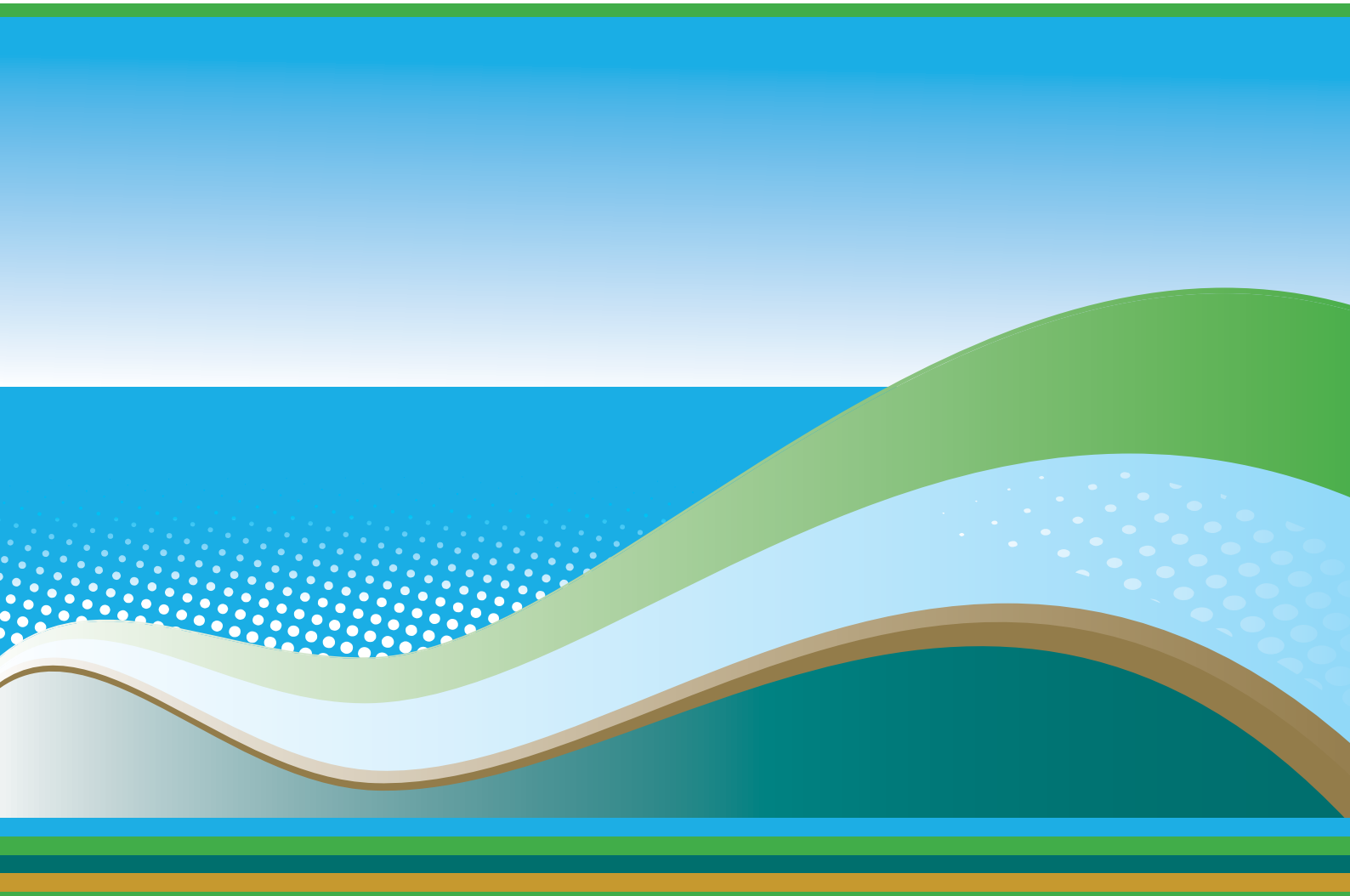
Water Security and Climate Resilient Development

TECHNICAL BACKGROUND DOCUMENT



Investing in water security for growth and development

About AMCOW

The African Ministers' Council on Water (AMCOW) was formed in 2002, primarily to promote cooperation, security, social and economic development and poverty eradication among member states through the effective management of the continent's water resources and provision of water supply services. In 2008, at the 11th ordinary session of the African Union (AU) Assembly in Sharm el-Sheikh, Heads of States and Governments of the African Union agreed on commitments to accelerate the achievement of water and sanitation goals in Africa and mandated AMCOW to develop and follow up an implementation strategy for these commitments. AMCOW has also been accorded the status of a Specialised Technical Committee for Water and Sanitation in the African Union.

About CDKN

The Climate and Development Knowledge Network (CDKN) supports decision makers to design and deliver climate compatible development. It does this by combining research, advisory services and knowledge sharing to support locally owned and managed policy processes. CDKN works in partnership with decision makers in the public, private and non-governmental sectors nationally, regionally and globally. CDKN operates in Africa, Latin America and Asia and the African programme is managed by SouthSouthNorth.

About GWP

The Global Water Partnership is an intergovernmental organisation of 13 Regional Water Partnerships, 80 Country Water Partnerships and more than 2,500 Partner Organisations in 161 countries. Its vision is a water secure world. Its mission is to support the sustainable development and management of water resources at all levels through Integrated Water Resources Management (IWRM). IWRM is a process that promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems and the environment.

Water Security and Climate Resilient Development

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This document is an output from a project funded by the UK Department for International Development (DFID) and the Netherlands Directorate-General for International Cooperation (DGIS) for the benefit of developing countries. However, the views expressed and information contained in it are not necessarily those of or endorsed by DFID, DGIS or the entities managing the delivery of the Climate and Development Knowledge Network*, which can accept no responsibility or liability for such views, completeness or accuracy of the information or for any reliance placed on them.

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Message from the African Union

On behalf of the African Union, I welcome the development of the Technical Background Document to complement the Framework for Water Security and Climate Resilient Development by the African Union Commission's Specialised Technical Committee on Water and Sanitation (AMCOW), and its partner the Global Water Partnership.

The Technical Background Document with the Framework is a key milestone towards the attainment of the Africa Water Vision 2025 of equity and sustainability in the use and management of water resources for poverty alleviation, socio-economic development, regional cooperation and the environment.

Water security contributes to job creation, gross domestic product (GDP) and development goals across most sectors – health, energy, agriculture, environment, mining, industry and social protection. It also supports climate change adaptation and disaster risk reduction, particularly floods and drought-related disasters.

The African Union is aware that one of the key challenges facing policy- and decision-makers is to understand the current water resource situation and trends in the face of the increased uncertainties brought about by climate change.

Aware of this challenge, the heads of state and government of the member countries of the African Union have been providing leadership in global climate change negotiations under the UNFCCC. In addition, the 2008 Sharm El-Sheikh Declaration on water and sanitation includes specific commitments on climate change adaptation and investment plans.

The African Union is pleased to note that, as part implementation of the Sharm El-Sheikh commitments, AMCOW has mobilised partners to develop this guidance document to support AU members in advancing climate resilient development.

Ultimately, this document and the Framework is a contribution towards the vision of the African Union for "*an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in global arena.*"

The AU remains committed to helping AMCOW and its partners in implementing development programmes that support countries to adapt to climate change and spur climate compatible development.

Mrs Rhoda Peace Tumusiime
Commissioner for Rural Economy and Agriculture, African Union Commission

Foreword by AMCOW President

As the president of AMCOW, I was pleased to launch the Framework for Water Security and Climate Resilient Development as part of our continued support to the implementation of climate change commitments in the Sharm el-Sheikh Declaration. I welcome the developement of this Technical Background Document that supports application of the Framework by providing detail on concepts, methods and approaches that underpin the actions and steps identified in the Framework. The process of applying the Framework itself will build climate resilience by strengthening institutional capacity, improving knowledge and understanding, and enhancing partnerships for action to improve water security and climate resilient development.

The Framework serves as a tool to help integrate water security and climate resilience into development planning, with a focus on prioritising 'no or low regrets' investments and financing strategies.

Climatic fluctuations are nothing new in Africa. Many countries experience cycles of drought, flooding and other extreme climatic events that cause damage, suffering and disruption to their populations, particularly the most vulnerable and poor. These climatic events have serious economic consequences, which can derail a government's best intentions and set back progress in development by years. Such experiences provide a sober warning of what could be in store in future with the climatic changes that increasingly seem likely. For many countries, climate change implies the worsening of all-too-familiar climatic fluctuations, and long term changes in climate which could introduce new risks and threats to the viability of African development.

Strategies, plans and investments that promote sound water resources management are a cost-effective way of delivering immediate development benefits while building resilience to longer term climate change. Water is at the heart of development objectives across most sectors – health, energy, agriculture, environment, social protection, and others – yet most African countries are far from achieving water security, and the onset of climate change will further compromise prospects. Ensuring water security through more effective water management contributes to development goals, climate change adaptation and disaster risk reduction, particularly floods and drought-related disasters.

Promoting water security and climate resilient development reinforces actions that reflect the overarching messages and objectives of Rio+20 and the outcomes of the UNFCCC meeting held in Durban, which emphasised the green economy, sustainable development, meeting the Millennium Development Goals, and strengthened international climate action.

We invite you to work together to achieve the vision of this document and to ensure that African nations make the necessary investments and develop adaptive capacity to achieve future economic and social development goals, despite the onset of a harsher climate.

Honorable Edna Molewa
President of the African Ministers' Council on Water, Southern African
Minister of Water and Environmental Affairs, South Africa

Preface by AMCOW Executive Secretary

The African Ministers' Council on Water's (AMCOW's) recognition of the importance of climate change and its potential impacts on water security can be traced back to the Africa Water Vision 2025 (2000) as well as high level commitments by African heads of state and governments.

The Technical Background Document directly supports the aspirations of the Africa Water Vision.

The Technical Background Document together with the Framework for Water Security and Climate Resilient Development has been formulated to support the implementation of climate change related commitments expressed by African heads of state in the 2008 Sharm el-Sheikh Declaration on water and sanitation. In particular, the Declaration calls for African countries to put in place adaptation measures and investment plans to improve the resilience of countries to the increasing threat of climate change and variability to water resources, and to enhance capacity to meet water and sanitation targets. Development of the Framework was also identified as the first milestone for AMCOW's climate change adaptation target presented at the 6th World Water Forum.

This document and the Framework have been developed as part of the Water, Climate and Development Programme (WACDEP), an AMCOW programme implemented by the Global Water Partnership. The milestones towards the development of the Framework were:

- Sharm el-Sheikh declaration on water and sanitation (2008)
- Formulation of the Water, Climate and Development Programme (WACDEP by AMCOW and GWP, 2010)
- Decision by AMCOW Executive Council of Ministers for GWP to operationalize the WACDEP (Nov 2010)
- WACDEP launch at Stockholm Water Week and Framework inception meeting (Aug 2011)
- Presentation of the Framework road map to AMCOW TAC Johannesburg (Oct 2011)
- GWP/AMCOW First Expert Panel review meeting for the Framework (Nov 2011)
- Southern Africa stakeholder consultation on the Framework at a COP17 side event in Durban, South Africa, during the launch of the SADC Climate Change Adaptation Strategy (Nov 2011)
- West Africa stakeholder consultation on the Framework at a sub-regional consultation workshop for implementing AMCOW West Africa work programme, held in Bamako, Mali (Dec 2011)
- Pan-African multi-stakeholder stakeholder consultation at the 6th World Water Forum Africa preparatory process regional validation workshop, held in Banjul, Gambia (Dec 2011)
- GWP/AMCOW second Expert Panel review meeting for the Framework (Feb 2012)
- Presentation of draft Framework as part of AMCOW's climate change target for the 6th WWF, Marseille (Mar 2012)
- Launch of the Framework by AMCOW during the 4th Africa Water Week, Cairo, Egypt (May 2012)
- Technical Background Document presented at the Stockholm World Water Week (August 2012).

We hope that over the coming years the Framework and this document will enable African countries to put in place measures that enhance water security and climate resilience for growth and development.

Bai Mass Taal
AMCOW Executive Secretary

Message from GWP Executive Secretary

In the face of increased global challenges such as food price spikes, disasters, energy insecurity and climate change, the urgency to address water security is mounting. Ensuring water security through more effective water management contributes to development goals, climate change adaptation and disaster risk reduction, both now and in the future.

Addressing water security is at the core of Global Water Partnership's (GWP's) strategy for a water secure world. Through its network of more than 2600 partner organisations worldwide, GWP works with governments, business leaders, civil society, academia and funding agencies at all levels, to advance better water management for a water-secure world.

The GWP supports the efforts of the African Ministers Council on Water to enhance water security and climate resilience in Africa. These efforts reinforce the goals and aspirations of the 2025 Africa Water Vision.

There is widespread consensus on the urgent need for immediate action to tackle climate change, as indicated by the commitments made by African leaders in the 2008 Sharm el-Sheikh Declaration on water and sanitation.

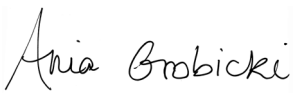
The 2011 famine in the Horn of Africa and recently the drought in the Sahel provide evidence that Africa, the continent that contributes the least to greenhouse gas emissions, is likely to be the most affected by climate change. The economic cost of inaction is very high, and governments should protect their development goals and ambitions from derailment by future climate change.

Investing in water security increases resilience of future economic development and is a sound strategy for policy and decision makers.

GWP commends the African Union and AMCOW for this progressive step of having developed and launched the Framework for Enhancing Water Security and Climate Resilient Development.

This Technical Background Document supports the application of the Framework by providing further details on the concepts, approaches, methods and tools underpinning economic development that is resilient to climate change, as outlined in the Framework.

GWP is pleased to have worked closely with our partners, in particular the Climate Development Knowledge Network, to support this work. We encourage governments, development cooperation agencies, business leaders, civil society and other decision makers to use the opportunity offered by this document to increase the resilience of economies not only in Africa but worldwide.



Dr Ania Grobicki
GWP Executive Secretary

Acknowledgements

AMCOW wishes to express its thanks to the Global Water Partnership (GWP) and Climate Development Knowledge Network (CDKN) who coordinated and supported the development of the Strategic Framework as well as this Technical Background Document.

This work has evolved through a strong collaborative relationship between AMCOW and its Technical Advisory Committee, GWP and CDKN, who funded the work. AMCOW further wishes to acknowledge the Austrian Development Cooperation for support to the Water Climate Development Programme, which set the basis for this document.

Special thanks to Alex Simalabwi (GWP), Andrew Takawira (GWP) and Jo McDonnell (CDKN), who in addition to providing expert inputs also managed and coordinated the development of this document.

The Framework would not be where it is today without the unwavering guidance and direction of the following members of the GWP/AMCOW Expert Panel (EP), coordinated by the Stockholm International Water Institute (SIWI), who provided technical guidance and inputs in the formulation process:

- Professor Torkil Jønch Clausen (Chair of EP, GWP Senior Advisor)
- Ms Lindiwe Lusenga (AMCOW TAC, AMCOW President's office)
- Dr Mats Eriksson (Secretary to EP, Stockholm International Water Institute)
- Mr Alan Hall (EU Water Initiative Finance Working Group)
- Ms Belynda Petrie (Southern Africa)
- Professor Edward Kairu (Eastern Africa)
- Professor Michael Scoullos (Mediterranean and North Africa)
- Professor Mathias Fonteh (Central Africa)
- Professor Abel Afouda (West Africa)

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Finally, we wish to thank the many other people and institutes that provided comments, suggestions and invaluable contributions during the stakeholder workshops, such as representatives of the AMCOW Technical Advisory Committee, national governments, sector agencies, river basin organisations, regional economic commissions, NGOs and international agencies. These stakeholders made invaluable contributions on the needs and priorities for ensuring the relevance of the Framework and this Technical Background Document.

Glossary of terms

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. An adaptation assessment combines elements of impact and vulnerability assessments by examining the potential impacts of climate change on systems together with the system's vulnerability or capacity to adapt to changing conditions or added stresses.

Adaptive capacity: Ability of a human or natural system to: adapt, i.e., to adjust to climate change, including to climate variability and extremes; prevent or moderate potential damages; take advantage of opportunities; or cope with the consequences. The adaptive capacity inherent in a human system represents the set of resources available for adaptation (information, technology, economic resources, institutions and so on), as well as the ability or capacity of that system to use the resources effectively in pursuit of adaptation.

Adaptation deficit: Failure to adapt adequately to existing climate risks largely accounts for the adaptation deficit. Controlling and eliminating this deficit in the course of development is a necessary, but not sufficient, step in the longer-term project of adapting to climate change. Development decisions that do not properly consider current climate risks add to the costs and increase the deficit. As climate change accelerates, the adaptation deficit has the potential to rise much higher unless a serious adaptation program is implemented.

Climate: The characteristics of weather (temperature, precipitation, wind patterns) that occur annually or seasonally, usually averaged over a 30-year time period for planning purposes.

Climate change: This refers to a statistically significant change in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).

Climate change justified: This refers to measures which are only viable if climate change scenarios materialise and would not normally be considered viable in their absence. Examples might include changing design standards to accommodate higher temperatures in future. However, many climate change justified measures have co-benefits in reducing levels of risk under present day climate variability.

Climate change risky: This refers to measures which are at risk of becoming unviable due to changing climate, or which do not consider potential climate variability. Such measures may include dams sited without a proper understanding of river flow variability or the potential impacts of climate change on hydrology.

Climate hazard: A climate hazard is a potentially damaging physical manifestation of climatic variability or change, such as droughts, floods, storms, episodes of heavy rainfall, long-term changes in the mean values of climatic variables, and potential future shifts in climatic regimes.

Climate resilient development: Development activities that will deliver benefits under all potential future climate scenarios and can cope with uncertainties over future conditions. It differs from business-as-usual development in actively considering and addressing potential existing and future climate risks.

Climate risk screening: A process of rapidly assessing existing and future climate risks relating to a system, such as a proposed investment option. It can be used to identify risks and resilient options for prioritisation.

Climate variability: The departure of climate from long-term average values, or changing characteristics of extremes, for example, extended rainfall deficits which cause droughts, or the prevalence of a greater than average rainfall depth occurring over a season.

'Hard' and 'soft' adaptation: 'Hard' adaptation measures usually imply the use of specific technologies and actions involving capital goods, such as dikes, seawalls and reinforced buildings, whereas 'soft' adaptation measures focus on information, capacity building, policy and strategy development, and institutional arrangements.

Impact (climate change): The effect of climate variability or long-term change on the functioning of a system. For example, an intense rainfall event may impact on agriculture negatively through crop damage. An impact assessment is the practice of identifying and evaluating, in monetary and/or non-monetary terms, the effects of climate change on natural and human systems.

Integrated water resources management (IWRM): A process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems'.

Integrating climate resilience: Refers to the near term inclusion of climate resilient investment opportunities in existing planning

processes, such as national or sector strategies, programmes and budgets.

Mainstreaming climate resilience: Refers to the long-term adjustment of decision making processes to include climate resilience concerns. This results in a pervasive improvement of the resilience of strategies, programmes, budgets and individual investments.

Maladaptation: An action or process that increases vulnerability to climate change-related hazards. Maladaptive actions and processes often include planned development policies and measures that lead to increased vulnerability in the medium to long-term, for example, constructing new houses on a flood plain.

Mitigation: Refers to implementing policies to reduce greenhouse gas emissions and to enhance the capture and storage of greenhouse gasses.

No/low-regret investment: No regrets investments will be unaffected by climate change and will deliver benefits under the full range of potential future climate change scenarios. Low-regrets investments are those which may be negatively impacted by climate change to some degree but will still deliver acceptable net benefits under the full range of potential future climate change scenarios.

Projection: A description of a potential plausible future situation and the pathway leading to it. An example of a projection could be average annual temperatures in the 2020s.

Risk assessment: Risk is often defined as the combined probability and severity of an event occurring. For example a highly likely, severely hazardous event is considered high risk whereas a highly likely mild event (or unlikely but severe event) is considered medium or low risk. A risk assessment seeks to quantify the level of risk either quantitatively, such as in monetary terms, or qualitatively, such as high, medium, low.

Resilience: The ability of a social or ecological system to resist, absorb, accommodate and recover from the effects of a (climate) hazard in a timely and efficient manner, while retaining the same basic structure and ways of functioning. It reflects the amount of change a system can undergo, the degree to which it can re-organise, and the extent to which it can build capacity to learn and adapt.

Robust decision making: Robust decisions are those made with consideration of uncertainty, in this case climate uncertainty. A robust decision will deliver the desired benefits under all potential future climate scenarios but will not necessarily be the optimal decision for any one single climate scenario.

Scenario: A scenario is a coherent, internally consistent and plausible, and often simplified, description of how the future may develop. It is not a forecast; rather, each scenario is one alternative of how the future could unfold. A projection may serve as inform a scenario, but scenarios often require additional information from other sources, sometimes combined with a narrative storyline. A set of scenarios is often adopted to reflect, as well as possible, the range of uncertainty in projections.

Sensitivity: This is the degree to which a system is affected, either adversely or beneficially, by climate related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise). A sensitivity analysis typically involves gaining an understanding of how varying climate to different extents (e.g., a 20% increase in annual rainfall) effects human or biophysical systems (for example hydropower production).

Uncertainty: An expression of the degree to which a value (e.g., the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures, for example, a range of values calculated by various models, or by qualitative statements, for example, reflecting the judgement of a team of experts.

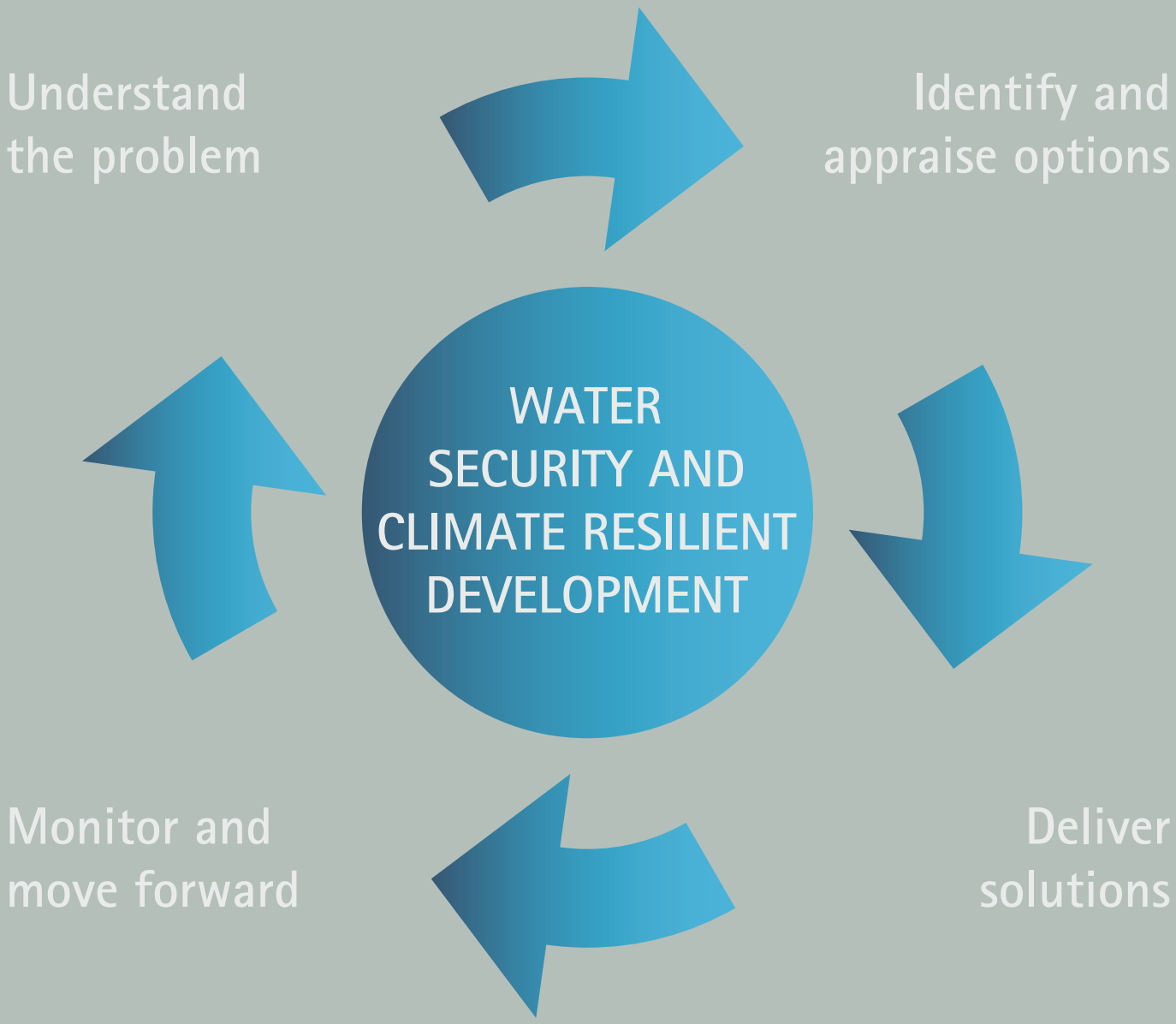
Vulnerability: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. Vulnerability assessment in the context of climate change refers to an analysis of the characteristics of a system (social vulnerability for example) that make it susceptible to negative (or positive) impacts due to climate change or variability.

Water security: Water security is the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, the environment and economies. This definition should be expanded to encompass access (financially, socially and legally) and capacity to use water, in addition to availability.

Abbreviations

AfDB	African Development Bank
AICD	Africa Infrastructure Country Diagnosis
AMCOW	African Ministers' Council on Water
AR4	IPCC Fourth Assessment Report
AU	African Union
BCA	Benefit-Cost Analysis
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate-Transfer
BSP	Budget Strategy Paper
CBD	Convention on Biological Diversity
CCASWS	Climate Change Adaptation Strategy for the Water Sector
CCIAV	Climate Change Impact, Adaptation and Vulnerability assessment
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CE	Cost Effectiveness
COP	Conference of the Parties
CPEIR	Climate Change and Public Expenditure and Institutional Review
CRF	Catastrophe Risk Finance
CSO	Civil Society Organisation
CSR	Corporate Social Responsibility
DFID	Department for International Development
DRR	Disaster Risk Reduction
DSS	Decision Support System
EAC	East Africa Community
EC	Eurpoean Commission
ECOWAS	Economic Community of West African States
EIB	European Investment Bank
ERR	Economic Rate of Return
FAO	Food and Agriculture Organization of the United Nations
FRM	Flood Risk Management
GBS	General Budget Support
GCF	Green Climate Fund
GCM	Global Climate Model
GDP	Gross Domestic Product
GEF	Global Environment Fund
GIS	Geographic Information System
GNP	Gross National Product
GWP	Global Water Partnership
ICT	Information and Communication Technology
IFI	International Financial Institution
IFPRI	International Food Policy Research Institute
II	Impact Investment
IIED	International Institute for Environment and Development
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IUWM	Integrated Urban Water Management
IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
LDCs	Least Developed Countries
MCA	Multi-Criteria Analysis
MDG	Millennium Development Goal
MIE	Multi-lateral Implementing Agencies
MTEF	Medium Term Expenditure Framework
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation
NIE	National Implementing Entity
NPV	Net Present Value
O&M	Operations and Maintenance
ODA	Official Development Assistance
ODI	Overseas Development Institute
OECD	Organisation for Economic Co-operation and Development
PER	Public Expenditure Review

PPCR	Pilot Programme on Climate Resilience
PPF	Project Preparation Facility
PPIAF	Public Private Infrastructure Advisory Facility
PPP	Public-Private Partnerships
PRSP	Poverty Reduction Strategy Paper
RCCP	Regional Climate Change Programme
RDM	Robust Decision Making
REC	Regional Economic Community
RLBO	River or Lake Basin Organisation
SADC	Southern African Development Community
SEI	Stockholm Environment Institute
SRES	IPCC Special Report on Emissions Scenarios
SRI	Socially Responsible Investment
SWOT	Strength, Weakness, Opportunity and Threat analysis
UN	United Nations
UN-DESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-FI	United Nations Environment Programme Finance Initiative
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCCC	UN Framework Convention on Climate Change
UNISDR	United Nations Office for Disaster Risk Reduction
WACDEP	Water, Climate and Development Programme
WatSan	Water and Sanitation
WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development
WWDR	World Water Development Report
WWF	World Wide Fund for Nature


Understand the problem
Identify and appraise options
WATER SECURITY AND CLIMATE RESILIENT DEVELOPMENT
Monitor and move forward
Deliver solutions

1 ABOUT THE TECHNICAL BACKGROUND DOCUMENT

Key messages

- **The African Union (AU), through the African Ministers' Council on Water (AMCOW), has developed a Strategic Framework for Water Security and Climate Resilient Development.**
- **The Framework is a tool to help users to identify and develop 'no/low regrets' investment strategies, to integrate these into planning processes, and to adapt future development planning activities to make them more resilient to climate change and variability.**
- **This Technical Background Document supports application of the Framework by providing detail on concepts, methods and approaches that underpin the actions and steps identified in the Framework.**
- **The Framework also helps to identify financing strategies for investments, and ways of exploiting new funds offering finance for climate adaptation in combination with funding from conventional sources.**
- **The process of applying the Framework itself will build climate resilience by strengthening institutional capacity, improving knowledge and understanding, and enhancing partnerships for action to improve water security and climate resilient development.**

This chapter introduces the Framework for Water Security and Climate Resilient Development and explains the role this Technical Background Document plays in supporting the application of the Framework.

Recommended sources of further information:

Strategic Framework:

GWP/AMCOW. 2012. *Water Security and Climate Resilient Development: Strategic Framework.* GWP, Stockholm, Sweden.
GWP/AMCOW. 2012. *Summary – Strategic Framework for Water Security and Climate Resilient Development.* GWP, Stockholm, Sweden.

Policy Brief series:

GWP/AMCOW. 2012. *Investing in Water Security for Growth and Development: Policy Brief Series.* GWP, Stockholm, Sweden.
No.1 – Water Security for Development in an Uncertain Climate
No.2 – Building on the Foundations of Integrated Water Resources Management
No.3 – Ensuring Adaptation at All Levels
No.4 – Managing Risks and Making Robust Decisions for Development
No.5 – Innovative Approaches to Water and Climate Financing

1.1 Background

The sustainability of Africa's economic growth and development will depend on what happens to water resources on the continent. Water is a key input to economic growth sectors and contributes to employment, job creation and gross domestic product (GDP).

Climate change threatens the continent's water resources. To sustain jobs, employment, economic growth and social stability, African leaders of today and tomorrow must make investment decisions that promote water security and climate resilient growth and development.

There is widespread consensus on the need for immediate action to tackle climate change. The process of adapting to climate change will benefit from the prioritisation of investments that perform well under a full range of climate scenarios. These investments are referred to as 'no/low regret' investments and are a key recommendation of the Intergovernmental Panel on Climate Change (IPCC) on climate risk management. Fast-tracking these investments allows action to be taken now to manage both current and future climate risks, despite a substantial level of uncertainty about the future climate.

Improved water management can benefit many sectors – for example, health, energy, agriculture, industry, mining, tourism, environment and others – while also contributing to development goals, climate change adaptation and disaster risk reduction (particularly floods and drought-related disasters). Water security and climate resilience need to be built at all levels; from transboundary to national and sub-national levels.

