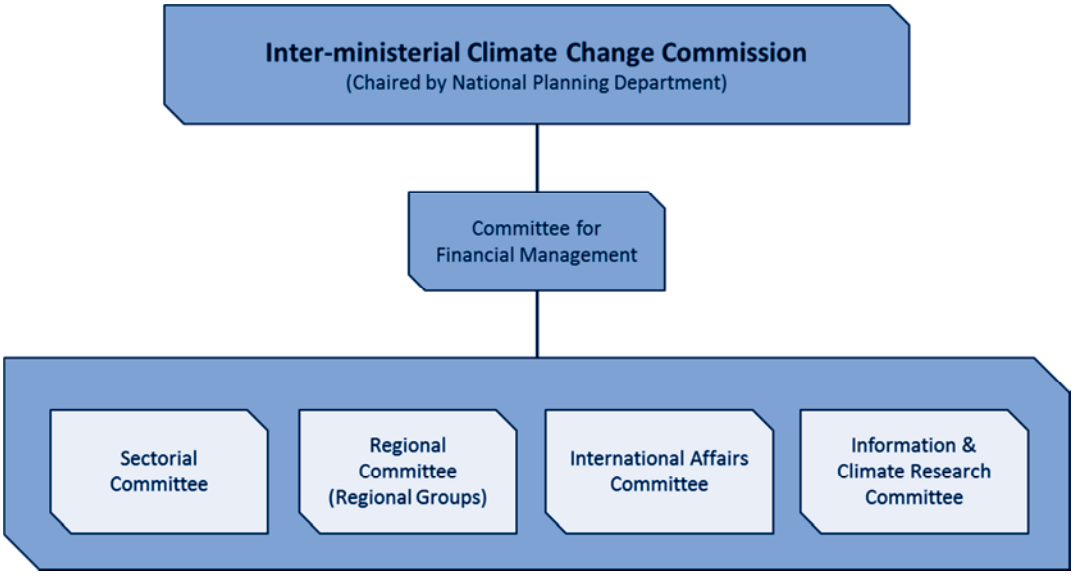
An effective institutional framework is proposed

The Colombian government has designed an institutional framework to address climate change adaptation and mitigation. Called the National Climate Change System (SISCLIMA), it follows a high-level ministerial decision to implement an institutional strategy for climate change in 2011 (Conpes, 2011). The decree to create SISCLIMA had not been sanctioned by the President at the time of writing, partly because a new Environment Minister took office in 2013. Thus, this analysis is based on the draft decree as of 12 August 2013 and other institutional aspects that have been implemented prior to the signature of the decree (President of Colombia, forthcoming). If adopted, SISCLIMA has the potential to improve policy coherence and foster expertise on climate resilience across government. To be successful, it will need to clarify the scope of the mandates of different institutions and facilitate better co-ordination between institutions.

A key feature of Colombia's institutional strategy that has already been implemented is a shift in responsibility for co-ordinating the national adaptation policy from the Environment Ministry to the National Planning Department. With this, adaptation is no longer seen as solely an environmental issue; instead it has become more central to development. The National Planning Department also co-ordinates the formulation of the national development plans, as well as some other cross-sectoral planning processes. As the responsibilities for co-ordinating climate and development policies reside in the same

institution, climate-resilient development becomes more feasible. The National Planning Department will also play a key role in the new SISCLIMA, by chairing the main decision-making body: the Inter-ministerial Climate Change Commission (Figure 4.1).

Figure 4.1 The institutional design envisaged for SISCLIMA



Source: President of Colombia (forthcoming), *Decreto Borrador - Por el cual se crea el Sistema Nacional de Cambio Climático (Draft Decree - By which the National Climate Change System is created)*, Bogotá.

The National Planning Department has formally taken the lead on developing the National Adaptation Plan. However, it co-ordinates closely with the Ministry for the Environment and Sustainable Development, the Institute for Hydrological, Meteorological and Environmental Studies (IDEAM), and the National Unit for Disaster Risk Management. This institutional arrangement aims to ensure technical expertise and coherence with national planning processes. The Environment Ministry will also play an important role in SISCLIMA. It is foreseen as the technical secretariat to the Inter-ministerial Climate Change Commission. The IDEAM will be a member of the Commission, and also chair a dedicated committee for information and climate change research.

A primary objective of SISCLIMA is to engage institutions that have not traditionally worked on climate change adaptation. By encouraging dialogue and information exchange, SISCLIMA provides opportunities to develop a holistic view of the issues at stake, and to feed climate information back into development planning processes. Once operational, the Inter-ministerial Climate Change Commission will bring together 15 ministries and entities involved in climate-relevant activities. Meetings of the Commission will have to be attended by ministers or vice-ministers to encourage high-level political engagement.

SISCLIMA will include dedicated permanent sectoral and regional committees to foster co-operation among sectors and regions. The Committee for International Affairs aims at attracting and co-ordinating development partner engagement, and at promoting Colombia's role in the international climate negotiations. International engagement is expected to support domestic initiatives on climate resilience and encourage a sustained

commitment beyond the next elections. A Committee for Information and Climate Research is intended to create a link between policy makers and researchers, as well as build evidence on climate-resilient development and adaptation needs.

Colombia intends to mainstream adaptation activities into sectoral policies, programmes and projects and thus place them under the responsibility of the respective ministries. The Sectoral Committee to be established under SISCLIMA will aim to increase co-operation among sectoral activities on climate change adaptation. This will help to identify cross-sectoral proposals for adaptation activities, and to find coherent ways to implement them.

At the sub-national level, the Regional Committee will facilitate co-ordination through regional groups *(nodos regionales)* that undertake adaptation activities in specific geographical areas. These regional groups are already up and running and have involved private sector actors in past meetings. Regional entities, including departments, regional environmental bodies (Autonomous Regional Corporations) and municipalities also have the option to develop adaptation plans. The National Development Plan 2010-2014 states that, if needed, the Environment Ministry will assist regional entities in developing these plans. Under the national adaptation policy framework, guidelines for the sub-national level are being developed to support vulnerability analyses and the elaboration of adaptation plans and implementation. These processes aim at building capacity at sub-national level so that climate-resilient planning can become independent of external support.

The systematic integration of climate change adaptation into sub-national planning has been slower than at national level, mainly because of competing priorities and capacity constraints. Better integration with local-level processes, such as local economic development plans, and improved articulation of needs identified at the sub-national level are still required. Adaptation plans are currently being developed in a number of cities and regions, including the capital region of Bogotá and the neighbouring department of Cundimarca, Cartagena de Indias, the Rosario and San Bernardo Archipelago, the Huila department, the Amazon region, Monteria, Risaralda, Nariño, San Andrés and Providencia and Orinoquia.

Capacity constraints are a challenge for integrating climate resilience into development planning, particularly at regional and sub-national level. Limited financial resources and a cap on the number of civil servants and consultants make it difficult to establish work on climate change adaptation even in vulnerable sectors. Ensuring sufficient capacity and building an institutional memory for climate change adaptation are therefore important areas for improvement. National government officials have started to train staff in local and regional entities to integrate climate resilience into their planning processes.

Evidence and research are helping to prioritise actions

Climate research in Colombia aims at better understanding the linkages between socio-economic development and climate, recognising that climate change impacts are cross-sectoral and related to a broad range of public policies. It also tries to raise awareness of the complementarities between mitigation and adaptation actions. The government strongly relies on climate data and vulnerability analyses for policy making, and climate change research also aims at securing support from stakeholders who have not traditionally engaged in climate change adaptation. However, uncertainty is often

characteristic of climate analysis, and policy makers will need to improve their ability to make decisions despite uncertainty.

The formulation of the National Adaptation Plan is being informed by a major research project on the links between climate change, economic development and resilience. This study is co-ordinated by the National Planning Department in collaboration with other government institutions, and supported by several development partners. It combines top-down modelling of climate change effects on the economic system with bottom-up approaches of detailed analysis of specific sectors or ecosystems. The objective is to include an analysis of adaptation measures and policies, together with a cost-benefit assessment of key adaptation measures. Some preliminary estimates have already been published. These included an overview of the estimated costs of climate change, effects on the health sector, and a methodology for modelling impacts in the agricultural sector (ECLAC, 2013a, 2013b, 2013c). Climate information in Colombia has been collected for around 90 years, and regular measurements are available for the last 70 years. IDEAM is currently developing climate projections on the basis of three regional models with resolutions of 25 km by 25 km, 20 km by 20 km and 4 km by 4 km grids. The highest resolution modelling is being developed for the Andean region. The government also collects data on climate-related hazards and their impacts, and climate projections relevant for Colombia's coastal and marine ecosystems, including approximate estimations of future sea-level rise. The National Administrative Department of Statistics is in charge of the National Environmental Accounts, which measure variations in the stock of natural assets. These are currently monitored for water, forests, energy and environmental protection expenditure.

Despite progress on downscaling climate models, challenges remain in generating information that can be used at the local level to perform hazard and vulnerability analyses. Information needed at local level, such as changes in the seasonal timing of precipitation, reliable estimates for inter-annual variability, or predictions of system or "state" level changes, are often not available (OECD, 2013b). Other challenges include improving the evidence on the potential benefits of adaptation measures, increasing knowledge on how economic development might affect climate resilience, further analysing existing data and communicating results more effectively to make them directly relevant to policy-makers. A balance needs to be found between refining research models and results, and increasing the capacity to make decisions under uncertainty.

Colombia is putting systems in place to fund action

Colombia is currently developing a financing strategy for climate change adaptation and mitigation. This may lead to some adaptation finance being earmarked in the next national development plan. International development co-operation continues to play an important role in financing adaptation research, planning and projects (discussed in the next section). Colombia has already mainstreamed adaptation expenses into its domestic budget. Government spending on adaptation takes place at different local, regional and national levels and comes from the regular budgets of each ministry, either as sectoral or cross-sectoral projects. Some ministries perceive that this creates a trade-off between adaptation and other investments. Significant investments were made after the floods in 2010/11 to better integrate climate resilience into infrastructure and housing designs. However, whether reconstruction has improved climate resilience has not yet been monitored.

Monitoring public spending on climate resilience has proved challenging. Such spending takes place in many different parts of government, often as a small financial contribution to larger projects, rather than a stand-alone adaptation measure. Colombia is due to participate in the Climate Finance Readiness Programme implemented by the UNDP and UNEP. This is likely to include a Climate Public Expenditure Review that will analyse sources and destinations of climate-related financing in the government budget, as well as institutional systems to channel them. As one of the outcomes, the government expects to implement a system to monitor public climate investments.

To guide the strategic development of domestic and international sources of climate finance, the government has created a Committee for Financial Management as part of SISCLIMA (Figure 4.1). According to the draft decree, the committee will be responsible for exploring financing options, developing a financing strategy and finding mechanisms to manage funds from different sources. The committee will also facilitate discussions on appropriate mechanisms to mainstream climate change investments into the general national budget, and might provide opportunities to discuss trade-offs between climate resilience and other policy objectives.

The Committee for Financial Management has defined priorities for climate finance and engaged in discussions with the financial sector, among others, to identify capacity-building needs. The committee has also conducted a first review of available financing mechanisms at domestic and international level, and agreed to commission a study on barriers to accessing and managing climate finance effectively.

International co-operation remains vital

Development co-operation has played a useful role in establishing climate change adaptation as a long-term approach in Colombia. For example, studies on the economic impacts of climate change on Colombia have received funding from development co-operation providers. This research provides important input for prioritising sectors and policies for adaptation activities. Other studies include:

- Research and pilot initiatives on adapting to sea-level rise. The international Climate and Development Knowledge Network (CDKN) has supported the coastal City of Cartagena de Indias to mainstream climate change adaptation into their land-use and development planning.
- A major project on integrating ecosystems and climate change adaptation, supported by the Global Environment Facility. This served to develop climate change and vulnerability scenarios at national and sub-national levels. It also facilitated the introduction of climate change into national policy documents, including the National Development Plan 2010-2014.
- The UNDP is co-ordinating a project to integrate climate resilience into development and land-use planning in the capital Bogotá and its surrounding regions. One aim is to protect the high-mountain *páramo* ecosystems to secure freshwater supply for the capital region.
- Sectoral plans have also benefitted from development partner support. For example, the CDKN is helping the Transport Ministry develop its sectoral climate change adaptation plan.

In 2011, USD 0.76 million of ODA to Colombia was invested in projects targeting adaptation as a principle objective, and USD 23.19 million went to projects with

adaptation as a significant objectives (OECD, 2014a). Although the engagement of development co-operation providers has proven essential to initiating the move to climate-resilient development, the Colombian government has strong ownership of the process. The Colombian government drives policy making, but makes use of technical and financial assistance from development co-operation agencies to support priority areas of its work. It is likely that subsequent stages, particularly the implementation of climate change adaptation measures, will require a more substantial commitment of domestic resources. The current mainstreaming approach is likely to support this, but the government will need to develop financing mechanisms to channel domestic and external resources in support of climate-resilient development.

4.3 What are the policy priorities for building resilience?

This section looks at selected policy areas that are relevant to climate-resilient development. These include:

- *Five key growth sectors:* mining and energy, transport infrastructure, agriculture, housing and innovation are either climate sensitive or play a key role in climate resilience.
- *Land-use planning and water resource management:* these two cross-cutting policy areas will affect the climate resilience of all sectors.
- *Disaster risk management policies and processes:* since Colombia's climate change adaptation policy was prompted by the major flooding disaster in 2010/11, the integration of disaster risk management and climate change adaptation is particularly important.
- *Financial resilience:* extreme climate events and variations can have damaging implications for the economy in the absence of well-planned measures to protect the state from liability and to cushion the population from financial losses.

Climate-sensitive key growth sectors are priorities

Development planning affects future vulnerability to climate change because it influences the exposure, sensitivity and adaptive capacity of people and ecosystems. Future climate change is one variable to consider when examining the relative merits of different policy options. Sectoral planning in Colombia aims at both climate-proofing existing strategies and at modifying strategic directions within the sectors to make them climate resilient in the future. Although activities are identified by a specific sectoral ministry, many of the proposed adaptation activities are inherently cross-sectoral.

Colombia is gradually mainstreaming climate resilience into sectoral planning. In prioritising adaptation activities, the links between economic development and climate resilience are likely to be particularly important for three types of sectors:

1. sectors that are highly sensitive to climate change;
2. sectors that have a negative impact on the climate resilience of ecosystems or communities; and
3. sectors that are important for economic development because they make a significant contribution to GDP, are growing very quickly, or sustain a large number of poor households.

In Colombia, these three types of sectors largely overlap, highlighting the importance of climate-resilient development. Table 4.1 compares the five key growth sectors prioritised in Colombia's National Development Plan 2010-2014 with the priority sectors for mainstreaming climate resilience identified by the institutions working on the National Adaptation Plan. The priority sectors for adaptation were chosen primarily on the basis of how badly they were affected during the 2010/11 floods. This comparison highlights a timely opportunity to make development more resilient to the effects of climate change. The National Development Plan 2010-2014 has requested that sectoral plans take climate change into account.

Table 4.1 Priority growth sectors in Colombia: Are they vulnerable to climate change?

	Key growth sector	Adaptation priority
Mining and energy	✓	Only energy
Transport infrastructure	✓	✓
Agriculture	✓	✓
Housing	✓	✓
Innovation	✓	
Health		✓

Mining and energy are a high priority

Mining and energy have been assigned the highest priority among the five growth sectors identified in the National Development Plan 2010-2014. Together they absorb around 40% of total investment foreseen for the five growth sectors (Government of Colombia, 2011). Hydropower contributes more than 70% of Colombia's total electricity generation capacity (IEA, 2012). Mining, oil drilling and quarrying together form a fast-growing sector and drive Colombia's GDP growth. Value added from the sector tripled between 2005 and 2011. In 2011, the sector accounted for about 8% of Colombia's current GDP and about 70% of its exports (OECD, 2013a).

The energy sector is expected to be negatively affected by climate change, particularly due to Colombia's high reliance on hydropower (Ospina Noreña et al., 2011). Low storage capacity makes the system vulnerable to droughts – a phenomenon that is likely to increase in areas of the country where large parts of the population and economic activity are concentrated. A forthcoming report of the Colombian Planning Unit for Mining and Energy foresees that climate change will decrease the generation capacity of all hydropower installations in the country (UPME, forthcoming). Electricity price increases associated with future droughts caused by climate change have been projected to cost Colombia 0.7% of its GDP in 2050 (ECLAC, 2013a). This scenario assumes stable demand and unchanged infrastructure. But as energy demand is projected to increase in the coming decades, the costs may be even higher if no adaptation activities are undertaken (UPME, 2010). Policies introduced in the mid-1990s to increase generation capacity favoured conventional technologies (hydropower, gas and coal). Future policies would, therefore, need to realise Colombia's renewable energy potential

to avoid increasing greenhouse gas emissions while meeting future demand (OECD, 2014b).

The National Development Plan 2010-2014 recognises the importance of preparing the energy sector for future climate change. It requires the institution responsible for mining and energy planning – Colombian Planning Unit for Mining and Energy (UPME) – to take climate change into account in its plans for expanding production and also to create different demand scenarios for the energy and gas sectors. The planning authority is charged with co-ordinating the hydroelectric sector planning with a view to reducing the impacts of climate change. UPME (forthcoming) suggests four groups of adaptation measures for the energy system: 1) optimisation of conventional energies to improve efficiency in generation and transmission; 2) diversification of energy sources and promotion of renewable energy; 3) improvement in energy efficiency; and 4) conservation of watersheds and ecosystems.

While there is little research on the vulnerability of mining operations to climate change globally, the mining sector was heavily affected by the 2010/11 floods (ECLAC, 2012). The sector's operations might also affect climate resilience. In the absence of appropriate safeguards, the mining sector could damage the resilience of ecosystems and communities to climatic changes (Contraloría General de la República, 2013; Rodríguez Becerra et al., 2012). The linkages between climate change and the mining sector have not yet been addressed, partially because they have been overshadowed by other environmental challenges associated with mining, such as mercury pollution.

Colombia's comparative advantage in agriculture could be threatened by climate change

The agricultural sector plays a key role in promoting inclusive growth. It contributed 7% to Colombia's GDP in 2012 and 10% of exports (World Bank, 2013; DANE, 2013). Agriculture is Colombia's main export sector after petroleum oils, coal and gold (Hausmann et al., 2011). The sector employed 18% of the total workforce in 2011 (World Bank, 2013). Most jobs were located in Colombia's poorer rural areas, where 70% of the population is unable to meet some of their basic needs (World Bank, 2013; UNDP, 2011). The Colombian government envisages a strategic positioning of the sector due to a projected rise in global demand for agricultural products, rising commodity prices, and a perceived comparative advantage of Colombia's currently favourable climatic conditions and climatic diversity. Accordingly, the National Development Plan 2010-2014 sets out a programme to strengthen productivity in the sector.