The African Union (AU), through the African Ministers' Council on Water (AMCOW), has developed a Framework for Water Security and Climate Resilient Development as a tool to help users to identify and develop no/low regrets investment strategies, to integrate these into planning processes, and to adapt future development planning activities to make them more resilient to climate change and variability. The Framework also helps to identify financing strategies for investments, and ways of exploiting new funds offering finance for climate adaptation in combination with funding from conventional sources.

1.2 Framework for Water Security and Climate Resilient Development

The Framework is centred on an iterative, cyclical decision making process split into four phases (see Figure 1.1). The generic nature of the cycle provides flexibility to apply the Framework at a range of planning levels, and to accommodate the wide range of institutional contexts across Africa.

Application of the Framework will help users achieve the following:

- identify and develop no/low regret investments, and associated financing strategies for these investments, across a wide range of sectoral and sub-sectoral interests and aligned with national development goals and priorities;
- ensure measures and investments take into account current and future climate conditions, socio-economic development pathways, and water use trends;
- promote practical, robust decision making to ensure adaptation investments that deliver benefits across a wide range of possible climatic and socio-economic futures;
- reinforce development pathways that are firmly grounded in sustainable development, and that facilitate transitions towards the greening of economies;
- promote increased investment in water security and climate resilience from a variety of domestic and international financing sources.

1.3 Technical Background Document

1.3.1 Aims and scope

This document supports the Framework by providing further detail on the concepts, methods and approaches that underpin the actions and steps identified in the Framework (Figure 1.1).

The chapters of this document map directly onto steps within the Framework, as shown in Figure 1.2 and summarised thereafter.

1.3.2 Overview of chapters

Chapter 1 Introduction to the Framework and the Technical Background Document.

Chapter 2 Using climate change and socio-economic scenarios to inform development planning. Scenarios play a central role in the Framework and Chapter 2 is intended to provide support to multiple steps in the Framework, including climate impact and vulnerability assessments, opportunities for building climate resilience, robust decision making and others.

Chapters 3–5 Phase 1 – Understand the problem.
Guidance, methods and tools to help with:

- producing a case for investing in water security for climate resilient development;
- identifying stakeholders and their roles in subsequent stages;
- identifying studies and evidence for review in Phase 2.

Chapters 6–9 Phase 2 – Identify and appraise options.
Guidance, methods and tools to help with:

- identifying and developing a balanced portfolio of investment options that enhance water security for climate resilient growth and development;

Understand the problem

Make the case for climate resilience

Gain stakeholder perspectives

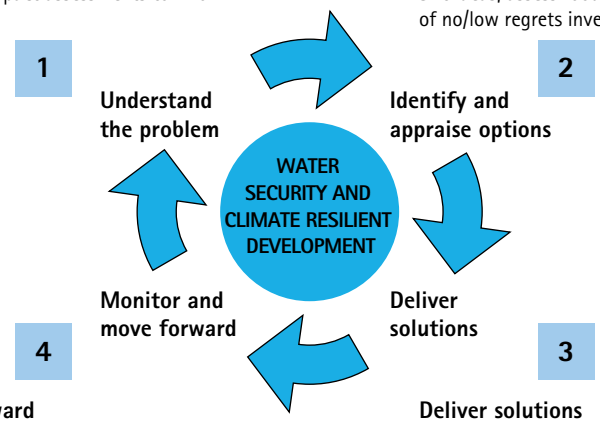
Climate vulnerability and impact assessments to inform decision makers

Identify and appraise options

Identify opportunities for building resilience in ongoing development activities

Identify new and innovative investment opportunities

Sift ideas, assess robustness and make the economic case for a balanced portfolio of no/low regrets investments



Monitor and move forward

Learn lessons from application of the Framework

Set a monitoring and review process

Deliver solutions

Integrate no/low regrets investment strategies in development planning

Develop financing and investment strategies

Mainstream climate resilience in development planning

Figure 1.1 The Framework cycle

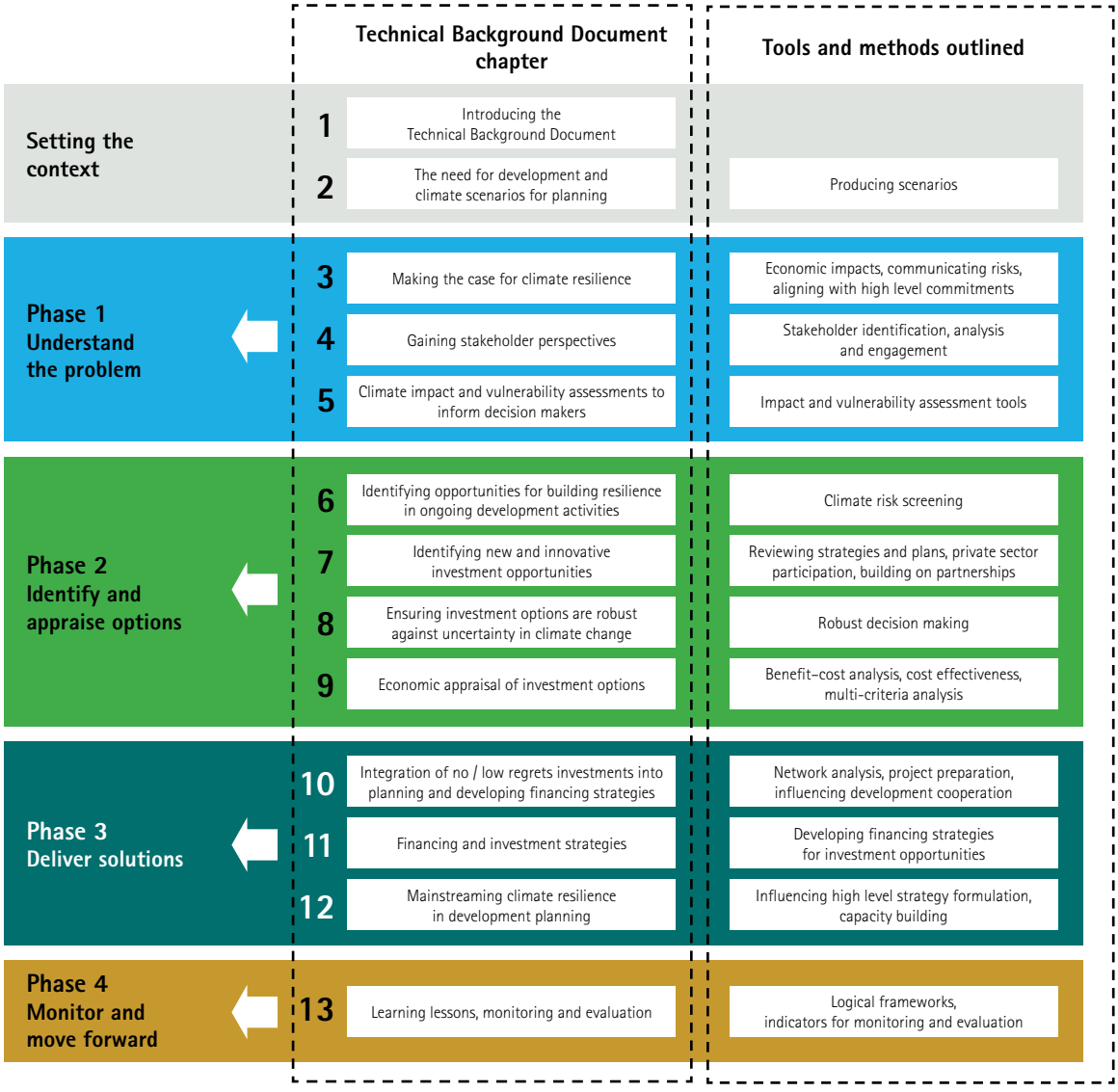


Figure 1.2 Phases of the Framework mapped onto chapters within the Technical Background Document

- prioritising no/low regret options and making a clear economic case for investment.

Chapters 10–12 Phase 3 – Deliver solutions.
Guidance, methods and tools to help with:

- integrating a balanced portfolio of no/low regret investment options into existing development planning systems and project implementation pipelines;
- developing financing strategies for these investments;
- mainstreaming climate resilience into development planning processes, as a longer term measure.

Chapter 13 Phase 4 – Monitor and move forward.
Guidance, methods and tools for:

- reviewing the application of the Framework process;
- setting up a system for monitoring implementation progress.

1.3.3 Target users

The Technical Background Document (TBD) is targeted at mid- to senior-level planners and technical specialists tasked with applying the Framework in African countries. This includes:

- officials in ministries responsible for policymaking and expenditure in water-dependent sectors (i.e. health, energy, agriculture, industry, mining, tourism, environment and others);
- officials in economic, finance, planning, and other 'apex' ministries;
- water managers and practitioners in the field.

The TBD is relevant to a wide range of water resource-dependent sectors, including drinking water supply and sanitation, agriculture, energy, environment, health, tourism, industry, mining and others.

It is also relevant for development cooperation partners who may be involved in the application of the Framework, such as: professional, technical and financial consultants and advisors to government; external donors agencies; United Nations organisations; international financial institutions (IFIs); non-government organisations (NGOs); and others engaged with national and regional governments in the delivery of national and regional development.

1.3.4 Using the document

The TBD should be read in conjunction with the Framework document, which provides the context and setting for the content of this document. The TBD is intended as a source book, not a manual. It provides guidance and case examples of good practice relevant to the methods and approaches for application of the Framework, but avoids being overly prescriptive. This enables the document to retain relevance across a wide range of different country conditions and contexts. The TBD also provides sources of further information and guidance. A glossary of key terms used throughout the TBD is provided at the front of the document.

1.4 Other resources in the series

This document is one of a suite of resources or knowledge products for planners and decision makers wishing to increase investment in water security for climate resilient growth and development. The full suite of resources is shown schematically in Figure 1.3 and includes:

- **Strategic Framework:** a high-level, strategic document outlining the 'what', 'why' and 'how' for implementation.
- **Technical Background Document:** details on tools and methods for application of the Framework.
- **Policy Briefs:** summaries of the key messages for high-level decision makers and policymakers.
- **Capacity Development Strategy and Implementation Plan:** to support application of the Framework.

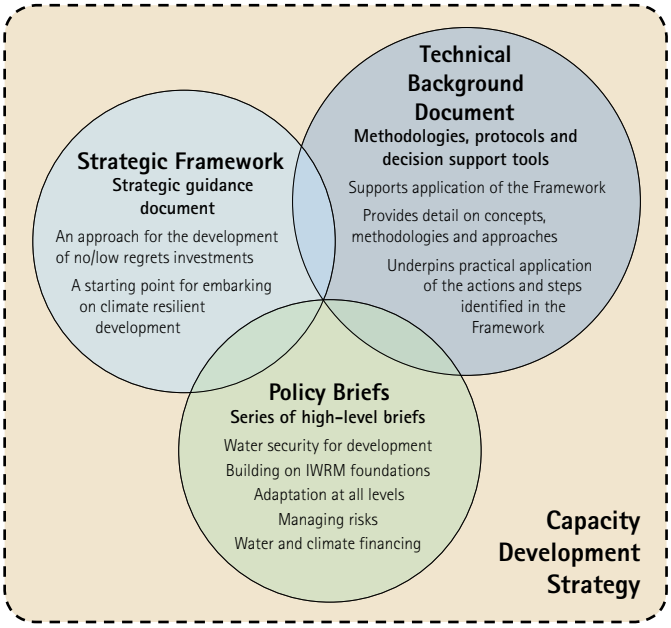


Figure 1.3 Schematic diagram of the relationships among the Strategic Framework, Technical Background Document, Policy Briefs and Capacity Development Strategy and Implementation Plan

2 | USING CLIMATE CHANGE AND SOCIO-ECONOMIC SCENARIOS TO INFORM DEVELOPMENT PLANNING

Key messages

- **Climate change scenarios are an important tool for informing the development planning process despite the substantial uncertainties in climate change science and socio-economic development trajectories.**
- **Non-climate drivers of change, such as population growth, land use and current climate variability, may be equally important as climate change in the African context due to the rapid pace of change on the continent.**
- **Uncertainties arise as a result of imperfect representations of the climate in global climate models (GCMs), unconfirmed estimates of future emissions of greenhouse gases, and natural variability of the climate systems that are overlaid on longer-term trends.**
- **Scenarios should be developed with a clear purpose and view of the end-user requirements.**
- **Scenarios can be developed relatively quickly on the basis of a growing body of research and data, which are often readily accessible on the Internet.**

This chapter does not correspond to a specific step within the Framework but provides support to Phases 1 and 2 of the Framework. Guidance is provided on the development of climate change and socio-economic scenarios that can be used in impact, vulnerability and adaptation assessment studies, in climate risk screening exercises, and to inform robust decision making analysis. The rationale for using scenarios to understand the range of uncertainty is presented and the importance of focusing on the end purpose of the scenarios is highlighted. A discussion of some of the key considerations when developing scenarios is presented, covering emissions scenarios, climate variables, spatial and temporal resolutions, and global climate model (GCM) selection. Finally, sources of further information for scenario development are identified and case studies are provided to exemplify some applications of scenarios in climate change impact studies.

Recommended sources of further information:

The United Nations Development Programme (UNDP) has produced a guidance document, aimed at project managers and decision makers, providing technical guidance on the development of climate change scenarios for climate change impact assessments. The diversity of requirements is recognised in the pragmatic stepwise approach that the guidance takes.

Puma, M.J. and Gold, S. 2011. *Formulating Climate Change Scenarios to Inform Climate-Resilient Development Strategies: A Guidebook for Practitioners*. UNDP, New York, NY, USA. Available at: http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/climate_strategies/green_lecrds_guidancemanualsandtoolkits.html

The United Nations Framework Convention on Climate Change (UNFCCC) National Communications Support Unit has prepared guidance for developing socio-economic scenarios. This guidance is part of a wider training package aimed at informing National Communication implementation teams about vulnerability and adaptation assessment approaches, which can be accessed online at: http://unfccc.int/resource/cd_roms/na1/v_and_a/index.htm.

Malone, E.L., Smith, J.B., Brenkert, A.L., Hurd, B., Moss, R.H. and Bouille, D. 2004. *Developing Socio-economic Scenarios for Use in Vulnerability and Adaptation Assessments*. UNDP, New York, NY, USA.

The Intergovernmental Panel on Climate Change (IPCC) has recently released a *Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)*. This provides key scientific evidence supporting the development of climate change scenarios. The full and summary reports can be accessed online at: http://ipcc-wg2.gov/SREX/

2.1 The need for climate change and socio-economic scenarios for planning

Scenarios are a central theme of the Framework and support multiple activities, including climate impact, adaptation and vulnerability assessment, climate risk screening and robust decision making. This central role is reflected in this chapter, which sits outside the Framework steps as an independent source of information for reference during any phase of the Framework.

Box 2.1
Defining a scenario

The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) includes a Special Report on Emissions Scenarios (SRES)[1], which defines a scenario as "a plausible description of how the future may develop, based on a coherent and internally consistent set of assumptions ('scenario logic') about key relationships and driving forces (e.g. rate of technology changes, prices). Note that scenarios are neither predictions nor forecasts."

2.1.1 What is a scenario for?

Scenarios provide representations of potential future situations; Box 2.1 provides a more detailed definition. If we could accurately predict the future, then planning would require only a single scenario. In reality the future is uncertain and more than one scenario must be considered.

Scenarios are required for planning purposes, in order to specify assumptions about the conditions that planned investments will need to respond to in the future. For example, scenarios of water demand and population are often combined with scenarios of climate change, to facilitate better planning for future investments in water supply systems.

The creation of a set of scenarios is an attempt to boil down the myriad possible future conditions into a manageable number of scenarios that encompass the major uncertainties. The Intergovernmental Panel on Climate Change (IPCC) developed 40 socio-economic scenarios as the basis for estimating emissions of greenhouse gases, six of which are commonly used to capture the full range of future emissions (these six are known as A1F1, A1B, A1T, A1, A2 and B2). These IPCC scenarios are described in the Special Report on Emissions Scenarios (SRES) and form a useful international benchmark for high-level projections of socio-economic development. Figure 2.1

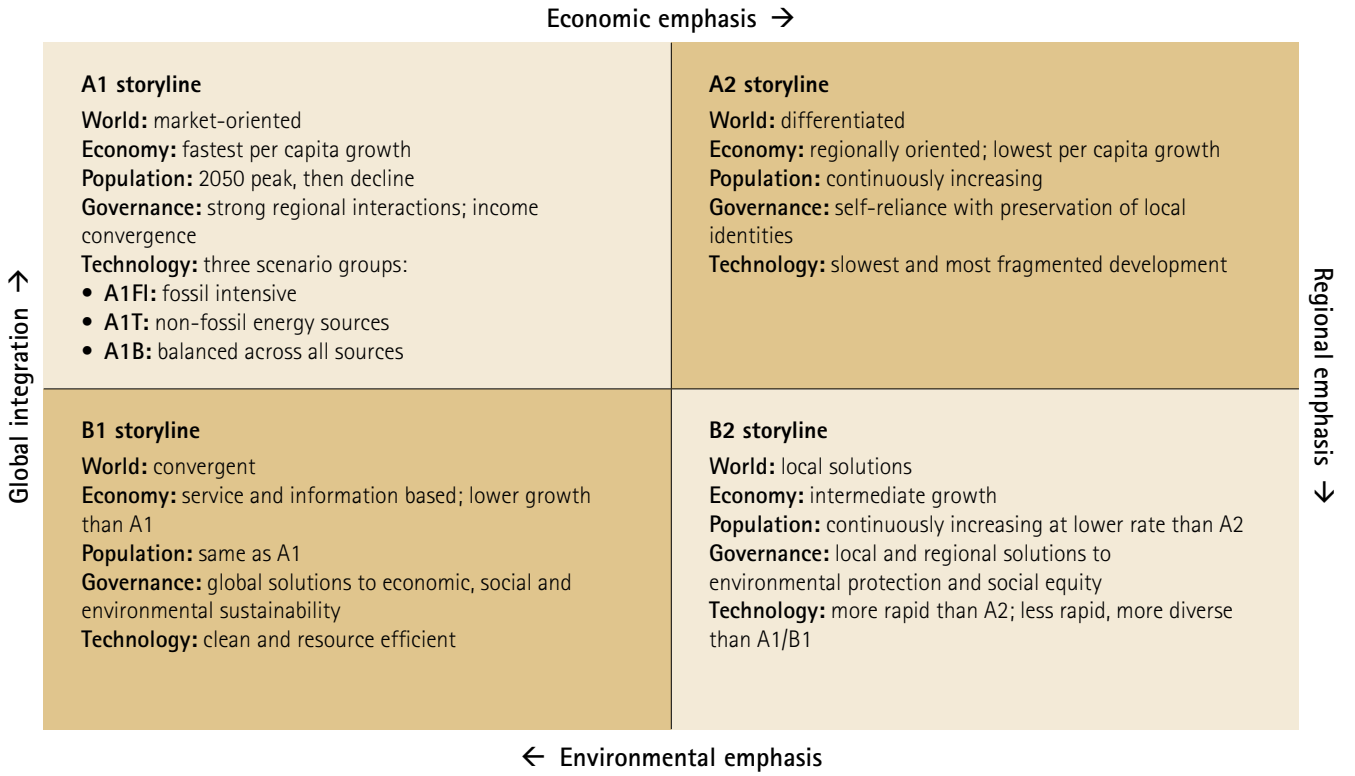


Figure 2.1 The four standard SRES scenarios (Source: Carter et al., 2007[2])

outlines the main assumptions unpinning the four main families of scenarios, known as storylines A1, A2, B1 and B2. Note that the A1 storyline encompasses three technological assumptions; intensive fossil use, mixed or balanced fossil use and non-fossil energy source use.

At a national or sub-national level, scenarios will need to take into account the key socio-economic changes relevant to the problem being addressed. For example, assessing the impact of climate change on agriculture may require more detailed scenarios of land use change at a sub-national level driven by economic and demographic changes at the national level, framed by the international trade and political environment.

2.1.2 Why are both socio-economic and climate change scenarios needed?

The social, economic and development trajectories of African nations are characterised by a high level of uncertainty. Unlike the relatively static demographics of developed nations, the rapid pace of change in Africa means that climate change impacts will be superimposed on dynamic societies. This means that, in the African context, the non-climate drivers of change are likely to be at least as important as the climate drivers in many circumstances and should not be overlooked.

Climate change and socio-economic scenarios can be used separately. In many cases this can be an advantage as it allows the impacts of climate change to be assessed in isolation from changing socio-demographic conditions, thus shedding light on the relative importance of climate and socio-economic drivers. However, the reality for planners is that both climate and socio-demographic changes will occur simultaneously and are likely to interact. Therefore, a consideration of both is required in planning initiatives and investments to enhance resilience.

In practice, applying both climate and socio-economic scenarios together is challenging. Care should be taken, therefore, to use scenarios which capture the main potential trends without being unnecessarily complex.

Selecting the number of scenarios required depends on the uncertainties to be captured and the feasibility of carrying out multiple analyses. For most practical purposes, it is advisable to restrict the selection to a manageable number of scenarios that represent a plausible set of future climate and socio-demographic conditions. For example, uncertainties in climate models may result in a range of possible futures for precipitation change and the range may be suitably represented by a wet and a dry scenario. In many cases the key climate sensitivities may be more complex – for example, they may relate to the reliability of rainfall or the frequency of floods – but a simple approach is still possible. Similarly, development scenarios may be classified under 'high growth' and 'low growth' to represent social and economic futures.

A frequently used approach is to identify the main climate and socio-economic drivers of change as dimensions or 'axes' and, where two dimensions are the most important, to develop scenarios in each of the four quadrants. Taking this approach when considering 'wet' and 'dry' future climate scenarios and 'high' and 'low' future economic growth scenarios may provide a useful and relatively simple framework for capturing uncertainty ranges. Climate drivers may encompass long-term trends in rainfall (annual or seasonal), changes in temperature, changes in sea level or changes in the extremes of these climate variables. Figure 2.2 illustrates a hypothetical and simplified scenario framework using development and climate scenarios for the axes.

Development futures	**High**	**High growth** Increased rainfall	**High growth** Decreased rainfall
	Low	**Low growth** Increased rainfall	**Low growth** Decreased rainfall
		Wet	**Dry**
		Climate futures	

Figure 2.2 An illustrative future scenario framework for capturing uncertainty

2.2 Constructing socio-economic scenarios

Developing socio-economic scenarios is at least as challenging as developing climate change scenarios. The complex and interrelated systems which drive social, industrial, environmental, economic and technological changes are extremely difficult to forecast. One hundred years ago it would have been difficult to predict the world situation as it is today, and the pace of human change is accelerating. The UNFCCC National Communications Support Unit has prepared useful guidance on developing socio-economic scenarios.[3]

The attributes of the socio-economic scenarios will depend on the nature of the assessment. National-level assessments may look at high-level indicators such as gross domestic product (GDP), demographic changes and economic structural changes. Sector assessments, such as for the agriculture sector, may look

at technology uptake, food prices and land use changes (which are driven by global or at least national developmental changes).

Data for constructing socio-economic scenarios may include the following:

- **Global storylines consistent with the SRES scenarios.** These global scenarios can be used to provide a backdrop to the development of scenarios tailored to the country or sector context. The SRES socio-economic data can be obtained from the IPCC Data Distribution Centre (see Box 2.5).
- **Population projections.** Population projections are an integral driver of resource demand. The United Nations Department of Economic and Social Affairs (UN-DESA) provides country-level population projections as well as trends in urbanisation and demographic distribution (see Box 2.5).
- **National development strategies and other high-level strategies.** These documents present targets that countries are attempting to reach, such as targets for GDP growth, industrial development, social and environmental protection. Such documents can be used as a guide when producing sensitivity tests to examine the direction of anticipated future changes. As an example, Box 2.2 presents the key variables for scenario development as set out in Rwanda's Green Growth and Climate Resilience Strategy.

Box 2.2

Key variables for scenario planning in Rwanda (based on Rwanda's Green Growth and Climate Resilience Strategy[4])

Rwanda's Green Growth and Climate Resilience Strategy sets out the key national-level variables and uncertainties impacting on Rwanda's future growth and development trajectory:

- oil price
- oil dependency
- population growth
- urbanisation
- temperature increase
- rainfall change
- energy demand
- water demand

Integrated planning and management was identified as a key pillar in the Strategy to better understand the feedbacks and interconnections between land use, ecosystem services, water availability and energy supply going forward under future population and climate change scenarios. The resulting scenarios are used to assist planning and decision making to achieve 'green' economic growth.

2.3 Constructing climate change scenarios

Global climate models (GCMs) have been used extensively to investigate the impacts of human activities on the global climate system. The IPCC has synthesised the results of many GCMs developed by a number of institutions in order to draw broad conclusions on the impacts of climate change at a high level (regionally and across sectors). However, for this vast wealth of climate change data to be useful to planners, simpler scenarios of future climate are needed. Scenarios should capture the range of potential climate futures in a sufficiently manageable form and size to enable assessment of the potential impacts on vulnerable sectors, economies, basins and communities. The UNDP has produced a guide designed specifically to assist practitioners in the development of climate change scenarios for impact assessment.[5]

Scenarios are required because of the substantial uncertainties in climate change science. These uncertainties arise from several sources, and they compound each other. In many cases it is not possible to quantify the magnitude of the uncertainty, giving rise to 'unknown unknowns'. Sources of uncertainty include:

- future levels of greenhouse gas emissions, which drive climate change;
- usage of GCMs, which are a simplification of the global climate system; different GCMs can produce strikingly different results, especially in the direction and magnitude of precipitation changes; and
- natural climate variability, which occurs on decadal cycles regardless of climate change, and which may mask longer-term climate trends.

A clear view of the purpose of climate change scenarios is essential as a first step in their development. Two examples of purposes for scenarios are outlined below:

1. **Scenarios that are developed in order to set high-level policy responses.** These will need to be sufficiently simple to be understood by non-technical decision makers and broad enough to achieve buy-in from a wide range of stakeholders. Scenarios should cover the entire country for key climate variables, sea level rise and changing extremes. Box 2.3 presents an example of a set of very simple climate change scenarios developed for Cameroon. These would not be suitable for detailed modelling, but provide a rapid overview of the main trends.

2. **Scenarios that are developed for detailed modelling studies.** For example, such scenarios would be needed for modelling crop response in a particular district. These scenarios are likely to be much more focused on the climate drivers that crop response models respond to and require as

Box 2.3

Example of simple climate change scenarios for Cameroon

Based on the UNDP's country profiles, simple climate scenarios can be developed rapidly to give an indication of future trends. Temperature projections for Cameroon indicate temperature increases of 1.5 to 4.7°C by the 2090s. Rainfall projections are less certain, with anticipated changes in annual rainfall of between approximately -7% and +20% (based on 1970–1999 averages and the maximum range across the A2, A1B and B1 IPCC SRES scenarios). This information has been used to produce six simple scenarios outlined below.

	Rainfall decrease of 7%	No change in rainfall	Rainfall increase of 20%
Temperature increase of 1.5 °C	A – Warm / dry	C – Warm	E – Warm / wet
Temperature increase of 4.7 °C	B – Hot / dry	D – Hot	F – Hot / wet

If the project or programme is sensitive to storm rainfall, then simple scenarios can be developed based on changes in maximum rainfall intensity. The UNDP projects a maximum increase of approximately 20% in rainfall intensity by 2090.

If the project or programme is sensitive to a rise in sea level, then simple scenarios based on the level of the projected rise can be developed. The projections range between 0.13 and 0.56 metres by 2090. Sea level rise may also have implications for coastal processes such as erosion and accretion.

The UNDP country profiles are available online via the country pages of the UNFCCC National Communications Support Programme, available at: http://ncsp.undp.org/

inputs. These scenarios may need to provide future daily time series data downscaled to a fine resolution, and are likely to consider a range of futures without requiring excessive modelling work. An African initiative to downscale GCMs to create scenarios for the African continent is responding to the need for more detailed scenarios for impact assessment (see Box 2.4).

Scenarios should ideally be as simple and transparent as possible, while ensuring that the main climate trends and uncertainties are incorporated. The complexity of scenarios is dictated by a number of factors (see Table 2.1).

Understanding the baseline climate is an important step in generating climate scenarios. Typically GCM outputs will not be of sufficiently high quality to represent local climate, day-to-day weather and extreme events. Therefore, many studies apply GCM change factors to historical data rather than using the GCM data directly. Such approaches have the advantage that the assessment is grounded in observed data. It is important to compile as much historical data as reasonably possible in order both to apply climate change scenarios and also to calibrate models to the historical period. Some historical data are stored in web accessible repositories, such as the Global Observing

Box 2.4

Coordinated Regional Downscaling Experiment (CORDEX)

The Climate Systems Analysis Group (CSAG) at the University of Cape Town is leading a project to downscale climate change data from global models to provide more detail for Africa. Information at this regional level is needed by scientists in disciplines affected by climate change (e.g. hydrologists), as well as decision- and policymakers, and by those assessing climate change impacts, adaptation and vulnerability.

In addition to providing detailed climate change information for scientists, the CORDEX Africa Analysis campaign is a follow-up activity that brings together African scientists working on climate as well as on vulnerability, impacts and adaptation, not only to interrogate the raw downscaled data for information on how climate processes over the continent may change but also to assess how these changes may impact various sectors (e.g. health, agriculture, water security) in multiple regions across the continent.

Table 2.1 Considerations in defining the main characteristics of climate change scenarios

Factor	Consideration
Climate variables	Temperature and precipitation are the two key climate variables, although derived variables – such as cooling degree days – may be required for specific applications. Sea level rise is a key variable for many coastal areas and is related to thermal expansion of the oceans and melting of ice on land as the planet warms.
Extremes	Some analyses, such as for disaster risk reduction, will require estimates of changing patterns of climate extremes. These may include storm events, cyclones and heatwaves, which operate on short timescales.
Temporal resolution	Change in annual temperature or precipitation may be sufficient for some applications, whereas seasonal or monthly changes may be required for more detailed applications (e.g. crop response modelling). Some types of modelling will require daily time series of future climate, which are often created by applying monthly change factors to historical datasets, or if they are of sufficient quality the outputs of climate models may be used directly.
Time slices	Typically climate changes are reported as the average of a 30-year period in the future. The use of a 30-year period irons out some of the natural variability. The time slice is the future period of interest to planners. For instance, infrastructure with a 30-year lifetime and 10-year lead-in period may suit a future time slice period of 2030–2060. Longer-term planning may require the use of more than one time slice to assess how changes evolve in the future.
Spatial scale	Climate impact studies may be reported at global, regional, national, river basin, district or site-specific scales. At the national level large countries may straddle impact zones, which may require scenarios to be developed at a sub-national scale to capture this variability. Conversely, the GCM resolution may be too coarse to correctly represent district or site scales that may be influenced by local climate drivers, such as topography. Downscaling from GCMs to smaller spatial units may be appropriate in such cases.
Emissions scenarios	The IPCC SRES[6] provides a set of standard emissions scenarios that describe various ranges of greenhouse gas emissions based on assumptions of global development. The six scenarios focused on in the IPCC Fourth Assessment Report are known as A1FI, A1B, A1T, A2, B1 and B2. These scenarios are likely to be updated in the IPCC Fifth Assessment Report, as they are now over 10 years old and trends indicate recent greenhouse gas emissions are exceeding the scenario projections. Some acknowledgement of the uncertainty in emissions scenarios should ideally be captured in scenarios rather than using a single 'middle of the road' scenario.
GCM model selection	The IPCC Fourth Assessment Report uses a multi-model ensemble approach for climate scenarios. The use of multiple GCMs provides greater confidence in scenarios and identifies areas where GCMs do not agree in their projections. The use of a single GCM may be appropriate if it can be demonstrated that it offers good agreement with other GCMs. However, in most cases taking a range of scenarios from a multi-model ensemble captures the substantial uncertainty in individual GCMs.

Systems Information Center (GOSIC) or the Food and Agriculture Organization of the United Nations' (FAO's) AQUASTAT database. Much data may be available from National Meteorological and Hydrological Services (NMHS) departments. It is estimated that only approximately 10% of data collected by NMHS departments is disseminated to the international portals.[7] Some data may only be available in paper form in national or sub-national archives and these documents should be secured as a priority before they are lost.

Climate change information is becoming increasingly widely available online. Online data portals are intended to facilitate dissemination of information to specialists and non-specialists, allowing government planners to assess risks without having to process large volumes of detailed climate model data. Box 2.6 provides an annotated list of some of the key online climate change data resources.

Boxes 2.6 and 2.7 provide two case studies of climate scenarios used in impact assessment, which exemplify the complexity of decisions facing technical staff and the challenges inherent in developing scenarios for impact assessment. Box 2.6 provides an example of using qualitative approaches to integrate climate and non-climate scenarios across sectors in the Mekong subregion. Box 2.7 details an example of focused quantitative modelling studies where scenarios are required to drive models of water resources.

2.4 Final remarks

This chapter provides guidance on developing climate and socio-economic scenarios to support multiple steps within the Framework. The guidance is necessarily generic and signposts to more detailed guidance and sources of information are provided.

Box 2.5

Climate change and demographic projection data resources for scenario development

The following sources provide data which can be used to create simple scenarios for high-level planning purposes. Ideally, countries should attempt to produce more detailed projections based on national and local data sources. The use of consistent scenarios by planners working in different sectors is crucial in ensuring unbiased decision making.

UNDP Climate Change Country Profiles

These profiles are a first port of call for country scale climate change assessment and provide observed and projected climate data and a summary report in a concise and user-friendly format. The profiles are ideally suited to non-climate specialists looking to build simple scenarios to assess climate change impacts using a screening approach. Available online via the country pages of the UNFCCC National Communications Support Programme: http://ncsp.undp.org/

The IPCC Data Distribution Centre (DDC)

The DDC is a key resource for accessing baseline climate, climate change and socio-economic data and information. It also provides guidance on the selection of climate change scenarios and a visual interface to inspect and communicate the data. Available at: http://www.ipcc-data.org/

The World Bank Climate Change Knowledge Portal

The portal provides climate and socio-economic data and projections in a user-friendly format. It also links to the World Bank's Assessment and Design for Adaptation to Climate Change (ADAPT) tool, a computer-based climate risk screening tool designed to evaluate the sensitivity of activities or components of development projects, and to provide a list of practical recommendations on adaptation and on how to enhance the climate resiliency of a project and manage its risks. Available at: http://sdwebx.worldbank.org/climateportal/

The University Corporation of Atmospheric Research (UCAR) MAGICC / SCENGEN

MAGICC (Model for the Assessment of Greenhouse-gas Induced Climate Change) consists of a suite of coupled gas-cycle, climate and ice-melt models integrated into a single software package. The software allows the user to determine changes in greenhouse gas concentrations, global mean surface air temperature, and sea level resulting from anthropogenic emissions. SCENGEN (a regional climate SCENario GENerator) constructs a range of geographically explicit climate change projections for the globe using the results from MAGICC together with Atmosphere-Ocean General Circulation Model climate change information from the archives of phase 3 of the Coupled Model Intercomparison Project and the Fourth Assessment Report. Available at: http://www.cgd.ucar.edu/cas/wigley/magicc/

The United Kingdom Met Office's PRECIS

The PRECIS (Providing Regional Climates for Impacts Studies) system is designed to put the control of climate modelling into the hands of users, allowing them to generate their own high resolution climate projections at a regional level. Available at: http://www.metoffice.gov.uk/precis/

United Nations Department of Economic and Social Affairs (UN-DESA)

UN-DESA provides demographic projections, including data on urbanisation by region and country. Available at: http://www.un.org/esa/population/unpop.htm

Scenarios are a crucial component of development planning, especially when considering the management of natural resources and climate risks, which will be subject to the uncertainties around climate change over the coming decades.

The expected outputs at this stage are:

- An understanding of the principles and processes for developing scenarios, which can be used to inform their development during later steps within the Framework as required.
- An awareness of the sources of information for developing climate scenarios.

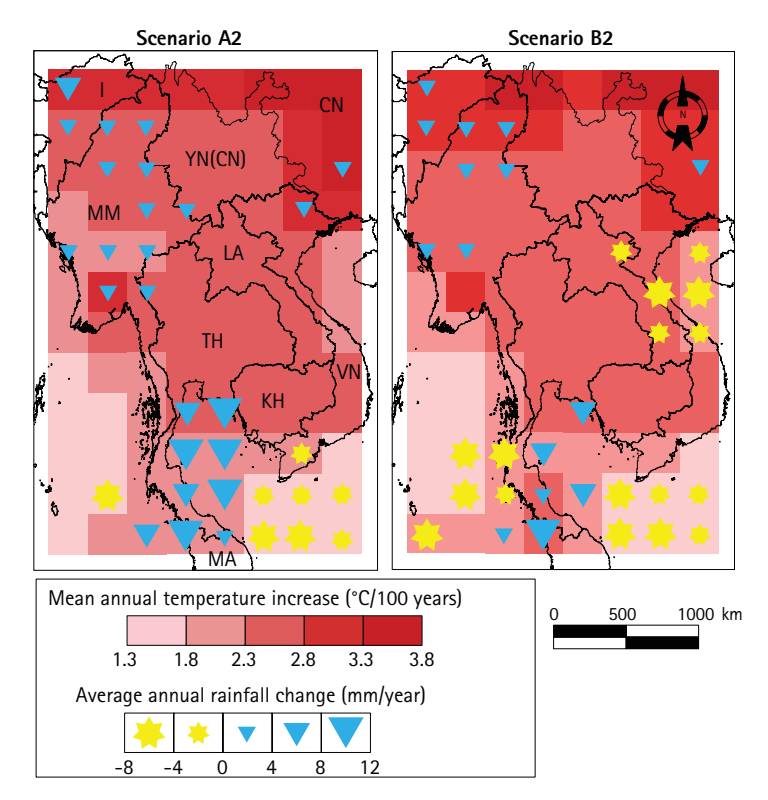
The outcome of this chapter is an understanding of scenarios; what they can comprise and the level of detail required. This will inform later steps in application of the Framework, when scenarios are required as inputs to inform impact, adaptation and vulnerability assessments as well as climate risk screening and robust decision making.

Box 2.6

Case study of the use of scenarios for climate change, water and agriculture in the Greater Mekong subregion[8]

This case study provides an example of a qualitative impact assessment of climate and non-climate drivers on water resources, including a discussion of potential priorities. This study reviews the existing relevant body of research and uses expert judgement to qualitatively assess the key impacts of climate and non-climate drivers on the Greater Mekong subregion.

- **Existing conditions** – A review of the current status and trends in the water and agriculture sectors is presented in order to set a baseline.
- **Climate scenarios** – Climate change scenarios (including river flow and sea level rise) are drawn from preceding academic studies rather than directly from climate change databases. These scenarios are compared and contrasted to give an overall qualitative picture of the uncertainties involved.
- **Non-climate scenarios** – Population growth, trends in diet, investment and trading patterns and projections are discussed, based on various sources.
- **Regions** – The Greater Mekong is the subregion of interest, but scenarios derived from other studies have been developed, which do not entirely overlap with this region. Particular areas within the region are discussed if they are considered to be subject to particular risks.
- **Modelling** – No modelling is carried out in this impact assessment; instead the approach is to review more detailed studies and use expert judgement to provide a qualitative weighting of the importance of different challenges.
- **Uncertainty** – Qualitative impressions of the relative uncertainty and importance of different drivers are provided throughout but no attempt is made to quantify these. This is likely to be beyond the scope of this discursive (non-technical) study.
- **Further analysis** – In addition to assessing the likely impacts of climatic and non-climatic drivers on the Mekong subregion, expert judgement is utilised to highlight potential priority areas for adaptation activities.



Projected changes in temperature and rainfall in the Greater Mekong subregion, 1960–2049

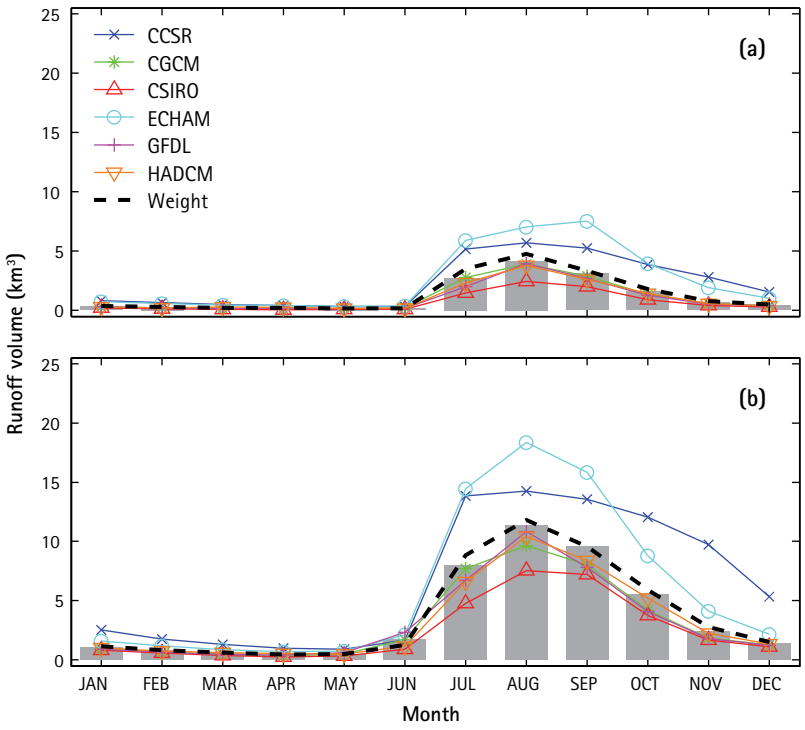
Box 2.7

Case study of the use of scenarios for climate change impacts on hydrology and water resources of the Upper Blue Nile River Basin, Ethiopia[9]

This study is an example of a technical, modelling-based climate change impact assessment. It constrains the number of scenarios by using only one emissions scenario, one future time slice and no additional non-climate scenarios. The GCMs show a wide and conflicting range of outputs, indicating that confidence in future river flows is low and highlighting the need for a robust and flexible decision making approach to planning for climate change in the basin.

The study is relatively technical and uses quantitative modelling to assess future impacts of climate change. It is also focused on the impact of climate on hydrology and does not address the potential range of non-climatic drivers on water resources within the basin.

- **Climate change data** – Climate change scenarios were developed using six GCMs (for one emissions scenario) with data extracted via the IPCC Data Distribution Centre.
- **Scenarios** – A baseline scenario and seven scenarios of future climate change, using the mean monthly changes for each GCM model and one set of monthly changes for the combined GCMs. Only one future time slice was used (2050s).
- **Non-climate scenarios** – No non-climate scenarios were needed as this study focused on potential supply rather than demand for electricity.
- **Regions** – Six basins were modelled in the Upper Blue Nile catchment.
- **Modelling** – The climate change scenarios were applied to rainfall-runoff models of the basins to assess the changes in river flow regime for each scenario. This modelling required time series data of temperature and rainfall for the baseline and future scenarios to drive the runoff models.
- **Further analysis** – The scenarios were also used to assess future drought frequency and to investigate the operation of potential future multi-purpose dams.



Comparison of the mean monthly runoff distributions at
(a) Station 2001, and (b) El Diem under different climate scenarios for the 2050s.
The bars represent the baseline runoff.

Baseline and future runoff volumes at two flow gauging stations on the Blue Nile

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3 | MAKING A CASE FOR WATER SECURITY AND CLIMATE RESILIENT DEVELOPMENT

Key messages

- Ensuring water security through more effective water management contributes to development goals, climate change adaptation and disaster risk reduction, both now and into the future.
- The economic cost of inaction could be very high, and governments should protect their development goals and ambitions from derailment by future climate change.
- There is widespread consensus on the urgent need for immediate action to tackle climate change, as indicated by the commitments made by African leaders in the Sharm el-Sheikh Declaration.
- A succinct and well-argued case for water security and climate resilient growth and development helps to ensure buy-in from high-level decision makers and planning teams for increased investment and reinforced water and climate strategies.
- Economic arguments for the benefits of water security and climate resilience, and the potential costs of inaction, will highlight clearly the case for investment, in terms that high-level officials can readily grasp.
- Communications about the case must address real world problems, advocate practical and implementable solutions, and persuade the target audience to do what they know must be done.

This chapter supports Phase 1 of the Framework process and provides further information on making a case for building in climate resilience. Alignment of arguments for climate resilience with related high-level commitments and decisions can strengthen the case. Economic arguments for climate resilience are powerful tools for communicating the magnitude of the costs of inaction and the benefits which climate resilient development could help realise. Finally, the communication of science for non-specialist decision makers is required as part of making a strong case.

Recommended sources of further information:

The Overseas Development Institute (ODI) have produced a note on communicating evidence through policy briefs and the characteristics of policy briefs that influence decision makers.

Overseas Development Institute (ODI). 2008. *Policy Briefs as a Communication Tool for Development Research*. ODI Background Note. ODI, UK. Available at: http://www.odi.org.uk/resources/details.asp?id=425&title=policy-briefs-communication-tool-development-research

The Climate and Development Knowledge Network (CDKN) have produced a summary report on changing climate extremes and their impacts in Africa. It is a good example of a technical subject presented in a convincing manner for policymakers.

Climate and Development Knowledge Network (CDKN). 2012. *Managing Climate Extremes and Disasters in Africa: Lessons from the SREX Report*. CDKN, UK. Available at: http://cdkn.org/srex/

3.1 Overview

Presenting a well-argued and supported case can provide the evidence that high-level decision makers need in order to justify giving their support to initiatives and investments for water security and climate resilience. A strong case for climate resilience can centre on:

- **Identifying the high-level commitments that align with the proposed initiatives or investments for climate resilience.** These range from pan-African commitments such as the Sharm el-Sheikh Declaration and the Millennium Development Goals, to national- and sector-level strategies and policies. These may include environmental, social welfare, gender equity, and other relevant development commitments.
- **Quantifying the economic benefits of climate resilience efforts and the costs of inaction.** Economic arguments provide a readily digestible measure of the costs and benefits of initiatives and investments for climate resilience. High-level economic studies of the impacts of climate change include the African Development Bank's (AfDB's) report, *The Cost of Adaptation to Climate Change in Africa*.[1] Similar studies may have been completed at country level. For more specific investment proposals, primary research may be required to produce a tailored macroeconomic analysis for the specific circumstances.
- **Presenting the scientific evidence in a readily digestible format.** The impacts of climate variability and change must be presented in a form that can be understood by non-specialists. One example of this type of science communication is the Intergovernmental Panel on Climate Change's (IPCC's) Summary for Policymakers, which presents the widely accepted evidence for climate change and its impacts in a format that can be readily understood.

Box 3.1

Adaptation-related commitments in the Sharm el-Sheikh Declaration on water and sanitation

- Put in place adaptation measures to improve the resilience of countries to the increasing threat of climate change and to the increasing variability of water resources, and to improve Africa's capacity to meet the water and sanitation targets.
- Ask Regional Economic Communities and River and Lake Basin Organisations to initiate regional dialogues on climate change and its impacts on the water sector, with the aim of designing appropriate adaptation measures.
- Ensure the equitable and sustainable use – and promote the integrated management and development – of national and shared water resources in Africa.
- Significantly increase domestic financial resources allocated for implementing national and regional water and sanitation development activities, and call upon ministers of water and finance to develop appropriate investment plans.

The case for water security and climate resilient growth and development should be succinct and readily digested by non-specialists. Tools for communicating the case may include policy briefs, briefing notes, short reports or presentations. Ideally, the sources of information and assumptions behind the arguments should be recorded in a supporting technical note to be used as a source of further information for technical advisors, and for dissemination and capacity development purposes.

This chapter includes examples of ways to present the case for water security and climate resilience in Africa, which may be helpful as a guide for presenting the relevant arguments when advocating for climate resilient development.

3.2 Meeting water and climate commitments

Part of the purpose of making a case for water security and climate resilient development is to reinforce the message that this is *not* new; rather it is helping to achieve commitments that have already been agreed at a high level by government ministers and their advisors.

There is now widespread consensus on the urgent need for immediate action to tackle climate change through adaptation, and this has been reiterated at many United Nations Framework Convention on Climate Change (UNFCCC) and African regional meetings on climate change. Box 3.1 highlights the key commitments for African nations in the Sharm el-Sheikh Declaration.

Water security and climate resilient development reinforces achievement of the targets and goals set out in the following commitments:

- Africa Water Vision 2025
- Millennium Development Goals (MDGs)
- UNFCCC processes
- Sharm el-Sheikh Declaration on water and sanitation
- Rio+20 United Nations Conference on Sustainable Development

Actions and issues reflected in the overarching messages and objectives of many of the above include: poverty alleviation and improvements in health status, access to resources, service provision, sustainable development, green growth, energy and food security, climate change, public and private investment, and peace and security. In individual countries there will also be many national and sub-national commitments to which water security and climate resilience will contribute.

It is important that key messages for high-level decision makers emphasise how different aspects of water security and climate resilient development contribute to some or all of the above.

3.3 Economic analysis of climate change

Economic studies often serve a number of different objectives, each aimed at different potential stakeholders. Studies generally require aggregated information on the economic costs of climate change and the costs and benefits of adaptation. Further analysis can be undertaken to look at alternative pathways – for example, the economic costs and benefits of a low carbon growth pathway – or to help inform priorities at different levels: national, regional and local.

A multilevel approach is required, using different aggregation levels to iteratively build up several lines of evidence on impacts and adaptation. For example, this could encapsulate top-down aggregated economic analysis, sectoral economic impact assessment at the national level using more bottom-up assessment techniques, and a series of sub-national and local case studies on vulnerability and adaptation to provide local context and inform decision making. The local studies allow consideration of livelihoods, development and poverty alleviation, which would be missed by a high-level economic assessment.

The combined evidence across the levels provides information on the economic costs of climate change and the costs and benefits of adaptation, to contribute to the process of national priority setting.

Methods for economic assessment, especially for adaptation, are still evolving but examples can be found, such as the economics of climate change study for Kenya described in Box 3.2.

A combination of high-level economic assessments and local-level vulnerability studies contribute to a comprehensive evidence base, and can provide some cross referencing between model-derived aggregations with national and sectoral economics studies and local experiences, as well as allowing ground truthing. The analytical framework used for the Kenya economic study is shown in Figure 3.1 and illustrates the combined use of analysis at different levels, all contributing to the national-level assessment.

There is inevitably a wide range of climate impacts and vulnerabilities that could be considered in making a case for climate resilience. Building on existing literature allows the main climate risks in each sector to be sifted, with more detailed analysis reserved for the key priority impacts.

Box 3.2
Economics of climate change in Kenya[2]

To better understand the economic impacts of climate change in Kenya, the UK's Department for International Development (DFID) and Danish International Development Agency (DANIDA) funded studies by the Stockholm Environment Institute (SEI) to assess the economic impacts of climate change in Kenya and two other East African countries.

The aims of the Kenya study included assessing the impacts and economic costs of climate change for Kenya, considering key sectors of the economy as well as non-market sectors such as health and ecosystems; and analysing the costs and benefits of adapting to these effects over different timescales.

The study findings provided a sobering warning to high-level decision makers on the potential economic impacts of climate change. Annual losses of 2.6% of GDP were predicted to occur by the 2030s. Extreme events would have an increasingly dramatic impact on infrastructure and the built environment, and other key sectors such as agriculture, industrial processing, manufacturing, tourism, infrastructure and health would also be impacted.

3.4 Communication tools to make the case: writing policy papers and briefs

The case for water security and climate resilient growth and development should be succinct and digested readily by non-specialists. Policy papers and briefs are often used to engage with high-level decision makers; they must provide a persuasive argument justifying the recommendations presented in the paper. Policy papers are generally more comprehensive while policy briefs are more succinct.

Policy papers and briefs are calls to action for the target audience. To be effective for a high-level audience, they must address real world problems, suggest courses of action to address those problems, and also convince the target audience of the suitability of the recommendations (Box 3.3). The aim should be to ensure that the underlying analysis is targeted at practical and implementable solutions. The emphasis is not necessarily to show what should be done, but to persuade the audience to do what they know should be done. Timing of message delivery is often crucial.

Tools for communicating risks are evolving from static documents to interactive systems that allow users to interrogate datasets through computer interfaces, typically over the Internet. Some tools are intended for non-specialists while others offer more in-depth information but require prior knowledge on climate. Such resources complement or provide content for

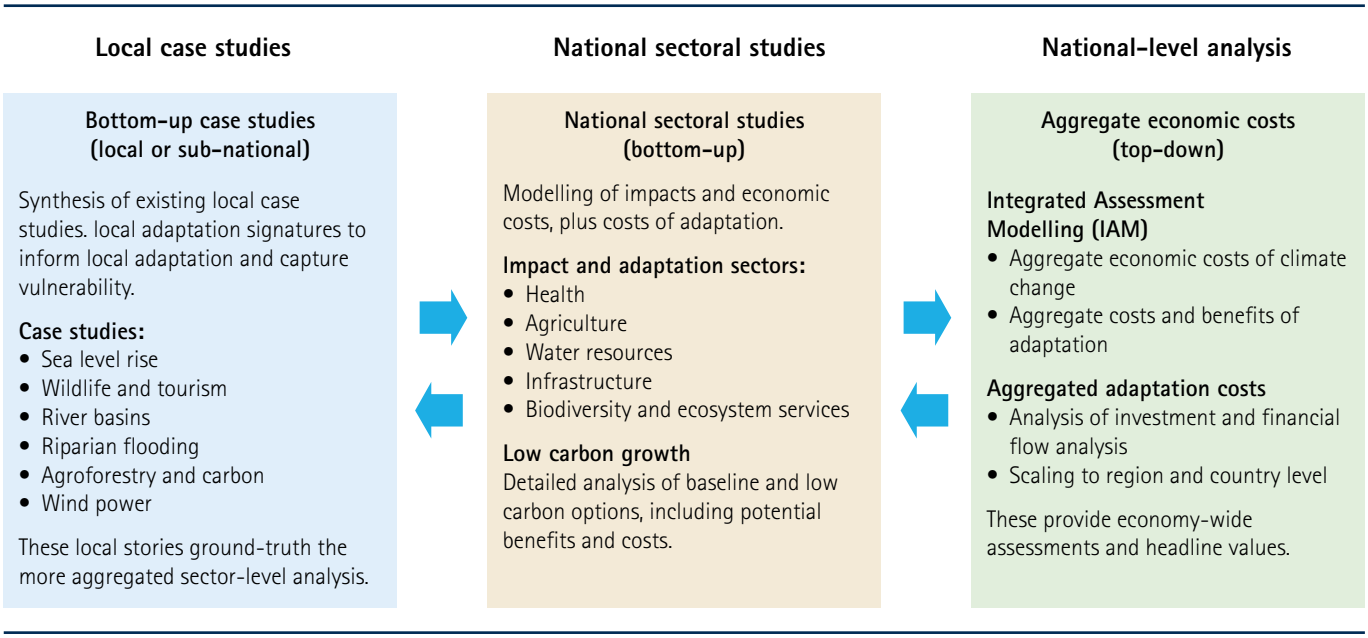


Figure 3.1 Schematic diagram of line of evidence. Source: Adapted from a study by Stockholm Environment Institute (2009)[3]

high-level policy papers by giving evidence in a user-friendly or graphic format. One example of such a tool is the Water Risk Atlas, which was developed by the World Resources Institute (WRI) and is discussed in Box 3.4.

Box 3.3
Planning checklist based on the Overseas Development Institute RAPID toolkit[4]

In preparing policy papers and briefings, the following questions are of interest:

- Which stage(s) in the policymaking process are you trying to influence?
- Which stakeholders have been/are involved at each stage of the policymaking process?
- Have you identified a clear problem to address? Can you summarise it in two sentences?
- Do you have sufficiently comprehensive evidence to support your claim that a problem exists?
- Have you outlined and evaluated the possible policy options that could solve this problem? What evaluation criteria did you use?
- Have you decided on a preferred alternative?
- Do you have sufficient evidence to effectively argue for your chosen policy alternative over the other options?

3.5 Example cases for water security and climate resilience

The following sections provide some examples of argued cases on water security and climate resilience. These provide high-level arguments for investment centred on themes of growth, economic risks, climate change projections and non-climate drivers of change. This type of high-level evidence can be tailored to particular sectors or geographical areas to provide a high-level introduction to the problems and potential solutions being addressed using the Framework.

3.5.1 Example 1: Water security as a driver for growth and development

Water is a key input to economic growth sectors and contributes to employment, job creation and gross domestic product (GDP). Water is at the heart of development objectives across most sectors, including health, energy, agriculture, environment and social protection. Yet most African countries are far from achieving water security, and the onset of climate change will further compromise prospects. Ensuring water security through more effective water management contributes to development goals, climate change adaptation and disaster risk reduction.

The Africa Infrastructure Country Diagnostic[5] (AICD) study summarises the case:

"*The [Africa] region's weak capacity to buffer the effects of hydrological variability and unpredictability in rainfall and runoff can encourage risk averse behaviour at all levels of the economy. It discourages investment in land, advanced technologies, or*

Box 3.4

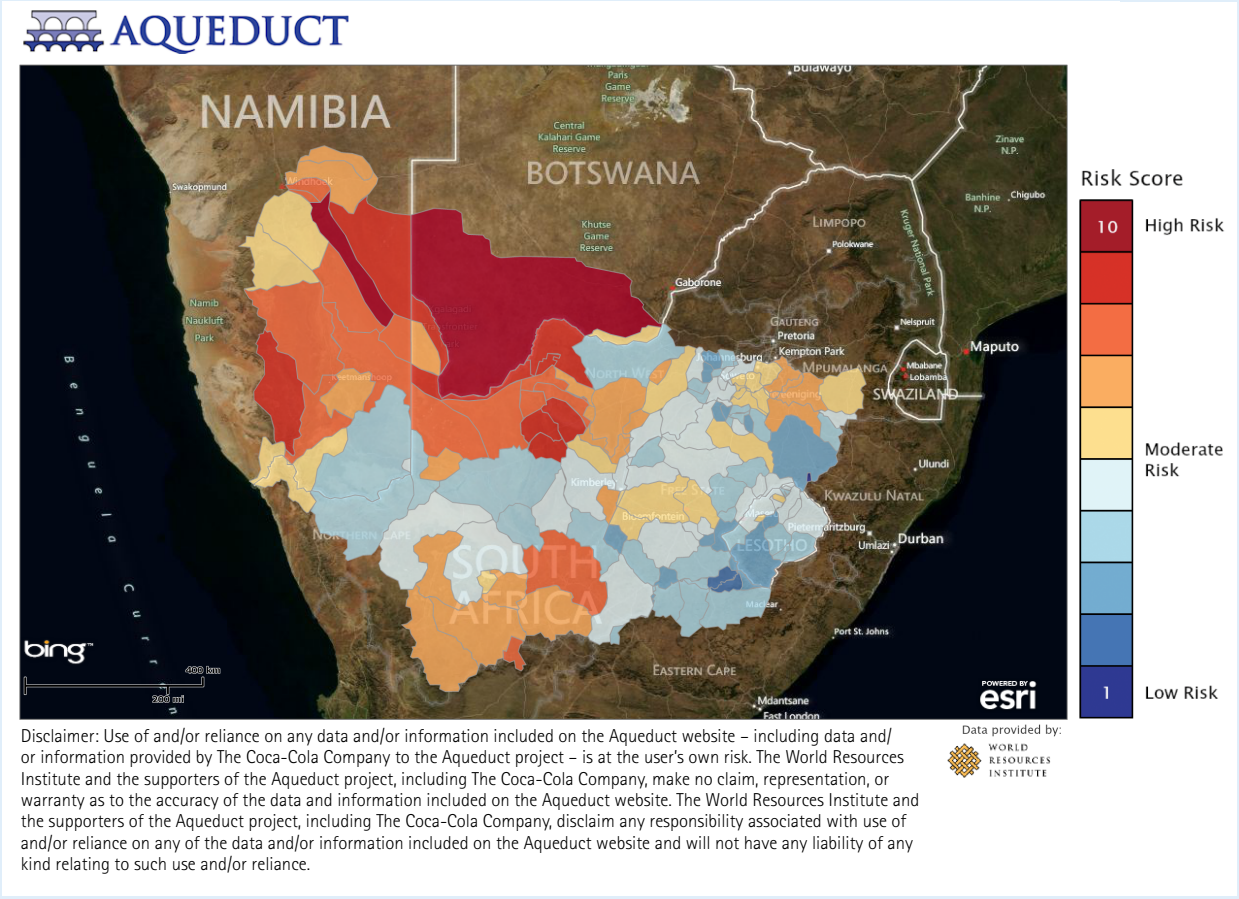
Example of communicating risks: The Water Risk Atlas

The World Resources Institute (WRI) Water Risk Atlas is an example of a tool for communicating risks at a high level for business leaders and investors. The Atlas uses a composite risk index based on indicators in the following sub-themes:

- Physical risks related to water quantity (e.g. water stress and flooding).
- Physical risks related to water quality (e.g. pollution).
- Regulatory and reputational risks to business presented by unstable regulatory environments and social tensions/conflicts over water.

Each of these themes contains individual indicators for which data is collected at a sub-national level, allowing a detailed picture of risk to be built up. A web interface allows the user to weight the risks according to their own concerns, unlike many static indices whose weightings are fixed at an early stage. While the index resolution is not appropriate for making individual or local investment decisions, it does provide an overview of risk hotspots at a regional level.

This image from the World Resources Institute's Water Risk Atlas shows the baseline water risk for the Orange–Senqu River Basin.



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agriculture. An unreliable water supply is also a significant disincentive to investments in industry and services."

Climate change threatens the continent's water security. Predicted impacts on water resources include an increase in the severity of natural disasters, including floods and droughts. It seems very likely that temperatures will increase throughout Africa at a higher rate than global average increases. Rainfall projections are less certain; some climate models predict increases in some areas whilst others predict decreases.

However, all projections predict that storm rainfall will become more intense. With many major urban centres located on the coast, the predicted onset of sea level rise will also increase the vulnerability of these cities to flooding and other related risks.

A lack of investment in water security in Africa has led to an adaptation deficit; in other words, an inability to adequately manage existing climate risks and hydrological variability. Climate change and rising populations will only serve to add further pressures and to increase the deficit. This lack of

investment has been seen not only in assets and infrastructure but also in institutional policies, plans and systems for the improvement of integrated water resources management.

3.5.2 Example 2: The high cost of inaction in the face of climate change

The economic cost of inaction could be very high, and governments should protect their development goals and ambitions from derailment by future climate change.