However, climate change may reduce Colombia's comparative advantage. Up to 80% of crops and more than 60% of today's cultivated areas could be affected by climate change (Ramirez-Villegas et al., 2012). Agricultural production is projected to be on average 24% lower over the century, compared to a baseline scenario without climate change. This reflects a projected decline in productivity, which could reach 45% at the end of the century (ECLAC, 2013a). Similarly, livestock production could decrease by 35% in 2100, and fisheries by 30% in 2100 (ECLAC, 2013a). Under a climate scenario where temperatures increase by 1.5-1.7°C and there is some decline in annual precipitation, productivity reductions in the agricultural sector alone could cost 1% of national GDP in 2050, compared to a scenario without climate change (ECLAC, 2013a). This might have knock-on effects for other sectors. For example, the food processing industry is directly dependent on agricultural productivity, and output could decrease by

around 16% over this century compared to a baseline scenario without climate change (ECLAC, 2013a).

The Colombian government is currently developing an adaptation strategy for the agricultural sector. This has been informed by a series of workshops involving various government agencies and stakeholders from the agricultural sector. It has not yet been decided whether the strategy will be granted legal status. Legal status would mean that activities would be matched by budget allocations and subject to national monitoring and evaluation procedures. This should make the strategy easier to implement, given that it covers activities that require resource commitments from a wider range of government institutions. The strategy is expected to be finalised in 2014.

Colombia has an opportunity to build climate resilience into its transport infrastructure

Colombia's transport infrastructure development is lagging behind other countries in the region. Increased investment is necessary to raise productivity and export potential (IMF, 2013), and hence Colombia has made transport infrastructure development a growth sector in the National Development Plan 2010-2014. In some cases, there will be trade-offs between the objective of rapid expansion and ensuing the robustness of the network in the longer-term. The integration of climate projections into infrastructure design can lead to higher upfront costs and longer time for implementation. However, it should also increase reliability and reduce the risk of having to implement costly retro-fitting in the future.

Transport infrastructure in Colombia is sensitive to climate extremes and climate change. In the past, floods and landslides have caused significant damage. For example, transport infrastructure damage accounted for 38% of total damage during the 2010/11 La Niña event and had indirect effects on growth, for example by blocking access to markets (ECLAC, 2012). Over the longer term, climate change is projected to pose further problems. For example, increased extreme precipitation might damage infrastructure and cause sedimentation to shipping routes in some regions. In other regions, reductions in rainfall might harm shipping because of low water levels. High temperatures could damage road infrastructure, as could subsidence resulting from low ground-water levels. Sea-level rise will be an additional threat. A one metre rise in sea levels, which is at the upper end of projections for 2100, would put almost half of coastal transportation routes at risk of occasional or permanent flooding (IDEAM, 2001).

The National Development Plan 2010-2014 requires the effects of climate change to be considered in transport infrastructure planning. It calls for new "high-impact strategies" to make the infrastructure system more resilient in the medium and long term by tackling the most important routes that are regularly affected by climate-related events (Government of Colombia, 2011). The plan asks competent institutions to undertake concerted efforts and develop a new financial framework for climate-resilient infrastructure. It also requires the sector to undertake vulnerability studies and prioritise adaptation measures. A forthcoming vulnerability study for the transport sector will provide estimated closure times for roads and railways, indicating productivity losses due to climate change.

The National Development Plan also requires state and territorial entities, as well as concessionaries, to acquire insurance for primary transport infrastructure to cover the cost of damage related to natural hazards. With World Bank support, the government has developed a technical document outlining good practice in climate-resilient infrastructure

development and insurance in other countries. The government has subsequently strengthened legislative requirements to contract insurance and has already included changes in the contractual obligations of concessionaries. In addition to this, it will be important that infrastructure planning at all levels of government is closely integrated with land-use and development plans. This will encourage the consideration of broader developmental aspects of infrastructure, such as its role in disaster risk response, food security and market access.

Housing is a very vulnerable sector

The construction sector contributed 6% to Colombia's GDP in 2011 and has been identified as one of the key sectors to drive growth in the coming years (OECD, 2013a; Government of Colombia, 2011). Housing was also the sector worst-affected by the 2010/11 floods, exacerbated by the location of housing in areas at risk from flooding and landslides (ECLAC, 2012). Urbanisation in Colombia is still fast paced and often exceeds the capacity of local administrations to provide adequate services to the growing urban population. Rapid urbanisation may be exposing an increasing number of households to climate hazards – mainly floods and droughts – and may also contribute to environmental degradation (Rodríguez Becerra et al., 2012).

The National Development Plan 2010-2014 recognises the need for increased resilience in the housing sector. For example, it calls for reducing the number of precariously located settlements within peripheral urban areas (Government of Colombia, 2011). The plan also requires the sectoral tools and incentives for infrastructure to manage rainwater in urban areas to be revised and strengthened. The housing ministry is working towards a sectoral adaptation plan together with the National Planning Department. The process includes developing policies on sustainable construction, sustainable cities and integrating risk management into water and sewage operation systems.

The housing sector illustrates some of the trade-offs and synergies between development and climate resilience. For example, a plan to provide 100 000 free housing units for poor people has shifted attention away from the medium and long-term goal of adapting the sector to climate change. In principle, however, this project could offer an opportunity to increase climate resilience by providing housing in safer areas to households currently living in high-risk areas. Another challenge for the housing sector is the scarcity of land in urban areas, which has contributed to an increase in housing prices of 40% between 2006 and 2011 (OECD, 2013a). Ambitious construction targets are intended to reduce house prices, but risk encouraging construction in areas that are exposed to the effects of climate change, such as floodplains. It is therefore important that land-use plans identify high-risk zones.

Innovation is key for climate change adaptation

The fifth priority growth area in the National Development Plan is innovation. By supporting sectors with high innovation potential and innovation capacity in general, the government hopes to further diversify the economy and export portfolio. Measures include education and strategic skills development, incentives for investment in specific sectors and new options through the financial system, and the promotion of technological clusters and value chains (Government of Colombia, 2011).

Innovation can provide ways to expand economic activity in sectors where Colombia has a comparative advantage today and under future climate scenarios. The prioritisation

of sectors and specific research projects could benefit from considering climate change as one selection criterion. For example, targeting investment in non-agricultural sectors to regions where agricultural activities are highly vulnerable to the effects of climate change would reduce the economic impact of declining yields. Innovation can also help to cope with climate change, such as finding new agricultural techniques or crops, new procedures for regulation and planning, or alternative financial instruments. The National Development Plan highlights the need for studies and analysis of climate change adaptation. This underlines the importance that the government attaches to evidence-based policy making.

Resilient land-use and water policies are vital

In addition to the five priority sectors discussed above, the cross-cutting themes of land-use planning and water management are also priorities for climate resilience in Colombia. More than 70% of Colombia's population and the country's main economic centres are located in the Andean and coastal regions, with a high concentration of people along river banks. Many of these areas are particularly exposed to flooding, landslides, projected temperature increases and sea-level rise (DNP, 2012). Climate impacts and economic development thus coincide spatially in certain parts of the country. Incorporating climate change into land use and water management can therefore reduce the negative impacts on economic growth.

Ensuring that regulations are fit for purpose is important, but not sufficient for building climate resilience in those sectors. They need to be viewed in the context of the underlying drivers of inappropriate land and water use, such as poverty and weak property rights. Regulation may therefore need to be combined with additional instruments to address these underlying issues.

Economic growth is one of the main factors driving land-use change. Thus, land-use planning and water management can be important instruments to prevent economic growth having negative impacts on climate resilience. In the past, economic development has affected climate resilience through deforestation, the conversion of wetlands and other ecosystems such as the *páramos*, and the diversion of rivers. This is widely thought to have exacerbated floods and landslides, rendered ecosystems more vulnerable to degradation and biodiversity loss, and made natural habitats more vulnerable to climate change (Government of Colombia, 2011; Restrepo and Alvarado, 2011; ECLAC, 2012; Ardila et al., 2013; Rodríguez Becerra et al., 2012). For example, the expansion of agricultural activities in the Andes has led to a decrease of high altitudinal forests by more than 30% in 20 years (Hincapié et al., 2002; Van der Hammen et al., 2002). This has degraded soil quality irreversibly, as well as reduced rainfall over the *páramos*, a crucial ecosystem for securing water supply to the surrounding areas, including the capital Bogotá (Box 4.2; Etter and Villa, 2000; Buytaerta et al., 2006).

Currently, there is a considerable underuse of land that is suitable for arable farming and an overuse of land for livestock. In 2004, only 30% of suitable land was being cropped, while 36% of total land was used as pastureland despite the fact that only 17% is considered suitable for this activity (World Bank, 2004). This overuse of land for livestock contributes to deforestation, in turn leading to degradation and urban sprawl (Slunge, 2008). Urban sprawl has increased the flood risk in several Colombian cities, among them Cali, where investments in drainage infrastructure have lagged behind urban development (UNISDR, 2009).

Climate change, in contributing to natural disasters, sea-level rise and resource scarcity, may also affect patterns of internal migration, further driving land-use change. Colombia already has high numbers of internally displaced people due to the internal armed conflict. Between 1999 and 2011 alone, more than 8% of Colombia's total population was displaced (OECD, 2013a). Climate change could add to these existing migratory pressures (Slunge, 2008).

This complex situation calls for land-use and development policies that contribute to social inclusion, employment, general environmental protection and climate resilience. Land-use planning can achieve synergies between climate change adaptation and socio-economic development and thus improve the quality of life of the population through more efficient use of the land, improved settlements, and other measures.

Colombia is integrating climate into land-use plans

Municipal land-use plans (*planes de ordenamiento territorial,* or POTs) are at the core of Colombia's land-use planning, and operate within a framework of national and regional regulations. They determine the permitted use of land in municipalities, including the delineation of urban areas, environmental protection zones and zones at risk of natural hazards. They also promote plans for road development and other construction projects, thereby providing the basis for licensing for local housing and infrastructure projects. The national government establishes the legal framework and broad guidelines for land-use planning. It can impose restrictions on land use for reasons of national interest (e.g. national park designation) and reinforce national economic interests through infrastructure planning and mining licenses. The national government also co-ordinates local efforts under a national climate change policy. The regional environmental bodies are responsible for watershed management plans. Separate management plans are developed for some strategic ecosystems, such as the *páramos* or forests.

The POTs are designed to take a comprehensive approach to land-use planning that includes social, economic, cultural and environmental considerations (see Box 4.2). Integrating the effects of climate change in POTs is important for three reasons. First, POTs set the framework for economic development at the municipal level. Second, they require the analysis of long-term consequences of specific land uses and the integration of disaster risk and risk prevention measures. In addition, the POTs are required to prioritise environmental criteria in their decision-making processes and this component is controlled and authorised by the Regional Autonomous Corporations. Third, the POTs' nine-year time horizon provides a better framework for long-term planning than the shorter development plans that correspond to one local government term of three years.

Climate projections at local scale are usually subject to high uncertainty, which makes it difficult for municipalities to restrict land use based on this information. This is particularly true for trends in precipitation, while temperature increases, glacier retreatment and sea-level rise may be more easily considered in land-use planning. This uncertainty requires flexible approaches to land-use planning, as well as better understanding of potential risks and tools for making decisions under uncertainty.

In a review of the POTs in the context of mining practices, the Office of the General Comptroller states that there is currently a lack of effective and adequate land-use planning through this instrument. Despite the existing legal framework and control process by the Autonomous Regional Corporations (the regional environmental bodies), the review found that inappropriate land-use practices have led to environmental degradation, particularly of water, soil, biodiversity, air and landscapes, and negatively

affected the people who live in the areas concerned (Contraloría General de la República, 2013). While the Office of the General Comptroller cites a lack of adequate information about the land in question as the main reason for these deficiencies, interviews with policy makers have also suggested structural and capacity challenges. For example, municipalities have to pay compensation to landowners if they severely restrict the potential use of their land, which is a strong disincentive for imposing restrictions (Blanco, 2008). Municipal land-use management is further confronted with the challenges of the internal armed conflict and displacement, poverty and inequality, particularly in rural areas.

Box 4.2 An example of climate-resilient land-use planning: The Bogotá region

The capital region Bogotá-Cundinamarca is home to almost 10 million people, or 22% of Colombia's population and 41% of national industry, generating 32% of the national GDP (PRICC, 2013). Due to rapid urbanisation, the city's geographical area is likely to occupy 26% more space in 2050 than today (Planning Secretariat Bogotá, 2013a). The region is prone to multiple hazards, and these are likely to be exacerbated by climate change. This includes increased rainfall in areas that are already vulnerable to flooding and landslides, and less precipitation over the Chingaza massif that is in large part composed of the high-mountain *páramos* ecosystem – the current source of around 75% of Bogotá's water supply (Planning Secretariat Bogotá, 2013b).

Bogotá has integrated climate change as one of three strategic components in its district development plan. For the first time, this puts natural resource management, particularly water management, at the centre of development decisions. A climate change component aims to reduce the city's vulnerability to climate impacts and envisages promoting a co-ordinated approach to disaster risk management and climate change adaptation. Priorities include the management of the *páramos* ecosystem and of informal settlements in risk zones. The focus is on preventive activities instead of disaster risk response. The city is planning to spend 2.1% of the total budget for the district development plan on climate resilience and risk management. Bogotá is currently updating its POT, among other reasons to integrate disaster risk management and climate change adaptation. This is an unusual procedure since the current POT would usually be in force until 2020. The Department of Cundinamarca has also included climate change adaptation into its development plan and set up a programme on disaster risk reduction and climate change adaptation. These initiatives have benefited from development co-operation support (PRICC, 2013).

Land-use management is multi-layered and complex, and involves several inter-related planning procedures. Municipalities and Autonomous Regional Corporations already have to comply with a number of different planning requirements, including watershed management plans, municipal land-use plans, municipal plans for risk management, and municipal climate change adaptation plans, as well as development plans at local, municipal, district and departmental level. Interviews with public officials indicated that there is scope to better integrate and sequence these planning processes to avoid overwhelming local administrations. Land-use management also involves the particular way land is used. For instance, inefficient agricultural management, particularly livestock breeding, can degrade land. This makes it more vulnerable to climate change and encourages farmers to convert undeveloped land, such as forests, for agricultural use. Programmes to encourage efficient agricultural and livestock management are therefore

important components of a comprehensive approach to climate-resilient land-use management.

With its two low-lying coasts, Colombia is highly exposed to sea-level rise, which is already occurring at a rate of 3.5mm every year for the Caribbean Sea and 2.3mm every year for the Pacific Ocean (IDEAM, 2010). A rise of 40-60cm is projected by 2060 (IDEAM, 2001). A one metre sea-level rise by 2100 could affect more than 1.4 million people through damage to coastal buildings, infrastructure and agricultural land (INVEMAR, 2003; IDEAM, 2001). As such, it is important to develop sustainable costal development plans early to prevent "locking-in" vulnerable patterns of development. It is also important to create stable expectations about which sites will be protected, while remaining flexible about the way that protection is achieved (Hallegatte, 2009).

The National Policy for the Ocean and Coastal Areas of 2007 requires the government to monitor coastal vulnerability and identify adaptation actions. However, currently there is no requirement to consider sea-level rise in coastal land-use or development planning. This is also absent from legislation related to coastal management more generally. In May 2013, Presidential Decree No 1120 created ten Coastal Environmental Units. Their main function is to support the regulation of land in coastal areas, subject to the Environment Ministry's consent. So far, sea-level rise has been considered in a few pilot projects supported by international development partners, including an integrated planning project in the port city of Cartagena (CDKN, 2013). Pilot projects can feed back into regional and national policy-making and encourage other local and regional governments to take action.

Water resource management plans need to incorporate climate resilience

Water management has become increasingly prominent on the political agenda in Colombia, and there is also an increasing awareness of the implications climate change might have for this area. The National Policy for Integrated Water Resource Management for the period 2010-2022 recognises climate change and variability as a challenge to water resources management, both in terms of flood risk and securing water supply (Ministerio de Ambiente, Vivienda y Desarollo Territorial, 2010). It focuses on the implications of changes in water supply and water demand in the hydropower and agricultural sectors, as well as for inland navigation and freshwater supply. The policy also foresees the design and implementation of climate change adaptation measures in ecosystems that are crucial for water regulation and these other sectors. It calls for activities at the regional and local levels to reduce current disaster risk.

Sustainable watershed management influences flood risk and water quality and can prevent water shortages during dry periods, particularly during El Niño years. Climate change is expected to change the water cycle with a likely intensification of climate extremes, both intense rainfall and severe droughts. Water scarcity is expected to be most problematic in the Andean and Caribbean regions, both of which have comparatively high population density, a high level of economic activity, and high water demand for domestic and industrial uses (Pabón, 2010; DNP, 2012). The changing climate is likely to adversely affect industries, agriculture, ecosystem, health and electricity prices. Watershed management has to reconcile all these water demands, including those for irrigation, electricity generation, households and industrial activities. It is thus a cross-cutting issue that requires the co-operation of multiple stakeholders.

Water resources management in Colombia is conducted at the river basin level. Accordingly, Water Basin Designation and Management Plans (*planes de ordenación y manejo de cuencas,* POMCAs) are formulated under the leadership of the regional environmental bodies, the Autonomous Regional Corporations (Decree 1729 of 2002). In addition, the government is developing strategic water management plans for the macro-basins around its five largest rivers. The Autonomous Regional Corporations grant concessions for water use, depending on water availability for the specific water basins.

Challenges to watershed management are similar to those associated with the development, implementation and enforcement of the POTs. Constraints on skilled technical personnel and financial resources prevent many Autonomous Regional Corporations from effectively modelling water availability and measuring water quality, as well as from developing, implementing and enforcing the river basin plans. Their capacity varies considerably as their main source of finance comes from property tax transfers from municipalities, which favours urban regions. Also, the extent of transparency in decision making and licensing, and their exposure to political pressures vary. More generally, the relationship between the POMCAs and other regulatory instruments, such as the POTs, is not well established, and co-ordination tends to be insufficient (Blanco, 2008). A similar lack of co-ordination has been noted by public officials with regard to the departmental development plans that are under the responsibility of the regional governments, while the POMCAs are formulated by the Autonomous Regional Corporations.

There is scope to improve the integration of climate projections into water management. The Autonomous Regional Corporations have the right to modify the initial allocation of concessions if supply in a water body is critically low. This allows them to react to climate variability. However, climate resilience might require a more anticipatory approach to water allocation to prevent future scarcity. Anticipatory action might also be required for flood protection infrastructure and water storage basins that serve both to ensure supply for irrigation in dry years and to store excess water caused by intense precipitation. During the floods in 2010/11, even newly built storage basins were too small to cope with the intensity of precipitation. Following the introduction of a new disaster risk management law in 2012 (see next section), all POMCAs now have to incorporate disaster risk (Congreso de Colombia, 2012). The Environment Ministry and the IDEAM are currently developing guidance for regional bodies on this, but so far it does not encourage regional bodies to take account of climate projections. Several development co-operation projects in Colombia focus on adaptation in water management and support the formulation and support of sub-national adaptation plans. These will provide important lessons for the National Adaptation Plan.

Disaster risk management and climate resilience need to be better linked

The 2010/11 floods put disaster risk management high up on the national policy agenda. Colombia has several decades of experience with disaster risk management. However, the government decided that reforms were needed after adaptation deficiencies became apparent during the 2010/11 floods. In 2012, the World Bank published a comprehensive review of Colombia's disaster risk management policy (World Bank, 2012). This review identified four factors that had contributed significantly to disaster risk in the past:

1. the absence of a comprehensive national disaster risk management policy;
2. insufficient land-use and watershed management;

3. insufficient consideration of disaster risk in sectoral plans and policies; and
4. limited incentives for civil society and the private sector to engage in risk prevention due to the absence of a clear policy framework and the dominant role of the state in post-disaster assistance.

This assessment and the devastating impacts of the 2010/11 flooding prompted the Colombian government to create a new comprehensive policy framework for disaster risk management, expressed in a disaster risk management law in 2012 (Congreso de Colombia, 2012).

In contrast to previous legislation, which only focussed on disaster risk response, the new law includes important provisions for disaster risk reduction. Notably, the law requires risk and risk management to be integrated into land-use and development plans at all levels of government. The shift towards disaster risk reduction has financial implications. The law mandates the reform of the main disaster risk management financing tool, the National Fund for Disaster Risk Management, to give greater emphasis to funding disaster risk research and risk reduction activities.

Disaster risk management was also included in the National Development Plan 2010-2014 and now has improved institutional standing due to a reassignment of responsibilities. This has involved placing the main institution at the national level, the National Unit for Disaster Risk Management, under the direct responsibility of the President's Office. A National System for Disaster Risk Management was created to bring together relevant government institutions to better co-ordinate their policies. Colombia has also made disaster risk management one of six priority areas for international co-operation (UNGRD, 2013).

The changes made to disaster risk management policies after the floods were more ambitious than those made to climate change adaptation, as Colombia could rely on existing knowledge and established procedures for disaster risk management. However, the institutions responsible for disaster risk management and climate change adaptation policies (SISCLIMA) have not yet been formally linked. The National Unit for Disaster Risk Management is part of a Technical Committee charged with the formulation of the National Adaptation Plan and has been involved in the drafting of the conceptual bases of adaptation policies in Colombia (DNP et al., 2012). This engagement has encouraged a dialogue between the two fields, but joint action has not yet reached the projects and programmes at sub-national level. At that level, disaster risk management projects usually rely on historical records for decision making. The integration of climate change into projects is further hampered by a perception among some stakeholders that climate change adaptation essentially means disaster risk management, and that disaster risk reduction measures will be sufficient to provide protection against future climate change.

As policies, plans and concrete projects are developed further, better co-ordination between climate change adaptation and disaster risk management may be required.

Financial resilience is being built

Colombia developed a *Financial Strategy to Reduce the Fiscal Vulnerability of the State against Natural Disasters* in 2012 following the high financial needs after the 2010/11 flooding (Box 4.3). The strategy aims to maintain fiscal stability and reduce the negative impacts of disasters. The measures intend to reduce liabilities on the state and to facilitate access to finance in the case of a natural disaster.

For this, three types of risk management strategies are proposed:

1. risk reduction through preventive measures;
2. risk retention through reserves and contingent credit; and
3. risk transfer through insurance.

In the empirical literature, this kind of risk layering and the arrangement of financing instruments before disasters strike has been found to be a cost-effective way to deal with disaster risk (Cummins and Mahul, 2009). The strategy is led by the Finance Ministry. However, it focuses on current climate variability only; climate change is not discussed.

Box 4.3 The importance of fiscal resilience to disasters

Sufficient access to capital after extreme events has shown to be essential for limiting negative impacts on economic growth and loss of human life. So-called counter-cyclical spending, i.e. maintaining or increasing government spending despite declining revenues, can limit the long-term effects of disasters (Cavallo and Noy, 2010; Cuaresma et al., 2008; Hallegatte and Dumas, 2009). In contrast, financial constraints after disasters hamper investment in reconstruction and limit the options governments have to respond to them (Ranger et al., 2011). This can cause indirect costs and slow down economic growth for several years after a disaster (McDermott et al., 2013). As Colombia's vulnerability to climate extremes is projected to increase, fiscal preparedness for disasters will become even more important.

Public investment in flood response in 2010/11 was substantial. Total damages for the period amounted to USD 6 billion, almost 2% of GDP (ECLAC, 2012). In 2011 and 2012 the government invested 0.9% and 0.7% of GDP, respectively, in flood response (CONFIS, 2011, 2012). This compares with total investment by the national government of 1.8% of GDP in 2011 and 2.9% of GDP in 2012. Financing needs were covered, among others, by an additional tax on high value real estate (0.1% of GDP), a levy on financial transactions, a loan from the World Bank, and reallocations within the current budget (CONFIS, 2011).

Risk reduction

Risk reduction activities are intended to reduce potential damage and subsequent liabilities on the state. New risk prevention policies were included in the 2012 disaster risk management law (Congreso de Colombia, 2012), but there is also a potential to include climate change adaptation measures. Key aspects of this strand include the development and implementation of risk management plans and prevention measures through land-use and watershed management plans, as discussed in the section above. The strategy also recommends the inclusion of disaster risk in contracts awarded for infrastructure projects. Currently, most financial resources for disaster risk management are invested in risk management, recovery and financial protection activities. Very little funding is provided to risk reduction and activities that generate knowledge about risks. However, by 2019 the government aims to allocate at least 20% of resources to the generation of knowledge about risks, 30% to risk reduction, and 50% to risk management. By 2025, the allocation of 30%, 30% and 40% to these respective activities is envisaged.

Risk retention

Risk retention mechanisms are the second element of the financial strategy. Three instruments are intended to maintain public reserves to cover an unexpected financial claim: a National Disaster Risk Management Fund, a contingent credit line with the World Bank, and an increase in budget flexibility. The National Disaster Risk Management Fund was created on the basis of an earlier Calamities Fund established in 1984. Under its new name and statute, the National Disaster Risk Management Fund finances knowledge generation about risk; risk reduction; risk management; recovery; and financial protection activities. To ensure its financial sustainability, funding is allocated from the national budget. The state also channels private donations made for emergency relief and reconstruction through this fund. It is placed under the authority of the National Unit for Disaster Risk Management.

The contingent credit line "Catastrophe Deferred Drawdown Option" (Cat DDO) with the World Bank provides quick liquidity in case of a natural disaster. The advantages of a Cat DDO are that financial resources are made available immediately after a national emergency, and that financing terms are better than those of commercial loans. Colombia was the first country to contract a Cat DDO with the World Bank. The initial credit was USD 150 million, but the credit was increased after the La Niña events in 2010/11 and currently amounts to USD 250 million. To be eligible for a Cat DDO, countries have to prove macroeconomic stability when the agreement is signed and whenever the credit is extended. They are also required to have a risk management programme in place, which is then regularly monitored by the World Bank. This is intended to enhance the cost-effectiveness of disaster risk management.

As a third risk retention measure, the strategy envisages an increase in the flexibility of allocations in the national budget. Budget flexibility can help redeploy spending in the face of climate-related disasters (Laframboise and Loko, 2012). Colombia used this mechanism to finance its emergency response to the floods in 2010/11. However, current budget flexibility is limited. In 2010, 86% of the national budget consisted of inflexible allocations. Major sources of inflexibility are debt repayment (27%), pensions (15%), and allocations to the sub-national level (16%).

Risk transfer

The financial strategy further aims to transfer risk through public and private insurance, and via capital markets. As a first step, the government is working towards increasing the share of insured public goods, particularly real estate, priority transport infrastructure and assets used to provide public services. The Finance Ministry is currently evaluating options for collectively insuring government-owned real estate, primarily buildings dedicated to health and education. The legal framework for insuring infrastructure that is administered by public-private associations has been strengthened since the floods and recent infrastructure projects already take insurance into account. The ministry is also planning to condense lessons learned in guidelines and capacity-building activities directed to sub-national entities that seek to insure their assets. In addition, the government is also exploring options to access additional capital through financial markets, for instance through catastrophe bonds.

Gaps remain in engaging the private sector, including through private insurance. According to the Federation of Insurance Companies in Colombia (FASECOLDA), only 7% of asset losses caused by the severe rainfalls in 2010/11 were insured. The government and the private sector have yet to develop a strategy for increasing private

sector insurance coverage. The agricultural sector has received most attention with regards to climate insurance, with government subsidies equivalent to 60-80% of the premiums. FASECOLDA has pointed out that despite this, insurance is still expensive for smallholders and has called for a wider range of insurance models (Díaz, 2013). Private ownership of risk might be encouraged by a better clarification of the respective roles and liabilities of the public and private sectors with respect to disasters and climate resilience.

The financial strategy will help reduce negative impacts both from current climate variability and climate change. While the potential implications of climate change are not considered in the current financial strategy, the individual instruments can be adjusted over time. Cost-effective adaptation includes strengthening the link between disaster risk management and climate change adaptation, but might also benefit from making risk transfer mechanisms conditional on risk prevention activities. In this context, FASECOLDA has stated that higher public investment in risk reduction could support private sector insurance provision (Rincón, 2013). To date, most insurance arrangements in developing countries have not directly linked risk response and risk reduction. Initiatives that have made the link have required public sector involvement or development partner support (Surminski and Oramas-Dorta, 2011). In any case, the potential impacts of climate change on climate extremes will require close monitoring, so that the sustainability of disaster risk management arrangements, including the availability of sufficient finance and the sustainability of insurance mechanisms, can be ensured.

References

Ardila, G. et al. (2013), *Desarrollo Económico y Adaptación al Cambio Climático [Economic Development and Climate Change Adaptation]*, Friedrich Ebert Stiftung en Colombia and Foro Nacional Ambiental, Bogotá.

Blanco, J. (2008), "Integrated water resource management in Colombia: Paralysis by analysis?", *International Journal of Water Resources Development*, Vol. 24, pp. 91-101.

Buytaerta, W. et al. (2006), "Human impact on the hydrology of the Andean Páramos", *Earth-Science Reviews*, Vol. 79, pp. 53-72.

Cavallo, E. and I. Noy (2010), "The economics of natural disasters – A survey", *International Review of Environmental and Resource Economics*, Vol. 5/1, pp. 63-102.

CDKN (2013), "Embedding climate change resilience in coastal city planning: Early lessons from Cartagena de Indias, Colombia", Inside Stories on Climate Compatible Development, Climate & Development Knowledge Network (CDKN), available at *http://cdkn.org/resource/embedding-climate-change-resilience-in-coastal-city-planning-early-lessons-from-cartagena-de-indias-colombia/*.

CONFIS (2011), *Actualización Plan Financiero 2011/03 [Update of the Financial Plan 2011/03]*, Consejo Superior de Política Fiscal [Senior Council for Fiscal Policy, Ministry of Finance and Public Credit].

CONFIS (2012), *Plan Financiero 2012/03 [Financial Plan 2012/03]*, Consejo Superior de Política Fiscal [Senior Council for Fiscal Policy, Ministry of Finance and Public Credit].

Congreso de Colombia (2012), Ley No. 1523 [Law 1523], Colombian Congress, Bogotá.

Conpes (2011), *Estrategia Institutional para la Articulación de Políticas y Acciones en Materia de Cambio Climático en Colombia [Institutional Strategy for the Development of Policies and Actions related to Climate Change in Colombia]*, Consejo Nacional de Política Econímica y Social [National Council of Economic and Social Policy], Bogotá.

Contraloría General de la República (2013), *Minería en Colombia: Fundamentos para Superar el Modelo Extractivista [Mining in Colombia: Bases for Overcoming the Extractionist Model]*, Contraloría General de la República de Colombia [Office of the National Comptroller General of Colombia], Bogotá.

Cuaresma, C., J. Hlouskova, and M. Obersteiner (2008), "Natural disasters as creative destruction? Evidence from developing countries", *Economic Inquiry*, Vol. 46, pp. 214-226.

Cummins, J. and O. Mahul (2009), *Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention*, World Bank, Washington DC.

DANE (2013), *Colombia: Exportaciones Totales - Según Agregación CUCI Rev.3 (Mayo de 2013) [Colombia: Total Exports - According to Aggregation CUCI Rev.3 (May 2013)], http://www.dane.gov.co/index.php/comercio-exterior/exportaciones* (accessed 12 November 2013).

Díaz, A. (2013), *Lecciones para la Protección de la Pequeña Agricultura [Lessons for Protection Small-scale Agriculture],* Fasecolda en Línea.

DNP (2012), "Cambio Climático y Políticas Públicas: ¿Qué Está Haciendo el Gobierno Colombiano?" [Climate Change and Public Policy: What is the Colombian Government Doing?], presentation by the Departamento Nacional de Planeación (DNP) [National Planning Department], held by Ana María Loboguerrero at the 3rd Congress of Colombian Economy, Bogotá.

DNP et al. (2012), *ABC: Adaptación Bases Conceptuales - Plan Nacional de Adaptación al Cambio Climático [ABC: Adaptation Conceptual Bases - National Climate Change Adaptación Plan]*, DNP, Bogotá.

ECLAC (2013a), "Panorama del cambio climático en Colombia" [Panorama of climate change in Colombia], *Medio Ambiente y Desarrollo*, No. 146, United Nations Economic Commission for Latin America and the Caribbean (ECLAC), Santiago de Chile.

ECLAC (2013b), "Efecto del cambio climático en el costo de los eventos de interés en salud pública en Colombia: Estudio de caso sobre malaria y dengue" [Climate change effects on the cost of relevant public health issues in Colombia: Case study malaria and dengue], *Medio Ambiente y Desarrollo*, No. 138, ECLAC, Santiago de Chile.

ECLAC (2013c), "Desarrollo de una función agroclimática para estimar la productividad de los cultivos agrícolas en Colombia" [Development of an agroclimatic function to estimate the productivity of agricultural crops in Colombia], *Medio Ambiente y Desarrollo*, No. 147, United Nations Economic Commission for Latin America and the Caribbean, Santiago de Chile.

ECLAC (2012), *Valoración de Daños y Pérdidas - Ola Invernal en Colombia 2010-2011 [Valuation of Damages and Losses - Winter Floods in Colombia 2010-2011]*, ECLAC and Inter-American Development Bank, Bogotá.

Etter, A. and L.A. Villa (2000), "Andean forests and farming systems in part of the Eastern Cordillera (Colombia)", *Mountain Research and Development*, Vol. 20, pp. 236-245.

Government of Colombia (2011), *Plan Nacional de Desarrollo 2010-2014: Prosperidad para Todos [National Development Plan 2010-2014: Prosperity for All]*, Bogotá.

Hallegatte, S. (2009), "Strategies to adapt to an uncertain climate change", *Global Environmental Change*, Vol. 19, pp. 240-247.

Hallegatte, S. and P. Dumas (2009), "Can natural disasters have positive consequences? Investigating the role of embodied technical change", *Ecological Economics*, Vol. 68, pp. 777-786.

Hausmann, R. et al. (2011), *The Atlas of Economic Complexity*, Puritan Press, Cambridge.

Hincapié, J.C.A. et al. (2002), "Transformación y cambio en el uso del suelo en los páramos de Colombia en las últimas décadas" [Transformation and land-use change in the Colombian páramos over the last decades], in Castaño, C. (ed.), *Páramos y Ecosistemas Alto Andinos de Colombia en Condición Hotspot y Global Climatic Tensor [Páramos and Ecosystems in the High Andes of Colombia under the Condition of Hotspot and Global Climate Change]*, pp. 211-333, Bogotá.

IDEAM (2010), *Segunda Comunicación Nacional de Colombia ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático [Second National Communication by Colombia to the UNFCCC]*, IDEAM, Bogotá.

IDEAM (2001), *Primera Comunicación Nacional Colombia ante la Convención Marco de las Naciones Unidas sobre el Cambio Climático [First National Communication by Colombia to the UNFCCC]*, Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM) [Institute of Hydrology, Meteorology and Environmental Studies], Bogotá.IEA (2012), *Energy Balances of non-OECD Countries 2012*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/energy_bal_non-oecd-2013-en*.

IMF (2013), "Colombia", *IMF Country Reports*, No. 13/35, The International Monetary Fund, Washington DC.

INVEMAR (2003), *Colombia: Definición de la Vulnerabilidad de los Sistemas Bio-geofísicos y Socioeconómicos debido a un Cambio en el Nivel del Mar en la Zona Costera Colombiana (Caribe Continental, Caribe Insular y Pacífico) y Medidas para su Adaptación. [Colombia: Definition of Vulnerability of Bio-geophysical and socio-economic Systems due to Changes in Sea-level in the Colombian Coastal Zone (Continental Caribbean, Insular Caribbean and Pacific) and Adaptation Measures],* Instituto de Investigaciones Marinas y Costeras 'José Benito Vives De Andreis [Institute for Maritime and Coastal Research], Santa Marta.

IPCC (2001), *Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

IPCC (2007), *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge and New York.

Laframboise, N. and Loko B. (2012), "Natural disasters: Mitigating impact, managing risks", *IMF Working Paper*, No. 12/245, International Monetary Fund, Washington DC.

McDermott, T., F. Barry and R. Tol (2013), "Disasters and development: Natural disasters, credit constraints and economic growth", *CEDI Discussion Paper Series*, No. 13-03, Centre for Economic Development and Institutions (CEDI), London.

Ministerio de Ambiente, Vivienda y Desarollo Territorial (2010), *Política Nacional para la Gestión Integral del Recurso Hídrico [National Policy for Integrated Water Resources Management]*, Ministry for the Environment, Housing and Regional Development, Bogotá.

Ministerio de Hacienda (2012), *Estrategia Financiera para Disminuir la Vulnerabilidad Fiscal del Estado ante la Occurencia de un Desastre Natural [Financial Strategy to Reduce the State's Fiscal Vulnerability in the Case of a Natural Disaster]*, Ministry of Finance and Public Credit, Bogotá.

OECD (2014a), "Creditor Reporting System: Aid activities", *OECD International Development Statistics* (database), March 2014, *http://dx.doi.org/10.1787/dev-cred-data-en*.

OECD (2014b), *OECD Environmental Performance Reviews: Colombia 2014*, OECD Publishing, Paris.

OECD (2013a), *OECD Economic Surveys: Colombia 2013: Economic Assessment,* OECD Publishing, Paris, *http://dx.doi.org/10.1787/eco_surveys-col-2013-en*.