"*Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by the interaction of 'multiple stresses', occurring at various levels, and low adaptive capacity.*"

—Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report[6]

The International Monetary Fund (IMF)[7] has warned that deteriorating climatic conditions could lower GDP growth due to reductions in output and productivity, particularly in the least developed countries (LDCs) and in sectors such as agriculture, fisheries and tourism, which depend heavily on water. For example, climate impacts on Namibia's natural resources are projected to cause annual losses of 1–6% of GDP. Livestock production, traditional agriculture and fishing are expected to be hardest hit, with an estimated combined loss of US$461–2045 million per year by 2050.[8]

Climatic fluctuations are nothing new in Africa. Most countries experience cycles of drought, flooding and other extreme climatic events that cause damage, suffering and disruptions to their populations. Climate change will change the severity and frequency of extreme climate events. For example, IPCC research[9] suggests with medium confidence that droughts are likely to become more severe in southern Africa during the 21st century and that storm rainfall is likely to become heavier worldwide.

Drought in sub-Saharan Africa is a dominant climate risk. It destroys economic livelihoods and farmers' crops and has a major negative effect on GDP growth in one third of the countries in the region.[10] Floods are also highly destructive to infrastructure and transportation, and hence to the flow of goods and services. Floods also contaminate water supplies and increase the risk of epidemics of waterborne diseases, such as cholera.[11]

In Kenya, the 1997–1998 floods caused a GDP drop of 11%, and the drought of 1999–2000 led to a further drop of 16%.[12] Average annual GDP growth rates in Ethiopia have been shown to fall by as much as 38% as a consequence of rainfall variation (see Figure 3.2). A substantial infrastructure deficit is a major contributor to this vulnerability to hydrological variability; Ethiopia has less than 1% of the per capita water storage of North America.[13]

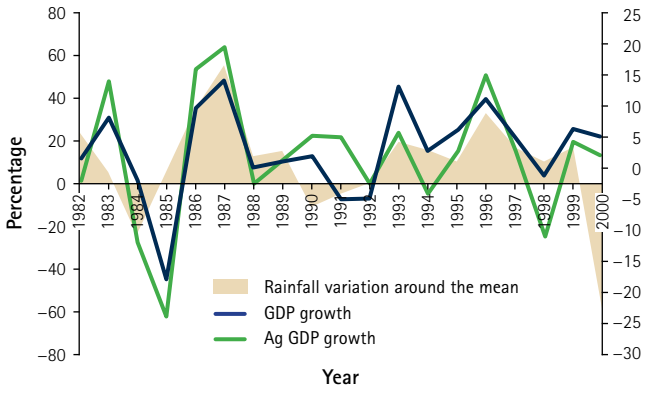


Figure 3.2 Rainfall *(left hand-y axis)*, agricultural GDP growth and total GDP growth *(right hand y-axis)* for Ethiopia, 1982–2000. Source: Grey and Sadoff (2006).[14]

Such experiences provide a sober warning of what could be in store for the future, with the climatic changes that seem increasingly likely. For many countries, climate change implies the worsening of already familiar climatic fluctuations, with the addition of new threats and risks.

It is worth noting that the impact of climate change will not be negative in all situations for all parties. There will be gains as well as losses between regions and countries, and between different sectors and individuals, depending on their situations and the form that climate change takes. To make the most of the positive opportunities, however, governments and societies need to be adequately informed about climate change projections and the anticipated impacts.

3.5.3 Example 3: Greater risk of extreme conditions

Many African countries already suffer marked climate variability and extremes. Climate change will manifest itself as changes in both the frequency and magnitude of extreme events, such as floods and droughts, as well as changes in average temperatures and precipitation.

The IPCC publishes comprehensive synthesis reports on the state of scientific understanding on global climate change. The IPCC Fourth Assessment Report (AR4), published in 2007, is considered to be a benchmark output for global climate change research. The Fifth Assessment Report is expected in 2014. Although AR4 collates information from a range of global sources, regional climate modelling initiatives may capture details missing from high-level analysis. The IPCC *Special Report on Managing the Risks of Extreme Events* (SREX) launched in 2012 focuses on changes in climate extremes. A high-level summary of projected climate changes reported in the AR4 and SREX reports is provided in Table 3.1.

Table 3.1 Headline climate change projections for Africa based on the IPCC AR4 and SREX

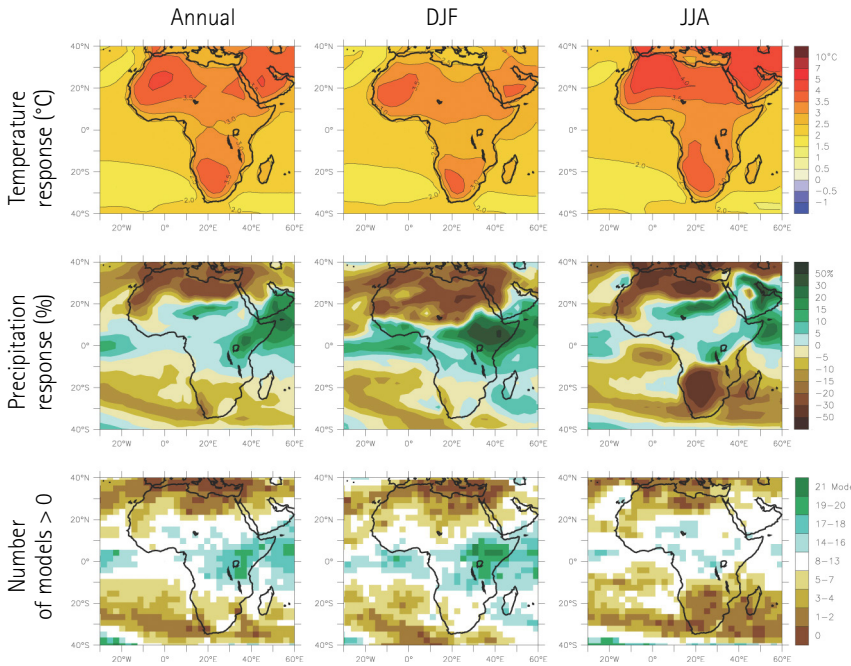
Climate variable	Summary of projected change
Temperature[15]	Warming across the African continent is very likely to be 1.5 times higher than the global annual mean warming, in all seasons and over the entire continent. The IPCC predicts that average temperatures in Africa will increase by 3–4°C by 2090, based on 1990 levels.
Rainfall[16]	Rainfall patterns will change, with some regions seeing increasing rainfall (Eastern Africa and the Horn of Africa) and others seeing decreasing rainfall (Southern Africa and the African Mediterranean coast), although a high degree of uncertainty exists.
Sea level[17]	Increase in mean sea level of between 0.28 and 0.43 metres (best estimate) depending on emissions scenario, based on change from 1990 to 2100; the risk of coastal flooding will be exacerbated by more intense storms.
Climate extremes[18]	Storms, heavy rainfall and heat waves are likely to become more intense, as are tropical cyclones. Heavy rainfall events, which at present occur only 1 in 20 years, are likely to increase in frequency relative to the late 20th century, occurring between 1 in 5 and 1 in 15 years by 2090. The 1 in 20 year hottest day is likely to occur every 2 years by the end of the 21st century.

Figure 3.3 graphically presents the key climate change projections for Africa from the IPCC AR4 report. This illustrates the differences in regional rainfall projections and the broad warming trend across the entire continent.

Projected higher temperatures across Africa will lead to higher evapotranspiration rates over open ground leading to generally drier soil conditions. This will be either exacerbated or offset by any reductions or increases in rainfall, respectively. Runoff rates and river flows are impacted by similar processes, although basin-specific hydrological models offer the best insight into the impacts of temperature and rainfall changes on flows. Figure 3.4 presents projected changes in runoff from 12 global climate models (GCMs), showing that there is little agreement with regard to large parts of Africa but that Southern and Mediterranean Africa show decreasing runoff and Eastern Africa increasing runoff, following the projections for rainfall.

Changing climate extremes may result in more frequent and intense storms and heat waves. The conclusions of recent IPCC research[21] include the following:

- It is likely that the frequency of heavy precipitation or the proportion of total rainfall from heavy falls will increase in the 21st century over many areas of the globe, particularly in the high latitudes and tropical regions.
- Heavy rainfalls associated with tropical cyclones are likely to increase with continued warming.
- There is medium confidence that increases in heavy precipitation will occur in some regions, despite projected decreases of total precipitation in those regions.



Top row: Annual mean, December, January, February (DJF) and June, July, August (JJA) temperature change between 1980–1999 and 2080–2099, averaged over 21 models.

Middle row: Same as top, but for fractional change in precipitation.

Bottom row indicates the number of models showing positive rainfall change.

Figure 3.3 Temperature and precipitation changes over Africa from the MMD-A1B simulations. Source: Reproduced from Christensen et al. (2007), Figure 11.2 on p. 869[19]

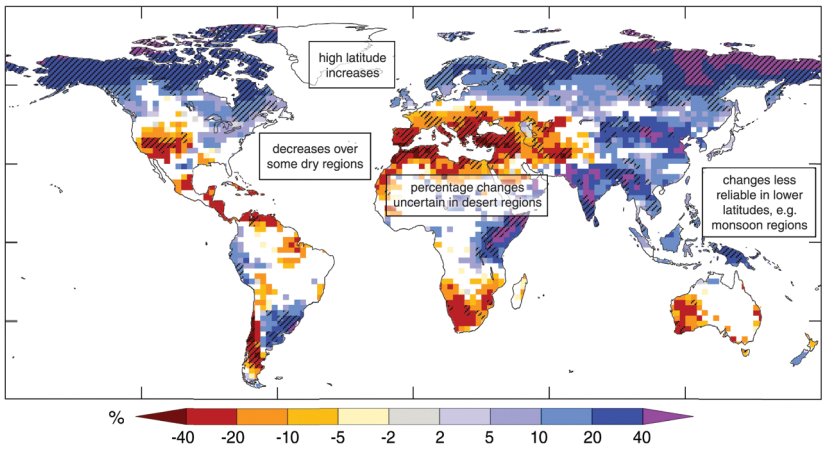


Figure 3.4 Large-scale relative changes in annual runoff for the period 2090–2099, relative to 1980–1999[i]. Source: IPCC (2007)[20]

- Based on a range of emissions scenarios (B1, A1B, A2), a 1 in 20 year annual maximum daily precipitation amount is likely to become a 1 in 5 to 1 in 15 year event by the end of the 21st century in many regions.

In addition, research indicates an almost certain increase in the frequency of heat waves. Based on the A1B and A2 emissions scenarios, a 1 in 20 year hottest day is likely to become a 1 in 2 year event by the end of the 21st century in most regions.

Sea level rise presents a serious threat to some African nations. Coupled with potential increases in cyclone severity and frequency, this poses a significant risk to the development of coastal countries. A recent study by the World Bank[22] concluded that by the 2040s, if there is no adaptation, Mozambique could lose up to 4850 km^2 of the land it has today (or up to 0.6% of national land area) and a cumulative total of 916,000 people could be forced to migrate away from the coast (or 2.3% of the projected population in the 2040s).

3.5.4 Example 4: Impacts across many sectors

Climate change will cause impacts across a range of sectors either directly, as a result of changes in water availability or water quality, or indirectly as resources become squeezed between competing demands. Table 3.2 presents a summary of impacts across a range of vulnerable sectors.

3.5.5 Example 5: The compounding pressure on development from climate and non-climate drivers

Africa is faced with the prospect of a rapid developmental trajectory accompanied by climate change over the coming decades. Understanding these twin challenges is crucial if development is to be sustainable in the long term, see also Box 3.1.

Water is intrinsically linked to food and energy security and climate change is one among a number of pressures that could continue to undermine the achievement of water, food and energy security. The combination of climate change with the intense pace of social, demographic and industrial changes in Africa further compounds the challenge for sustainable economic development and growth.

Population growth: The population is expected to increase from 700 million in 2007 to 1100 million in 2030 and to 1500 million by 2050. Many of the least developed countries could see populations triple by 2080.

Urbanisation: The urban population in Africa is projected to treble from 2010 to 2050, from 413 million to 1231 million, while the rural population will increase by just 24%, from 620 million to 767 million. The stresses on the water and food resources presented by this urban growth will be significant. The population of Lagos is projected to increase from 10.6 to 15.8 million and Kinshasa from 8.8 to 15.0 million from 2010 to 2025.[24] With many major urban centres being located on the coast, the projected rise in sea level will increase vulnerability to flooding and other related risks.

i Values represent the median of 12 climate models using the SRES A1B scenario. White areas are where less than 66% of the 12 models agree on the sign of change and hatched areas are where more than 90% of models agree on the sign of change. The quality of the simulation of the observed large-scale 20th century runoff is used as a basis for selecting the 12 models from the multi-model ensemble. The global map of annual runoff illustrates a large scale and is not intended to refer to smaller temporal and spatial scales. In areas where rainfall and runoff is very low (e.g. desert areas), small changes in runoff can lead to large percentage changes. In some regions, the sign of projected changes in runoff differs from recently observed trends. In some areas with projected increases in runoff, different seasonal effects are expected, such as increased wet season runoff and decreased dry season runoff. Studies using results from few climate models can be considerably different from the results presented here.

Table 3.2 Key impacts of climate on the major water-related sectors in Africa

Sector	Climate vulnerability (existing)	Climate change impacts (potential future)
Water resources	• Significant existing water stress. • Limited access to improved water sources for domestic supply. • One third of Africans are vulnerable to drought (especially in the Sahel, Horn of Africa and Southern Africa).	• Increased water stress due to increasing demand, exacerbated by climate change in some regions (and ameliorated in others). • Reduction in groundwater recharge in some areas due to higher temperature, and reduction in rainfall in some regions.
Health	• Significant disease problems, including vector-borne (e.g. malaria) and water-borne (e.g. cholera) diseases, which are influenced by climate.	• Uncertainty is high on disease prevalence, as many other drivers have an influence. Potential changes in distribution and severity of outbreaks in future.
Fisheries	• Aquaculture activities are key livelihoods in coastal areas and inland lakes and contribute significantly to dietary protein.	• Long-term changes in flow rates within estuaries may affect fish species. • River flows and nutrient fluxes into lake systems may be impacted by climate change; 30% reduction in production anticipated in Lake Tanganyika.
Agriculture	• Livestock health and disease influenced by heat and water-borne diseases. • Rain-fed agriculture and irrigated agriculture form the backbone of livelihoods and local economies in many areas. Both are highly dependent on climate.	• Changes in rainfall and river flow patterns will alter crop yields and selection. Irrigation yields may change over time. • Pastoral agriculture distribution and viability may be affected.
Energy	• Africa is heavily dependent on hydropower for electricity, although supplies are limited relative to developed nations.	• Hydropower influenced by long-term changes in flows and also occurrence of droughts, which may cause outages. • Knock-on impacts for industrial productivity. • Reductions in generation, particularly in the sub-humid zones.
Industry and infrastructure	• Industry is exposed to unreliable power supplies (often hydropower). • Infrastructure, particularly for transportation, is vulnerable to climate extremes such as storms.	• Sea level rise and increasing prevalence of storm events may bring increased damage to infrastructure.
Ecosystems	• Africa's rich ecosystems are influenced heavily by climate and by human activities.	• Climate change may shift natural biomes towards the poles, which may result in an overall expansion of some and reduction in others – especially coastal biomes such as the fynbos in South Africa.

Source: Compiled from Bates et al. (2008)[23]

Energy: Energy services play a critical role not just in supporting economic growth and generating employment, but also in enhancing the quality of people's lives. Lack of access to energy increases the challenges of reducing poverty. Africa has developed only ten percent of its hydropower potential, much less than other world regions, and the harnessing of Africa's waters could be used to drive development while contributing to climate change mitigation.

Agriculture: Agriculture is mostly rain-fed, with irrigation accounting for less than 6% of the cultivated area in sub-Saharan Africa. Most of the existing irrigated areas (almost two thirds) are concentrated in five countries: Egypt, Madagascar, Morocco, South Africa and Sudan. Major irrigation development, as seen in Asia, is not considered viable, but there is considerable scope for the development of small-scale irrigation. The estimated rate of agricultural output increase required to achieve food security in Africa is 3.3% per year. The potential for achieving this exists, since two thirds of African countries have developed less than 20% of their agricultural production and less than 5% of the cultivated area is under irrigation in all but four countries.[25]

Industrialisation: Economic and industrial development are likely to exert further stress on water resources with greater demands for access to resources and potential threats to water quality from wastewater discharges. Increased demand, particularly in the more developed countries, will increase competition for available resources through trade in 'virtual water' (water that is used in the production of goods which can then be traded) (see Figure 3.5). While this is a potential growth opportunity for parts of Africa, careful management will be required to ensure that these economic opportunities do not result in inequitable allocation of resources for communities and small-scale farmers.

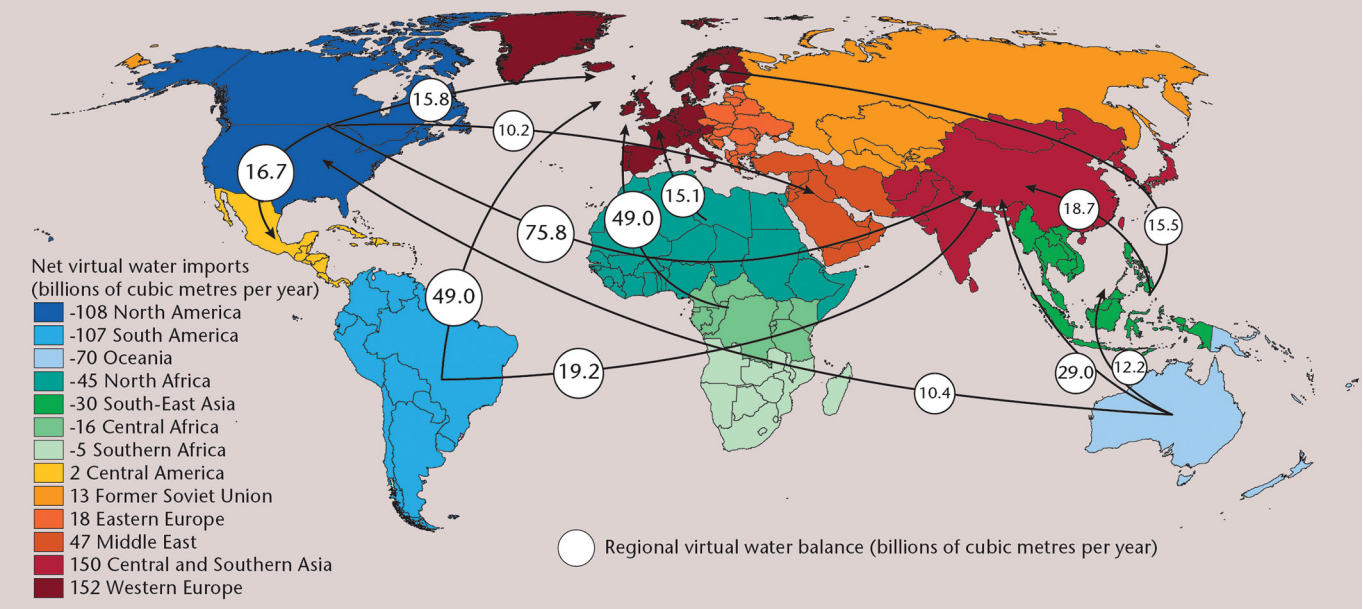


Figure 3.5 Regional virtual water balances and net inter-regional virtual water flows related to trade in agricultural products
Source: Reproduced from World Water Assessment Programme (2009)[26]

3.6 Final remarks

The case for water security and climate resilient development is compelling on many fronts, yet it still has to compete with many other priorities and issues that governments face. Emphasising the extent to which water security contributes to economic growth and development priorities (e.g. job creation, GDP and development goals across most sectors) ensures that the evidence-base speaks to development planners and high-level decision-makers alike, not just to water sector professionals and practitioners.

The overall message should emphasise that business-as-usual and inaction are no longer tenable. Investment is urgently needed to manage water resources and climate risks in order to secure Africa's macroeconomic development, and this investment will deliver good returns.

The expected outputs from making the case should include:

- A short briefing note or similar identifying the high-level commitments that are aligned with improvements and investments in water security and climate resilience.
- A macroeconomic appraisal of the benefits of water security and climate resilient development, including the costs of inaction.
- A summary for policymakers on the scientific evidence for climate change and its impacts, in a format which can be readily digested by non-specialists.
- Strengthened government commitment to protect national development goals and ambitions against derailment by water and climate impacts.

The outcomes of this step in the process should encourage high-level advisors and decision makers to increase the priority placed on water security and climate resilient growth and development, with planners and practitioners mandated to use and benefit from the Strategic Framework approach.

With this in place, the task of building teams for action and identifying entry points for the development of no/low regrets investment portfolios can begin.

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4 | GAINING STAKEHOLDER PERSPECTIVES

Key messages

- A 'stakeholder' refers to an individual, community, group or organisation with an interest, or stake, in particular outcomes related to water, climate and development.
- Stakeholder perspectives on the urgency of water security and climate risk vary depending on their roles and remits.
- Bridging the divide between the 'water', 'development' and 'climate' communities is essential.
- Efforts should be made to build on existing stakeholder platforms that are already widely accepted and influential.
- Stakeholder analysis will contribute to understanding of the interests and influence of different stakeholders with regards to water security and climate resilience in a particular country.
- Institutional mapping can be used alongside stakeholder analysis to gain an understanding of the organisational framework that informs decision making on water management and related investments.

This chapter supports Phase 1 of the Framework process (Understand the problem), and provides further information on gaining stakeholder perspectives and priorities, and strengthening existing multi-stakeholder platforms. Methods and tools for stakeholder analysis are introduced, alongside examples of their application. The outcomes of stakeholder engagement feed into later phases of the Framework concerned with identifying new and innovative solutions and also mainstreaming climate resilience in development planning.

Recommended sources of further information:

The World Bank sourcebook on tools for institutional, political, and social analysis of policy reform is targeted at practitioners and provides an overview of numerous analytical techniques for policy reform, including stakeholder analysis and organisational mapping. Chapter 7 of the sourcebook provides an overview of the tools and their application at different levels of planning.

Holland, J. 2007. *Tools for Institutional, Political, and Social Analysis of Policy Reform: A Sourcebook for Development Practitioners*. World Bank, Washington D.C., USA. Available at: http://siteresources.worldbank.org/EXTTOPPSISOU/Resources/1424002-1185304794278/TIPs_Sourcebook_English.pdf.

4.1 The purpose of stakeholder engagement

Stakeholder engagement is a key activity in Phase 1 of the Framework. A 'stakeholder' refers to an individual, community, group or organisation with an interest, or stake, in particular outcomes related to water security and climate resilience. Stakeholders may be individuals, including politicians and civil servants, or they may be interest groups including local community groups and national civil society organisations, the media, government agencies or corporate organisations.

Using stakeholder engagement to build a well-functioning stakeholder base is crucial in later phases of the Framework, including identifying innovative investment opportunities and mainstreaming climate resilience in planning.

Stakeholder engagement is the process of identifying relevant stakeholders and bringing them on board with the Framework process. It is crucial for the stakeholders to understand their relationship to the Framework and to each other, as well as for those implementing the Framework to gain a full picture of the stakeholder base. Engagement should be an equitable process, engaging both decision makers and those directly influenced by the outcomes of decision making for water security.

The process of ensuring stakeholder participation follows three broad steps:

1. **Stakeholder identification** – The initial process of drawing up a long list of potential stakeholders. This should aim to identify a broad base of stakeholders spanning a range of sectors, planning levels and mandates. Efforts should be made to accommodate marginalised and vulnerable groups as well as to bring important and high-level political decision makers on board.

2. **Stakeholder analysis** – The process of systematically reviewing the characteristics of stakeholders, the information and value they can add to the Framework process, and how the Framework can benefit the stakeholders. This leads to a defined stakeholder base and potential roles for stakeholders.

3. **Stakeholder engagement** – The process of building a coherent stakeholder base including refining roles within the base and gaining a mutual understanding of the terms of reference of the engagement process.

4.2 Identifying stakeholders across the dimensions of planning level, sector and mandate

Stakeholders in water security are highly diverse, representing a wide range of organisations and platforms. The relevant stakeholders who need to be engaged in applying the Framework depend on the scale of application and the institutional arrangements in the region, country, district or basin in which the Framework is applied. A key step in stakeholder engagement, therefore, is identification of the stakeholders representing the multi-faceted nature of water security and climate resilience.

Stakeholder identification can be used to:

- Map the institutional roles and responsibilities for decision making and operational processes related to the application of the Framework.
- Identify a broad range of stakeholders spanning a range of planning levels, sectors and mandated activities.
- Identify established stakeholder platforms that are already widely accepted and have influence within and across sectors; examples might include existing platforms for disaster risk reduction, GWP country water partnerships and sector advisory groups.
- Identify potential gaps in stakeholder representation with regard to application of the Framework – stakeholders outside existing networks may bring additional skills and innovation.

Mapping institutions should be a relatively rapid process and can bring valuable insights to the process of identifying stakeholders. But this mapping may not be required if the Framework is being applied in a well-understood institutional context. Institutional mapping does not require formal methods and can take the form of the following activities:

- Workshops that bring together representatives from a range of organisations to build up detailed maps of the main decision processes and lines of reporting and communication. The resulting maps identify where organisations are working together and independently. In addition, these maps can be a useful starting point for identifying opportunities for innovative collaboration.
- Rapid reviews of the legal framework within which organisations operate can yield an overview of institutional processes, although this is unlikely to elucidate the realities of decision making.

Stakeholders are distributed across sectors, levels of planning (local to regional) and mandates (government, civil society groups, research and business). Ensuring that all these dimensions are represented is important for gaining a full picture of the players involved in and affected by decision making processes, and also facilitates the bridging of established silos of planning that do not interface. Figure 4.1 illustrates the multidimensional nature of stakeholder groups. Depending on the context in which the Framework is applied, the stakeholders engaged will be distributed differently across these dimensions. For example, a local application will require stronger representation for local planners and community representatives than a national application. Illustrative examples of stakeholders in water security and climate change are provided in Box 4.1.

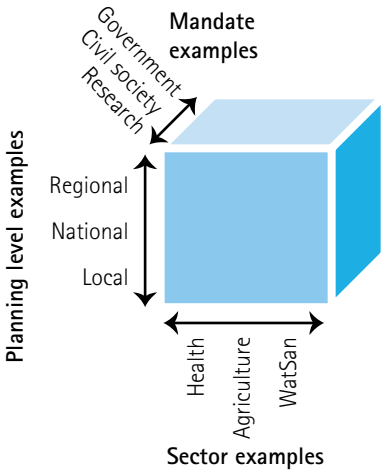


Figure 4.1 Stakeholder engagement spans sectors, planning levels and mandates

Box 4.1

Example of key stakeholders in water security and climate resilience

Some of the potential stakeholder groups listed below operate across sectors and planning levels, while others are focused on single-sector issues or a particular level of planning. In order to ensure high-level political buy-in for the Framework, engagement with influential high-level decision makers will be essential from the start.

Supranational bodies and programmes

- African Union (AU) and African Ministers' Council on Water (AMCOW)
- African Ministerial Council on the Environment (AMCEN)
- New Partnership for Africa's Development (NEPAD)

Regional/transboundary

- Regional Economic Communities (RECs) – water resources and climate change coordination units
- River/lake basin organisations (RLBOs)
- Central government

Economic and development planners

- Ministry of Finance – Representatives of the budget strategy paper (BSP) and medium-term expenditure framework (MTEF) planning
- Ministerial advisors, policymakers and development planners from central government
- Focal points for international initiatives, such as the United Nations Framework Convention on Climate Change (UNFCCC), Convention on Biological Diversity (CBD) and the United Nations Convention to Combat Desertification (UNCCD)
- Focal points within government for ongoing initiatives, such as integrated water resources management (IWRM) planning, development of National Adaptation Programmes of Action (NAPAs), National Adaptation Plans (NAPs) and poverty reduction strategy papers (PRSPs)
- Finance technical specialists

Sector and other specialists

- Sector specialists and implementation bodies (e.g. water suppliers)
- Climate and disaster risk specialists

Sub-national bodies

- Local government (municipality, state and district levels)
- Traditional rulers (chiefs)
- Decentralised planning and local development agencies

Research and capacity building organisations

- Networking and capacity building organisations such as GWP and Cap-Net
- Civil society representatives (i.e. business, environment, society) and NGOs
- Technical institutes (i.e. universities and research centres)

Development cooperation partners

- International organisations such as the UNDP, UNEP, UNCCD and UNFCCC
- Donors and international financial institutions (IFIs)
- Climate fund representatives

The private sector

- Business leaders
- Service delivery operators
- Private investor representatives

Civil society

- Civil interest groups (i.e. water users, farmers unions, women's groups)
- Grassroots and environmental NGOs

4.2.1 Ensuring vulnerable and marginalised groups are engaged in the process

When planning stakeholder engagement, it is important to ensure that marginalised and vulnerable stakeholders are represented. Efforts to raise the profile of marginalised groups – including women and young people – have led to high-level strategies, such as AMCOW's Policy and Strategy for Mainstreaming Gender in Africa's Water Sector.

Such strategies highlight the high-level commitment to under-represented groups. As such, stakeholder engagement should make every effort to ensure that a full spectrum of stakeholders are engaged, not just those who are easiest to access. This should ideally include representatives from high-level organisations tasked with pushing the gender and youth agendas forward, as well as civil society and other local-level representatives involved in implementing activities to address gender and youth issues.

4.3 Stakeholder analysis: a systematic approach

Stakeholder analysis is a well-established tool that provides a systematic approach to understanding the interests and influence of identified stakeholders in water security and climate resilience.

Stakeholder analysis can be used in this phase of the Framework to provide the following outputs:

- Formal appraisal of roles, responsibilities and objectives of the identified stakeholders.
- Understanding of how stakeholders can benefit or obstruct the application of the Framework and how the Framework application may benefit stakeholders.
- Identification of stakeholder roles for the application of the Framework including:
  - decision making;
  - championing and leadership within organisations;
  - providing opinions and guidance;
  - receiving and disseminating information.

Reporting on a stakeholder analysis does not need to be a lengthy process; a succinct report summarising the approach, outcomes and way forward will avoid excessive and redundant reporting.

A common approach for conducting stakeholder analysis involves the use of matrices to provide a simple framework for plotting the relationships of the various stakeholders to the application of the Framework. These matrices can be used, for instance, to plot two or more of the following variables:

- the degree to which the Framework application will impact stakeholders;
- the level of interest in the Framework;
- the level of importance attached to satisfying the needs and interests of each stakeholder;
- the level of influence that stakeholders have to facilitate or impede application of the Framework; and
- the level of resources that stakeholders possess.

Table 4.1 shows a sample stakeholder analysis table, which can be adapted as required.

The results of these analyses can be plotted on an 'influence versus importance' matrix, which is a simple yet powerful way to understand the relative positions of stakeholders. Table 4.2 provides an illustrative example and a description of the broad characteristics of stakeholder engagement activities for each broad class of stakeholder.

Table 4.1 Sample stakeholder analysis table or 'influence matrix'

Stakeholder categories	**Relevant stakeholders**	**Characteristics** (social, geographic, organisational, etc.)	**Influence** (power to facilitate or impede)	**Importance** (degree of priority needs and interests)	**Interest** (types of potential benefits or adverse impacts)
Government policymakers					
Local government officials					
Local communities					
Humanitarian groups					
Donors					
Other interest groups, etc.					