OECD (2013b), *Water and Climate Change Adaptation: Policies to Navigate Uncharted Waters*, OECD Studies on Water, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264200449-en.*

Ospina Noreña, J.E. et al.(2011), "A proposal for a vulnerability index for hydroelectricity generation in the face of potential climate change in Colombia", *Atmósfera*, Vol. 24, pp. 329-346.

Pabón, D. (2010), *Informe de evaluación del Cambio Climático en Colombia [Evaluation Report of Climate Change in Colombia]*, Universidad Nacional de Colombia y Conservación Internacional, Bogotá.

Planning Secretariat Bogotá (2013a), *Bogotá se Concentra: POT - Una Ciudad Bien Pensada [Bogotá Gets Centered: Territorial Ordering Plan - A City Well Imagined]*, Bogotá.

Planning Secretariat Bogotá (2013b), "Regional integration experience of the city of Bogotá D.C.", Presentation given in Nagoya, Japan, 28th of May 2013, *http://www.uncrd.or.jp/events/doc/130528/UNCRD_EGM_Chica.pdf*.

President of Colombia (forthcoming), Decreto Borrador - Por el cual se crea el Sistema Nacional de Cambio Climático [Draft Decree - By which the National Climate Change System is created], Bogotá.

PRICC (2013), *Avances, logros y retos del PRICC: Resumen ejecutivo del Informe de Gestión a marzo 2013 [Progress and challenges of the PRICC: Executive summary of the Management Report as of March 2013]*, Capital Region, Bogotá-Cundinamarca.

Ramirez-Villegas, J. et al. (2012), "A way forward on adaptation to climate change in Colombian agriculture: Perspectives towards 2050", *Climatic Change*, Vol. 115, pp. 611–628.

Ranger, N. et al. (2011), "An assessment of the potential impact of climate change on flood risk in Mumbai", *Climatic Change*, Vol. 104, pp. 139-167.

Restrepo, J. D. and E.M. Alvarado (2011), "Assessing major environmental issues in the Caribbean and Pacific Coasts of Colombia, South America: An overview of fluvial fluxes, coral reef degradation, and mangrove ecosystems impacted by river diversion", *Treatise on Estuarine and Coastal Science*, Vol. 11, pp. 289-314.

Rincón, L.E. (2013), "Cambio Climático: El Rol del Sector Asegurador" [Climate Change: The Role of the Insurance Industry], *Revista Fasecolda*, No. 151, pp. 30-33.

Rodríguez Becerra, M. et al. (2012), "Adaptación al Cambio Climático y las Locomotoras de Desarrollo - Ideas básicas para el debate", Synthesis of a seminar organised by Friedrich Ebert Stiftung Colombia and Foro Nacional Ambiental, Bogotá.

Slunge, D. (2008), "Conflict, Environment and Climate Change in Colombia", policy brief prepared by the School of Economics and Commercial Law, University of Gothenburg.

SNPAD (2010), *Estado Actual, Perspectivas y Prioridades para los Preparativos ante Desastres en Colombia [Status Quo, Outlook and Priorities for Disaster Preparation in Colombia]*, Sistema Nacional para la Prevención y Atención de Desastres [National System for Disaster Prevention and Response], Bogotá.

Suárez, C. F. et al. (2011), "Land use changes and their synergies with climate change", in Herzog, S.K. et al. (eds) *Climate Change and Biodiversity in the Tropical Andes*, Inter-American Institute for Global Change Research and Scientific Committee on Problems of the Environment, pp. 141-151.

Surminski, S. and D. Oramas-Dorta (2011), *Building Effective and Sustainable Risk Transfer Initiatives in Low- and Middle-Income Economies: What can we Learn from Existing Insurance Schemes?*, Centre for Climate Change Economics a Centre for Climate Change Economics and Policy, Leeds and London.

UNDP (2011), "Colombia rural: Razones para la esperanza [Rural Colombia: Reasons for hope], Human Development Report, United Nations Development Programme (UNDP), Bogotá.

UNGRD (2013), *Colombia: Informe Nacional del Progreso en la Implementación del Marco de Acción de Hyogo (2011-2013) [Colombia: National progress report on the implementation of the Hyogo Framework for Action (2011-2013)]*, Unidad Nacional para la Gestión del Riesgo de Desastres [National Unit for Disaster Risk Management], Bogotá.

UNISDR (2009), *Risk and Poverty in a Changing Climate: Invest Today for a Safer Tomorrow. Global Assessment Report on Disaster Risk Reduction*, United Nations Office for Disaster Risk Reduction (UNISDR), Geneva.

UPME (forthcoming), *Estudio para determinar la vulnerabilidad y las opciones de adaptación del sector energético colombiano frente al cambio climático [Study of vulnerability and adaptation options for the Colombian energy sector in the face of climate change]*, Unidad de Planeación Minero-Energética (UPME) [Mining and Energy Planning Unit], Bogotá.

UPME (2010), *Proyección de Demanda de Energía en Colombia [Projection of Energy Demand in Colombia]*, UPME, Bogotá.

Van der Hammen, T. et al. (2002), "El cambio global y los ecosistemas de alta montaña de Colombia" [Global change and high mountain ecosystems in Colombia], in Castaño, C. (ed.), *Páramos y ecosistemas alto andinos de Colombia en condición hotspot y global climatic tensor [Páramos and ecosystems in the high Andes of Colombia under the condition of hotspot and global climate change]*, Bogotá.

World Bank (2013), *World Development Indicators 2013*, The World Bank, Washington DC. License: Creative Commons Attribution CC BY 3.0.

World Bank (2012), *Analysis of Disaster Risk Management in Colombia: A Contribution to the Creation of Public Policies*, The World Bank: GFDRR, Bogotá.

World Bank (2004), "Colombia: Land policy in transition", Report No. 27942, The World Bank, Washington DC.

Chapter 5

Climate-resilient development in Ethiopia

Ethiopia's objective of reducing its vulnerability to climate extremes and its ambitious growth plans have come together in its Climate-Resilient Green Economy initiative. The initiative aims to transform the country into a middle-income economy by 2025, without increasing net greenhouse gas emissions and while protecting itself against the negative impacts of climate change. This case study brings together the lessons from Ethiopia's experience to date. It discusses the links between climate and socio-economic development in Ethiopia, analyses the key enabling factors, and examines the entry points for building resilience in selected policy areas, focusing on the agricultural sector and macroeconomic management.

Key messages

- Climate and development are strongly interlinked in Ethiopia. Extreme and variable climate is already affecting GDP and the livelihoods of a large part of Ethiopia's population, most of whom are small-scale subsistence farmers. If Ethiopia is to achieve its goal of becoming a middle-income country by 2025, building resilience to current and future climate impacts will be vital.
- Ethiopia's efforts to build a climate-resilient economy have been driven by strong political leadership. The late Prime Minister Meles Zenawi's vision and commitment triggered high-level support across the government, lifting climate change from the environmental sphere to become a cross-government concern.
- There is significant overlap between climate resilience and good development practice. Ethiopia's first sectoral resilience strategy, which focuses on agriculture, revealed that 38 of 41 priority climate resilience options are already being carried out to some extent. This indicates that most early resilience efforts will concentrate on scaling-up and enhancing the resilience of existing measures, rather than crafting new ones. As Ethiopia's future climate conditions are highly uncertain, it will be crucial to adopt an iterative and flexible approach to building resilience.
- Strengthening climate resilience will require a solid fiscal strategy to deal with climate risks. At present, Ethiopia primarily relies on disaster response financing from official development assistance. Strengthening risk reduction and risk sharing mechanisms will help increase Ethiopia's fiscal resilience. This may include both macro-level responses, such as contingency funds and national-level insurance schemes, as well as micro-level measures, such as rural access to finance, climate-smart social protection and micro-insurance schemes.
- Development co-operation providers have contributed substantially to Ethiopia's resilience efforts, through both financial and technical support. Technical support has involved close collaboration between external experts and Ethiopian government officials. This has strengthened the technical knowledge and capacities of local officials while maintaining domestic ownership of the resilience agenda.

Ethiopia is one of the poorest, yet fastest-growing, economies in the world. The country is committed to achieving middle-income status by 2025, but high climate variability and recurrent extreme weather events are putting development achievements at risk (Box 5.1). The social and economic costs arising from climate variation and climate extremes are already significant, and are expected to become even more severe under climate change. If no adaptation measures are taken, climate change may reduce Ethiopia's GDP by as much as 10% by 2050 under extreme scenarios (World Bank, 2010). The Ethiopian government recognises the close link between environmental concerns and economic development and is therefore incorporating climate resilience into its development policies.

The alignment of environmental, social and economic goals led to the launch of the Climate-Resilient Green Economy (CRGE) initiative. Launched in late 2011, the initiative is intended to make Ethiopia's economy resilient to the effects of climate change, while retaining greenhouse gas emissions at a similar level to now. Developed under the leadership of the Environmental Protection Authority (now the Ministry of Environment), the Prime Minister's Office, and the Ethiopian Development Research Institute, the initiative has led to the establishment of new institutions, new efforts in capacity building and financial resource mobilisation, and triggered comprehensive green economy, climate risk and vulnerability analyses. This case study brings together the lessons from Ethiopia's experience to date, focusing on the resilience components, and suggests ways to further improve Ethiopia's climate-resilient development trajectory.

5.1 Ethiopia's development is closely linked to climate

Climate has a strong impact on Ethiopia's population and economy. The country experiences high climate variability, with high and erratic rainfall causing both droughts and floods every year. The impacts are widespread, affecting millions of livelihoods, agricultural production and food security, damaging property and infrastructure, accelerating land degradation, and contributing to malnutrition and water-borne disease (Federal Democratic Republic of Ethiopia, 2007). This section explores how climatic patterns translate into socio-economic damage, and how socio-economic development in turn influences Ethiopia's vulnerability to climate shocks. It does so with reference to the three channels of vulnerability – exposure, sensitivity and adaptive capacity outlined in Box 1.2 in Chapter 1.

The country is highly exposed to climate risks

Ethiopia's topography and location in relation to global weather systems result in very high climate variability, particularly with respect to rainfall. Precipitation varies considerably across the country, and there is a strong variation in the onset, intensity and duration of rainfall. This variability frequently causes hazards resulting from extreme weather events, notably droughts, floods and soil erosion. Since the 1980s, Ethiopia has suffered from seven major droughts – five of which resulted in famines – and numerous local droughts. Droughts have large economic costs, with major event years estimated to reduce Ethiopia's GDP by 1% to 4%. Rain-induced soil erosion is estimated to cost a further 1% of GDP per year (Federal Democratic Republic of Ethiopia, forthcoming a). Concentrated rainfall also caused major floods, including both large-scale flooding in the lowlands and flash floods caused by intensive rainfall after drought periods in the highlands (World Bank, 2010).

Box 5.1 Ethiopia's ambitions for growth

Between 2004 and 2011, Ethiopia's economy grew at an average rate of 10.7% per annum and GDP per capita almost doubled (World Bank, 2013a). Even so, Ethiopia's 92 million inhabitants' average per capita income was USD 370 in 2011, almost four times below the sub-Saharan average of USD 1 270. In 2012, Ethiopia's growth rate decelerated to 7%, and it is projected to stay at about 6.5% over the next five years (World Bank, 2013a; IMF, 2012). The Ethiopian government's growth plan aims to resume double-digit growth rates over the next few years and to reach middle-income status by 2025 (MoFED, 2010). To achieve this, the government aims to increase per capita income to over USD 1 000 by 2025 (Federal Democratic Republic of Ethiopia, forthcoming a). This is an ambitious target, especially in light of its rapidly growing population (2.3% over the past decade).

The agricultural sector is the major component of the Ethiopian economy and its main source of growth. In the 2011/12 financial year, crop production accounted for about one-third of GDP, with livestock and hunting accounting for a further 10% (World Bank, 2013a). Year-to-year agricultural growth rates fluctuate widely, driven by climate variability and fluctuations in international prices for Ethiopia's export crops. The economic contribution of the services sector has been increasing – from 38% to 45% of GDP between 2003/04 and 2011/12, while the agricultural sector decreased from 51% to 44% of GDP (World Bank, 2013a). The industrial sector accounted for around 10% in 2011/12, but it has recently gained pace thanks to a rapid expansion of mining activities. Despite this shift in the structure of the economy, agriculture remains of overriding importance, accounting for 80% of employment and 70% of export earnings (ADB et al., 2012; Bass et al., 2013).

Ethiopia's growth strategy is characterised by high public-sector investment. In 2011/12, public spending accounted for almost two-thirds of total GDP growth. The large public investments were financed through shifts in budgetary priorities, ODA and domestic and external borrowing. While external debt has so far remained at a sustainable level, large domestic borrowing has contributed to inflation, which peaked at 40% in mid-2011. Ethiopia has since managed to reduce the official inflation rate to 7% in March 2013, aided by tighter monetary policy and a slowdown in global food and fuel price inflation (World Bank, 2013a; IMF, 2012). However, mobilising financial resources for the substantial investments foreseen in the government's growth strategy while maintaining a stable macroeconomic environment will be challenging for the Ethiopian government. Ethiopia's high investment rates coexist with a low domestic savings rate of 5.2% of GDP, resulting in a wide and persistent savings and investment gap (MoFED, 2013). The recent stabilisation of a single-digit inflation rate and increasing interest rates (although still negative in real terms) may encourage savings, which will be critical for scaling up investments (IMF, 2013). The World Bank and International Monetary Fund (IMF) have recommended strengthening private sector investment to help sustain growth over the next decade (World Bank, 2013a; IMF, 2012).

The public sector-led growth strategy has been positive for poverty reduction and development. The number of people living below the national poverty line (less than USD 0.6 a day) decreased from 38.7% to 29.6% between 2004/05 and 2010/11 (MoFED, 2012a). Ethiopia has also achieved notable progress in human development, increasing life expectancy by 8 years, and expected years of schooling from 4.4 to 8.7 years over the past decade. Ethiopia is on track to meet its Millennium Development Goals (MDGs) on child mortality, HIV/AIDS and malaria (UNDP, 2013). However, poverty remains high by international standards. Almost 80% of the Ethiopian population live under the USD 2 poverty line; 39% live in extreme poverty with less than USD 1.25 a day (World Bank, 2012a). The absolute number of people affected by food poverty increased by almost 2 million over the last decade, reaching 28.4 million in 2010/11. Ethiopia currently ranks 173 out of 187 countries in the Human Development Index. Significant investment will be needed to meet the scale of these challenges.

Geographical patterns, such as the location of human settlements and economic activity, further increase Ethiopia's exposure to climate risks. These patterns are strongly shaped by Ethiopia's diverse topography and consequently varied ecological and climatic conditions. The country encompasses alpine, vegetated cool highlands (2 500 m to 4 000 m above sea-level) and hyper-arid lowlands with desert-type vegetation (Mengistu, 2006). About 90% of Ethiopia's population and most of its food crop production are concentrated in the country's humid highlands (World Bank, 2010). About two-thirds of these lands usually receive sufficient rainfall to sustain agricultural production, but the high variation in rainfall across seasons and years puts agricultural activity and livelihoods at risk. About 10% of the Ethiopian population (largely pastoralists and agro-pastoralists) reside in lowland areas that face increased risk of drought. Rapid population growth and urbanisation is exposing an increasing proportion of Ethiopia's population and assets to flooding. For example, the rapidly growing capital of Addis Ababa has experienced an increasing number of flash floods during the rainy seasons in recent years (Bass et al., 2013; World Bank, 2013b).

Climate change is projected to expose Ethiopia to even greater weather variability. Ethiopia's average annual temperature is projected to increase by 1.5°C to 3°C by the 2050s (relative to the baseline 1961-1990 period) (Federal Democratic Republic of Ethiopia, forthcoming a). There is large uncertainty over how this increase will affect yearly and seasonal rainfall. Projections of the change in annual rainfall range from -30% to +30% by the 2050s (Federal Democratic Republic of Ethiopia, forthcoming a). Increases in extreme events (heavy precipitation and drought periods) are also possible, though there is considerable uncertainty about these changes. In models projecting increased incidences of such events, losses are expected to concentrate in the densely cultivated and populated highlands (World Bank, 2010; Ferede et al., 2013). There is also evidence that climate change, in combination with development and population pressures, will exacerbate asset destruction in urban areas due to flood events (Jalayer et al., 2013).

The economy is sensitive to climate impacts

Ethiopia's sensitivity to climate change stems from its dependence on climate-sensitive activities for economic development, notably rain-fed agriculture. Despite a gradual shift in the economy's economic structure towards the service and industry sector, agriculture remains the central pillar of the Ethiopian economy, accounting for 44% of GDP in 2011 (World Bank, 2013a). More than 90% of total agricultural crop output (which accounts for two thirds of agricultural GDP) is produced by small-scale household farmers who rely on rain-fed and traditional farming techniques (World Bank, 2010; Federal Democratic Republic of Ethiopia, forthcoming a). This makes agricultural yields strongly dependent on prevailing climate conditions. Pastoralism and livestock production in the arid lowlands, which account for 26% of agricultural GDP, are also climate-sensitive. Under some climate scenarios, changes in the onset or intensity of rainfall are projected to decrease agricultural productivity and production in many regions (Robinson et al., 2013; Ferede et al., 2013). As the majority of the Ethiopian population derives its income directly or indirectly from agriculture, fluctuations in agricultural production can have strong effects on household income and food security. Due to its central role for income and employment, shocks to the agricultural sector will also be transmitted to other sectors of the economy. Section 5.3 looks at the sensitivity of agriculture in greater detail.

Transport and energy infrastructure in Ethiopia are also climate-sensitive. Approximately 80% of Ethiopia's road network consists of unpaved roads (Federal

Democratic Republic of Ethiopia, 2007; World Bank, 2010). As these can easily be degraded by heavy rains and floods, Ethiopia's road system is regularly damaged by climate extremes, interrupting supply chains. Ethiopia's energy infrastructure is linked to climatic conditions through its strong reliance on hydroelectric power generation. To date, rainfall variability has had little impact on power generation capacity. However, the sector's sensitivity is expected to increase non-linearly after 2030, due to a combination of climate change and a significantly greater volume of hydroelectric power generation (World Bank, 2010). Pressures are likely to increase further as competing water demands for agricultural irrigation become stronger. Depending on future hydropower investments, new climatic conditions and higher competition for water could therefore lead to significant fluctuations in annual energy generation, impeding both domestic industrial growth and expected electricity exports.

Climate sensitivity is also likely to increase due to accelerating pressures on ecosystems and natural resources. Uncontrolled land conversion could accelerate environmental degradation and decrease the resilience of ecosystems to climate impacts (Secretariat of the Convention on Biological Diversity, 2009). Some land management practices, such as over-cultivation and over-grazing, have already led to severe land degradation. This, combined with population pressures and deforestation, has put ecosystems under significant pressure and increased the sensitivity of Ethiopia's forest, water and biodiversity resources (Federal Democratic Republic of Ethiopia, 2001). In some highland areas, pressures on land resources have led to an expansion of the agricultural frontier into forest areas and steep slopes, which has accelerated environmental degradation and made agricultural production very vulnerable to weather shocks (Diao, 2010).

The Ethiopian government recognises climate variability as one of the major causes of the fluctuations in its real GDP growth rates (Federal Democratic Republic of Ethiopia, 2001). Figure 5.1 shows a time series of rainfall variation against GDP growth, demonstrating the strong correlation between climate and the economy. It can be noted that a decoupling appears to have occurred after 2000. The authors of the study suggest that this may be explained by the fact that the 2000-2003 droughts were concentrated in southern and south-eastern Ethiopia where productivity and contribution to GDP are relatively low (Conway and Schipper, 2011). Alternatively, it might indicate a decrease in the economy's climate sensitivity, for instance due to the increasing share of other, less sensitive sectors, or enhanced social protection in vulnerable areas.

Adaptive capacity is constrained by poverty

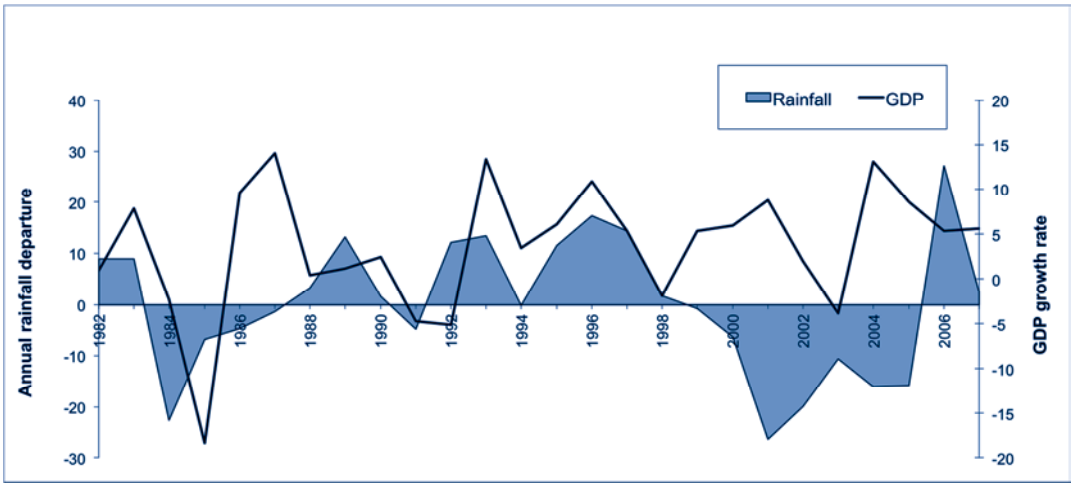
The economic and social impacts of high exposure and sensitivity to climate risks can be cushioned if adaptive capacity is high. As a low-income country, Ethiopia's capacity to adapt to climate impacts is generally viewed to be constrained (World Bank, 2010). Traditional strategies to cope with climate variations and extreme weather events include reducing consumption, selling assets such as livestock and agricultural tools, and migrating either temporarily or permanently in search of employment (Federal Democratic Republic of Ethiopia, 2007). Coping strategies that involve the depletion of productive assets, such as the sale of livestock, can have severe and long-lasting consequences for poor households. If a climatic shock is severe enough to make it impossible for households to rebuild their asset stock, it may even create poverty traps (Carter et al., 2007). In Ethiopia, such strategies are however common practice for small-scale farmers and large parts of the rural population. Uptake of modern adaptation measures, such as small-scale irrigation systems, new seed variations, and other

engineering solutions, remains low in Ethiopia. This is often due to lack of financial and technical capacity at the macro level, and capital and knowledge constraints at the micro level (MoARD, 2010).

Adaptive capacity is closely linked to economic growth and generic development factors such as education, income and health. Indeed, an International Institute for Sustainable Development study on the adaptive capacity of selected local communities in Ethiopia confirms that limited education and skills, and limited access to information, financial services and markets were key constraints for individuals to adapt to changing climatic conditions, along with other pressures such as environmental degradation and population growth (Riche et al., 2010). Inclusive economic growth is likely to improve the adaptive capacity of Ethiopia's population and economy; as will the gradual improvement in market access, capital access, and productivity of the economy. Development policies and programmes can accelerate this process by explicitly examining how interventions affect individual or community capacity to adapt. This would require a careful analysis of the particular constraints in the targeted region, or social group, in order to understand which livelihood resources are sensitive to climate hazards, and which resources are important for adaptation.

Figure 5.1 Relationship between rainfall variability and GDP growth in Ethiopia, 1982-2007

Ethiopia rainfall departure from the mean and GDP growth (correlation = 0.10, one-year lag correlation = 0.24)



Data used in figure: Conway, D. and L. Schipper (2011), "Adaptation to Climate Change in Africa: Challenges and Opportunities Identified from Ethiopia", *Global Environmental Change*, Vol. 21, pp. 227-237; figure source: Declan Conway.

5.2 Ethiopia is taking steps towards climate-resilient development

Ethiopia has recognised the close links between development and climate resilience and therefore aims to bring its responses to climate change into its broader growth and development planning processes. This section discusses the steps Ethiopia has taken to achieve this. It outlines how Ethiopia has been implementing the building blocks of climate-resilient development, starting with creating a policy framework which makes climate central to the planning process. This framework is being implemented by creating a well-structured institutional set-up, building the capacity required, mobilising the necessary financial resources and strengthening the evidence base. The role played by

development support providers has been crucial throughout, and this role is also discussed below.

The Climate-Resilient Green Economy initiative

Ethiopia is developing a strategic, national-level response to climate change, driven by strong political leadership. This response has been triggered by awareness of the magnitude of climate impacts on the economy and people, both historically and in the future. Ethiopia's current national development plan – the Growth and Transformation Plan 2010-2015 (GTP; Box 5.3) – explicitly identifies climate variability and climate change as threats to development goals, and calls for "[a] plan of action, strategies, laws, standards and guidelines (…) to lessen the effect of forecasted climate change" (MoFED, 2010). This was complemented by the strong leadership and vision of the late Prime Minister Meles Zenawi to put Ethiopia on a climate-resilient green development path. This has been an important trigger for high-level engagement and policy action across ministries (Bass et al. 2013).

With the launch of the Climate-Resilient Green Economy (CRGE) initiative in September 2011, Ethiopia laid the foundation for integrated planning for climate-resilient development. The CRGE process builds on Ethiopia's national development plan, with a view to ensuring that Ethiopia's development targets are achieved in a low-carbon and climate-resilient manner (EPA, 2011). The CRGE's three key objectives are to foster growth and economic development; manage greenhouse gas emissions; and improve resilience to climate change. This marks a significant shift in Ethiopia's climate change policy, lifting both climate change mitigation and adaptation from the environmental sector to become a cross-government concern. To achieve full integration of climate resilience and green growth into development planning, Ethiopia intends to integrate the CRGE into the next period of the national development plan (2015-2020; see next section for details).

The CRGE consists of four elements which, once finalised, are intended to build a comprehensive national framework for Ethiopia's climate change mitigation and adaptation policy:

1. the development of a national *vision*, laying out the key objectives and long-term development goals;
2. the development of a national *strategy*, outlining concrete steps for both climate change adaptation and mitigation;
3. the establishment of an *institutional climate change system* to facilitate cross-governmental co-operation and planning linkages; and
4. the establishment of *financial and capacity-building mechanisms* to support the implementation of the national CRGE strategy.

The vision summarises key challenges and opportunities arising from climate change in Ethiopia, defines common goals and objectives, and outlines key steps required to achieve climate-resilient development. Prepared under the leadership of the Prime Minister's Office, the CRGE vision has been an important step for creating awareness about the benefits of climate resilience for economic and social development across the government, and has helped build a momentum for change. The CRGE vision also received significant international attention when it was presented at the 2011 climate negotiations in Durban.

Building on this vision, Ethiopia began to develop a national CRGE strategy to identify and prioritise concrete steps for building a climate-resilient green economy. The CRGE strategy has two components: the mitigation-focused Green Economy Strategy (GES) and the adaptation-focused Climate Resilience Strategy (CRS). The GES was published in September 2011 (Federal Democratic Republic of Ethiopia, 2011), and the development of the CRS began in early 2012. The CRS will be implemented through resilience strategies for several sectors. The first sectoral CRS on agriculture was released in October 2013 (see section 5.3); the second CRS – on water and energy – is currently being developed. This sequential approach to climate-resilience planning will allow Ethiopia to focus its capacity and resources on specific sectors, i.e. those which are most important to the economy, or which are most at risk from climate change.

The subsequent sections provide more detail on the institutional arrangements, capacity-building and financing mechanisms, data and evidence and role of international co-operation.

An effective institutional set-up is evolving

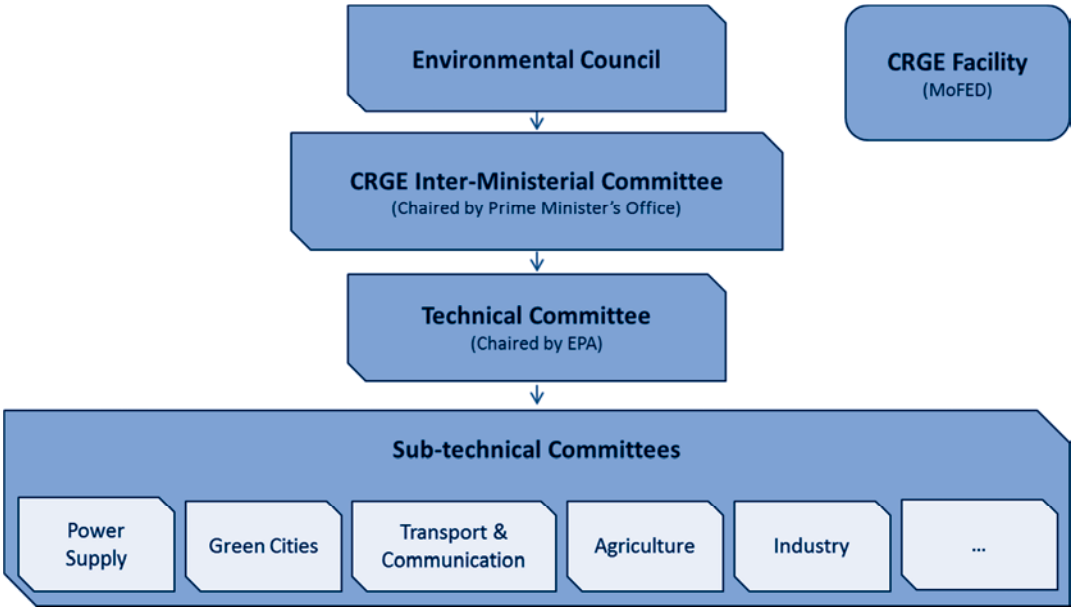
Linking climate change and development planning requires close co-ordination and co-operation across ministries and levels of government (OECD, 2009). The institutional system that Ethiopia designed to development and implement the CRGE has evolved significantly over the past three years, in response to emerging administrative, co-ordination or technical needs[1]. The changing nature of the CRGE's institutional framework reflects the novelty of the challenges posed by climate-resilient development, and the need to adopt a flexible, "learning-by-doing" approach.

To spur the development of the CRGE strategy in early 2011, Ethiopia put in place an institutional system that was based on inter-ministerial committees at different levels of government (Figure 5.2):

- *Sub-technical committees* composed of government officials from various line ministries were established to develop the sectoral components of the strategy.
- A cross-sectoral *Technical Committee* chaired by the Ministry of Environment and Forest (MEF) was set up to co-ordinate and the sectoral work.
- The *CRGE Inter-Ministerial Committee*, was established to directly oversee and guide the process to ensure overall policy coherence and alignment to existing government structures. The committee is composed of high-level representatives from line ministries and chaired by the Prime Minister's Office, which provided a direct link to Ethiopia's key national planning institution.

The CRGE Facility has been set up within the Ministry of Finance and Economic Development (MoFED) to secure finance for implementation (see details below). The Environmental Council – an established public institution chaired by the Prime Minister and comprising members from federal ministries, presidents of regional states, private sector and civil society – kept overall responsibility and oversight.

Figure 5.2 The institutional structure for Ethiopia's Climate-Resilient Green Economy Strategy



Sources: Adapted from EPA (2011), *Ethiopia's Vision for a Climate-Resilient Green Economy*, Federal Environmental Protection Authority of Ethiopia (EPA), Addis Ababa; and EPA (2012), *United Nations Conference on Sustainable Development (Rio+20): National Report of Ethiopia*, EPA, Federal Democratic Republic of Ethiopia, Addis Ababa.

This committee-based structure was chosen so as to maximise stakeholder engagement. The new cross-sectoral bodies were established to facilitate co-ordination across ministries and levels of government, and to better allocate responsibilities, overcome potential conflicts and avoid unnecessary duplication of activities. The lower-level technical teams ensured that the necessary technical and operational expertise would feed into decision making. Both the mitigation-based GES and the adaptation-focused CRS for agriculture have been developed using this framework. The development of the GES, for example, involved seven sectoral teams with more than 50 experts from 20 government institutions (EPA, 2012; Federal Democratic Republic of Ethiopia, 2011).

To move from strategies to action, Ethiopia replaced this initial structure with a comprehensive implementation framework. The Sectoral Reduction Mechanism (SRM) has been designed to support a truly programmatic and long-term approach to CRGE implementation. The SRM's five key objectives are (Federal Democratic Republic of Ethiopia, forthcoming b):

1. to systematically *mainstream* green growth and climate resilience into all of Ethiopia's economic development planning;
2. to *leverage finance* by making catalytic investments through a multi-donor trust fund;
3. to *ensure policy coherence* by institutionalising a process of co-ordination;
4. to *inform policy making* by making potential barriers and trade-offs transparent; and
5. to *create synergies* within plans, programmes, and global conventions.

The SRM allocates clear roles and responsibilities to a wide range of public institutions (Figure 5.3). In short, the system foresees that implementing entities (i.e. federal line ministries and regional governments), develop sectoral and regional implementation plans as well as concrete investment proposals. This process will be supported and guided by the CRGE Facility, the central institution responsible for CRGE delivery. The implementation plans will be reviewed by the CRGE Advisory Board, a body comprising development partners, academia, civil society and private sector representatives. They will then be submitted to the CRGE Management Committee for approval. The Management Committee is comprised of state ministers and high-level government officials, and is chaired jointly by MEF and MoFED state ministers.

The SRM builds on the initial institutional set-up, but shifts from the committee-based structure to rely more on permanent and full-time teams. Each executing entity should establish permanent CRGE units, and there will be a permanent secretariat in the CRGE Facility, comprising a technical team with staff from MEF and a finance team within MoFED. These teams are currently being established, with varying progress across ministries. The Ministry of Agriculture (MoA), for instance, has established a team of four full-time staff members to work on CRGE implementation. Additional staff may be needed at sub-national levels, however, given MoA's size and volume of activity in regions and districts. Other ministries face difficulties in employing sufficient staff devoted to the CRGE, partly because of capacity and financial constraints.

Figure 5.3 The key features of Ethiopia's Sectoral Reduction Mechanism for CRGE implementation

Source: Federal Democratic Republic of Ethiopia (forthcoming b), *Sectoral Reduction Mechanism Framewor*k, draft, January 2014, Addis Ababa.

Capacity could be a key constraint

Capacity constraints in the public sector are a major challenge to implementing the CRGE effectively. Human resources and capacities, statistical and technical knowledge, and financial resources are constrained at all levels of government, particularly at the regional and local level where many public services are delivered. These challenges are amplified by a high level of staff turnover, which makes it difficult to build and maintain the technical capacity. Identifying capacity needs at each level and implementing appropriate capacity-building measures will therefore be critical for translating national-level decisions for climate resilience into policy action on the ground.

Capacity constraints are likely to be a particular challenge for the implementing entities, which have prime responsibility for planning and delivering CRGE interventions. For example, the sectoral and regional implementation plans, which implementing entities will develop, are subject to a comprehensive set of requirements and criteria (Federal Democratic Republic of Ethiopia, forthcoming b). These plans are required to:

- provide a sector-wide assessment of targets, plans and programmatic adjustments and interventions, and identify priority areas of action;
- be technically and financially viable (to be verified by the technical and finance teams within the CRGE Facility);
- outline the delivery mechanisms, implementation risks and potential trade-offs with the objectives of the Growth and Transformation Plan 2010-15; and
- include a monitoring and evaluation framework with expected outputs, outcomes and indicators.

Implementing entities are also responsible for developing concrete investment proposals in collaboration with private enterprises, parastatals, and other entities delivering CRGE investments with facility resources. Yet many ministries currently lack the skills, knowledge and technical expertise on climate change and resilience to deliver all this in the near to medium-term.

For these reasons, the Ethiopian government is planning to introduce a comprehensive, multi-year programme to increase capacity in all institutions involved in CRGE implementation. The details of this programme will be developed in 2014, in consultation with sectors and regions. The programme will likely involve an iterative process of capacity needs assessment and response, and will increase in scope and scale over the next few years. It will focus initially on capacity building within MoFED and MEF – the two key institutions for climate resilience-related work – before expanding to include implementing entities, the private sector, civil society organisations and other institutions that are active on the ground. The success of these capacity-building measures will be vital to stimulate CRGE activities across the government.

This programme is complemented by ad hoc measures to address immediate capacity needs. For example, to encourage immediate action within ministries and regional governments, MEF has already begun to organise workshops for sectoral and sub-national policy makers on how the SRM and the CRGE Facility work (MEF, 2013). As implementing agencies begin developing their sectoral or regional implementation plans, they can request capacity-building support through the SRM, to be provided by the technical team within the CRGE Facility. Whether the facility itself possesses sufficient capacity to deliver this service remains to be seen. To build a technical cadre of future policy makers and analysts, the Ethiopian government has established a graduate

programme in climate economics at Addis Ababa University. It also upgraded the Environmental Protection Agency to ministerial level (to become the Ministry of Environment and Forest, MEF) in late 2013. This may prove an important step for strengthening the former agency's profile and political weight.

Additional financing will be needed

While there are many synergies between resilience and development, aligning the two may imply additional costs in some cases. The CRGE is therefore likely to add to Ethiopia's already significant financing requirements for meeting its ambitious growth and investment goals (Box 5.1). Implementing the Green Economy Strategy component alone is estimated to require investments of USD 150 billion up to 2030 (Federal Democratic Republic of Ethiopia, 2011).[2] While the full costs of the CRS have yet to be identified, pressure on both domestic and international finance to deliver resilience-building is likely to increase. Between 2010 and 2012, total ODA, including finance from multilateral institutions, averaged USD 3.7 billion per year, equivalent to 12% of GNI (OECD, 2014). There are no comprehensive data on the extent to which these funds were intended to support resilience. However, OECD DAC statistics show that 10% of the USD 1.9 billion bilateral ODA provided by their members was marked as targeting climate change adaptation as a principal or significant objective.