Source: Based on Holland (2007)[1]

Table 4.2 Example of stakeholder 'importance versus influence' matrix

	High influence	Low influence
High importance	Key stakeholders to engage for driving through application of the Framework	Key stakeholder who may be under-represented; ensuring participation and protection of interests is important
Low importance	Stakeholder must be managed carefully as their priorities may not align with the Framework	Non-key stakeholders who should be involved in wider consultation

Source: Based on Holland (2007)[2]

Box 4.2 presents a case study of stakeholder analysis in the development process for an urban water management strategy in Alexandria, Egypt. Stakeholder analysis was integral to the process of defining the roles in the stakeholder base for development of the water management strategy.

4.4 Engaging stakeholders for application of the Framework

Following stakeholder identification and analysis, a good understanding of the stakeholder base will have been achieved. Stakeholder engagement is the final step in the process of operationalising the stakeholder base to fulfil its intended function. The form of engagement is likely to fall into four categories, as follows (see also Figure 4.2):

- **Decision making** – A small subset of key stakeholders may be engaged in decision making processes themselves.
- **Championing** – All stakeholders champion the cause to some extent by representing their organisation in the stakeholder base. However, as an explicit role championing involves promoting the Framework application and main activities in related organisations.
- **Steering the Framework** – Some stakeholders may be consulted for their views in order to maintain the legitimacy of the Framework application and steer the work in useful directions. This advisory role does not carry as much power over the process as a direct role in decision making.
- **Dissemination** – A wider stakeholder base will be consulted in order to gather opinions and disseminate the ongoing work to organisations outside the core stakeholder base.

4.5 Example stakeholders and roles and responsibilities for application of the Framework

Although stakeholder groups involved in water and climate are highly diverse, crossing sectors and levels of governance, some broadly recurring key stakeholders have been identified here. However, ensuring under-represented groups are included in stakeholder analysis is critical to the process.

Box 4.2

Stakeholder analysis and institutional mapping for Integrated Urban Water Management in Alexandria[3]

The EU-funded Sustainable Water Management Improves Tomorrow's Cities' Health (SWITCH) project involved developing Integrated Urban Water Management (IUWM) plans in a number of cities, including Alexandria. This plan is envisaged to use innovative approaches to meet future demands and to deal with existing problems in urban water management.

Stakeholder analysis and institutional mapping were included as part of the early stages of this project, to build an understanding of the existing stakeholders and institutional roles and responsibilities, relationships, strengths, weakness and priority issues. This was used to inform the development of stakeholder platforms for the IUWM planning process.

A four-stage process was used for the stakeholder engagement, as outlined below:

- Step 1 – identification and categorisation of stakeholders.
- Step 2 –identification of stakeholders' interests.
- Step 3 – assessment of the stakeholders' relative importance and influence.
- Step 4 – summarise a preliminary stakeholder engagement strategy.

The assessment of the stakeholders' relative importance and influence was carried out using a simple scoring matrix on the basis of attitudes (i.e. towards development of the IUWM plan) and power (i.e. human, financial and political resources at their disposal). The scores for each stakeholder, based on these metrics, determined the level of engagement with the process going forward, in terms of decision making, consultation and dissemination.

Informal institutional mapping was also carried out, involving a review by sector experts of the roles of water management agencies and of relevant legal acts governing water management.

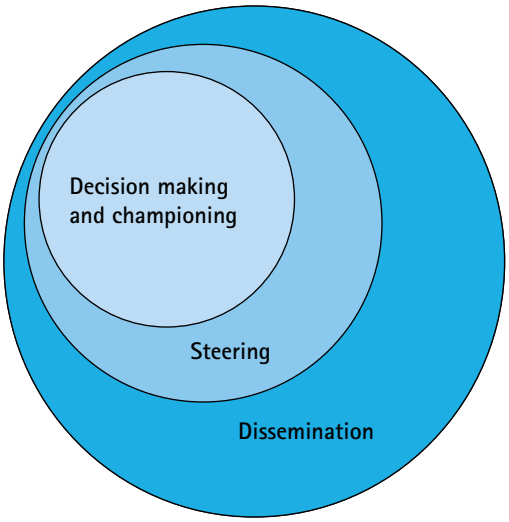


Figure 4.2 Conceptualisation of the relative group sizes for stakeholder roles within the stakeholder base

Regional Economic Communities (RECs) and pan-African bodies such as AMCOW and the AU are important stakeholders for driving forward application of the Framework at the highest levels. A commitment from these agencies to drive the process forward will assist those implementing the Framework with gaining the cooperation of national-level decision makers and funding agencies. RECs also often have units for climate change and water management that can be valuable entry points for applying the Framework at a regional level; for example, the Southern African Development Community (SADC) Water Division.

Ministries of finance and planning are key when it comes to pushing for access to limited funding. Strong links should be forged to present the economic arguments for 'no/low regrets' investments in water security. Ministers need to 'own' the Framework and advocate its use in promoting climate resilience at a high level and securing funding for investments prioritised under the Framework. This ownership needs to start with at the highest level of government such as the prime minister or vice president's office and be endorsed by the cabinet, with further support from parliament. Central finance and planning ministries may be an appropriate nexus for the coordination of climate resilience in planning across sectors at a national level.

Line ministries are significant players in design and implementation of investment programmes. Aligning no/low regrets priorities with line ministry strategies may provide a pragmatic route to improving the climate resilience of strategies in the long term. Line ministries are responsible for sector-level strategies and for classifying programmes and prioritising amongst programmes within their sectors. They manage most of the funding for current spending and for projects. Departmental directors will be most engaged in programme screening and new appraisal methods.

Multi-stakeholder platforms and committees operate at all levels of planning, from the regional and national levels (such as National Platforms for Disaster Risk Reduction; see Box 4.3) to district and basin level planning units. Any multi-stakeholder platform concerned with natural resource management (i.e. conservation, agriculture, water resources management) is likely to have a stake in water security and climate resilience.

Planning officials in local government are responsible for the implementation of many water-related programmes. They are also responsible for coordinating consultation with communities and other stakeholder forums, to access detailed local indigenous and untapped knowledge on climate hazards and related water problems, which may aid the design of solutions. Consulting local government planners during application of the Framework is important in bringing local knowledge and perspectives into the development of investment options. Local planners will have a correspondingly greater role to play if the Framework is being applied within sub-national basins or districts.

Transboundary organisations have an important role to play in promoting cooperation and providing technical support to member states. Applying the Framework in transboundary settings requires substantial input from these organisations to achieve consensus across national priorities.

Communities of practice are a useful resource for technical staff to absorb capacity building and share technical approaches across sectors and countries. Such activities are important in implementing the Framework and broadening its application in the future. Fostering benchmarking and best practices is likely to contribute to an innovative way of working. Capacity building networks are well established in Africa (e.g. Cap-Net) and online learning platforms such as AfricaAdapt and the Adaptation Learning Mechanism are providing a growing base of

Box 4.3

Engaging multi-stakeholder platforms, the example of National Platforms for Disaster Risk Reduction

National Platforms (NPs) are nationally owned and led multi-stakeholder forums or committees working on disaster risk reduction. NPs build on existing systems relevant to disaster risk reduction and include representatives from all stakeholder groups, such as government, international organizations, NGOs, academic institutions, the private sector and the media.[4] NPs are a good starting point to engage stakeholders as they already promote cross-sectoral integration of thinking. As of May 2012, 31 NPs have been established across Africa.

evidence and best practices for building capacity and transferring innovative ideas in the technical community.

Research institutes, including African universities, can offer access to individuals and teams with valuable technical skills and expertise, such as climate impact assessment and modelling studies required to inform the implementation of the Framework. Investment in increasing the technical capacity and applied research in these institutions is ongoing and their role in providing decision makers and planners with scientific information should be promoted.

Donors and climate funding agencies are influential players. The new climate funds, such as the Adaptation Fund and the Pilot Program for Climate Resilience (PPCR), are developing strong regulations and guidelines, and national implementing organisations need to be certified to qualify to implement programmes. Mainstream donor funding is more flexible and donors are increasingly willing to respect government priorities, as required by aid effectiveness principles agreed in the Paris, Accra and Busan Declarations.

Civil society organisations (CSOs) such as women's groups, farmer's associations and indigenous communities have a significant stakeholder role to play in applying the Framework, especially in terms of connecting the decision making process with grassroots livelihoods – the level at which investments are felt. CSOs can provide a wealth of valuable local knowledge and perspectives that should be incorporated into the development of no/low regrets investment strategies.

Networking organisations have a vital role to play in facilitating collaboration among a diverse range of players across sector silos and levels of governance. The GWP has a long track record in working towards IWRM, which provides an established foundation for cooperation in applying the Framework.

4.6 Final remarks

Strengthening existing multi-stakeholder platforms and identifying stakeholder groups and their interests in moving the Framework process forward should look beyond the water 'box' and is likely to involve economic and financial planners, technical specialists across different sectoral interests, researchers, the private sector, financing organisations, NGOs, CBOs, development cooperation partners, and others.

This step in Phase 1 of the Framework includes identifying and engaging with stakeholders, and understanding their respective roles, responsibilities, interests and influences on subsequent steps in the Framework application process. With this in place, the task of building teams to develop and identify no/low regrets investments can begin, with an emphasis on using well-established existing multi-stakeholder platforms, strengthened or broadened where necessary, rather than creating new platforms or structures.

The expected outputs from the process of stakeholder identification and analysis should include:

- A stakeholder analysis report, including the primary and secondary stakeholders, their roles and responsibilities, and their respective interests and influences.
- Recommendations and agreement on the multi-stakeholder platform(s), strengthened and supplemented where necessary, for detailed application of the Framework throughout its full cycle.
- Identification of leaders and champions who are able to drive the Framework application forward, and clear insight on how horizontal and vertical integration will be achieved.

This step in the process serves not only to identify key stakeholders and their interests and potential roles, but also to provide a foundation for many other steps in the application of the Framework, including an inventory of stakeholders to be included under the participatory approaches to identifying investment opportunities in Phase 2.

With stakeholder perspectives understood, and action teams assembled, the final step in understanding the problem (Phase 1) can be undertaken: gathering evidence on climate impact and vulnerability to inform decision making.

Chapter 4 references

1 Holland, J. 2007. T*ools for Institutional, Political, and Social Analysis of Policy Reform. A Sourcebook for Development Practitioners*. The World Bank, Washington D.C., USA.

2 *Ibid*.

3 Further information is available on the SWITCH website: http://www.switchurbanwater.eu/. The Alexandria stakeholder analysis report is available for download (http://switch.cedare.int/files28/File2826.pdf) as is the institutional mapping report (http://switch.cedare.int/files28%5CFile2978.pdf).

4 United Nations International Strategy for Disaster Reduction (UNISDR). 2012. *National Platforms*. Available at http://www.unisdr.org/we/coordinate/national-platforms

5 | CLIMATE IMPACT, ADAPTATION AND VULNERABILITY ASSESSMENTS

Key messages

- Assessments of climate impacts, adaptation and vulnerability are powerful tools for providing evidence to decision makers and other professionals about priority areas requiring intervention and investment.
- It is important to ensure that evidence is generated using both bottom-up techniques (e.g. community vulnerability assessments and engagement with sub-national stakeholders) as well as top-down studies (e.g. sector-wide climate impact studies).
- A gap analysis of the existing information base and engagement with stakeholders will highlight geographical areas and sectors that are lacking baseline evidence on vulnerability to the climate or the potential impacts of climate change.
- Maximum use should be made of existing studies, expert elicitation and stakeholder engagement, as a first step to providing a qualitative overview of current and future climate vulnerabilities. More detailed studies should be commissioned only when necessary.
- Approaches to impact, adaptation and vulnerability assessments should be tailored to specific sectors and to the nature of the problem being addressed. They may involve the use of sector-specific tools, hotspot mapping, community-level analyses and natural disaster modelling.

This chapter supports Phase 1 of the Framework and provides further information on the use of climate impacts, adaptation and vulnerability assessments to inform decision making. These assessments are highly diversified according to the scale of application, sector or geographical area required. This diversity makes it difficult to provide widely applicable and definitive guidance, and hybrid approaches for assessment are often developed on a case-by-case basis. Efforts are underway to streamline guidance on assessment approaches under the Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA), a joint initiative from the United Nations Environment Programme (UNEP), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Meteorological Organization (WMO).

The amount of effort for assessment should be proportional to the level of investment required. However, the importance of ecosystems services and the social dimensions of current and future climate risks require broad assessment beyond traditional economic analysis to estimate costs and damages.

Recommended sources of further information:

The United Nations Framework Convention on Climate Change (UNFCCC) National Communications Support Unit has developed guidance for carrying out vulnerability and adaptation assessments. This guidance, which is supported by presentations and additional resources, can be accessed online at: http://unfccc.int/resource/cd_roms/na1/v_and_a/index.htm

5.1 Overview

The final step in Phase 1 (Understanding the problem) is to identify studies and generate evidence for use in the analyses for Phase 2 (Identify and appraise options). Informed decisions need informed decision makers. Information and evidence are key to underpinning decisions on water security and climate resilient development options.

A gap analysis of the existing information base will highlight geographical areas and sectors that are lacking baseline evidence on climate impact or vulnerability. Filling these knowledge gaps is a prerequisite for identifying no/low regret investments.

Two levels of action and detail are recommended for using vulnerability and impact assessments to inform strategy development and the identification of no/low regret investments:

- Level 1 – Rapid review of existing studies, expert elicitation and stakeholder engagement.
- Level 2 – Commissioning of detailed impact and vulnerability assessment studies.

Impact and vulnerability assessments are important for providing the evidence to make decisions on the priority areas requiring investment and the nature of those investments. It is important to ensure that evidence is generated using both bottom-up techniques (e.g. community vulnerability assessments and engagement with sub-national stakeholders) as well as top-down studies (e.g. sector-wide climate impact studies).

This chapter presents an overview of key concepts around vulnerability and impact assessments within the wider context of climate change and adaptation. It discusses the various approaches around climate impact and vulnerability assessments, setting these within the context of the Framework and its application.

A broad range of tools and examples are provided as a brief overview of the tools available for addressing different problems, settings and contexts. The tools presented are not intended to be a fully exhaustive list; rather, they serve to illustrate the diversity of tools and methods available to practitioners with interests in water and climate. Practical application of the tools and methods in any particular context or setting will be highly dependent on many factors, including access to good quality information and data, and access to skills and expertise.

5.2 Key concepts

To understand how impact and vulnerability studies can assist in decision making, it is important to understand climate variability and how this relates to vulnerability and climate impacts.

5.2.1 Impact, adaptation and vulnerability

The climate – including rainfall, temperature and wind speed – varies year on year, month on month, and on daily timescales. This presents risks for human societies and systems, which must be able to operate successfully in the face of this variability. When variability causes systems to fail, for example a flood destroying a bridge, or a long-term drought reducing crop yields, systems are described as vulnerable to climate variability. When systems cope with such climate variability, they are said to be resilient.

Vulnerability is dependant on the adaptive capacity of the system and the impact of the variability on the system. Impact is itself a function of the exposure and sensitivity of the system to climate variability. Exposure refers to the characteristics of the variability itself, for example storms, heavy rainfall, drought or flooding, and the magnitude and frequency of occurrence. For example, some regions are highly exposed to cyclones while others are exposed to highly variable seasonal rainfall.

Sensitivity of the system refers to its characteristics, which interact with the exposure to cause impact. For example, rainfed agriculture is highly sensitive to rainfall variability (some crops more than others). Therefore rainfed agriculture combined with an exposure to variable seasonal rainfall is likely to result in a high level of climate impact on the agricultural system, for example through variability in year-on-year crop yields.

Adaptive capacity refers to the characteristics of the system that allow it to cope with climate variability. These might include assets, policies and knowledge that support systems in the face of variability. One example of adaptive capacity is the presence or absence of drought monitoring and response systems in areas prone to climate variability. Such systems help farmers to plan their activities and reduce the negative impacts of climate variability.

A graphical representation of the framework for describing vulnerability is provided in Figure 5.1, based on the Intergovernmental Panel on Climate Change's (IPCC) definitions of vulnerability.[1]

These concepts set the backdrop for impact and vulnerability assessments. These types of assessment approach the problem from different angles and with a different focus on the individual components of overall vulnerability. For example, impact assessment is mainly concerned with the exposure and sensitivity of systems to climate, whereas vulnerability assessments focus on how systems cope and adapt to impacts.

However, each assessment is driven by the specific needs and questions to be resolved and will contain a different emphasis on the components of vulnerability. For example, a top-down

economic impact study may seek to evaluate the economic impacts of climate events on transport infrastructure, whereas a bottom-up assessment may look in detail at how local transport authorities manage climate risks in their transport networks.

The wide application of vulnerability assessments across sectors and practitioners has resulted in a mixture of definitions. Other frameworks describe vulnerability as risk, and adaptive capacity as vulnerability, relative to the framework described above. This can make consistent definitions difficult, especially as some definitions are more applicable to certain sectors than others. For example, disaster risk uses a framework that describes risk as a function of the climate hazard and vulnerability of the system.

5.2.2 Climate and non-climate risks

Risk is commonly taken to be a measure associated with some level of likelihood of occurrence and severity of impact. A risk assessment therefore seeks to determine, for each risk identified, the likelihood and severity of impact. In some cases, risks may be quantified; for example, flood risk can often be evaluated quantitatively using hydrological and hydraulic models. In other cases, such as community livelihoods risk assessment, quantification may not be possible and risks may be qualitatively described and ranked based on local knowledge.

Risk relates to the vulnerability framework in Figure 5.1 in the sense that impacts can be associated with likelihoods and severities, and thus become risks. Adaptive capacity can act to reduce risks and therefore overall vulnerability.

Another layer of complexity is introduced when thinking about the future. This discussion so far imagines a static world where past risks are representative of the future. Rapid social change coupled with projected climate changes means that to understand risks in the future, these changes must be accommodated. Uncertainties in climate-related risks are exacerbated by the imperfect foresight offered by climate and socio-economic projections.

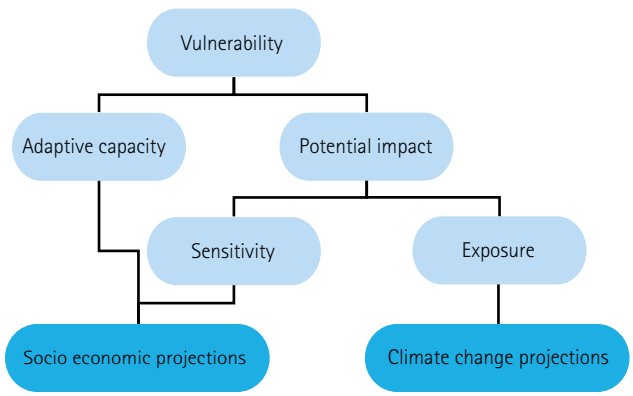


Figure 5.1 A framework for describing vulnerability

Climate change may alter the nature of the physical exposure of human systems to climate variability through changes in both the long-term climate (e.g. average annual rainfall) or changing the nature of variability (e.g. more intense storms, irregular seasonal rainfall). Socio-economic changes may put pressure on human systems that are influenced by the climate; for example, population growth in cities may increase their sensitivity to water shortages. Socio-economic change may also present opportunities for reducing risks, for example through improved communication systems.

5.2.3 Adaptation and climate resilient development

It is important to understand the concepts of vulnerability, risk and climate change, and make assessments of climate vulnerability and impacts, in order to decide what the priority areas for investment are and what needs to be done.

Vulnerability and impact assessments can feed into adaptation assessments. These are designed to determine the activities that should be undertaken to address the risks identified.

This is the remit of climate resilient development, which comprises two main elements:

- **Development addressing the adaptation deficit.** Managing existing risks and reducing existing vulnerabilities is a key development goal, one that is required to improve economies, social wellbeing and environments. This must be carried out with uncertainty over future conditions in mind. Development activities that yield short-term benefits, but create longer-term risks as climate and societies change, are known as maladaptation.
- **Adaptation.** These activities address future risks and vulnerabilities, adapting human systems to the potential changes in the climate and socio-economic conditions. Adaptation activities should function across the range of future uncertainties, rather than being designed for a most likely future. These activities are termed 'no/low regret', as they aim to deliver benefits regardless of future conditions.

Phase 2 of the Framework addresses approaches for identifying opportunities for climate resilient development.

5.3 Methods for climate change impact, adaptation and vulnerability assessments

There are several methods available for conducting assessments, at different geographical scales and aimed at different levels of decision making. Climate change impact, adaptation and vulnerability (CCIAV) methods have developed greatly over the last decade, from the original IPCC 'Seven Steps'[i], to the much wider range of methods summarised in the IPCC Fourth Assessment Report (Working Group 2).[3] The latter splits these methods into four categories: impact assessment; vulnerability assessment; adaptation assessment; and integrated assessment (noting that these often have different objectives).

Over subsequent cycles of IPCC assessments, methods have moved towards a risk assessment approach. This change has been driven by the demand for policy-relevant information and the desire to 'mainstream' climate change adaptation into government and institutional decision-making processes. The latest assessments are generally characterised by a risk-based approach and an emphasis on understanding the uncertainties related to climate model projections and impacts. Moreover, there has also been a greater recognition of the need to move beyond isolated impact assessment studies and increase the focus on decision making, especially in the context of implementing adaptation.

More recently, there has been a greater emphasis on how to ensure that decisions made today are robust to wide ranges of future changes in the climate (including extremes), rather than seeking to make the best choices for the most likely scenarios. In this context, the Framework includes impact and vulnerability assessments to guide adaptation assessments, which use a 'robust decision making' framework to manage risks and uncertainties.

The requirements of impact, vulnerability and adaptation assessments are highly dependent on a number of factors, such as: the end purpose of the assessment, the geographical scale of application, and the resources and data available. Therefore, although tools exist to carry out assessments, the approach taken in any one assessment is often a bespoke hybrid that uses a mix of tools, assumptions and data. This diversity is a function of the complex problems being addressed, but has resulted in an overall problem of incoherent technical guidance.

Assessment methods may be classed broadly into impact, vulnerability, adaptation and hybrid approaches. These assessment methods may incorporate risk assessments to varying degrees. The assessment of risk implies a quantitative or qualitative association of likelihood and severity of impacts or vulnerabilities. For example, the risk of drought may be assessed for current conditions and future conditions, or with and without proposed adaptation options.

- **Impact assessments** tend to adopt a top-down and 'science first' approach, starting with detailed climate models, assessment of biophysical impacts, and then social, economic and environmental consequences. They typically take a long-term perspective, making use of climate models for the 2050s and 2080s. A key question often answered by impact assessments is: How might climate change alter the biophysical systems, and what would this mean for society, the economy and/or the environment?
- **Vulnerability assessments** generally take a bottom-up approach, focusing on the factors that make different people or places vulnerable to current and future climate risks. While they can be developed at local or broader scales, they focus on exposure to climate hazards and how to reduce vulnerability. A key question often answered by vulnerability assessments is: What are the characteristics of the society, economy and/or environment that cause climate variability to have a negative or positive impact?
- **Adaptation assessments** go beyond impact and vulnerability assessments to look at potential solutions to address impacts and vulnerabilities. The Framework can be viewed as a form of adaptation assessment, within which impact and vulnerability assessments are used to inform decision making on adaptation. Adaptation assessments are typically more focused on the need to support near-term decisions (5–10 years) and concerned with current risks and the promotion of flexible strategies, given the deep uncertainties about future climate and socio-economic change. A key question often answered by adaptation assessments is: What changes can be made to the society, economy and/or environment that will reduce vulnerability and the negative impacts of climate change and variability?
- **Integrated or hybrid approaches** that incorporate aspects of the above methods can be developed to meet specific needs. This may be integration across sectors, scales or across the top-down and bottom-up approaches. One example is the UK's Climate Change Risk Assessment,[4] which can be classified as a risk assessment that included aspects of impacts and vulnerability methods and extensive stakeholder engagement. Figure 5.2 shows the methodological framework used. Note that this framework combines assessments of impacts, vulnerabilities and aggregate risks for existing and future climate and socio-economic change.

Box 5.1 provides further sources of guidance on CCIAV assessment methods.

i The Seven Steps are: (i) define problem; (ii) select method; (iii) test method/sensitivity; (iv) select scenarios; (v) assess biophysical/socio-economic impacts; (vi) assess autonomous adjustments; (vii) evaluate adaptation strategies.[2]

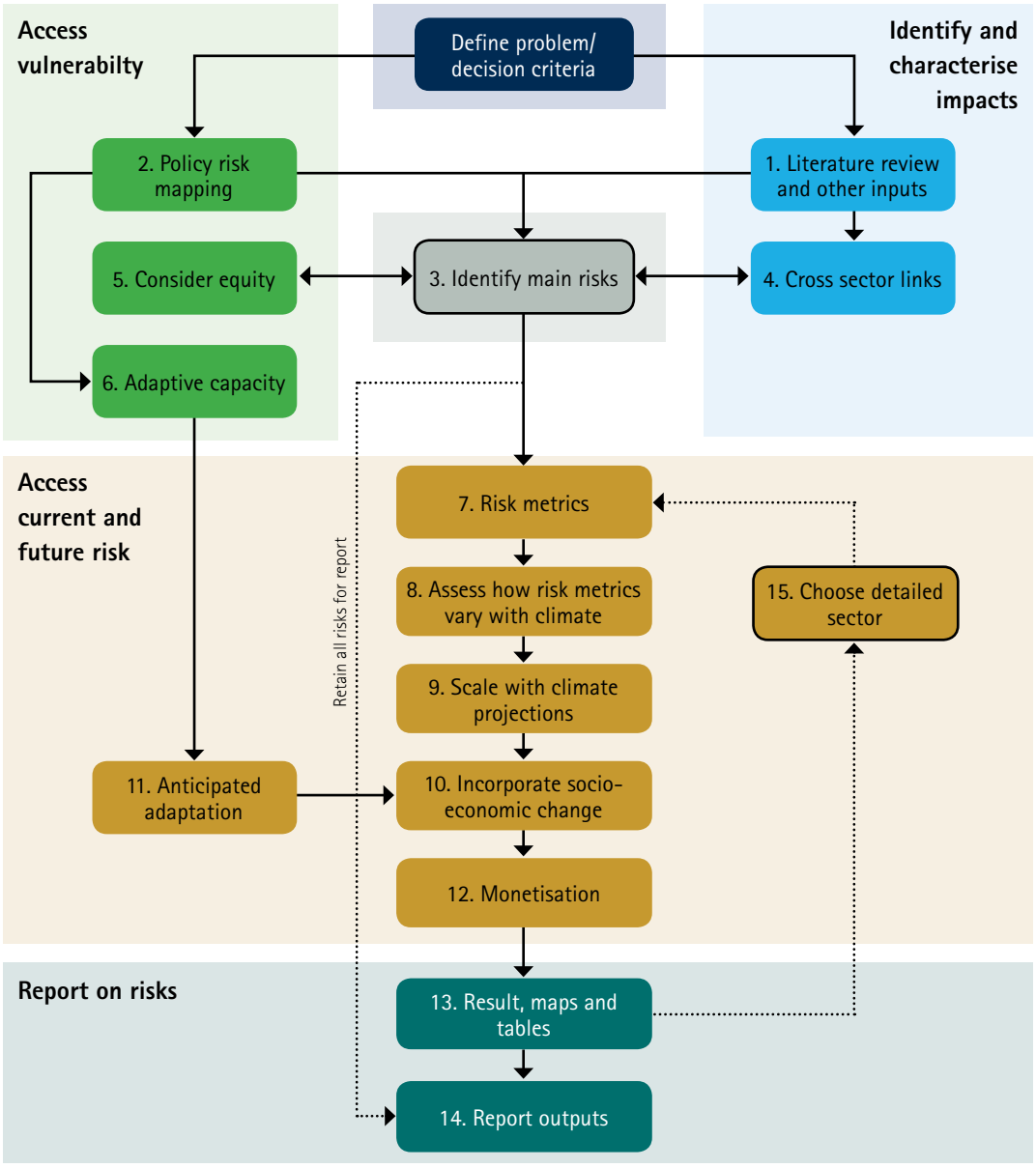


Figure 5.2 The UK Climate Change Risk Assessment methodological framework[5]

Box 5.1

Further guidance on CCIAV methods

There are a lot of guidance documents on CCIAV methods. In the context of water security and climate resilience in Africa, the different methods have different strengths and weaknesses; the choice of method depends on project aims and objectives, spatial scales, intended audience, the availability of data and information, and the time, resources and capacity to complete studies.

The UNFCCC National Communications Support Unit has developed guidance for carrying out vulnerability and adaptation assessments directed at non-annex I parties to support the production of National Assessments. This guidance, which is supported by presentations and additional resources, can be accessed online at: http://unfccc.int/resource/cd_roms/na1/v_and_a/index.htm

UNEP has produced a comprehensive introduction to the wide range of impact assessment methodologies that are needed for the diverse impacts of climate change on human activities and ecosystems. In addition, the development of socio-economic and climate scenarios are discussed.[6]

A diverse range of CCIAV approaches has arisen due to the different information needs of decision makers across sectors and scales of planning. PROVIA, a joint UNEP, UNESCO and WMO initiative, is producing streamlined guidance on the use of CCIAV, available online at www.provia-climatechange.org/

5.4 CCIAV assessments in the context of the Framework

Phase 1 of the Framework involves the use of impact and vulnerability assessments to provide the evidence for developing no/low regrets investment opportunities in Phase 2 of the Framework. This aligns with the broad concepts of impact, vulnerability and adaptation assessments that are established in the literature. It should be noted that although vulnerability (bottom-up) and impact (top-down) assessments are rooted in different approaches, in practice this divide is unhelpful. Developing no/low regret investments requires an understanding of both the root causes of climate vulnerability as well as the longer-term potential impacts of climate change. Therefore, assessment methods should not fix themselves rigorously to bottom-up or top-down approaches, but rather use integrated approaches where possible. For example, in a water resources context, an impact assessment may include modelling river hydrology under different scenarios, as well as investigating the legal mechanisms for managing the resource and how these cope with climate variability.

Figure 5.3 aligns CCIAV approaches with the phases in the Framework, highlighting that impact and vulnerability assessments are the core area for building the evidence needed to carry out adaptation assessments, which are covered in Phase 2 of the Framework and expanded on in Chapters 6, 7 and 8 of this document.