The CRGE Facility aims to mobilise additional resources and to ensure that implementing entities have access to sufficient funds. The facility is intended to channel all climate and domestic finance into a single multi-donor trust fund (EPA, 2011). Institutions can apply directly to this fund, rather than attempting to source funding themselves from climate finance providers. While primarily targeted at government institutions, other actors (e.g. civil society and private sector organisations) may also apply for financing.

The facility is based in and managed by MoFED. The UNDP has played a key role in establishing the facility by initially providing fiduciary risk and financial management functions (MoFED, 2012b). UNDP will also manage a multi-partner trust fund housed in New York. The intention of these arrangements is to enable the Ethiopian government to attract more external financing than would be available if it only had a domestically-managed account. At the same time, it should allow the Ethiopian government to build up its domestic capacity for attracting, managing and disbursing climate finance. The facility became operational in late 2012, with Austria providing an initial tranche of development support. The government of the United Kingdom recently provided a further substantial tranche (USD 24 million), and the Norwegian government has announced the provision of another USD 60 million every year for five years. In addition, the Ethiopian Parliament has endorsed an allocation of 2% of the federal budget to the facility (Federal Democratic Republic of Ethiopia, 2013).

The government of Ethiopia has designed a two-track approach to financing the CRGE, to allow for both long-term strategic planning and immediate action (Federal Democratic Republic of Ethiopia, forthcoming b). To support longer-term strategic planning, the CRGE Facility will allocate resources to ministries and regional governments against the prioritised investments detailed in their sectoral and regional implementation plans. These resources will complement existing investment and funding streams, meaning that ministries can draw on the facility for additional funding for CRGE projects. Resources disbursed from the facility are intended to be channelled through existing delivery mechanisms where possible.

At the same time, so-called "fast-track investments" will allow implementing agencies to commence immediate action. Line ministries and regional governments are invited to develop fast-track investment proposals for projects that align with both CRGE priorities and GTP objectives. High-level guidance and ad hoc support from the CRGE Facility will be provided to accelerate the development of these fast-track proposals, so that implementation can commence before 2015, when the next period of the national development plan begins. The intention of these fast-track investments is to build momentum and spur the development of CRGE activities across the government; to deploy CRGE Facility resources that are already available; and to pilot and test CRGE investments. The lessons learned from the fast-track pilots will then feed back into the development of the next national development plan, 2015-2020.

Data and evidence are being developed

Data limitations and incomplete information about climate impacts remain a challenge. Ethiopia's diverse topography and high current climate variability complicate the estimation of future climate impacts. Capacity and resource constraints exacerbate these problems. To date much of the climate information available on Ethiopia has been generated by external actors, including academics, NGOs and international agencies. The World Bank's *Economics of Adaptation to Climate Change* (2010), for example, provides partial sectoral cost estimates of climate impacts under different climate change scenarios, as well as indicative, technical adaptation costs for Ethiopia. However, as with many developing countries, local-scale data and detailed estimates on climate impacts and costs remain limited. Scaling-up efforts to gather tailored and down-scaled data and projections will therefore be crucial for climate resilience, particularly in such a geographically and climatically diverse country. These efforts must not come at the expense of inaction today though, given Ethiopia's current resilience gap.

The CRGE initiative has triggered considerable data advances. The CRS for agriculture, for example, has produced a detailed vulnerability analysis of livelihoods in Ethiopia's various agro-ecological regions. This analysis combines climatic hazard maps with livelihood maps to identify the key socio-economic challenges that are likely to arise due to climate change. This work has benefited substantially from the support of external partners. MEF has also analysed vulnerabilities and adaptation options for key economic sub-sectors, such as coffee and sugar. While these activities have helped identify key risks and priority responses, developing similarly detailed analyses for other sectors will require significant resources and thus continued support from development co-operation partners.

Where resources and capacities for advanced analysis are limited, a systematic analysis of existing climate data can inform policy making. Ethiopia's complex climate patterns make modelling of future climate and future vulnerabilities highly challenging. The CRS for agriculture considered "downscaled" climate model information, finding that these results were characterised by large uncertainty bounds. However, this was complemented by a systematic analysis of historical climate data, which yielded important and policy-relevant results. For example, the analysis of satellite and rain gauge data revealed a 20% decline in rainfall since the 1960s in south-central Ethiopia (Funk et al., 2012). If these trends were to continue, crop yields and pasture conditions could be heavily affected. This finding – which stands in contrast to climate modelling results, which project increasing rainfall for this area – caught the government's attention and triggered policy engagement in climate adaptation and resilience measures. It also

highlights the informative value that systematic and in-depth analyses of historical climate data can have.

While continued investment in sectoral climate and vulnerability assessments are critical, it will also be important to strengthen the capacity of Ethiopia's National Meteorology Agency (NMA). The NMA collects and analyses climate-relevant data and produces weather forecasts and early warnings to inform policy making. However, the data and service are impeded by resource constraints. For example, the uneven distribution of weather stations across the country – with most stations located in cities and towns along the main roads – limits the availability of climate information and services for rural communities (Dinku et al., 2011). Moreover, where records do exist, they often suffer from data gaps and variable quality, and are hard to access. Recent investments, however, have expanded the network of weather stations and improved the quality of and access to climate-related data. For example, in 2012 the NMA (with technical support from external partners) upgraded its website to offer online access to nearly 30 years of rainfall and temperature records on a ten-day timescale, incorporating measurements from rain gauges, temperature stations and satellites (Thomson Reuters Foundation, 2012). The NMA has also started to provide tailored downscaled forecasts in some districts to improve the agro-climatic forecasting. More investment in these types of efforts will be just as important as advances in sectoral vulnerability and climate impact reports.

The role of international co-operation has been crucial

Providers of development co-operation have played a key role in supporting countries to integrate climate resilience into their national planning processes. In Ethiopia, they provided critical support in the development of the national climate resilience framework. The CRGE was initiated domestically and co-ordinated by the Ethiopian government, yet the development of both the GES and the CRS for agriculture has drawn on input and support from external development partners. The Global Green Growth Institute (GGGI) in particular provided substantial support to the development of the CRGE, from the data collection phase to the prioritisation of mitigation and adaptation measures. Close co-operation between Ethiopian government officials and development co-operation providers proved valuable for building domestic capacity, while at the same time strengthening domestic ownership.

Despite this, there have been concerns about the extent to which the CRGE is an externally promoted and conducted exercise (Bass et al., 2013). Experience has shown that limited ownership risks eroding the commitment across ministries, particularly if ministry staff lack the technical capacity to understand the analysis done by the external experts (Bass et al., 2013). It is therefore critical to strike a balance between external support and domestic ownership. At present, as in many developing countries, there is a tendency for development support in Ethiopia to be fragmented, ad-hoc and supply-driven (OECD, 2012). Ethiopia’s long-term vision and investment frameworks under the CRGE may however help ensure that that development co-operation flows are better co-ordinated and aligned with national priorities.

5.3 What are the policy priorities for building resilience?

In Ethiopia, economic activity is strongly driven by government decisions. Public-sector investment accounted for almost two-thirds of total GDP growth in 2011/12 (World Bank, 2013a). Public sector interventions, in turn, are strongly linked to Ethiopia's five-year national development plan. Linking climate to the development and implementation of these plans provides a key entry point for building resilience. This section will briefly sketch out development planning and development trends in Ethiopia and their links to climate resilience. The two sub-sections analyse two entry points of particular relevance for Ethiopia: agricultural development planning and macro-economic management.

Ethiopia's national development plan, the GTP 2010-2015, is the country's key policy document. The GTP outlines the medium-term growth strategy to transform Ethiopia into a middle-income economy by 2025, including development objectives, strategies and targets for each economic sector (Box 5.2). Guiding policy making at all levels of government, the GTP has a direct influence on Ethiopia's socio-economic patterns of development and hence its future vulnerabilities to climate. In addition to the GTP, Ethiopia has a small number of "off-budget" development programmes, such as the Productive Safety Net Programme (see below), which are also important drivers of development. Adjusting these programmes to make them "climate smart" will be equally important. Effectively building climate resilience into both these pillars will be vital for Ethiopia's development.

The CRGE intends to "climate-proof" the GTP by supporting the achievement of Ethiopia's development goals while managing greenhouse gas emissions and enhancing the country's resilience to adverse climate impacts. This will be done by fully integrating the CRGE into the GTP for the planning period 2015-2020. Efforts to climate-proof current development objectives have so far concentrated on agriculture, water and energy: the first sectors to develop sectoral resilience strategies. Those ministries that have not yet begun to develop sectoral resilience strategies are expected to include CRGE objectives in their sectoral development plans, which will directly feed into the GTP 2015-2020. The CRGE Facility's "fast-track investments" finance (see above) will also help stimulate action across ministries. However, it remains to be seen whether the existing structures and capacities in line ministries are sufficiently developed to allow for a systematic integration of resilience into their planning. Experience from other countries suggests that close collaboration between the key institutions – i.e. the CRGE Facility and the National Planning Commission, which co-ordinates GTP 2015-20 development – will be crucial.

Reconsidering development objectives with a view to future vulnerabilities is both important and timely. As a fast-growing economy, Ethiopia is likely to see considerable structural transformation of its economy over the next decade. The direction that this transformation takes will have important consequences for Ethiopia's vulnerability to climate variability and future climate change. Linking resilience efforts to development objectives will make decisions affecting future vulnerability explicit as well as the implications for vulnerability arising from different policy options.

Box 5.2 Ethiopia's Growth and Transformation Plan 2010-2015

The main goals of the GTP are to achieve high growth rates so as to reduce poverty and meet the MDGs. It sets the path for Ethiopia to reach middle-income status by 2025. Its stated objectives are to attain GDP growth rates of 11% within a stable macroeconomic framework; to achieve the MDGs in the social sector; and to establish a stable democratic and developmental state. Economic growth and employment creation are the key means for accomplishing these objectives.

OBJECTIVES
1. Maintain at least an average real GDP growth rate of 11% and meet the Millennium Development Goals
2. Expand and ensure the quality of education and health services, thereby achieving the MDGs in the social sectors
3. Establish favourable conditions for sustainable state building through the creation of a stable democratic and developmental state
4. Ensure growth sustainability by realising all the above objectives within a stable macroeconomic framework

STRATEGIC PILLARS						
1	2	3	4	5	6	7
Sustaining faster and equitable economic growth	Maintaining **agriculture** as a major source of growth	Creating favourable conditions for **industry** to play a key role in the economy	Enhancing expansion and quality of **infrastructure** development	Enhancing expansion and quality of **social development**	Building capacity and deepening **good governance**	Promoting **women and youth empowerment** and equitable benefits

The GTP envisages modern **agriculture** as the primary engine of growth, with the industrial sector playing an increasing role over time. The strong support for the agricultural sector reflects the sector's importance in terms of both GDP and employment. The GTP supports the intensification of the production of marketable agricultural products by both small and large farmers. This intensification relies on a shift towards high value crops, greater commercialisation and greater support for large-scale commercial agriculture. The agricultural development plan also includes support for smallholder farmers, by encouraging a scaling-up of best technologies and practices, expansion of small-scale irrigation schemes and a gradual shift to the production of high-value crops. The GTP also encourages greater development of pastoral areas and targeted interventions to boost livestock production and its contribution to the economy. Chemical fertilisers are also intended to play an important role in boosting productivity.

Industry is intended to play an increasingly important role in Ethiopia's economy, with its contribution to GDP projected to increase from 13% in 2010 to 32% in 2025. The Federal Government intends to provide additional support to export-oriented and import-substituting industries, and for industries that are labour-intensive and based on agricultural inputs. Micro and small enterprises are therefore a key strategic focus, though there will also be support for a range of medium and large industries (including textiles, leather, sugar, cement, metals and engineering, chemicals, pharmaceuticals and agro-processing).

The GTP also contains plans for extensive **infrastructure** investments, which are intended to support economic growth in the short term and to build the foundation for future growth and industrial development. The GTP's targets for the 2010-2015 period include expanding the road network by 30%, increasing power generation capacity by 300%, doubling the construction of electricity distribution lines, increasing potable water coverage from 68.5% to 98.5%, and increasing the land developed for medium and large- scale irrigation schemes from 2.5% to 15.6%. The GTP recognises that previous efforts to increase infrastructure provision have been

Box 5.2 Ethiopia's Growth and Transformation Plan 2010-2015 (continued)

hampered by shortfalls in the foreign capital required to meet all investment needs, and by insufficient domestic capacity for infrastructure development and hence a reliance on foreign capacity. While the GTP makes explicit provisions to increase domestic savings and reduce foreign currency needs by promoting the substitution of imports by domestic products and services, it nonetheless envisages that external official development assistance will be necessary to fund all planned investments.

Source: based on: MoFED (2010), *Growth and Transformation Plan 2010/10-2014/15*, MoFED, Addis Ababa; and EPA (2011), *Ethiopia's Vision for a Climate-Resilient Green Economy*, Federal Environmental Protection Authority of Ethiopia, Addis Ababa.

There is considerable overlap between the GTP's economic growth and poverty reduction objectives and the CRGE's climate-related goals. For example, the GTP places substantive emphasis on capacity building within public institutions. Improved institutional quality will also help the government to better cope with climate shocks, e.g. in providing emergency services, or capacity building services for citizens. Another example is agricultural irrigation. The GTP aims at increasing small-scale irrigation from about 850 to 1 850 million hectares, and to increase the percentage of land developed for medium and large-scale irrigation schemes from 2% to 15.6% by 2015 (MoFED, 2010). Such investments are intended to smooth agricultural production on an aggregate level.

In some cases however, "business-as-usual" development strategies may also increase climate vulnerabilities. For example, irrigation is not well regulated at present and there is scope to improve integrated water resource management. Industrial development and socio-economic trends (such as population growth and rising incomes) will increase pressure on water resources, exacerbating the possible risk of water scarcity is some parts of the country. Another example is the transport sector. The GTP foresees a broad expansion of the country's road network. At present, a large part of the network consists of unpaved roads, which are easily damaged by flooding. This leads to disruption of supply chains and creates the need for frequent maintenance. The benefits of "climate-proofing" road design standards would exceed the costs, but doing so would make it more expensive to reach the targets set in the GTP (World Bank, 2010).

Further examples of potential synergies and conflicts are provided in Table 5.1, which maps the economic sectors that are likely to be important for Ethiopia's medium-term economic development against potential synergies and trade-offs with climate resilience. Understanding these links and making them explicit when assessing the merits of different policy options is vital, and may reveal the need to deviate from the "business as usual" development path. The CRS for agriculture is a good example of how this can work in practice. Looking forward, it will be important that Ethiopia undertakes similar analysis for remaining sectors, particularly fast growing and vulnerable ones, such as infrastructure, and those expected to gain in importance over the next decade, such as industry.

Table 5.1 Sectoral development trends and possible links to climate resilience in Ethiopia

Economic Sectors	Growth trends / targets under the GTP	Sensitivity to climate change	Potential synergies with climate-resilience	Potential trade-offs with climate-resilience
Agriculture & rural development	• Agricultural growth of 9% foreseen for 2010-15; through increases in both crop and livestock production; smallholder support promoting best-practices, use of fertiliser, shift to higher-value crops; focus on 'high-potential areas' • Promotion of medium and large-scale agricultural farms	• High, though depends on agro-climatic zone, crop/livestock choice, farming techniques and technology • Pastoralists in arid lowlands particularly vulnerable • Climate change will increase pressures on natural capital stock	• Increases in productivity levels will increase farm income and reduce likelihood of poverty-related resilience-gaps • Climate-smart agriculture such as effective irrigation schemes, new crop varieties, and improved farming techniques	• Expansion of cultivated land might increase pressure and increase sensitivity of ecosystems • Promotion of climate-sensitive crops (e.g. requiring more water) may increase vulnerability
Industry & trade	• Growth strategy is agricultural-led industrialisation, focusing on labour-intensive, export-oriented, import-substituting industries • Particular emphasis on promotion of micro and small-scale enterprises, and selected medium and large-scale industries	• Currently low, but could increase depending on i) linkages to agricultural sector and water and ii) exposure of activity to at-risk areas	• Promotion of micro and small-scale enterprises may encourage income diversification and reduce climate sensitivity at farm level	• Vertical and horizontal linkages between agriculture and industry may increase sensitivity of industrial sector to stronger indirect effects of climate-induced shocks
Mining	• Expansion of extractive industry planned (coal, industrial minerals, petroleum)	• Low, though water demand can be high for some types of mining	• Incorporate climate into the design and operation of mines to increase resilience	• Possible environmental impacts could weaken the resilience of ecosystems and communities
Water & energy infrastructure	• Energy supply and security recognised as precondition for meeting growth targets; energy exports planned in medium to long term; large investments in hydropower foreseen • Focus on harnessing water use; six-fold increase of irrigated land (small, medium and large scale)	• Water: high for both demand and supply • Energy: medium, will depend on future reliance on hydro and changes in rainfall	• Hydropower installations, e.g. dams, can facilitate irrigation schemes • Irrigation schemes increase number of options available for water management	• Technological lock-in: Large reliance on hydro may lead to vulnerabilities if climate change reduces annual average rainfall • Multiple demands and scarcity issues: possibly conflicts between large-scale irrigation and hydro; danger of side-effects on wetlands
Road infrastructure	• Significant investments in road infrastructure foreseen (30% expansion of current network), particularly in rural areas	• Currently high, given large share of climate-sensitive unpaved roads; possibly lower if road standards adjusted to climate change	• Improved resilience through better connectivity (e.g. for disaster responses), access to market can cushion impacts of local climate shocks	• Tension between rapid network expansion and meeting climate-resilience standards (climate shocks can induce disruption to transport and supply chains)
Construction & urban sector	• Expansion of urban infrastructure foreseen to enable rapid, equitable growth in urban centres • Construction industry is growing quickly	• Increasing: people and assets in urban areas increasingly affected by flash flooding	• Improved building standards could reduce sensitivity to climate impacts	• Uncontrolled growth might accelerate soil degradation, leading to increased sensitivity of urban areas to flooding

Sources: MoFED, 2010; World Bank 2013a, 2013b, 2010.

Agriculture is a top priority for resilience

To date, Ethiopia's policy-related resilience efforts have mostly focused on agriculture. This is because:

- agriculture is the backbone of the economy, accounting for 44% of Ethiopia's GDP, and intended to remain so in the short to medium term;
- the sector is very sensitive to climate variation and climate change; and
- around 80% of Ethiopia's population depend either directly or indirectly on farming for their livelihoods (MoFED, 2010).

Climate change will affect agriculture in many ways

Ethiopian agriculture is characterised by low productivity and high climate sensitivity. Over 90% of total agricultural output is produced by small-scale subsistence farmers, 50% of whom farm one hectare or less (Federal Democratic Republic of Ethiopia, 2013). Production is largely rain-fed and heavily dependent on traditional production practices. Productivity is low and fluctuates along with rainfall patterns. The limited uptake of modern agricultural technologies can mainly be attributed to high input prices (e.g. for seeds or fertilisers), credit constraints, and limited access by smallholder farmers to improved production technologies, irrigation systems and agricultural markets (MoARD, 2010). Limited agricultural research and extension services, inadequate transport networks, land degradation and tenure insecurity are other factors contributing to low agricultural productivity (World Bank, 2010).

The impacts of climate change on agricultural production could be significant. Temperature increases that coincide with drier climatic conditions are expected to reduce crop yields over time. Projections of future crop yields under climate change suggest there could be increasing variations in yield (Robinson et al., 2013; World Bank, 2010). Water supply shortages could emerge under the scenarios that project future reduced rainfall, exacerbating existing pressures on water resources from population growth, rising incomes, and increasing demands from industrial activities.

In the livestock sector, higher temperature increases might also alter the feed, mortality and growth of animals – effects which collectively could have a negative impact (up to a 30% decline) on livestock productivity (World Bank, 2010). Climate change may also alter the incidence of some animal diseases (EPA, 2007). These effects could be exacerbated by changes in the frequency and severity of climate extremes, notably droughts, floods and heat waves.

Climate impacts on the agricultural sector will not be uniform, but will vary over agro-climatic zones, regions, crop types, farm systems and timescales. For example, the humid highlands are likely to experience the highest economic losses, while the impacts in lowland areas seem smallest due to its lesser dependence on crop production and very low levels of productivity (Ferede et al., 2013). While economic losses here are likely to be lower, the human impact is likely to be strongest given that the lowlands' pastoralist communities are amongst the most vulnerable groups in Ethiopia. Climate effects will also vary over time. Research suggests that the cool and humid highlands may experience an increase in overall crop productivity until 2030 as a result of climate change, but then sharply decline thereafter, especially under more extreme (and unfavourable) scenarios of change (Gebreegziabher et al., 2011).

Agricultural growth can have both positive and negative effects on climate resilience. In general terms, improvements in agricultural production and productivity are likely to generate additional income for a large share of Ethiopia's population. Research indicates that agricultural growth in Ethiopia will be pro-poor, generating proportionally more income to farm households (Diao, 2010). Higher income, in turn, may reduce poverty-related gaps in adaptive capacity and allow farming households to increase their resilience. On the aggregate level, productivity increases may also help to ease food shortages after external shocks (both climatic and non-climatic) and pressures on local or, in the event of extreme drought, national food prices. The Ethiopian government views improved agricultural output and productivity as an essential part of its wider risk-management strategy. However, agricultural growth that fails to account for climate change may increase climate vulnerability in the longer term. For example, growth that is based on the use of water-intensive crops risks high crop failures during periods of drought, or unsustainable use of groundwater resources.

Building resilience in the agricultural sector will require a flexible response. The huge challenge for Ethiopia is to develop resilience measures without knowing the exact patterns of future climatic conditions. The scale of uncertainty associated with climate change in Ethiopia, particularly with respect to future rainfall patterns and extremes, complicates the policy planning for preventive, resilience-building action. In a nutshell, agricultural growth strategies need to be robust to both increasing and decreasing amounts of rainfall in different regions. This calls for an iterative, flexible approach to build resilience – one that focuses on no-regret and low-regret options (Box 2.4) that reduce current vulnerabilities and foster growth today, while improving capacity and adopting a flexible approach to decision making. This will allow action to be taken now, but adapted once more information becomes available.

The Climate Resilience Strategy for agriculture

The CRS for agriculture, Ethiopia's first sectoral resilience strategy, involved detailed analysis of the potential linkages between agricultural growth and climate resilience (Federal Democratic Republic of Ethiopia, forthcoming a). It examines in-depth current and future climate trends and their impacts on agricultural activities and livelihoods across Ethiopia's different agro-ecological zones. It also identifies and prioritises measures to reduce vulnerability and maps the steps necessary to achieve them. The analysis underlying the CRS identified what measures are needed most to build resilience and subsequently examined how these measures differ from current policy practices.

The CRS drew up a long list of almost 1 000 options for building agricultural resilience. After several rounds of analysis and consultation, these options were then filtered down to 41 final policy measures selected according to their: 1) relevance and feasibility; 2) contribution to achieving GTP targets; 3) contribution to poverty eradication and food security; and 4) reduction of current and future costs of climate impacts. In other words, the CRS explicitly sought to identify adaptation measures that would also support Ethiopia's growth and development targets. The resulting 41 measures cover a wide range of areas, including climate information and research, on-farm resource management, and cross-sectoral themes such as disaster risk management and social protection (Federal Democratic Republic of Ethiopia, forthcoming a). Of the 41 priority options, 38 were already being delivered in some form by the Ministry of Agriculture. This indicates that Ethiopia's focus will be on making resilience-adjustments to existing efforts, e.g. addressing existing barriers and scaling-up, rather than on instituting a raft of new measures.

The 41 identified options were further prioritised to manage the sequencing of implementation. This process built on two types of analysis: a multi-attribute analysis (MAA) and an "iterative risk management approach". Using the MAA, the identified 41 options were assessed against 5 broad criteria with 20 specific attributes. To illustrate some findings: capacity building options performed best in the role of addressing current and future climate risks; sustainable agriculture options performed well in terms of their resilience benefits and co-benefits, yet scored less well on financial costs and benefits (than options targeting productivity improvements); early warning systems and livelihood diversification also scored highest in terms of their resilience benefits and received high urgency scores (Federal Democratic Republic of Ethiopia, forthcoming a).

Based on these findings, an iterative risk management approach was used to map the sequencing of these options. This approach incorporates flexibility into decision making, allowing for immediate action, while avoiding the lock-in of vulnerabilities by maintaining the flexibility to adjust options if new evidence becomes available. The framework maps 15 actions to be taken immediately, with the remainder to be implemented in the medium or long term. The immediate actions are those which are either not currently covered (or not covered sufficiently) by any programme, are essential for capacity building, or are important for beginning to prepare for long-term risks.

The CRS also identified long-term risks that require an immediate change from "business as usual" development practice. One example is Ethiopian coffee production. The GTP strongly promotes the extension of coffee production and export, which is currently based around Arabica coffee beans. The analysis underlying the CRS revealed however that climate change and related shifts in agro-ecological zones might threaten future production, as Arabica coffee can only grow optimally in narrow temperature thresholds. Sustaining coffee production at the target levels set in the GTP may therefore require adjustments to current strategies or additional policy measures (e.g. planting shade trees, changing varieties, shifting production areas) to ensure resilience of future coffee production. A similar finding emerged for sugar plantations, which might require climate-smart irrigation to sustain production under future drier climate conditions. Both these examples illustrate the importance of anticipating the potential consequences of climate change for business as usual growth and development strategies.

Agricultural extension needs to become more resilience-focused

Agricultural extension is key for bringing to bear synergies between agricultural growth and resilience. Extension aims to increase agricultural development by supporting farmers to acquire the knowledge, tools and skills to improve the productivity of their activity. Empirical research suggests that access to extension services increases farm investments in Ethiopia and, if combined with information on climate change, strongly affects farmers' decisions to undertake adaptation investments (Di Falco et al., 2011; Deressa et al., 2010). It was also found that farmers who undertook adaptation measures tend to have higher food productivity and higher farm net revenues. This illustrates the potentially strong co-benefits between productivity improvements and resilience. Given the great number of smallholder farmers in Ethiopia, the cumulative effect of many individual decisions will also have a significant effect on the sector's overall resilience to climate change.

Ethiopia's agricultural extension system is one of the largest in the world, with more than 60 000 development agents providing training to local farmers (ATA, 2012). The GTP foresees a further expansion of these services, tripling the number of users to over

14 million beneficiaries by 2015 (MoFED, 2010). Building on these plans, the CRS wants to mainstream climate resilience into public extension activities through, for example, better dissemination of information and the promotion of climate-resilience building activities (Federal Democratic Republic of Ethiopia, forthcoming a).

Designing and effectively implementing climate resilience into Ethiopia's extension services will be challenging. The access, quality, and the level of adoption of extension services remain a barrier to the effectiveness of service provision (Gebremedhin, 2006). Some authors attribute the limited success to the top-down character of the services and to an over-emphasis on the dissemination of standardised packages (Davis et al., 2010). The Ethiopian government has recently begun to shift towards a more "farm-driven" approach to deliver services that are more responsive to farmers' needs. However, further capacity building is required to enable the delivery of more targeted support. This capacity building could target areas that are relevant to both growth and resilience goals, such as understanding and using climate information, intensifying or diversifying farming systems, and in agricultural marketing.

Financial resilience is needed at macro and micro scales

Macroeconomic management is closely linked with climate resilience. Climate-related shocks can endanger macroeconomic stability in the short term and, in some cases, even lead to sustained reductions in economic growth over time. Macroeconomic conditions will also determine whether public and private actors can access sufficient funds to finance long-term adaptation measures and to respond to climate-related disasters. While Ethiopia has maintained a relatively stable macroeconomic environment over the past decade, mobilising sufficient finance to implement development and resilience goals will be challenging. To minimise the impact of climatic shocks on its macro-economy, Ethiopia is prioritising the reduction of its physical vulnerability to climate shocks, but is also exploring a range of financial risk reduction and risk transfer measures.

Strengthening climate resilience will require a solid fiscal strategy to deal with climate risks. At present, Ethiopia primarily relies on risk reduction as well as ex-post disaster risk financing through official development assistance. Strengthening ex-ante risk financing mechanisms can help increase Ethiopia's macroeconomic resilience against climate risks. This may include both macro-level responses, such as contingency funds and national-level insurance schemes, and micro-level measures, such as rural access to finance and climate-smart social protection and micro-insurance schemes.

Ethiopia's macroeconomic context has implications for investment needs

The macroeconomic conditions in Ethiopia pose considerable challenges to public and private-sector access to finance. One key challenge that has been shaping Ethiopia's macroeconomic context is high inflation, which averaged 33% during 2011 (World Bank, 2012b). Inflation rates of this magnitude not only threaten macroeconomic stability, but can also crowd out the private savings and investments that will be important for sustaining growth. Private savings and investment rates in Ethiopia are among the lowest in the world (World Bank, 2013a; IMF, 2012). Despite improvements in the past two years, both high inflation and low savings rates will complicate the realisation of the government's growth and development goals, and may lead to suboptimal investments in climate resilience. High inflation rates have been particularly burdensome for Ethiopia's

poorest, increasing their vulnerability to external shocks and their capacity to undertake resilience building investments (World Bank, 2013a).

Food prices have been a significant driver of recent high inflation rates in Ethiopia, which hints at the indirect links between climatic factors and macroeconomic variables. High global food prices in 2008 and 2011 triggered inflation rates of 60% and 40% in Ethiopia; food prices saw an even stronger increase: 60% and 100% respectively (World Bank, 2012b). Large public investments relying on monetary financing, increased fuel prices, and agricultural supply shocks due to localised droughts further exacerbated the effects of high international food prices (World Bank, 2011; FAO-GIEWS, 2011; World Bank, 2012b). The most recent 2011 Horn of Africa drought, for example, contributed as much as 6% of total price inflation in Ethiopia, according to IMF estimates (cited in GFDRR, 2012). As climate change is projected to influence international and domestic food prices, it might exacerbate the occurrence of future food price-induced inflation in Ethiopia, with adverse consequences for macroeconomic stability, economic growth and development.

In an effort to control inflation, the government has introduced both temporary and longer-term measures. In response to the 2011 peak in inflation, the government introduced a tighter monetary policy; began importing and distributing wheat, edible oil and sugar; and introduced a ban on exporting certain agricultural goods. These helped the inflation rate to decelerate below 10% in 2013. However, inflation could rise again if pressure from international food prices resumes (World Bank, 2011). The government is also undertaking measures to address the underlying causes of inflation by strengthening the economy's resilience to external shocks (e.g. measures to increase agricultural productivity and national food production and to promote adaptation in the sector). Bottlenecks remain, however, in the areas of transport infrastructure and other trade logistics, as well as market access by small-scale farmers in particular (World Bank 2013 a). As high fuel prices have been responsible for exacerbating food price inflation in the past, there may also be scope to link resilience strategies such as the CRS to Ethiopia's Green Economy Strategy by promoting alternative sources of energy and fuel efficiency.

Despite these improvements in macroeconomic conditions, the financing of Ethiopia's ambitious growth and resilience goals remains a challenge. Ethiopia already has one of the world's highest public investment rates, and total public expenditures are expected to increase by another 5 percentage points to 23.7% of GDP during the current GTP period (MoFED, 2010; World Bank, 2013a). This ambitious target will require a substantial increase in resource mobilisation, and resilience objectives under the CRGE will further amplify financial needs. The GTP does not mention specific strategies for mobilising external funding, but recognises the importance of international development co-operation flows and foresees an increase in foreign direct investments. Measures to meet these objectives can be designed with a view to trigger co-benefits for climate-resilience.

A sound financial strategy is required to deal with climate extremes

Ethiopia faces a range of external risks which increase pressure on the government's budget, impeding the country's fiscal sustainability and broader macro-stability. Climate variability and shocks in international oil and coffee prices have created the greatest external shocks to the Ethiopian economy. Economic losses due to droughts and floods, notably in the agricultural sector, occur almost on an annual basis. While there is no systematic tracking of economic losses or government expenditures following climatic

shocks, Oxfam estimates that droughts alone cost Ethiopia approximately USD 1.1 billion per year (Martlew, 2009). The most recent drought, the 2011 Horn of Africa drought, resulted in total costs of about USD 450 million of emergency food and non-food aid between July and December, accounting for nearly 1.4% of GDP (GFDRR, 2012).

Climate shocks can also release a range of knock-on effects with indirect effects and wider impacts on the macro-economy. The stronger the interconnections between economic sectors, the more widely the impact will be felt. For example, beyond impacts on agricultural output, they could extend to production losses in agro-processing or lower consumption due to income losses. In Ethiopia, such indirect effects are weak at present, due to the currently high share of subsistence farming and relatively weak integration among sectors. However, these linkages are likely to become stronger if the agricultural sector modernises and increases the share of tradable agricultural goods, as foreseen by the GTP.

Historically, Ethiopia's response to climate-related disasters primarily relied on ex-post disaster response financing mechanisms, with much of the financial resources being mobilised by international aid. Every year for the past 20 years, the government has issued appeals for international humanitarian aid of up to USD 350 million a year, primarily for emergency food security interventions, but also for fast onset disasters such as floods (GFDRR, 2012). However, the country's federal contingency[3] budget has also made available major amounts of financial resources for disaster response mechanisms (DRM).

Over the past decade, the Ethiopian government has taken steps to increase the use of ex-ante disaster risk financing mechanisms. In 2002, the government established the National Disaster Prevention and Preparedness Fund (NDPPF), an emergency fund providing resources for relief measures. The fund's financial reserves were intended to provide bridge funding for immediate disaster response, as well as for emergency employment schemes to support food security after natural disasters. The NDPPF has made a small number of loans since its inception in 2002, but it has never received sufficient funding to provide significant contingency financing in the event of disasters (GFDRR, 2012). The government's recent Disaster Risk Management Strategic Programme and Investment Framework (SPIF) reviews the financial mechanisms for disaster response and recovery, and creates a new, reformed national contingency fund for disasters: the national Disaster and Recovery Fund (DRF) (MoA, forthcoming). The DRF would primarily be capitalised by international partners, either through the CRGE Facility or through a dedicated pooled fund for disaster risk management programmes. However, given the low capitalisation of the NDPPF in the past and the substantial investments already planned under the CRGE Facility, it remains to be seen whether the DRF will accumulate sufficient resources.

Another example of an ex-ante financial management tool is the contingency budget established within the Productive Safety Net Programme (PSNP). The PSNP is one of the largest food security programmes in sub-Saharan Africa, providing food and cash to chronically food-insecure households (see details below). The PSNP's contingency budget is the first source of financing if the PSNP's activities need to be scaled-up, for example to finance unforeseen needs of transiently food-insecure populations after an extreme climate event (GFDRR, 2012). The contingency budget holds 20% of the PSNP's total budget and is administered at the regional and local level. In 2010, this was complemented by a federal contingency financing window. Capitalised with almost USD 160 million by international partners, this instrument was designed to cover localised and

intermediate droughts that exceed capacities of the local and regional contingency budget, but that are not severe enough to trigger a humanitarian response. It also provides bridge financing until humanitarian aid is delivered. The national financing window was triggered for the first time in August 2011 after four consecutive failures of seasonal rains. It released cash and food transfers worth USD 134.7 million to approximately 6.5 million PSNP beneficiaries and another 3 million transitory food insecure people.

Ethiopia has been a pioneer in the use of sovereign insurance as a tool for financial management of natural disasters. In 2006, Ethiopia piloted a macro-level drought index insurance, in which the World Food Programme (on behalf of the Ethiopian government) purchased a weather derivative with the AXA Re reinsurance company to secure contingency funding for emergency relief if extreme drought were to occur in Ethiopia's 2006 agricultural season. The maximum pay-out was fixed at USD 7 million for an annual premium of USD 930 000 (equalling a 13.1% premium rate), primarily paid by the United States Agency for International Development (Cummins and Mahul, 2009). The pay-out would have provided financing to provide cash transfers to up to 62 000 households; however the contract did not trigger and was not renewed the following year, due to "limited donor appetite" (GFDRR, 2012). Nevertheless, the pilot demonstrated the general feasibility of using risk transferring mechanisms to the private sector for managing extreme climate risks in a low-income country. The government's recent disaster risk management investment programme SPIF plans to examine the feasibility of establishing a National Insurance Programme, which could be integrated as a separate track of the reformed contingency fund DRF.

Financial resilience is also needed at the micro-level

Financial disaster risk management tools may also include instruments that increase people's financial resilience to climate risks. There are two reasons for paying attention to the micro-level when designing macro-level responses. First, insufficient risk coping mechanisms imply that households will undertake low-risk but low return-activities (e.g. plant less profitable crops), which may result in lower household income as well as aggregate welfare losses. Second, the lack of risk-coping mechanisms may lead to the depletion of assets in times of stress. This in turn will increase vulnerability to future shocks and, in the worst case, may create irreversible development setbacks and poverty traps. For example, the 1990 droughts in north-eastern Ethiopia forced farmers and herders to sell some of their livestock. The sudden oversupply of livestock from these distress sales led to a price drop of more than 50% (from an average of USD 74 in the pre-drought period to USD 35 (Carter et al., 2007). Price swings of this magnitude constitute a huge capital loss, which could have been dampened if insurance pay-outs or credit had been available to these farmers.