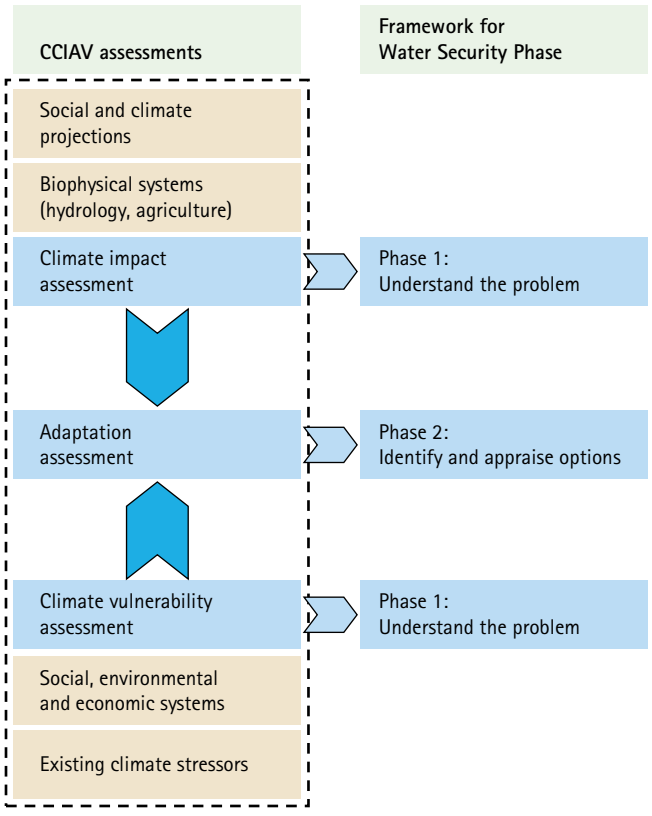


Figure 5.3 Alignment between CCIAV assessments and the Framework

The most important consideration is to ensure that studies can inform adaptation decision making, particularly for the identification of strategies that achieve development goals under a wide range of possible future scenarios. In this regard, it is important to note the following:

- Qualitative assessment, expert elicitation, synthesis and systematic reviews may be more appropriate in many contexts than complex impacts or risk assessment approaches.
- An understanding of the sensitivity to current climate, including extremes and other social and economic drivers is essential for building up an evidence base on future risks.
- Due to the deep uncertainties about future climate and socio-economic changes, a wide range of possible strategies should be considered, as well as a wide range of climate change scenarios.

Two levels of action and detail are recommended for using impact and vulnerability assessments to inform no/low regrets investment strategy development:

- **Level 1** – A rapid review of existing impact and vulnerability assessments, expert elicitation and stakeholder engagement, to provide a qualitative overview of the current and potential future climate impacts and vulnerabilities, should be included as priorities in strategy formulation. A rapid review also identifies knowledge needs and gaps without the need for protracted primary research programmes.
- **Level 2** – Commissioning detailed impact and vulnerability assessments targets knowledge gaps at a regional, national, sector or sub-national levels. Such studies provide the evidence for making significant investment decisions at a project or programme level, as well as providing the high-level evidence to influence policymakers.

5.5 Level 1 – Rapid review of climate impacts

Level 1 impact and vulnerability assessments can be used to directly drive for changes to national strategy priority areas as they are being developed, or to any decision-making process where limited timescales require a rapid assimilation of evidence. In addition, level 1 assessments should inform the selection of hotspot areas and sectors or themes for more detailed and strategic level 2 assessments.

5.5.1 Review existing impact and vulnerability assessments

This is key in avoiding duplication and maximising the value of any existing body of work. Regional economic communities (RECs), governments, line ministries, donors, non-governmental organisations (NGOs) and International Financial Institutions (IFIs) all carry out impact and vulnerability assessments to some degree as a part of their planning processes. A collation and synthesis of this work will identify evidence for short-term decision making and gaps that must be addressed through further assessments. If the timing of a sector's strategy-formulation process demands a quick appraisal of assessments, the filling of existing knowledge gaps could be included as a strategic action for the sector. Some examples of existing studies are provided below.

- **International studies** on climate change and it impacts. For example, the IPCC Fourth Assessment reports and SREX reports provide impacts by sector and world regions.
- **Pan-African studies** of climate change and impacts on related sectors. For example, the International Livestock Research Institute's *Mapping climate vulnerability and poverty in Africa*[7] study presents Africa-wide impacts of climate change on agriculture and poverty indicators.
- **National studies** on climate change impacts. For example, the Stockholm Environment Institute (SEI) has produced a high-level report on the impacts of climate change on the economies of Burundi, Kenya, Rwanda and Tanzania.[8]
- **Sector-specific studies** on the impact of climate change on economic performance, social welfare, environmental conditions. For example, the Centre for Environmental Economics and Policy in Africa has published numerous studies on the economics of the impacts of climate change on agricultural output.
- **Project-level studies** on the assessment approaches used in case-study examples of a similar nature or geographic area provide useful material for building on or understanding the types of climate risks being faced on the ground.

5.5.2 Stakeholder engagement

Engagement across a spectrum of relevant actors, including regional coordinators, central administrations, local government, sector specialists, climate specialists, community leaders and NGOs, is a tool for rapidly gathering information that can be analysed to unpick the priority areas where vulnerabilities are high and climate impacts require attention. At a national level, this has been undertaken by many African countries as part of National Adaptation Programmes of Action (NAPAs). For example, Mozambique's NAPA was informed by engagement with over 600 stakeholders at all levels of governance across the country. Building on the NAPA experience should not require substantial additional capacity development; existing multi-stakeholder platforms, such as those focused on disaster risk reduction, may provide an entry point.

Key questions that stakeholder engagement should address are:

- What sectors, livelihoods, districts and economic activities have been highly impacted by climate variability or extremes in the past?
- Are any emerging trends apparent in both climate variability and its impacts?
- What non-climate factors are causing negative impacts, and how do these interact with climate variability?
- What are the climate change projections and the potential magnitude of their impacts, both positive and negative?
- What is the capacity of national organisations to use information on future climate change and incorporating this information into long-term plans?

5.5.3 Expert elicitation

Expert elicitation is an invaluable source of information for decision making. It can range from informal roundtable discussions to tightly controlled methods that aim to maximise objectivity. The Cooke method is an example of an approach for soliciting expert judgement that attempts objectivity.[9] This method uses 'seed' questions prior to asking the main questions of interest. The answers to these seed questions are known, therefore the performance of individual experts against these questions can be assumed to reflect the accuracy of the expert's response to the main line of questioning.

The main benefits of expert elicitation are its rapidity and ability to provide answers to highly complex problems on the basis of experience rather than focused quantitative modelling. Its disadvantage is that unless the questions are clearly framed, misinterpretation can be a problem. Also, each expert is subject to different backgrounds and experiences, therefore elicitation can only be effective across a wide range of expertise.

5.6 Level 2 – Commission detailed impact assessment studies

A level 2 impact and vulnerability assessment seeks to fill knowledge gaps through the commissioning of primary research. These make use of available expertise and climate impact assessment tools. These are available in different sectors to provide qualitative or ideally quantitative estimates of potential climate vulnerabilities and impacts under agreed climate change scenarios. Level 2 assessments are likely to be more time consuming and expensive than level 1 assessments, and should therefore be targeted at responding to specific gaps in the knowledge or hotspots identified in level 1 assessments.

5.6.1 Key considerations for planners

When commissioning assessments, planners are faced with a number of approaches, each tailored to the sector and the nature of the problem being addressed. In some situations generic tools and models can be used, while in others bespoke tools or methods may need to be developed.

Selecting the most appropriate approach depends on the following factors:

- What are the questions? When commissioning new studies, planners should open a dialogue with a small group of experts and stakeholders to ensure that the questions to be answered are directly relevant for informing future strategy. Asking the right questions informs the methods adopted and the usefulness of the resulting evidence. For example, questions such as 'what are the most likely economic costs of climate change at the national scale' and 'which water strategies are resilient to future changes in river flows in a large transboundary basin' will lead to different methodological approaches. Table 5.1 provides examples of the different approaches that can be applied in impact assessment and the questions that may be resolved.
- In addition, the temptation to use a single tool in isolation should be avoided, as this may result in very narrow outcomes. For example, using an economic modelling tool may be quite straightforward. But unless this is backed up with case study work and stakeholder engagement, the results may not reflect the true vulnerabilities being faced on the ground.

- **What are the time, financial, capacity, information and data constraints on completing the assessment?** These are major constraints on the scope of the study. If limited funds are available, a simple qualitative approach – using stakeholder engagement to highlight vulnerabilities and simple climate scenarios to assess the direction and magnitude of impacts – may provide a 'first look' at potential issues. Time windows may also be limited by the constraints

Table 5.1 Different approaches that can be applied in impact assessments and the questions that may be resolved

Assessment approach and metric	Characteristics	Potential questions resolved
Sector-specific quantitative modelling tools	Each sector typically has specialist tools and models that are regularly applied to represent biophysical systems and can be used to conduct impact studies. Examples include: • hydrological and hydrogeological models for water resources assessment • hydraulic (river and coastal) models for flood modelling and mapping • crop response models for agricultural impact assessment • land suitability models for forestry and agriculture • water resources models for basin resource management • models of disease prevalence • fishery stock models • ecosystem models.	How could climate change affect water allocation in a river basin? How could climate change affect aquifer yields? What could be the impact of climate change on flooding in a coastal city? What could be the impact of climate change on crop production? What might be the most appropriate crop to grow under climate change scenarios? How might climate change influence the distribution of disease within a region?
Economic impact studies	Economic impact studies attempt to assign a cost to the impacts of climate change. This may be carried out directly (for example linking GDP with major natural disasters) or indirectly through the costs associated with power loss related to a reduction in river flow (modelled using a sector-specific tool). Economic impact studies are a powerful tool in presenting the case for action. Financial costs can be readily digested by financial planners, and also allow a common currency for impacts across sectors to be compared. However, the difficulty in assigning a value to some activities can bias comparisons. Most assessments will only be partial, as it is very difficult to monetise the full range of potential impacts.	What could be the economic impact of climate change on fisheries? How might the cost of managing flood risk change with climate change? What would be the sustainable forestry yield under climate change?
Indicator approaches	Indicators are used where impacts cannot be readily quantified or compared in common units. One example could be combining economic, social and environmental impacts into a composite score. Another example could be rating the vulnerability of different livelihood activities to climate extremes on a scale of 1–5 when more detailed quantitative impact models are not available. Such data can be collected relatively quickly through consultation, but may contain bias and require expert opinion to weight in any combined index. Indicators lend themselves to mapping and can be carried out at a national level to identify hotspots for action.	What are the likely climate impacts on livelihood activities? How might climate change affect social and environmental systems? How might the impacts of climate change on water stress be distributed across the country?

of planning cycles, and producing simple evidence to influence planning may be the most effective use of limited time. Lastly, conducting a pre-feasibility study on large or costly assessments may reveal gaps in datasets that may influence the selected methodology. For example, the application of data-hungry modelling techniques may be inappropriate in areas where little data is available to drive models.

- **What is the cost and strategic importance of the study for sectoral or national objectives?** Using limited resources to study climate impacts and vulnerabilities on the areas most at risk means that large strategic objectives should merit more thorough studies than smaller or less climate vulnerable areas of the sector. Studies may provide the leverage to request additional funds to increase the resilience of core strategic objectives.
- **What is the most appropriate modelling technique for impact and vulnerability assessment?** There is a diverse range of assessment approaches available (as described in the previous section). Detailed quantitative modelling depends on the availability of suitable models and sufficient data (observed and climate change information) to derive meaningful results. Quantitative models are generally sector specific (although hydrological models for river systems are a fundamental part of many water-related sector activities). A lack of data may mean that simpler qualitative approaches and expert elicitation methods using stakeholder approaches are the only viable methods.
- **What specific components need to be included or excluded from the assessment, in order to meet its objectives?** For example, does the assessment require the use of future population and other socio-economic data to estimate future risks, or is it only concerned with sensitivity to the climate? Should the assessment include anticipated adaptation, including autonomous adaptation and existing sector policies, or should it provide a baseline without these included? Does it need to include monetisation of potential impacts or risks, or will a qualitative description be sufficient? Will it include an evaluation of actions for increasing resilience or adaptation to climate change?

5.6.2 Decision support systems (DSS)

The use of decision support systems (DSS) can assist in making objective decisions by handling large volumes of data and presenting findings in a format that is easily digested by decision makers. Box 5.2 discusses some of the considerations when using DSS for water-related planning.

Box 5.3 outlines a recent study identifying climate and demographic stresses on transboundary resources in SADC.

5.7 Example – Sector-specific impact assessment techniques

Climate impact assessments are often completed by sectors or water-use typologies. As such, these sectors have developed specific tools and approaches to meet their needs, for example, the impacts of the climate on agriculture can be represented using crop-response models.

Some models assess only the primary impact of climate change; for example, the impact of changing rainfall on river flows is represented using hydrological models, while others represent second- or third-order impacts such as the economic impacts of flow changes on irrigation systems. Table 5.2 presents some examples of direct and indirect impacts of climate change on the sector.

Box 5.2

Decision support systems as a tool for assessing climate vulnerabilities and impacts

In the case of water resources management, DSS may contain models representing the hydrology of river systems, demand systems such as crop water, domestic demand, and the operation of water infrastructure such as dams. The use of models within DSS allows the user to change the system characteristics through scenarios (infrastructure development, changing water demand, river flows or rainfall) to explore how these affect the system performance (in terms of supply failure, for example). Such DSS tools are therefore valuable for planning basin-wide investment programmes, water allocation regimes, and sensitivity testing for the impacts of the changing climate and other factors on water resources or crop production, for example.

Systems can be data intensive, requiring large volumes of data to successfully simulate system behaviour, and often require strong technical capacity among operators to set-up and maintain. Engaging stakeholders in the development and use of systems helps to bring added-value and validity to the interpretation of results.

An example of this is the processes used to agree an optimal dam management system at the Diama dam in Senegal.[10] The construction and operation of the dam had negatively affected people whose livelihoods depended on the seasonal inundation of the floodplain. A participatory framework was established to understand the river flow requirements of these livelihood activities. These requirements were fed into the DSS to determine a revised dam management system, which integrated electricity generation with the requirements of the local population.

Box 5.3

Climate and demographic stresses on transboundary resources in SADC

The regional climate change programme[11] was a programme of work with Southern African partners on the impacts of climate change, with the broad objectives of increasing regional participation in globally funded adaptation projects and improving resilience. The study objectives were to:

- better understand climate- and water-related impacts and risks associated with change in transboundary basins throughout the region;
- highlight regional vulnerabilities in the ability of countries, river basins and the region to adapt to these emerging risks and potential climate change;
- explore approaches to evaluating these impacts, based on the characteristics of these basins, typical availability of information and the inherent uncertainty around change.

The approach that was developed for this assessment was built around three fundamental elements: qualitative assessment, scenario analysis and representative basin case studies. Three river basins were selected (the Okavango, Zambezi and Limpopo) using the following key criteria: geographic spread (reflecting different climatic, hydrological and institutional conditions); inclusion of a diversity of 'climate and water' stories; strategic relevance and climate vulnerability from a regional perspective; and information availability.

The study identified two climate change scenarios and two development scenarios, giving a matrix of four plausible future scenarios. Themes of climate change impact on water resources were developed through the use of regional workshops to develop: i) baseline assessment of current conditions; ii) syntheses of basin development plans; and iii) identification of significant climate and water stories or scenarios.

This qualitative analysis allowed an exploration of the key challenges facing transboundary basins in SADC and presented lessons that can be carried forward for the development of national and regional climate resilience.

Table 5.2 Examples of primary and secondary impacts assessments

Primary impact	Secondary impact
Impact of climate change on river flows	• Economic impact of changing river flows on energy production • Livelihoods impact of changing river flows on fishing communities • Political impact of changing flows on shared use of transboundary resources • Ecological impact of changing river flows on ecosystems • Economic impact of changing river flows on irrigation system performance
Impact of climate change on coastal flooding	• Economic cost of coastal flooding to business and tourism • Loss of valued coastal habitats
Impact of changing rainfall on crop growth	• Livelihoods and food security impacts on local communities • Economic impact on agricultural export markets
Impact of climate change on disease prevalence	• Cost to health services of changing disease distribution
Impact of climate change on storm rainfall	• Impact of storm rainfall on crops • Impacts of transport systems
Impact of changing sea temperatures and circulation on fisheries	• Impact on regional food security • Economic impact on exports

The assessment of climate impacts by one sector is unlikely to pick up the interdependencies with other sectors. Integrated assessments across sectors and simple qualitative assessment of the interactions of impacts between sectors, which highlights the main issues without requiring unfeasibly complicated integrated modelling efforts, are often desirable and more pragmatic to achieve in practice.

5.7.1 Water resources impact tools

Water resources climate impact assessment is mainly concerned with supply (rainfall, potential evaporation, river flows, groundwater levels) and demands (ecosystems, agriculture, energy, municipal and industrial). Understanding supply and demand (and its variability over time) within a basin can inform policy and decision making on water allocation between users during normal and stressed conditions, and inform the long-term planning in the basin. Such decisions require a value to be assigned to water for its various uses, such as agricultural output, domestic supply, energy production and ecosystems services. Building consensus on the economic value of water for such demands is a major challenge, as some benefits are more difficult to monetise than others and may be undervalued.

Climate impact assessment tools for water resources can be used to answer the following primary questions:

- What are the available water resources in the basin and how are these distributed geographically and over time?

- What are the impacts of climatic extremes such as floods and droughts on water resources availability and quality?
- How will water resource availability change over time with projected climate change scenarios? How will this affect water quality in the basin?
- What are the demands (human and ecological) within the basin and how are these distributed geographically and over time?
- How will socio-economic development pathways affect the demands for water in the basin?

These primary impacts on resources may be used to assess secondary impacts, which are of direct interest to policymakers. Secondary questions include:

- How can basin resources be shared equitably under changing climate and demographic scenarios?
- How will the impacts of climate change be distributed across social groups and water users?
- How will climate change affect economic and social development strategies?
- How can the impacts of changing flood and drought regimes be mitigated through basin management and operation?

A wide variety of tools exist for climate impact assessment on water resources. These range from mathematical models to represent river flows and groundwater storage, to optimisation models to represent water allocation within and across basins to meet user-defined criteria. Box 5.4 illustrates the use of hydrology and water resources tools to provide the basis for making planning decisions. An example of such a tool is SEI's Water Evaluation and Planning (WEAP) modelling system. [ii]

The selection of approach depends on the question being resolved. However, the provision of widely accepted tools for modelling and managing water resources is an important criteria for resilience, as it allows:

- a common understanding of basin systems performance for evidence-based decision making;
- assessment of the impacts of climate change, policy decisions and development activities;
- the collection and sharing of data to drive models operationally.

5.7.2 Agriculture

Agriculture is directly affected by seasonal climate variability and also by long-term climate change. Rainfed agriculture dominates in Africa and is particularly susceptible to the timing and amount of rainfall.

ii http://www.sei-international.org/weap-the-water-evaluation-and-planning-system

Box 5.4

Improving water resources modelling of the Orange–Senqu Basin

Part of a transboundary water management programme in South Africa's Orange–Senqu River Basin, supported by the Gesellschaft für Internationale Zusammenarbeit, supports Phase II of the Orange–Senqu River Basin Commission (ORASECOM) basin-wide integrated water resources management plan. This is being carried out as an activity within the Southern African Development Community's (SADC) regional strategy action plan on integrated water resources development and management.

This has involved the following technical capacity developments to improve ORASECOM water resources management:

- development of an integrated Orange-Senqu River Basin model;
- updating and extension of Orange-Senqu hydrology datasets;
- preparation and development of an integrated water resources quality management plan;
- assessment of global climate change;
- assessment of environmental requirements.

These activities are an essential component of the technical services in water resources management that ORASECOM requires to meet water security challenges across the four riparian states in the future.

Agricultural climate impact modelling can answer the following primary questions:

- How will changing rainfall regimes affect rainfed agricultural yields?
- How will changing river flows (based on water resources modelling) affect irrigated crop yields?
- How might climate change affect the distribution and prevalence of pests and diseases?
- How might climate change alter the frequency and severity of natural hazards that affect agriculture?

The answers can inform the more relevant secondary questions:

- How might climate change affect regional crop suitability and pastoral productivity?
- How might climate change affect food security among rural communities?
- How might climate change affect regional trade patterns and food prices?
- What are the likely impacts of climate change on regional agricultural policies and economic controls?
- What are the likely macroeconomic impacts of climate change on the agricultural sector?

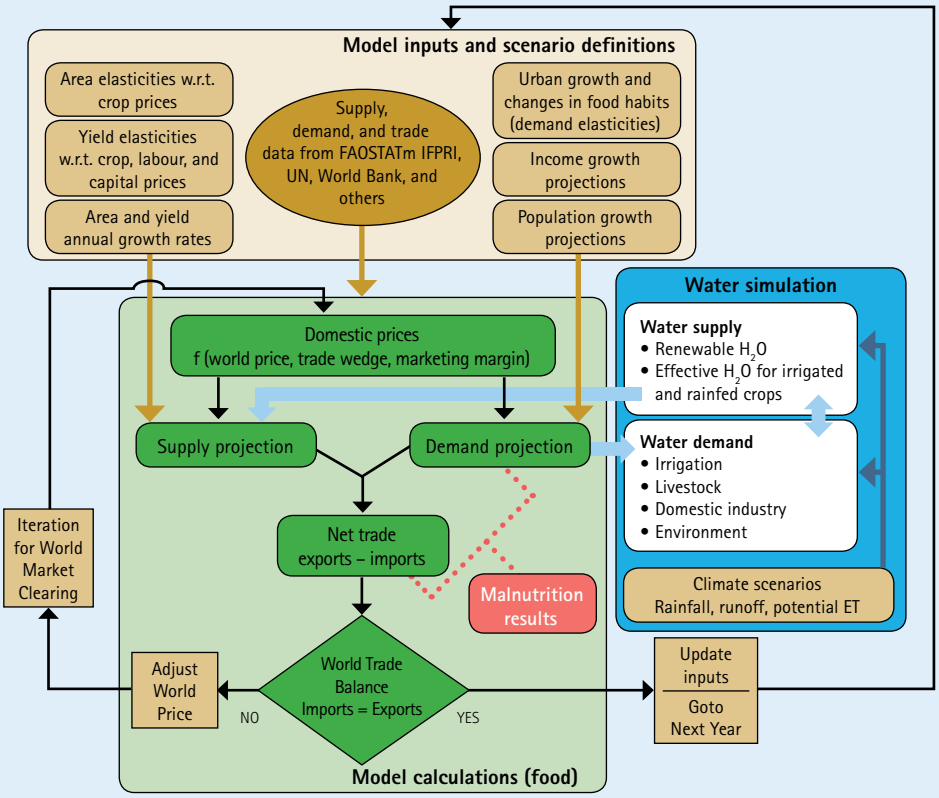
Examples of modelling tools for primary agricultural productivity include the Food and Agriculture Organization's AquaCrop, which simulates the yield response of several herbaceous crops to water. Another is the Decision Support System for Agrotechnology Transfer, which serves a similar function. Such crop response models have been integrated into sophisticated economic models, such as the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) developed by the International Food Policy Research Institute (IFPRI). This model can assess the wider implications of climate change on food prices and trade (see Box 5.5).

Box 5.5

The IMPACT model[12]

The IMPACT model was initially developed by IFPRI to project global food supply, food demand, and food security to 2020 and beyond. It can model 32 crop and livestock commodities over 281 spatial units, called food production units.

The challenge of modelling climate change impacts arises from the wide-ranging nature of the processes that underlie the working of markets, ecosystems, and human behaviour. The analytical framework used in the study integrates modelling components that range from processes driven by economics to those that are essentially biological in nature.



The IMPACT model conceptual framework

Reproduced with permission from the International Food Policy Research Institute (www.ifpri.org).
This policy report can be found at: http://www.ifpri.org/sites/default/files/publications/pr21.pdf and the
Appendix 1: Methodology that accompanies it can be found at: http://www.ifpri.org/sites/default/files/publications/pr21app1.pdf

The IMPACT modelling system was used to quantify climate change impacts, assess the consequences for food security, and estimate the investments that would offset the negative consequences for human well-being. This involved bringing together, for the first time, detailed modelling of crop growth under climate change, with insights from an extremely detailed global agriculture model, using two climate scenarios to simulate future climatic conditions. The results of the analysis suggest that agriculture and human well-being will be negatively affected by climate change:

- In developing countries, climate change will cause yield declines for the most important crops. South Asia will be particularly hard hit.
- Climate change will have varying effects on irrigated yields across regions. South Asia will experience large declines.
- Climate change will cause additional price increases for the most important agricultural crops – rice, wheat, maize and soybeans.
- Calorie availability in 2050 will not only be lower than in a 'no climate-change' scenario; it will actually decline relative to 2000 levels throughout the developing world.
- By 2050, the decline in calorie availability will increase child malnutrition by 20% relative to a world with no climate change.

5.7.3 Energy

In Africa, hydropower is an important energy source and much potential remains untapped. Water is also required for cooling thermal power generation units, which require a consistent water source.

Impact tools are often a combination of hydrological modelling tools and energy generation process models, which will be specific to each hydropower site and the proposed infrastructure. Box 5.6 presents an example of an assessment of the impacts of climate change on hydropower generation. Such studies can reveal the climate sensitivities of such large-scale investments.

5.7.4 Infrastructure and the built environment

The following aspects of infrastructure planning may require an assessment of climate risks: structural integrity; serviceability; functionality; operations and maintenance; emergency response risk; insurance considerations; policies and procedures; economics; public health and safety; and environmental effects. The United Nations Development Programme has produced a useful overview for practitioners and planners of the activities needed to improve the climate resilience of infrastructure.[14]

Risk assessments for infrastructure should take into account the type of climate hazard and the mechanism by which it causes impact on the infrastructure. For example, a railway line may suffer flooding due to the inadequate capacity of culverts. The impact assessment should also consider the consequences of the impact; for example, a road closure due to flooding may be considered a less severe consequence than the flooding of a power station. In addition to considering historic climate hazards, climate change scenarios for future changes in hazards should be considered when investing in infrastructure. This process of 'climate proofing' may involve overdesign to accommodate more severe future hazards, operational risk management such as warning services, or even relocation away from hazardous areas if possible. Climate impact assessments should be routine for large investments in all types of infrastructure.

Infrastructure design is typically informed by design standards for natural hazards, for example to withstand high wind speeds, rainfall intensities or floodwater levels. Specialist models are often required to translate projected changes in extreme climatic conditions to the receptors of interest. For example, hydrological and hydraulic models can translate estimates of changing rainfall characteristics to river flows and then inundated areas under extreme conditions. Such models can inform policy (such as floodplain zoning) and the design of hard interventions to reduce hazard risk (such as flood levees).

However, relatively simple modifications to design standards to account for climate change, based on the underlying evidence-base, can also be developed to account for climate change. For example, in the UK, the design of river flood flows are subject to an additional safety factor of 20% to insure against possible future increases in rainfall intensity due to climate change. This is an example of an extremely simple method for applying climate change to design standards. Very significant investments and water-related infrastructure are usually subject to more rigorous risk analysis.

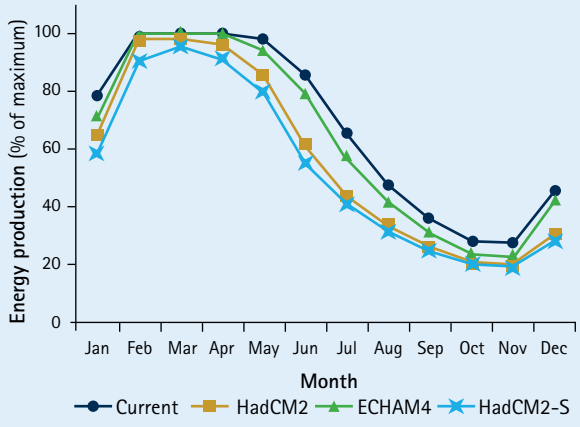
In addition to infrastructure development through official channels, the challenge of rapid and uncontrolled urbanisation places an increasing number of people at risk from climate hazards, through development on inappropriate land and insufficient attention to urban drainage and other services. Those at risk are often society's most vulnerable people, who are unable to live elsewhere or simply willing to accept the high levels of risk. Impact assessments of climate hazards in urban areas can highlight the risk hotspots for targeting limited funding for interventions.

Box 5.6

The impacts of climate change on hydropower generation[13]

Hydrological modelling was combined with an electricity generation and financial model in a study to assess the impacts of climate change on the performance of the proposed Bakota Gorge hydropower scheme in Zambia. Three climate change scenarios for the 2080s drove the hydrological model, providing future flow regimes to be fed into the electricity generation model. This gave estimates of power yield, which were then fed into a financial model to indicate the economic viability of the scheme.

All three scenarios indicated a reduction in the performance of the scheme, with two of the scenarios resulting in performance that would jeopardise the financial viability of the scheme.



Monthly mean energy production under historical and future global climate model scenarios

5.7.5 Ecosystems services and ecosystem-based adaptation

Maintaining and enhancing ecosystems offers benefits that are synergistic with climate change adaptation (see Box 5.7). The World Bank[15] identifies two major synergies between ecosystems and climate change:

- Natural ecosystems are resistant and resilient and provide a full range of goods and ecosystem services, including natural resources such as water, timber and fisheries, on which human livelihoods depend.
- Natural ecosystems provide proven and cost-effective protection against some of the threats that result from climate change. For example, wetlands, mangroves, oyster reefs, barrier beaches and sand dunes all provide coastal protection from storms and flooding. Such ecosystem-based approaches can complement, or be a substitute for, more expensive infrastructure investments to protect coastal settlements.

An example of a framework for assessing the impacts of climate change on freshwater ecosystems and the key indicators of selected risks is presented in Box 5.8.

Assessments can be carried out at a national or international scale by looking at the high-level vulnerabilities associated with large ecosystems such as fisheries or forests. These assessments can provide powerful arguments for adaptation responses to address large-scale risks. One such example is the international study of vulnerability of fisheries to climate change.[18] At the local scale, assessments of the vulnerabilities associated with communities and their interactions with ecosystems provides a detailed picture of the pressures facing ecosystems and communities, and the trade-offs between competing demands on resources. Local-level studies are often used to inform the development of ecosystem-based adaptation options

Box 5.7

Defining ecosystem-based adaptation

The 2009 Convention on Biological Diversity[16] defines ecosystem-based adaptation as "the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change. Ecosystem based adaptation uses the range of opportunities for the sustainable management, conservation, and restoration of ecosystems to provide services that enable people to adapt to the impacts of climate change. It aims to maintain and increase the resilience and reduce the vulnerability of ecosystems and people in the face of the adverse effects of climate change. Ecosystem based adaptation is most appropriately integrated into broader adaptation and development strategies."

Box 5.8

Assessment of climate change impacts on freshwater ecosystems

The World Wide Fund for Nature (WWF) and the World Bank produced a report[17] detailing a methodology for assessing the impact of climate change on freshwater ecosystems. This comprises impact and vulnerability assessments in the context of an overall risk framework that is used to identify adaptation options. The vulnerability and impact assessments use top-down assessments based on climate and development futures as well as bottom-up vulnerability assessments of the resilience of ecosystems to existing stressors.

Case studies include the Okavango Delta, in which the following climate change-related risks were evaluated on a qualitative scale of high, medium or low risk:

- low-flow impacts on ecosystems;
- shifts in the timing of floods and water pulses;
- evaporative losses from shallower water bodies;
- higher and/or more frequent storm flows;
- shifts in thermal stratification in lakes;
- saltwater encroachment in coastal and deltaic systems;
- increased runoff, increasing pollutants;
- hot or cold-water conditions;
- dissolved oxygen levels.

The report provides a useful example of a methodology for assessing climate change risks to ecosystems using a multi-criteria approach. It also provides recommendation on the adaptation responses that could be implemented to reduce climate change related risks.

Questions that an assessment of ecosystem vulnerability should answer include:

- Which ecosystem services are currently being provided, and what are their livelihood and economic values?
- What are the human pressures on the ecosystem? What is the overall health status of the ecosystem?
- How is the ecosystem managed? Who are the winners and losers in terms of ecosystems services? What are the high-level priorities in terms of ecosystem services?
- How might future human pressures and climate change affect the ecosystem's health and service provision?