An increasing body of literature suggests that social protection schemes are an important instrument for increasing resilience of the most vulnerable households and reduce the necessity for post-disaster state intervention (Béné et al., 2012; Davies et al., 2009). An example is Ethiopia's social safety net programme PSNP, mentioned above. Established in 2004, the programme aims to protect household assets in periods of increased stress, and to promote asset building at the individual and community level. The PSNP provides predictable cash and food transfers to almost 8 million chronically food-insecure households in exchange for seasonal labour-intense public works. Projects for public works are decided upon at the community level and focus on the development of community assets, such as soil and water conservation, water supply schemes, afforestation activities, community infrastructure (i.e. rural road rehabilitation, schools,

and clinics), and social services. Households who cannot undertake public works (about 15% of beneficiaries) receive direct support. In times of climatic shocks, the PSNP expands to also cover transitory food insecure households in districts that participate in the PSNP. The total PSNP budget amounts to more than USD 2.1 billion for the 2010-2014 phase. Most of the financing is provided by a group of nine donor institutions.

A specific component under the PSNP umbrella that seeks to support longer-term resilience is the Household Asset Building Program (HABP). The HABP aims to help chronically food insecure populations to improve their risk management, diversify their income sources, and to build up household assets. This is delivered through access to microfinance and by strengthening the agricultural extension system to provide households with better technical and business advice. A key component of the HABP-supported activities is the development of business plans to guide households' investments. Other activities include training for improving input sources, marketing, and supporting off-farm activities. Credit is provided through microfinance institutions and Rural Savings and Credit Co-operatives; yet is not linked to agricultural extension services. The HABP has the goal of graduating 80% of PSNP recipients out of chronic food insecurity by 2014 (Berhane et al., 2011).

The PSNP and its HABP are important entry points for resilience building at the micro-level, as they allow households to respond to climate-related shocks, reduce pressures to engage in maladaptive coping strategies, such as selling off assets, and instead allow investments for building resilience and assets. While some studies suggest there are limits to the effect of the PSNP on food security and risk resilience (e.g. Gilligan et al., 2008; Andersson et al., 2011), more recent research has found that PSNP beneficiaries have experienced less severe food insecurity after external shocks, including climate-induced ones (Béné et al., 2012; Berhane et al., 2011). However, it has also been noted that the PSNP may not be robust enough to protect the poorest from severe climate shocks. The recently established Climate Smart Initiative aims to systematically explore how climate risk management under the PSNP and HABP can be improved. This includes, for example, an assessment of the potential use of information and private sector engagement in income diversification pilots (World Bank, 2013c).

Private insurance schemes are another important climate risk management instrument, but large parts of the Ethiopian population remain without access to insurance services. Most farmers and herders are located in rural areas that are remote from the distribution network from traditional insurance companies. The development of the domestic insurance market is impeded by uncertainties over how rural markets can be accessed, and how agricultural risks can be assessed and priced (GFDRR, 2012). Numerous trials and pilot programmes have tested the development of smallholder crop and livestock insurance products. Most of these pilots promote weather index insurances – products in which losses are based on the measurement of a certain weather parameter according to an agreed pay-out scale that is assumed to proxy actual losses. The largest and longest-lasting pilot for an index-based insurance programme is the Horn of Africa Risk Transfer for Adaptation (HARITA), now called the R4 Rural Resilience Initiative (Box 5.3). Current packages are primarily offered by development partners and development banks, but scaling up of such programmes will require stronger engagement by the private sector.

Box 5.3 Index-based crop insurance in Ethiopia: The HARITA programme

The innovative Horn of Africa Risk Transfer for Adaptation (HARITA) is one of the largest projects providing risk-reduction for rural farmers in Ethiopia. The programme was initiated in 2007 by a consortium of development partners led by Oxfam America to help teff farmers in the Tigray Region in northern Ethiopia to strengthen their food and income security. The programme offered farmers a full risk-management package, including measures and support for 1) reducing risks through better resource management; 2) transferring risks through insurance schemes; and 3) prudent risk-taking through access to micro-credit.

The programme was designed to remove common barriers often associated with drought insurance, such as high administrative costs and the inability of cash-poor smallholders to afford premiums. Building on Ethiopia's PSNP infrastructure, HARITA enables farmers to obtain index-based crop insurance, either through conducting community labour, or through standard cash payments. Farmers using the "insurance for work" option engage in risk-reducing or resilience-building tasks, such as cleaning teff seeds and constructing flood diversion structures. In the event of a seasonal drought, insurance pay-outs would trigger automatically once rainfall drops below a predefined threshold. The programme also partners with local microfinance institutions to offer farmers access to credit to make investments in disaster resilience. The scheme therefore constitutes an innovative instrument that increases both technical and financial resilience to climatic shocks.

Having started as a pilot project with 200 households in one village in 2009, the scheme has expanded significantly since, covering more than 20 000 households in 80 villages in 2013. The programme has also expanded to include additional crop varieties and has diversified the contract types it offered. The insurance triggered in 2011 for the first time, with more than 1 800 farmers receiving small pay-outs (on average less than USD 10). Almost 90% of farmers had paid their policies through public works. The success of the project led to the launch of the R4 Rural Resilience Initiative which, in co-operation with the World Food Programme, aimed to expand HARITA to a multinational scale. R4 became operative in 12 villages in Senegal in 2013; and further scale-up and expansion to another two countries is planned over the next five years.

Sources: R4 Rural Resilience Initiative (2013), "Quarterly report April - June 2013", The World Food Programme and Oxfam America, available at *http://www.oxfamamerica.org/files/r4-quarterly-report-apr_jun2013.pdf (accessed* October 30, 2013); GFDRR (2012), *Disaster Risk Financing and Insurance. Country Note: Ethiopia*, Global Facility for Disaster Reduction and Recovery (GFDRR), World Bank, Washington DC.

Notes

1. As the process of CRGE development and implementation is still on-going, the exact institutional design and allocation of responsibilities may be subject to adjustments, and shall hence be considered preliminary. The description and analysis here is based on the state of knowledge in March 2014.
2. The estimated amount of USD 150 billion by 2030 is primarily for investment in power generation and the transport sector. Therefore, not all of the expenditure is necessarily additional to current investment plans, and would also be necessary in a conventional growth scenario.
3. The government allocates annual budgets to sectoral ministries with DRM responsibilities that are expected to account for foreseeable disaster response costs; ministries, however, are able to apply for additional funding from the contingency budget in the case of emergency costs that exceed their capacity.

References

ADB et al. (2012), *African Economic Outlook 2012: Promoting Youth Employment*, African Development Bank (ADB), Organisation for Economic Co-operation and Development, United Nations Development Program and United Nations Economic Commission for Africa OECD Publishing, Paris, *http://dx.doi.org/10.1787/aeo-2012-en10.1787/aeo-2012-en*.

Andersson, C., A. Mekonnen and J. Stage (2011), "Impacts of the Productive Safety Net Program in Ethiopia on livestock and tree holdings of rural households", *Journal of Development Economics*, Vol. 94/1, pp. 119-126.

ATA (2012), *Transforming Agriculture in Ethiopia. Annual Report*. Ethiopian Agricultural Transformation Agency, Addis Ababa, available at *http://www.ata.gov.et/wp-content/uploads/Annual-Report.pdf*.

Bass, S. et al.(2013), "Making growth green and inclusive: the case of Ethiopia", *OECD Green Growth Papers*, 2013-07, OECD Publishing, Paris, *http://dx.doi.org/10.1787/5k46dbzhrkhl-en*.

Béné, C., S. Devereux and R. Sabates-Wheeler (2012), "Shocks and social protection in the Horn of Africa: Analysis from the Productive Safety Net Programme in Ethiopia", *IDS Working Papers*, Vol. 2012/395, Institute of Development Studies, London.

Berhane, G. et al. (2011), *Evaluation of Ethiopia's Food Security Program: Documenting Progress in the Implementation of the Productive Safety Nets Programme and the Household Asset Building Programme*, International Food Policy Research Institute, available at *http://essp.ifpri.info/files/2013/05/ESSPII_EDRI_Report_PSNP.pdf*.

Carter, M. et al. (2007), "Poverty traps and natural disasters in Ethiopia and Honduras", *World Development*, Vol. 35/5, pp. 835-856.

Conway, D. and E. Schipper (2011), "Adaptation to Climate Change in Africa: Challenges and Opportunities Identified from Ethiopia", *Global Environmental Change*, Vol. 21/1, pp. 227-237.

Cummins, J. and O. Mahul (2009), *Catastrophe Risk Financing in Developing Countries: Principles for Public Intervention*, World Bank, Washington, DC.

Davies, M., K. Oswald and T. Mitchell (2009), "Climate change adaptation, disaster risk reduction and social protection", in *Promoting Pro-Poor Growth: Social protection*, OECD Publishing, Paris.

Davis, K. et al. (2010), "In-depth assessment of the public agricultural extension system of Ethiopia and recommendations for improvement", *IFPRI Discussion Paper*, No. 01041, International Food Policy Research Institute, Washington DC.

Deressa, T., C. Ringler and R. Hassan (2010), "Factors affecting the choices of coping strategies for climate extremes: The case of farmers in the Nile Basin in Ethiopia", *IFPRI Discussion Paper*, No. 132, International Food Policy Research Institute, Washington DC.

Di Falco, S. et al. (2011), "Estimating the impact of climate change on agriculture in low-income countries: Household level evidence from the Nile Basin, Ethiopia", *Environmental and Resource Economics*, Vol. 52/4, pp. 457-478.

Diao, X. (2010), *Economic Importance of Agriculture for Sustainable Development and Poverty Reduction: The Case Study of Ethiopia*, paper presented at the Global Forum on Agriculture on "Policies for Agricultural Development, Poverty Reduction and Food Security" at the OECD Headquarters in Paris, 29-30 November 2010, available at *http://www.oecd.org/tad/agricultural-policies/46378942.pdf*.

Dinku, T. et al. (2011), "Improving availability, access and use of climate information", *WMO Bulletin Weather, Climate, Water*, Vol. 60/2, available at *http://www.wmo.int/pages/publications/bulletin_en/archive/60_2_en/60_2_Tufa_en.html*.

EPA (2012), *United Nations Conference on Sustainable Development (Rio+20). National Report of Ethiopia*, Federal Environmental Protection Authority of Ethiopia (EPA), Addis Ababa.

EPA (2011), *Ethiopia's Vision for a Climate-Resilient Green Economy,* EPA, Addis Ababa.

EPA (2007), *Ethiopia Environment Outlook. Environment for Development*, EPA, Addis Ababa.

FAO-GIEWS (2011), *Global Food Price Monitor,* Food and Agriculture Organization (FAO), Global Information and Early Warning System on Food and Agriculture (GIEWS), Rome.

Federal Democratic Republic of Ethiopia (forthcoming a), *Ethiopia's Climate Resilient Green Economy Climate Resilience Strategy. Agriculture*, Addis Ababa.

Federal Democratic Republic of Ethiopia (forthcoming b), *Sectoral Reduction Mechanism Framework (draft, January 2014)*, Addis Ababa.

Federal Democratic Republic of Ethiopia (2013), "The Ethiopian Climate Resilient Green Economy Facility (CRGE Facility)", presentation held in June 2013 in Lombok, Indonesia, available at*https://www.forestcarbonpartnership.org/sites/fcp/files/2013/june2013/Ethiopia-CRGE Facility.pdf*.

Federal Democratic Republic of Ethiopia (2011), *Ethiopia's Climate-Resilient Green Economy*, Addis Ababa.

Federal Democratic Republic of Ethiopia (2007), *Climate Change National Adaptation Programme of Action (NAPA), of Ethiopia*, Addis Ababa.

Federal Democratic Republic of Ethiopia (2001), *Ethiopia's Communication to the United Nations Framework Convention on Climate Change*, Addis Ababa.

Ferede, T., A. Ayenew and M. Hanjra (forthcoming), "Agroecology matters: Impacts of climate change on agriculture and its implications for food security in Ethiopia" in M. A. Hanjra (ed.), *Global Food Security: Emerging Issues and Economic Implications*, Nova Science publishers, Hauppauge, pp. 71-112.

Funk, C. et al. (2012), "A Climate Trend Analysis of Ethiopia", U.S. Geological Survey Fact Sheet 2012–3053, available at *http://pubs.usgs.gov/fs/2012/3053/*.

Gebreegziabher Z. et al. (2011), "Climate change and the Ethiopian economy: A computable general equilibrium analysis", *EfD Paper Series*, No. 11-09, Environment for Development initiative, available at *http://miun.diva-portal.org/smash/record.jsf?pid=diva2:406612* (accessed August 27, 2013).

Gebremedhin, B. (2006), "Commercialization of Ethiopian agriculture: Extension service from input supplier to knowledge broker and facilitator", *IPMS Working Paper*, No. 1, International Livestock Research Institute (ILRI), Nairobi.

GFDRR (2012), *Disaster Risk Financing and Insurance. Country Note: Ethiopia*, Global Facility for Disaster Reduction and Recovery (GFDRR), World Bank, Washington DC.

Gilligan, D. O., J. Hoddinott and A. S. Taffesse (2008), "The impact of Ethiopia's Productive Safety Net Programme and its linkages", *IFPRI Discussion Paper*, No. 839, International Food Policy Research Institute, Washington DC.

IMF (2013), "The Federal Democratic Republic of Ethiopia: 2013 Article IV Consultation", *IMF Country Reports,* International Monetary Fund, Washington DC.

IMF (2012), *The Federal Democratic Republic of Ethiopia: Staff report for the 2012 Article IV Consultation – Debt Sustainability Analysis*, International Monetary Fund, Washington DC.

Jalayer, F., L. Herslund and G. Cavan (2013), "Climate change induced risk analysis of Addis Ababa city (Ethiopia)", *Geophysical Research Abstracts*, Vol. 15, EGU 2013/9457, Vienna, available at *http://adsabs.harvard.edu/abs/2013EGUGA..15.9457J* (accessed September 1, 2013).

Martlew, N. (2009), "Band aids and beyond: Tackling disasters in Ethiopia 25 years after the famine", *Oxfam Briefing Paper*, October 2009, available at *http://policy-practice.oxfam.org.uk/publications/band-aids-and-beyond-tackling-disasters-in-ethiopia-25-years-after-the-famine-114089*.

MEF (2013), *CRGE Highlights. Volume 1, No. 4, September 2013*, Ministry of Environment and Forest (MEF), Addis Ababa, available at *http://phe-ethiopia.org/admin/uploads/attachment-1692-CRGE-Highlights-NL-Final-September-2013.pdf*.

Mengistu, A. (2006), *Country Pasture/Forage Resource Profiles Ethiopia*, Food and Agriculture Organization of the United Nations, Rome.

MoA (forthcoming), *Disaster Risk Management Strategic Programme and Investment Framework (draft)*, Ethiopian Ministry of Agriculture, Addis Ababa.

MoARD (2010), *Ethiopia's Agricultural Sector Policy and Investment Framework: Ten Year Road Map (2010-2020)*, Ethiopian Ministry of Agriculture and Rural Development, Addis Ababa.

MoFED (2013), *Annual Progress Report for F.Y. 2011/12 - Growth and Transformation Plan*, Ethiopian Ministry of Finance and Economic Development (MoFED), Addis Ababa.

MoFED (2012a), *Ethiopia's Progress Towards Eradicating Poverty: An Interim Report on Poverty Analysis Study (2010/11)*, MoFED, Addis Ababa.

MoFED (2012b), *Ethiopia's Climate Resilient Green Economy (CRGE), Facility Terms of Reference*, MoFED, Addis Ababa.

MoFED (2010), *Growth and Transformation Plan 2010/10-2014/15*, MoFED, Addis Ababa.

OECD (2014), "Creditor Reporting System: Aid activities", *OECD International Development Statistics* (database), March 2014, *http://dx.doi.org/10.1787/dev-cred-data-en*.

OECD (2012), *Aid Effectiveness 2011: Progress in Implementing the Paris Declaration*, Better Aid, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264125780-en*.

OECD (2009), *Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance*, OECD Publishing, Paris, *http://dx.doi.org/10.1787/9789264054950-en*.

R4 Rural Resilience Initiative (2013), "Quarterly report april - june 2013", The World Food Programme and Oxfam America, available at *http://www.oxfamamerica.org/files/r4-quarterly-report-apr_jun2013.pdf (accessed* October 30, 2013).

Riche, B. et al. (2010), *Climate-related Vulnerability and Adaptive-Capacity in* Ethiopia's *Borana and Somali Communities,* Final assessment report, International Institute for Sustainable Development, Winipeg, available at *www.iisd.org/publications/pub.aspx?id=1239*.

Robinson, S., K. Strzepek and R. Cervigni (2013), "The Cost of Adapting to Climate Change in Ethiopia: Sector-Wise and Macro-Economic Estimates", *ESSP II Working Papers*, No. 53, International Food Policy Research Institute, Addis Ababa.

Secretariat of the Convention on Biological Diversity (2009), "Connecting biodiversity and climate change mitigation and adaptation: Report of the second ad hoc technical expert group on biodiversity and climate change", *CBD Technical Series No. 41*, Secretariat of the Convention on Biological Diversity, Montreal.

Thomson Reuters Foundation (2012), "Faced with changing weather. Ethiopia gets better forecasts" (website), Thomson Reuters Foundation, available at *http://www.trust.org/item/?map=faced-with-changing-weather-ethiopia-gets-better-forecasts/* (accessed November 08, 2013).

UNDP (2013), *Human Development Report 2013: The Rise of the South - Human Progress in a Diverse World*, United Nations Development Programme, New York.

World Bank (2013a), *Ethiopia Economic Update II: Laying the Foundation for Achieving Middle Income Status*, World Bank, Washington DC.

World Bank (2013b), "Climate Change Knowledge Portal", available at *http://sdwebx.worldbank.org/climateportal/index.cfm* (accessed September 02, 2013).

World Bank (2013c), *Coping with Climate Change. How Ethiopia's PSNP & HABP are Building Resilience to Climate Change*, World Bank, Washington DC.

World Bank (2012a), *Ethiopia Country Partnership Strategy 2013-2016*, World Bank, Washington DC.

World Bank (2012b), *Ethiopia Economic Update: Overcoming Inflation, Raising Competitiveness*, World Bank, Washington DC.

World Bank (2011), *Ethiopia - Joint staff advisory note on Growth and Transformation Plan (GTP), 2010/11-2014/15*, World Bank, Washington DC.

World Bank (2010), *Ethiopia - Economics of Adaptation to Climate Change (Vol. 1 of 2): Main Report*, World Bank, Washington DC.

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(97 2014 02 1 P) ISBN 978-92-64-20949-7 – 2014-01

Climate Resilience in Development Planning

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ISBN 978-92-64-20949-7
97 2014 02 1 P