Tools that can be applied to assess the components of ecosystem vulnerability to climate change can be found in the report *Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change*.[19] These are mainly technical tools that focus on the impacts of the climate on ecosystem functions, rather than qualitative local-level assessments of community uses of ecosystem services, which are equally

valuable. SEI's case study-based assessment of ecosystem vulnerability to human pressures in Cambodia provides a good example of a qualitative approach.[20] This study used interviews to build a detailed picture of community-level ecosystems services in several villages.

5.8 Community-level vulnerability assessments to ensure social inclusion in climate resilience

Community-level vulnerability assessments take a bottom-up view by conducting assessments of selected communities to identify, at a very fine scale, the particular climate challenges and vulnerabilities facing households and livelihoods. These approaches require site visits and intensive engagement with local stakeholders. A key challenge is to selectively target representative communities within regions, in order to identify vulnerabilities that may be present across wider sub-national regions.

Local communities and administrations will bear the full brunt of climate change. They are at the front line of its impact, and in many cases are already experiencing a foretaste of what is in store, though growing water stress, greater climatic extremes, and other symptoms of climate change. However, it is likely that local actors will have a different climate agenda and different priorities to their central counterparts. Centrally driven measures, including major hydraulic works, will have a differential impact on communities, and there will be losers as well as winners. Hence the climate-resilience agenda will involve consultation and even negotiation between central and local powers to produce full ownership by all concerned – some give and take will be necessary from all parties.

Poverty reduction is widely accepted as a no or low regrets activity for improving resilience at the community level. Poverty reduction generally involves raising incomes and improving health, education and basic infrastructure. This increases the capacity of communities to cope with climate stress by reducing ill health, reducing the time spent on basic tasks such as water collection, and building cash savings to invest in more productive livelihoods.

Community-level vulnerability assessments are carried out through local visits and extensive consultation with a wide range of stakeholders. Several tools and guidance manuals have been developed, primarily by NGOs, for conducting these assessments as part of their development project planning processes. Adaptive capacity, sustainable land management, and vulnerability to natural hazards are thematic areas commonly measured using community-level tools.

Data collection may be carried out by stakeholder engagement, in which communities provide information on their livelihood activities and the climate drivers that impact upon these. Such engagement is often accompanied by capacity building at the local level, so both parties gain in knowledge. These bottom-up approaches are typically qualitative and discursive, in order to gain information where data is not formally collected but is distributed across populations. The introduction of a systematic approach to qualitative data, and the ranking of hazards and impacts, is useful for applying scale to the analysis.

The main benefit of this approach is its ability to access information that is not formally recorded or reported, and to draw on local understanding of systems that are not apparent at a broader level of analysis. Drawbacks are potential poor geographical coverage for the analysis (it is typically limited to workshops within selected areas), and there may be subjectivity in the interpretation of data. The approach is effective in collecting information from under-represented groups, and where formal data collection is lacking (and quantitative modelling is not feasible or reliable). But it is ineffective where detailed, quantitative information is required.

CRiSTAL is one of a number of community-based tools to support climate change adaptation and knowledge sharing (see Box 5.9). This is a screening tool designed to help project designers and managers integrate risk reduction and climate change adaptation into community-level projects across all sectors.

CRiSTAL has been applied several African countries, including Ethiopia, Kenya, Mali, Niger, Tanzania and Zambia. Box 5.10 presents a case study of the application of CRiSTAL in Tanzania. The case study illustrates how a tool for bottom-up dialogue on climate vulnerability can assist central governments in setting priorities for local development policies.

Box 5.11 outlines two further tools that offer pragmatic guidance on the assessment of local vulnerabilities and present options for addressing climate risks in project planning.

5.9 Vulnerability mapping for hotspot analysis

Vulnerability or impact mapping takes a top-down view, looking at spatial datasets to create indictors of vulnerability that can be mapped to identify hotspots. These hotspots can then be targeted to enhance climate resilience. The key challenge is to create indicators that can be validated as representative of the vulnerabilities to which they are proxy. Indicators usefully reveal broad spatial trends, but are unlikely to unpick the climate and non-climate drivers of vulnerability that community-level assessments may illuminate. Some studies use community-level assessments to validate the findings of large-scale mapping exercises.

Box 5.9

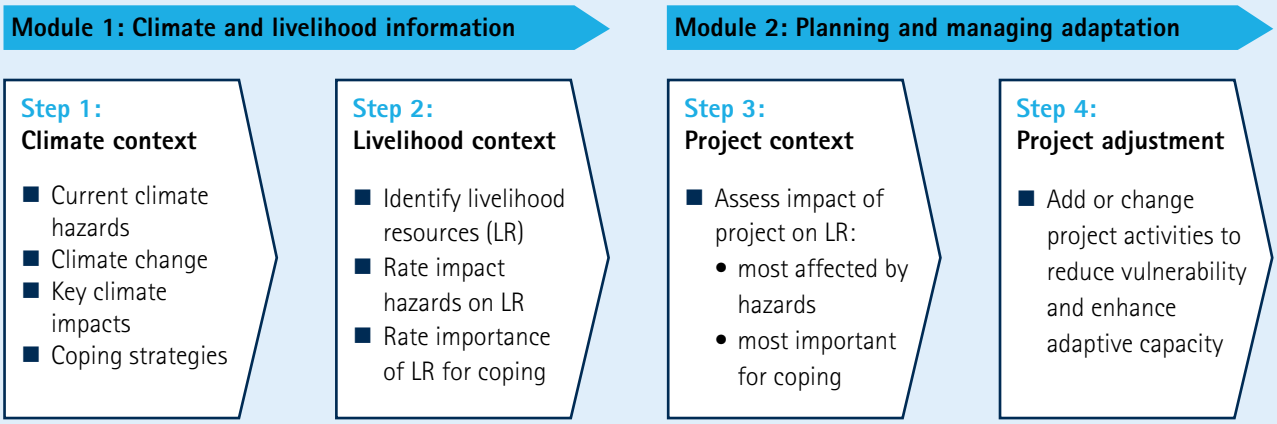
CRiSTAL: Community-based Risk Screening Tool – Adaptation and Livelihoods

CRiSTAL is a Microsoft Excel spreadsheet-based screening tool. It was designed to be applied to community-level projects to help project designers and managers reduce climate risks and promote adaptation to climate change. It emerged from the livelihoods and climate change project of the International Institute for Sustainable Development, Intercooperation, SEI, and the International Union for Conservation of Nature (IUCN).

The tool uses logical steps through three stages:

- understand the links between livelihoods and climate in a project area;
- assess a project's impact on community-level adaptive capacity;
- make adjustments to improve its impact on adaptive capacity and reduce the vulnerability of communities to climate change.

The figure below outlines the main logical steps in the CRiSTAL tool (reproduced from the CRiSTAL summary document).



Further information can be found at: www.iisd.org/cristaltool

Box 5.10

Climate change adaptation in the Pangani River Basin, Tanzania[21]

The Pangani River Basin management project is generating technical information and developing participatory forums to strengthen integrated water resources management in the Pangani Basin. This includes mainstreaming climate change adaptation to support the equitable provision and wise governance of freshwater for livelihoods and the environment, for current and future generations.

As part of the project, the CRiSTAL tool was applied at the community level to assess the vulnerability of livelihoods to climate change, and to identify adaptation activities and plan for implementation. The tool was applied through consultation in eight communities.

Activities identified using the CRiSTAL tool that directly benefit community resilience to climate risks include:

- training and facilitation of local poultry keeping and access to market as an alternative income-generating activity;
- improving the water supply for domestic use, irrigation and livestock (including the drilling of boreholes, pumps and electricity, management training);
- training on conservation farming;
- support for rainwater harvesting;
- irrigation, water-use efficiency training and water resources management;
- conservation of water sources through the provision of cattle troughs with permanent a water supply.

Box 5.11

Further tools for local-level vulnerability assessment

The climate vulnerability and capacity analysis handbook

The climate vulnerability and capacity analysis (CVCA) methodology, developed by CARE, provides a framework for analysing vulnerability and capacity to adapt to climate change at the community level. Recognising that local actors must drive their own future, CVCA prioritises local knowledge on climate risks and adaptation strategies in the data-gathering and analysis process.

The main objectives of CVCA are to:

- analyse vulnerability to climate change and adaptive capacity at the community level;
- combine community knowledge with scientific data to yield greater understanding about the local impacts of climate change.

The CVCA handbook is available online at: www.careclimatechange.org/cvca

Climate change and environmental degradation risk and adaptation assessment

Using climate change and environmental degradation risk and adaptation assessment (CEDRA), developed by Tearfund, agencies can prioritise the environmental hazards that may pose a risk to their existing projects and project locations. This enables them to make decisions to adapt some projects, stop doing some projects, or start new ones. In this tool, adaptation options are discussed and decision-making tools are provided to help organisations plan their responses to the hazards identified.

The CEDRA handbook can be found online at: http://tilz.tearfund.org/Topics/Environmental+Sustainability/CEDRA.htm

Simple indicators can be a valuable tool in making a rapid assessment of both vulnerability to climate and the impacts of climate change. Indicators have the advantage of allowing the combination of several vulnerability factors, using weightings to assign their relative magnitude or severity. Mapping these indicators provides a powerful tool for locating vulnerability hotspots and for disseminating information in a format that non-technical staff can understand. Indicators may encompass the exposure of populations to climate risks, their sensitivity, and their capacity to adapt. Examples of potential indicators are provided here, based on a recent study, which included risk and vulnerability mapping of the Zambezi Basin.[22]

This mapping of the Zambezi Basin involved risk and vulnerability hotspot mapping for the region. A wide range of environmental and social datasets were used to build composite indicators of exposure, sensitivity, climate impact, adaptive capacity and vulnerability, both for the current and future (2050) climate. These calculations were carried out on spatial datasets using a GIS, which allowed manipulation and mathematical operations to be carried out on large spatial datasets. The study used a definition of vulnerability that aggregates exposure and sensitivity into an impact score; impact and adaptive capacity are then aggregated as a measure of vulnerability.

Examples of indicators for exposure include:

- climate variability, for example a coefficient of variation for inter-annual rainfall and a coefficient of variation for monthly rainfall;
- climate hazards, for example the risk of cyclones and floods, fire frequency, the frequency and density of natural disasters.

Examples of indicators for sensitivity include:

- human pressures on natural systems, for example percentage of land under irrigation, human appropriation of net primary productivity, crowding on agricultural land, soil degradation;
- ecosystem conditions, for example net primary productivity, slope, easily available soil moisture;
- indicators of human well-being, for example subsistence food production, protein consumption, dietary diversity, people living in water stress.

Examples of adaptive capacity indicators include:

- asset base, for example infrastructure, poverty, economic wealth, access to improved water, subscribers to a cellular network;
- institutions and entitlements, for example health expenditure, gender inequality;
- knowledge and information, for example an education index;
- innovation, for example strategy documents considering climate risks;
- flexible forward-looking decision making and governance, for example governance accountability, conflicts.

Hotspot mapping can be used by central governments to target areas for more thorough assessments of vulnerability at district or community levels, or to target climate-sensitive funding to raise the adaptive capacity of areas most at risk.

Figure 5.4 presents one of the project's outputs, which identifies current health and food security hotspots.

Box 5.12 outlines a similar vulnerability mapping study, which examined climate and non-climate impacts on community vulnerability in India. The box details some of the main characteristics of the study, including the use of scenarios, geographical extent, modelling techniques and approaches for dealing with uncertainty.

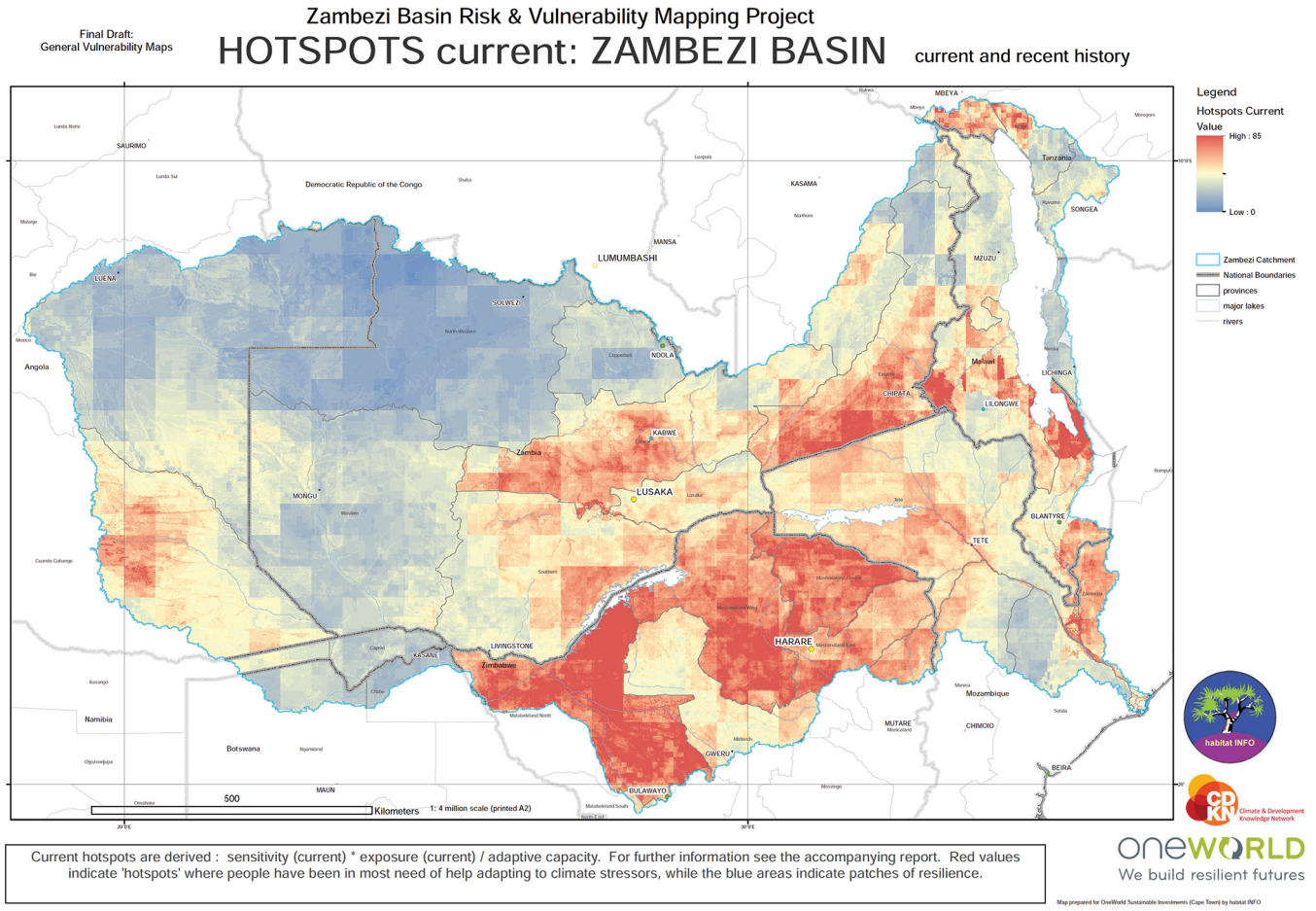


Figure 5.4 Current vulnerability hotspots in the Zambezi Basin

5.10 Multi-sector analysis

Within the context of an integrated approach to the development and management of a basin's water resources, all water-related sectors are important – for example hydropower, irrigation, water supply, flood management, environment, tourism, wetlands and others. Water users in all these sectors are legitimate stakeholders with claims on water allocation.

A multi-sectoral evaluation of water resources development and management options and scenarios from both national and basin-wide perspectives, can enhance cooperation and encourage benefit sharing among sectoral interests, and, in the case of transboundary river basins, among riparian countries. The use of integrated models allows a range of socio-economic and climate change scenarios to be assessed across short- and long-term timeframes, see Box 5.13.

Although complex, and requiring multi-disciplinary approaches, the coupling of hydrological and other models can be used to investigate the impacts of climate change and to identify optimal pathways for the management and development of river basins.

5.11 Assessing adaptive capacity

Adaptive capacity is one of the key measures of vulnerability to climate change. Improving this yields benefits under any future climate or development scenario. The UNDP adaptation policy framework[25] defines adaptive capacity as:

"*the property of a system to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability, or future climate conditions. In practical terms, adaptive capacity is the ability to design and implement effective adaptation strategies, or to react to evolving hazards and stresses so as to reduce the likelihood of the occurrence and/or the magnitude of harmful outcomes resulting from climate-related hazards. The adaptation process requires the capacity to learn from previous experiences to cope with current climate, and to apply these lessons to cope with future climate, including surprises.*"

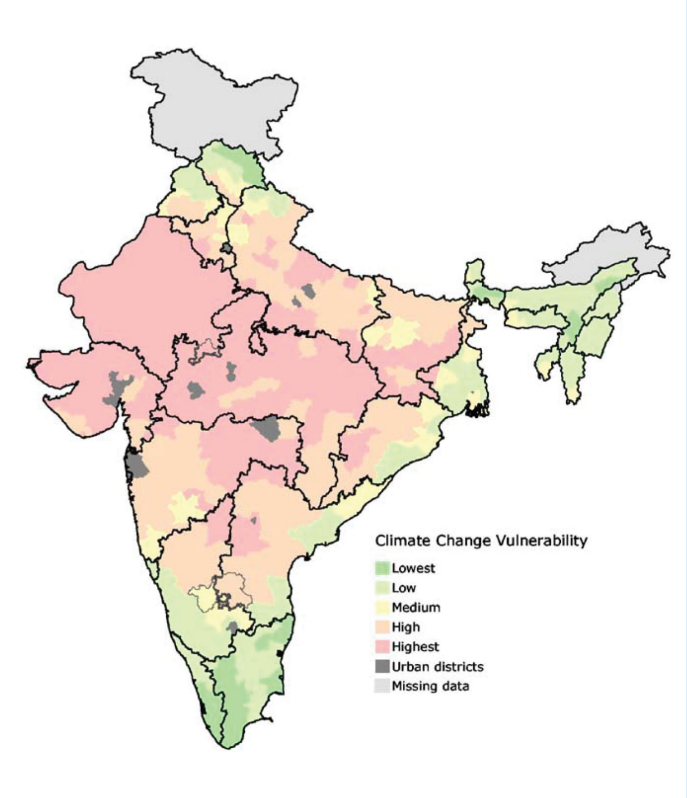
Adaptive capacity is a difficult concept to quantify. It requires the distillation of complex institutional and decision-making systems into simple indicators that can be used as proxies for adaptive

Box 5.12

Mapping vulnerability to multiple stressors: climate change and globalization in India[23]

This box presents the results of a qualitative modelling study that sought to combine the impacts of climate and non-climate drivers on Indian agriculture. The study used qualitative rankings to compare a range of drivers, and took a strong spatial element in mapping the entire country at district level to allow comparison across districts.

- **Climate scenarios** – The HadRM2 regional climate model was used to provide a single future climate scenario. Because of the number of other drivers and their scenarios, climate change scenarios are necessarily limited.
- **Non-climate scenarios** – Scenarios of adaptive capacity, import sensitivity, trade sensitivity and globalisation sensitivity were generated using distributed socio-economic data.
- **Regions** – The study used district-level data to create a relatively high-resolution map for national planning purposes. The authors acknowledge that the sharp transition between districts does not capture gradual changes or differentiate between urban and rural areas.
- **Modelling** – Modelling was primarily carried out by ranking and using quantiles to categorise drivers. This allowed the integration of the different drivers to give a single indicator.
- **Uncertainty** – The study acknowledged uncertainty arising from the use of a single climate model, assumptions on static adaptive capacity and limited spatial resolution. The underlying uncertainty arising from the generation and integration of a diverse range of drivers was not discussed.
- **Further analysis** – The study used three district-level workshops to 'ground truth' some of the assumptions used in the mapping on adaptive capacity and vulnerability. This used an interesting mix of top-down and bottom-up approaches.



Composite climate change vulnerability index for India

Box 5.13

The Zambezi River basin multi-sector investment opportunities analysis (MSIOA)[24]

The objective of the Zambezi River MSIOA was to demonstrate the mutual benefits of cooperation among the riparian countries in the Zambezi River Basin through a multi-sectoral economic evaluation of the options for development and management of water resources.

With funding from the World Bank, hydrologic and economic modelling tools were developed and applied to enable multi-sectoral and regional assessments of management and development scenarios. The scenario analysis was carried out with the primary objective of determining and maximising mutually beneficial economic gains while meeting essential water supply and environmental sustainability requirements.

This approach provided an objective analytical knowledge base useful for informed decision-making about investment opportunities, financing and mutual-gains benefit-sharing. Moreover, the analysis will help the Zambezi Watercourse Commission, the Southern African Development Community and the individual riparian countries in formulation of the basin level strategic plan by providing insights into the available options for joint and/or cooperative development.

The approach and analysis demonstrated that the riparian countries could achieve short- and long-term benefits through coordinated operation of existing and planned hydropower facilities, cooperative flood management and cooperative irrigation development.

capacity. Box 5.14 outlines the principles of adaptive capacity presented in the Africa Climate Change Resilience Alliance (ACCRA) framework.

A Tyndall Centre study[26] found that indicators of adaptive capacity and vulnerability to natural disasters are generally centred around health, governance and education, which are all core development objectives. However, such principles must be translated into indicators that are applicable to the situation of interest. Section 5.14 presented examples of indicators used to map adaptive capacity at a sub-national level. The selection of indicators for adaptive capacity is likely to be specific to each study. For example, a study of adaptive capacity in terms of flood risk within a basin will use different indicators to an assessment of agricultural adaptive capacity at the national level.

5.12 Final remarks

Impact and vulnerability assessments are important. They underpin the evidence base for improved decision making on priorities, options and investments. Several methods are available for conducting assessments at different levels. The requirements of impact, vulnerability and adaptation assessments depend on factors such as: the end purpose of the assessment; geographical scale of application; and the resources and data available.

Box 5.14

The features of adaptive capacity

The ACCRA local adaptive capacity framework characterises the features of adaptive capacity as: (i) the asset base; (ii) institutions; (iii) knowledge and information base; (iv) innovation; and (v) governance decision making. These are expanded upon below, together with hypothetical examples of indicators of adaptive capacity in flood risk.

Asset base

This is the financial, physical, natural, social, political and human capital necessary to prepare a system to best respond to climate change.

Physical assets include flood defences and hydraulic structures, as well as operational river management regimes. Financial assets include funding sources for flood-risk management. Social assets include the support systems for flooding events, which minimise impacts on affected communities and businesses.

Institutions and entitlements

The ability of a system to ensure equitable access and entitlement to key resources and assets is a fundamental characteristic of adaptive capacity. Entitlement to the key resources needed for adaptation can be differentiated according to age, ethnicity, class, religion and gender (among other factors).

Institutions include river management agencies, planning institutions with legal instruments enforcing flood management legislation, and insurers (private and national disaster risk).

Knowledge and information

Successful adaptation requires information and understanding of future change, knowledge about adaptation options, the ability to assess them, and the capacity to implement the most suitable interventions.

Requirements include: competent, specialist engineers and hydrologists able to quantify and plan flood risk management; design guidelines that accommodate flood risk concerns; primary data on rainfall, river flows and the impact of climate change on these at the basin level; and knowledge of flood risk issues among communities, government and planners.

Innovation

A key characteristic of adaptive capacity relates to the system's ability to support innovation and risk taking.

This includes: improvement in technical approaches for flood risk quantification and decision making; the presence of market competition among flood-risk service providers (contractors and consultants).

Flexible forward-looking decision making and governance

Informed decision making, transparency and prioritisation are all key elements of adaptive capacity. Ensuring that local organisations are well informed about future climate trends enables them to take measures to plan for their impacts.

Examples include flexibility of guidelines (e.g. through regular review processes) and the potential for legal challenges to existing decision-making systems.

Practical approaches in any one context or setting are often a bespoke hybrid, using a mix of tools, assumptions and data.

The outputs of applying the tools and approaches in this chapter should be:

- A review report identifying the existing body of evidence and ongoing research efforts into existing and future climate impacts and vulnerabilities, including the headline findings and gaps in the evidence.
- Proposals for additional assessments to address knowledge gaps, and strategic areas for capacity building to improve the long-term generation of evidence.
- Application of selected impact and vulnerability tools, if timescales and budget allow, for pilot basins or sectors.
- A short briefing note for policymakers that identifies and synthesises evidence on vulnerability, impacts and ongoing adaptation initiatives.

The outcomes of this step will set the scene for the identification of water security and climate resilient investments in Phase 2 of the Framework, by providing technical evidence on priority climate impacts and vulnerabilities to be addressed.

It should be noted that the outcomes of the analyses support a wide range of subsequent steps in the Framework process, including identifying opportunities for building climate resilience into ongoing development activities, identifying new and innovative investment opportunities, and ensuring investment options are robust against uncertainty in climate change.

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6 | IDENTIFYING OPPORTUNITIES TO BUILD RESILIENCE IN ONGOING DEVELOPMENT PROGRAMMES

Key messages

- Screening can rapidly highlight existing climate vulnerabilities and potential future risks to existing assets and systems and also to planned projects and programmes.
- Screening involves understanding the current climate vulnerabilities of existing or planned systems and understanding sensitivity to a wide range of future scenarios, in order to sift investment options that are no/low regret.
- Screening also identifies opportunities to modify existing or planned investments to reduce risk, and may highlight the need to consider alternatives that are less sensitive to future climate change.
- Simple screening tools, existing impacts or vulnerability assessments, stakeholder engagement and expert elicitation can all offer a rapid insight into climate risks without the need to commission time-consuming detailed studies.

This chapter supports Phase 2 of the Framework and provides a simple approach for screening existing and future climate risks to existing assets and systems, and planned projects and programmes. The screening is intended to be a rapid assessment, one that should not be onerous. The identification of risks and their reduction should offer long-term benefits to the performance of the project, programme or system. The screening process is intended to be flexible and applicable to a wide range of water-related or climate-sensitive sector activities.

The screening involves three stages:

1. Assess existing climate vulnerabilities due to current climate variability and exposure to risks.
2. Consider the sensitivity of the project or programme to simplified climate change scenarios and possible social and economic changes.
3. Assess the residual risks and identify risk-reduction measures or ways of hedging risks to enhance resilience.

Recommended sources of further information:

As part of their climate safeguards system (CSS), the African Development Bank (AfDB) has produced a screening methodology to assess climate risks and propose adaptation actions in their projects at the planning stage. Although this methodology has been designed for a single institution's planning activities, it illustrates the type of screening processes that are currently being used.

African Development Bank Group. 2011. Climate Safeguards System (CSS) Climate Screening and Adaptation Review & Evaluation Procedures Booklet. Available at: www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/CSS%20Basics-En_def.pdf

6.1 Overview

Phase 2 of the Framework process (Identifying and appraising investment options) is guided by the understanding of the problem gained in Phase 1. This may have included making a case for climate resilience, engaging stakeholders and carrying out vulnerability and impact assessments as required, depending on the context and state of existing knowledge. As a first step into Phase 2 of the Framework, climate risk screening provides opportunities for enhancing the climate resilience of existing water and climate dependent systems and planned development activities.

Screening involves using simplified climate change scenarios to determine whether existing assets, ongoing programmes and planned projects and programmes (referred to as 'projects' for brevity) are at risk from existing and future climate vulnerabilities, and whether wide-ranging uncertainties related to climate change are problematic for decision making. The outcome of this process is to gain a rapid qualitative understanding of climate risks and potential options for enhanced climate resilience in ongoing projects. Seeking out these opportunities also has other benefits, such as building the capacity of planners through 'learning by doing' by integrating climate risks and climate change into decision making.

Any development projects and programmes that are likely to be sensitive to water and climate variability, directly or indirectly, would benefit from risk screening. The screening approach helps to identify existing climate risks and potential future risks, and to categorise projects and programmes into those with no or low climate risk and those susceptible to future climate change, with a view to then taking measures to reduce risks in the latter category (for example, improving resilience through a planned infrastructure upgrade).

Screening will result in a broad range of ideas and options for no/low regret investments and risk-reduction measures. The outputs of the screening exercise are carried forward as investment opportunities that will directly influence and benefit ongoing activities.

6.2 Rapid assessments for early action

Planning teams within water-related line ministries can carry out screening to capture the most significant sector activities. Ideally, the screening could be extended to decentralised levels, supported by central line ministries.

The screening is used to identify current and future climate risks to projects. Existing climate risks can be identified through historical climate data and information on the performance of analogous systems. Future climate risks (and possible socio-economic risks) are identified through the use of simplified scenarios to represent potential future conditions.

The following principles of the screening approach should be considered:

1. The screening approach does not require onerous or time-consuming technical work and is not intended to slow the pace of urgent development priorities. More thorough risk analysis is required only for those projects where risks to long-term viability are identified. Screening does not preclude any particular type of development activity. Although supported by Phase 1 of the Framework, screening can be carried out as an early action if timescales do not allow full vulnerability and impact assessments to be completed.
2. The screening approach is designed for application within line ministry planning departments across sectors, although the principles can be applied at a local project level. The approach is necessarily generic to accommodate different sectors and national planning systems. Rather than a prescriptive approach, screening aims to promote consideration of climate risks and dialogue between stakeholders, climate specialists and planners.
3. The effort taken to carry this out should be proportional to the relative amount of investment under consideration. For example, a small investment in piloting new technologies may require less detailed consideration than a major infrastructure development representing a high cost.
4. The use of screening should be monitored to understand its effectiveness and areas where it could be improved in future. Ideally, the application of the screening approach should be treated as a 'learning through doing' exercise supported by relevant technical specialists, rather than being led by these specialists. This could allow continual improvement of the screening approach and tailoring for regional or sector-specific contexts.

Screening methodologies vary from bespoke approaches to screen assets and portfolios managed by a particular organisation, to generic tools designed to be applied to projects at the planning phase. An example of the former is the recent World Bank study to screen existing assets worldwide, to appraise their exposure to climate change.[1] An example of the latter is the Asian Development Bank's Disaster and Climate Risk Screening Tool[2] or the International Institute for Sustainable Development's Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL), which is discussed in more detailed in Chapter 5.[3]

More recently, the AfDB has developed procedures for ensuring that all of its projects are screened for climate risks and opportunities, and that appropriate climate adaptation is incorporated into project design (see Box 6.1).

Bespoke approaches are better suited to the screening of risks across an entire sector or geographical area. For example,

Box 6.1

Climate Safeguards System

The AfDB has developed a set of procedures for ensuring that all of its projects are screened for climate risks and opportunities and, where appropriate, climate adaptation is incorporated into project design. The Climate Safeguards System (CSS)4 includes water-related projects (water supply, irrigation and hydroelectricity) and provides further support for evaluating climate change implications for water and development in Africa.

The CSS delivers on a key objective of the AfDB's climate risk management and adaptation strategy to mainstream climate screening and adaptation in its projects. It enables the AfDB to address climate change risks in key climate-sensitive sectors at an early stage in the project cycle. This is a far more cost-effective approach than redesigning at the project appraisal stage or retrofitting a project after implementation.

The CSS has four modules: climate screening to assess for vulnerability; adaptation review and evaluation procedures to identify adaptation measures for a project; country adaptation factsheets with climate projections and country indicators; and an information base giving access to information sources on adaptation. While the CSS is currently limited to the agriculture, infrastructure, water and energy sectors, the need to expand it to additional sectors is recognised.

The CSS climate-screening module is designed for application during the project concept development phase. It uses simple sector-specific scorecards, which can be completed by non-climate specialists. Climate-risk scores are aggregated and used to categorise projects as high (1), medium (2) and low (3) risk. This classification determines the follow-up activities in project planning, which range from a comprehensive assessment of climate risks (1), review of project components at risk (2), and no further review (3).

An example scorecard for a road construction project in Ethiopia[5] is provided below. In this case, the total score of 47 places the project in category 2, requiring a review of the project components most at risk; in this case, damage to road infrastructure.

Topic	Selected option	Score
1. Damage to road infrastructure	What kind of terrain do the project roads cross?	15
2. Impact of flooding	Are the project roads susceptible to flooding?	10
3. Critical infrastructure	Will the roads (after project completion) form part of the host country's critical infrastructure?	5
4. Impact of road management practices	Does the host government have the capacity and/or budget for effective road management?	7
5 Design lifetime of the road surface	What type of road surface is planned for the project?	10
Total score		**47**

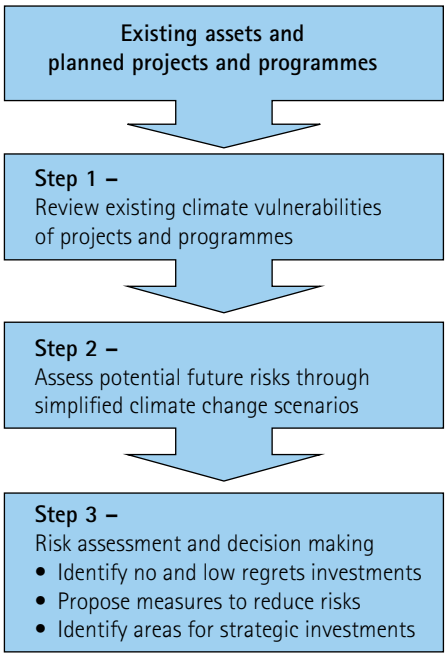
conducting a review of the climate vulnerability of water supply infrastructure across a country may merit the development of a bespoke approach. Generic tools are more suited to piecemeal assessments of planned projects as they arise. Such tools provide a consistent set of questions to address, and a format for recording the assessment.

6.3 A simple framework for screening existing and future climate risks

Screening involves using simplified climate change scenarios to determine whether projects or programmes are at risk from existing and future climate, and whether wide-ranging uncertainties related to climate change are problematic for decision making. Figure 6.1 illustrates this process, discussed in more detail later in this chapter.

The distinction between climate resilient and climate-risky projects can be informed by the screening exercise, but is also dependent on the risk preferences of the decision maker. This influences the level of risk the decision maker is willing to accept on the potential returns of the project. Projects that provide guaranteed returns for a low level of risk represent a more sustainable long-term investment than high-return, high-risk ventures. However, climate resilience is just one of a host of competing factors facing the decision maker, and this approach only screens for climate risks.

Many screening methodologies adopt a simple scoring system for risks that are based on the judgement of the planner. Scoring systems can be helpful for summarising screening outcomes but are inherently subjective and may give a false impression of accuracy.



Step 1 seeks to understand the climate sensitivities of the project or programme under consideration by reviewing existing studies and stakeholder engagement. This engagement with operators, managers, technical staff and users is a simple way to make use of institutional knowledge. Full screening of the many projects that are evidently not sensitive to the climate is not be required. Hence step 1 should be a swift process that does not hold up high priorities.

Step 2 uses simple climate change scenarios to make an assessment of the potential impacts that each scenario will have on the future performance of the project or programme under consideration. These scenarios could also encompass projected socio-demographic changes that may impact on the project or programme.

Step 3 assesses climate risks and seeks to reduce these where possible before the project or programme is passed on for detailed planning. If the project or programme is underway, parallel activities to reduce risk could be proposed. Non-climate sensitive projects will not require modification.

Figure 6.1 Framework for screening climate risks

6.4 Conducting the screening assessment

The screening framework is non-prescriptive and focuses on a questioning mode of approach, which can be addressed rapidly on the basis of expert judgement and stakeholder engagement. This builds an evidence base for decisions to be justified on whether projects are climate resilient, if more research is required, or if climate risks should be addressed.

Targeted screening tools that are more prescriptive could be developed for sectors or project typologies, but the approach outlined here covers the most important generic tasks for screening climate risks.

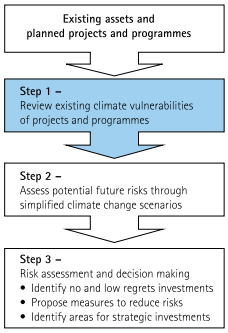
The aim of the screening exercise is to flag up current vulnerabilities and potential climate change-related risks that will require consideration when detailed planning or final decision making is undertaken. For example, a programme of hydro-meteorological monitoring for flood warning may be found to be relatively insensitive to climate change, whereas the development of a large-scale irrigation system may raise issues of performance with climate change that will require more detailed analysis and appraisal. Table 6.1 presents some examples of project areas where screening is applicable.

The boxes in each of the following sections provide key questions that should be answered, together with two examples illustrating some of the risks that may be identified.

Table 6.1 Examples of sector projects for which climate risk screening could enhance resilience

Sector	Examples of projects for screening
Water resources management	• Water management plans • Multi-purpose dams • Transboundary agreements • Water abstraction licensing arrangements
Agriculture	• Irrigation schemes • Smallholder and subsistence agriculture support programmes • Land-use management programmes and incentives
Water supply and sanitation	• Municipal water supply systems • Rural water supply programmes
Transport and infrastructure	• Major industrial developments • Road and other transport networks
Energy	• Hydropower dams • Energy infrastructure and transmission
Local government	• Development and urbanisation regulations
Healthcare	• Health infrastructure

Step 1 – Assessing current climate vulnerabilities



Existing systems may have recorded information on how past climatic events have impacted on their performance. For example, these may include drought events affecting the performance of a hydropower dam or the productivity of a farming community. Proposed programmes or projects will have to seek this kind of information from a similar system and similar climatic conditions. Climatic events that affect performance may take the form of discrete shocks, such as storms leading to flooding, high winds and storm surges, and droughts leading to lack of available water. Shocks may be associated with secondary effects such as water quality problems or salinisation. Longer-term stresses may take the form of declining water availability or sedimentation, leading to long-term shifts in the viability of systems.

This step will require inputs from stakeholders in the systems being screened (for example, dam operators, local irrigation managers) and may benefit from some input from climate experts. Stakeholders are able to offer experience from past climate impacts on performance at analogous sites, and may offer insights which are not formally recorded but are present as inherited or institutional knowledge. Climate experts may be able to offer the analytical expertise to associate performance with specific climate phenomena; this aids the quantification of impacts under future climate scenarios.

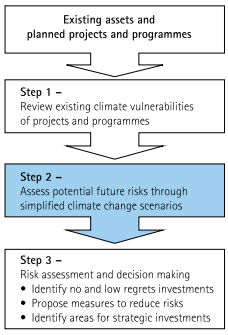
Climate experts are also likely to have access to valuable climate time series data, which can be used to build understanding of how sensitive the system is to the climate. Sensitivity is the degree to which a system is affected – either adversely or beneficially – by climate-related stimuli (for example, a change in crop yields in response to a change in the mean range or variability of temperature).

The key inputs to this step are the programme or project specification, which can be used as a benchmark for appraising the performance of similar systems under climate stress. Information on how climate stress or shock may have affected systems in the past is a crucial input for building the evidence to support assumptions about how such systems will perform in the future.

The main output of this stage is an understanding of the climate sensitivities of the programme or project under consideration, and which climate change scenarios can be overlaid to give an initial assessment of potential future impacts (see Box 6.2).

For each set of key questions in this section, simple scoring systems to structure responses should be developed for each specific context. For example, the sensitivity of a project to the climate may be regarded as low, medium or high, and agreed definitions of these categories would be helpful for comparing projects. Other key criteria, such as the urgency of a project to meet development goals, could also be categorised using an agreed set of criteria.

Step 2 – Assessing the impacts of future climate change

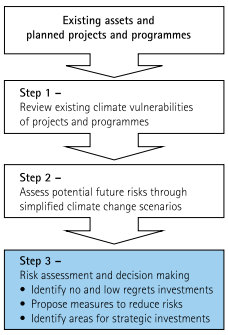


Assessing the impacts of future climate change is carried out by building on the understanding of the historical climate impacts explored in step 1. The climate change scenarios are applied to the qualitative relationships in step 1 to highlight issues that may arise for each climate scenario. This can be carried out in a qualitative manner, highlighting whether climate change exacerbates or ameliorates existing climate risks. Box 6.3 provides an example of simple climate scenarios, applied to the hypothetical example of an irrigation scheme in Cameroon.

The use of several climate change scenarios will provide a range of impacts, depending on the different climate sensitivities of the project. In the Cameroon example, rainfall projections are highly uncertain, hence impacts may be positive or negative. Projects should ideally not be impacted significantly by the full range of climate scenarios, and offer a satisfactory outcome in line with the principles of robust decision making.

Box 6.4 presents some of the key questions and hypothetical answers that will provide an understanding of the potential future impacts of climate change on the project being screened.

Step 3 – Assessment of risk and proposed risk reduction



This stage requires planners use the information produced in steps 1 and 2 to appraise the screened projects to determine the following:

1. Projects that can be 'fast-tracked' to detailed planning on the basis that they are insensitive to climate change impacts and are therefore climate resilient.
2. Proposals to reduce the residual risks in projects that have been identified as highly sensitive to climate change.

The Framework does not rule out carrying forward the planning of strategies that are impacted by the climate, but it does require that climate risks are effectively understood and, if possible, reduced so that the final decision on the financing of resulting programmes can be taken with a sufficient level of knowledge.

Box 6.2

Key questions to be resolved in screening for historical performance

Two hypothetical examples are provided to illustrate the screening of risks. Example 1 is for a large-scale irrigation development project and example 2 is for a community health programme.

Which climate related variables (temperature, rainfall, wind, storms, flooding, drought, seasonal timings) have had an impact on the performance of similar programmes or projects in the past, and what is the mechanism for the impact?

Example 1 – River flow is key to the performance of irrigation systems; the timing of flows is also important for planting schedules. Irregular river flow in nearby systems has led to reduced performance in the past. Storm rainfall also has the potential to damage irrigation structures through flooding.
Example 2 – Health programmes are affected by increases in waterborne diseases during wet years; storm rainfall causes flooding, which makes travelling to clinics difficult.

Is the project or programme located in an area that suffers from climate-related hazards or disasters?

Example 1 – The scheme is located within a river floodplain but is not at risk from coastal flooding.
Example 2 – The district is not in a major flood zone.

Does the impact of the climate cause a minor disruption, widespread disruption or catastrophic failure in the performance of the system, and what is the mechanism? It may be useful to develop a simple set of categories or scores to describe minor, moderate and major disruptions to qualify this response.

Example 1 – Low river flows cause below average yields in existing systems, in 1 in 4 years on average. A significant drought event results in complete crop failure once every 20 years of operation in similar systems in the catchment. A flood event on a nearby system damaged some of the intake structures and bunds, which required expensive repairs.
Example 2 – Clinics can be overwhelmed with cases following wet periods, resulting in staff shortages. Disruption to travel can result in life-threatening conditions remaining untreated.

Does this impact occur sufficiently frequently to cause an unacceptable reduction in performance?

Example 1 – Climate-related disruption occurs every few years and reduces income from the scheme; however, impacts do not result in irreversible losses. The significant drought event caused major problems and required government support.
Example 2 – Travel problems due to flooding occur almost every year during the wet season. The duration of travel problems varies considerably.

Does the project or programme offer improved climate resilience, relative to the existing situation?

Example 1 – The irrigation scheme offers increased resilience to climate variability relative to the rainfed agriculture that currently exists. However, the investment in the irrigation demands that farmers are significantly more productive in order to repay investment over the long term.
Example 2 – The healthcare programme will increase the resilience of the communities to climate change by increasing their overall adaptive capacity to cope with climate shocks and stresses.

Does the project or programme deliver immediate and high-priority benefits?

Example 1 – The project would offer benefits to the local economy and livelihoods, and may offer a route out of poverty for local communities.
Example 2 – The programme will deliver essential healthcare to communities and, as such, is a high-priority investment.

What is the confidence in this assessment?

Example 1 – The confidence in this assessment is high as it is based on an existing irrigation system in the same catchment, for which the operators have maintained good records of productivity and irrigation flow rates.
Example 2 – Confidence is medium as little information is recorded on disease case rates or transportation network problems, although local staff members are aware of the problems.

Box 6.3

Simple climate change scenarios for Cameroon, applied to the hypothetical example of a proposed irrigation scheme

Climate change scenarios were developed on the basis of United Nations Development Programme (UNDP) country profiles[6] (see Box 2.3 in Chapter 2). Climate risks are evaluated for each scenario based on consultation with sector specialists, irrigation operators and a review of detailed impact assessments for similar projects.

Cameroon climate change scenarios	Rainfall decrease of 20%	No change in rainfall	Rainfall increase of 20%
Temperature increase of 1.5°C	**A – Warm / dry** River flows reduced, irrigation demands likely to increase	**C – Warm** Potential for reduced river flows, irrigation demands likely to increase	**E – Warm / wet** Potential for increased water and yields, increased pests and disease
Temperature increase of 4.7°C	**B – Hot / dry** River flows reduced, irrigation demands likely to increase. Change in crop suitability?	**D – Hot** Potential for reduced river flows, irrigation demands likely to increase. Change in crop suitability?	**F – Hot / wet** Potential for increased water and yields, increased pests and disease. Change in crop suitability?

Box 6.4

Key questions to be resolved in screening for climate change impact

What is the planning horizon for the programme or project and its lifetime? Does the project represent a significant irreversible investment or is implementation staged over several discrete phases? The examples here are continuations of the two hypothetical examples introduced in Box 6.2.

Example 1 – The scheme will require significant investment in infrastructure, which cannot be used elsewhere. Potential for phasing in the scheme exists but short-term returns from the full scheme would be foregone.
Example 2 –Investment is largely in personnel, premises and equipment and can be flexibly upscaled or downscaled depending on demand, provided management systems can adapt to changing demands.

What are the projected changes in the climate for the programme or project area for each of the scenarios developed, over the planning timeframe?

Examples 1 and 2 – Temperatures are projected to increase by 1–3°C over the lifetime of the project. Rainfall projections show potential increases or decreases of -10% to +10%. Storm rainfall is projected to increase in intensity by 20%.

What are the implications of these climate changes for the performance of the programme or project (changes in storm frequency, temperature, rainfall, sea-level rise)?

Example 1 – Reduction in rainfall could reduce water available for irrigation, while increasing evapotranspiration from crops could raise water demands from the scheme and elsewhere in the catchment. Increases in rainfall and river flow could improve the reliability of supplies. More intense rainfall could increase the frequency of flood damage to infrastructure. Conversely, if a reduction in rainfall makes alternative rainfed agriculture impossible, irrigation may offer benefits even with reduced performance.
Example 2 – Changes in rainfall could change the prevalence of certain diseases, although it is difficult to predict with any confidence. More intense storms could worsen the travel situation.

What future socio-economic or other factors will determine the type and severity of the impacts and outcomes?

Example 1 – Increasing demand for water throughout the basin for high-value industry and municipal supply could reduce the availability of irrigation water further, or increase its cost.
Example 2 – Progress in healthcare and provision of tarred roads could dramatically improve disease rates, which may help to offset any climate change-related impacts.

Projects that show clear risks to climate change should be modified to increase climate resilience. This step is important in ensuring that any planning decisions consider the long-term sustainability of the development. However, it is acknowledged that such decisions are being taken to address urgent problems in the context of the wide adaptation deficit, hence reducing vulnerabilities in the short to medium term may be assigned a high priority, notwithstanding longer-term climate change risks under some scenarios.

The principles of robust decision making should be applied when assessing risks. This essentially involves examining risks across a number of possible scenarios and attempting to minimise risks (and maximise benefits) across all scenarios. Chapter 8 provides further information on robust decision making.

The approaches for increasing resilience lie in four principles:

1. Reduce uncertainties

- Can the uncertainties of climate change impacts **be reduced**, or at least **better understood**? High-cost projects and those which show substantial climate risk may benefit from detailed studies modelling the impacts of climate change. For example, the design hydrology for a large dam may require re-modelling using climate change scenarios to reduce the uncertainties first flagged up using the rapid screening. The additional costs of such studies are likely to pay for themselves many times over in long-term savings from avoiding potential climate impacts.

2. Do things differently

- Can the **project design be altered** to reduce risks? What is the additional cost? Is this worth it? Examples might include over-specification of flood defences to manage uncertainty. In some cases, over-specification may be carried out for limited additional cost, such as increasing capacity in an urban drainage system to cope with future uncertainty in rainfall.
- Can the project be **implemented in stages**, to test the impact of the climate and success of the project before committing substantial resources? Phased approaches to implementation give more opportunity to trial systems, and building flexibility into designs allows later stages to be adapted as conditions change in the future. This is especially true in large-scale and long-term infrastructure projects.

3. Do different things

- Are there **alternative ways** of achieving the project goals with lower climate risks? This might take the form of changing financial incentives, insurance, innovation in management practice, or the introduction of innovative technology to achieve more with fewer resources. Box 6.5 provides an example of using financial incentives to manage runoff rather than hard engineering solutions.

Box 6.5

Climate resilience through payments for ecosystem services: green water credits in Kenya's Tana River

Green water credits are a financial mechanism that offers incentives for farmers in the upper reaches of Kenya's Tana River to improve land and water management. Various soil and water conservation measures in the headwaters of the Tana River have been assessed to determine their potential to sustainably increase local productivity and water availability and, at the same time, to reduce siltation of downstream reservoirs. These reservoirs are especially important because Nairobi's water supply, most of Kenya's electricity supply, and several large irrigation schemes depend on them. A number of powerful economic actors, such as water and power companies and export producers, have come forward to support this ecosystem approach as an alternative to a conventional 'end-of-pipe' solution, which in this case would be to build a new reservoir once an old one has silted up.

This project is a good example of the application of an alternative approach (financial incentivisation) to achieve key goals (protection of water resources for downstream users) without adopting potentially climate-risky investments (a new dam to maintain supply). The option represents a dual benefit situation, as the farming community share the benefits of preserving the supply with other users. Sound land management delivers benefits regardless of the climate change scenario and is therefore a no-regret strategy. Typically, poor land management arises from poverty, hence financial incentives provide a powerful tool to implement good practice.

4. Bear the climate change risk

- The remaining strategy is to simply understand and plan to minimise the climate change risks, rather than fundamentally altering the proposal. This may be an acceptable strategy if it can be demonstrated that the immediate benefits are sufficiently important to render climate change of secondary importance. This should be a last resort but may be acceptable in cases where no modification is possible and short-term returns are substantial or aligned with high-level government priorities.

6.5 Sources of information for climate screening

The screening process will require the collation of climate and project information for each application of the process. Taking the time to collate information will lead to a more reliable output than relying on information from meetings and workshops. Table 6.2 summarises the information needs and sources.

Table 6.2 Summary of the sources of information for climate risk screening

Screening step	Information needed	Information source
1	**Available project plan or design information.** Greater detail will allow a more thorough assessment of existing vulnerabilities and future risks. This might include site locations, designs, operational procedures and management processes.	Project planning teams, and operational staff for analogous projects.
2	**Historical climate and system performance information.** To assess the impact of future climate change, the historic sensitivity of the programme or project to the climate should be understood. Examining how similar systems have performed during climate stresses or shocks in the past can be used to assess the sensitivities of existing systems. This might include information on climate extremes and the inter-annual variability of key climate variables. Information on the climate-related sensitivities of the project should be collated based on past experience of similar projects.	Climate information can be sourced from meteorological institutes, universities or via web-based portals such as the Intergovernmental Panel on Climate Change's (IPCC) data distribution centre. Information on the climate variables and extremes that cause project vulnerability can be obtained from operational staff, sector specialists or a literature review.
3	**Climate change scenarios.** Climate change can represent a wide range of potential futures (in terms of temperature, precipitation and sea-level rise). Consistent climate change scenarios are required to capture this range of futures while maintaining a feasible workload. These should represent lower, central[i] and upper estimates of future climate situations based on global or regional climate models, ideally covering the low, medium and high emissions scenarios. A common set of climate change scenarios should be applied across the range of programmes or projects being screened, hence this will only require a one-off effort to produce. Exploration of socio-economic scenarios may be valuable in some circumstances, but these may already be considered in standard planning procedures. For major infrastructure projects, designs should be tested against historical climate conditions and against a range of future climate change scenarios.	Chapter 2 provides general guidance on the development of climate scenarios for climate impact assessment. Where no specific country work has been done, the IPCC Fourth Assessment[7] and SREX[8] reports provide high-level information on climate trends and changing extremes.

6.6 Outcomes of screening assessment

A consistent approach to recording the results of screening is essential. However, this guidance is generic across sectors and countries, hence it is not appropriate to provide pro-formas or other metrics without piloting. A pro-forma could be produced relatively easily, based on the guidance in this document and steered by sector- and country-specific requirements.

The outcomes of the screening should:

- provide an awareness of climate change and its potential impacts among planning teams;
- provide an understanding of the climate risks associated with proposed projects;
- propose opportunities for risk-reduction measures that can be fed into project proposals, either as adjustments to the design of the project, further studies, or additional investments alongside the main project to reduce risks. An example of such an investment could be the development of a decision-support system as an additional investment to be used to assist in the implementation of a programme of basin-wide water resources development. Box 6.6 provides examples of climate risk-reduction measures for the hypothetical examples of an irrigation scheme and healthcare project.

The UNDP[9] has produced information on the tools and guidance available for climate screening, which serves as a good introduction to the work being carried out among the development community. It identifies the diversity of screening approaches that have been developed independently, as well as the different levels at which they apply (project, portfolio, sector, programme, national). It notes that this diversity offers benefits but also makes the establishment of general concepts and comparison difficult.

6.7 Final remarks

Opportunities to enhance climate resilience should start with consideration of the existing projects, programmes and systems that contribute to water security, followed by those in the pipeline or in the planning phase. The use of simple screening tools, existing impacts or vulnerability assessments, stakeholder engagement and expert elicitation can all offer a rapid insight into climate risks without the need to commission time-consuming, detailed studies.

i While it may be attractive to focus on the 'most likely' climate change scenario, it may not be possible in many situations. It is also problematic in locations where precipitation may increase or decrease depending on the choice of global climate model used to predict the scenario.

Box 6.6

Hypothetical examples of risk-reduction measures following screening for climate change risks

Example 1 – irrigation scheme. The project could offer more reliable agricultural production in the short term. Screening indicates that climate change may have an impact on the performance of the project, but uncertainty is high relative to the significant investment required. The project is a key strategic goal but, given the long lead-in for planning and design, further studies on climate change may identify opportunities to improve the long-term performance of the project. Therefore a detailed modelling study of the basin is recommended to assess future water availability and options for resilience.

Example 2 – community healthcare. As well as delivering health benefits, the resilience of communities to climate stresses and shocks, and their ability to adapt, is likely to be increase with improved health. The healthcare programme does not represent high sunk costs as staff and premises can be managed flexibly. Although climate risks are uncertain, they are generally indirect. Therefore this programme represents a high priority and should be fast-tracked. The following optional measures to reduce climate risk may be worth considering:

- Systems for issuing healthcare advice over the telephone during periods where travel is impeded by flooding or roads are impassable.
- Flexible resourcing and medical stock management to allow for climate-driven disease outbreaks.

Any development projects and programmes that are likely to be sensitive to water and climate variability, directly or indirectly, would benefit from risk screening. Rapid assessment of current and future climate risks can provide a qualitative understanding of climate risks and help to categorise projects, programmes and systems according to their sensitivity to future climate change. Once identified, opportunities and measures to manage or reduce negative impacts for those most at risk can be identified.

The expected outputs from the screening exercise should include:

- An inventory of existing projects, programmes and systems that may be impacted negatively by future climate variability and change.
- Categorisation of existing projects, programmes and systems at risk, according to their degree of climate sensitivity.
- Identified options and opportunities to reduce risks from climate change for existing projects, programmes and systems.
- A portfolio of investment opportunities that will directly influence and benefit ongoing activities.

The outcomes of this step will not only contribute to reducing the climate risk of existing projects, programmes and systems, but will also help to strengthen the capacity of planners and others through learning by doing in the integration of climate risks and climate change in decision making.

Chapter 6 references

1 World Bank. 2009. *Water and Climate Change: Understanding the Risks and Making Climate Smart Investment Decisions.* World Bank, Washington, D.C., USA.

2 Asian Development Bank. 2009. Disaster and climate risk screening tool. Available at: www.adb.org/Documents/RRPs/NEP/38423/38423-02-nep-oth-01.pdf

3 International Institute for Sustainable Development. Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL). Available at: www.iisd.org/cristaltool/

4 More details can be found in the summary booklet produced by the AfDB. Available at: www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/CSS%20Basics-En_def.pdf

5 Dorsouma, A.H. 2012. *Climate Safeguards System: Mainstreaming Climate Change Adaptation into Bank Operations.* SESA workshop presentation, 21–22 March 2012. Available at: www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/AfDB%20presentation_Climate%20safeguards%20system_Dorsouma.ppt

6 UNDP country profiles are available at: http://country-profiles.geog.ox.ac.uk/

7 Intergovernmental Panel on Climate Change. 2007. *IPCC Fourth Assessment Report: Climate Change 2007 (AR4).* Available at: www.ipcc.ch/publications_and_data/publications_and_data.shtml

8 Intergovernmental Panel on Climate Change. 2012. *Special Report Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX).* Available at: http://ipcc-wg2.gov/SREX/

9 Olhoff, A. and Schaer, C. 2010. *Screening Tools and Guidelines to Support the Mainstreaming of Climate Change Adaptation into Development Assistance – A Stocktaking Report.* UNDP, New York, USA.

7 | IDENTIFYING NEW AND INNOVATIVE INVESTMENT OPPORTUNITIES

Key messages

- Identifying new and innovative climate resilient development opportunities will benefit from working in partnership – with government, development agencies, NGOs, private sector and others – to increase the flow of bankable projects.
- Working across sectors and levels can result in dialogues, ideas and innovations that would otherwise remain hidden in independent silos of thinking.
- Innovation may involve 'doing things differently' or 'doing different things' to develop more effective, efficient and equitable means of achieving higher-order goals.
- Grounding the identification of new opportunities in existing development priorities, such as national- and sector-level strategies and poverty reduction strategy papers (PRSPs), means they are more likely to be relevant to high-level decision makers and less contentious.
- Revisiting projects and programmes identified previously in existing plans and strategies (but as yet unfunded) can avoid duplicate effort and help to fast-track these investments.

This chapter supports Phase 2 of the Framework (Identify and appraise options) and provides further information on the potential for generating new 'no/low regrets' investment opportunities through innovation and collaboration across sectors. Opportunities exist to revitalise and fast-track ideas and options already identified in existing plans and strategies, such as integrated water resources management (IWRM) plans and National Adaptation Programmes of Action (NAPAs). This chapter also considers the types of activities that might be proposed, with examples drawn from a range of water-related services. .

Recommended sources of further information:

Since 2006, the World Economic Forum's Water Initiative has pursued a Water Partnership Projects work stream in India, Southern Africa and, more recently, in Jordan. This work has created partnerships between governments, development agencies, NGOs and industry partners, among others. These partnerships have been used to increase the flow of bankable water-related projects in the region, and a significant amount of private sector finance has been harnessed for the purpose of new water project investments.

World Economic Forum. 2010. *Innovative Water Partnerships: Experiences, Lessons Learned and Proposed Way Forward.* Available at: http://www.weforum.org/reports/innovative-water-partnerships-experiences-lessons-learned-and-proposed-way-forward

7.1 Overview

In addition to identifying opportunities for building climate resilience into ongoing activities, Phase 2 of the Framework also recommends identifying new and innovative climate resilient development opportunities, across all priority sectors and at different levels. In this context, innovation may be characterised by the reappraisal of the status quo and the continual search for more effective, efficient and equitable ways of delivering growth and development, with built-in climate resilience.

Dialogues across sectors and/or levels – engaging a wide range of stakeholders' interests – can stimulate ideas that would otherwise remain hidden in independent silos of thinking. Consideration should be given to 'doing things differently' and 'doing different things' as ways of stimulating innovation. Doing things differently refers to the adjustment of existing practices and delivery mechanisms to enhance benefits and outcomes. Doing different things refers to a wider reappraisal of the way in which development and growth benefits are achieved, and seeks to identify new ways of achieving similar, or better, benefits and outcomes.

To do things differently, consider the following questions:

- How can systems be managed and decisions be made more effectively? *For example, perhaps by adjusting best practice design guidance or decision making practices.*
- How can strategies and plans be converted into measurable investments? *For example, perhaps by fast-tracking areas for strategic investments into implementation as pilot projects.*

To do different things, consider the following questions:

- What are the gaps and barriers to achieving high-level objectives? *For example, perhaps there is a need to build partnerships across sectors and levels to achieve mutual aims.*
- What opportunities and channels exist for accessing alternative sources of finance? *For example, perhaps there is a need to build capacity for accessing alternative funding and blending financing.*

A number of starting points are recommended to stimulate the process and to underpin innovation:

- **Building on partnerships across sectors and levels.** Partnerships across sectors yield benefits through coordinated planning and management of natural resources and climate risks. In addition, scaling up local lessons learnt to the level of national policy and planning can usefully upscale pilot schemes and ensure that different levels of planning are in dialogue.
- **Enhancing the enabling environment for private sector investment.** Getting the environment right for private sector investment can bolster investment in climate-resilience and green-growth initiatives.
- **Revisiting existing plans and strategies.** IWRM plans, NAPAs and disaster risk reduction plans may have already been developed, representing a substantial investment of time and effort. Referring to these plans as a source of investment opportunities avoids duplicate efforts. Likewise, ongoing initiatives to stimulate the green economy, enhance low-carbon growth, balance food/water/energy requirements and promote ecosystems approaches are also likely to be relevant.

The National Adaptation Plan (NAP) process will align closely with the aims of the Framework and offers opportunities for integration of investment opportunities with the NAP planning and implementation process.

7.2 Building on partnerships across sectors and levels for innovation

Climate resilience is a recent and cross-cutting issue, and will call for systems and administrative structures that promote integration both vertically and horizontally (see Figure 7.1). 'Vertical integration' draws together roles and responsibilities across central, sectoral and local levels, as well as having international, regional and transboundary dimensions. 'Horizontal integration' aims at cross-sectoral coordination and mediation that will improve resource efficiency and enhance sustainability.

Bridging the divide between the *development* and *climate* communities is essential. Efforts should be made to build on existing stakeholder platforms that are already widely accepted and influential. Many of the principles and practices underpinning IWRM are equally valid for integrating and mainstreaming climate resilience in development planning. A large number of African countries have IWRM strategies in place or under preparation. Cross-sectoral coordination mechanisms and work practices have been established and are becoming the norm in planning and strategy formulation.

Integrating climate resilience into development planning processes requires action across a range of planning levels and sectors. Central governments must direct and drive this process, but their actions have to be implemented by a hierarchy of actors and agencies, each with their own constraints and agendas. Many governments have delegated responsibilities for water issues to lower levels of administration. This approach requires extensive consultation and negotiation among parties to produce a consensus.

Central governments and supportive donor agencies must take into account the limited capacity of lower-level actors. Many of the planned activities or steps will have to be implemented by parties not under the direct control of central government

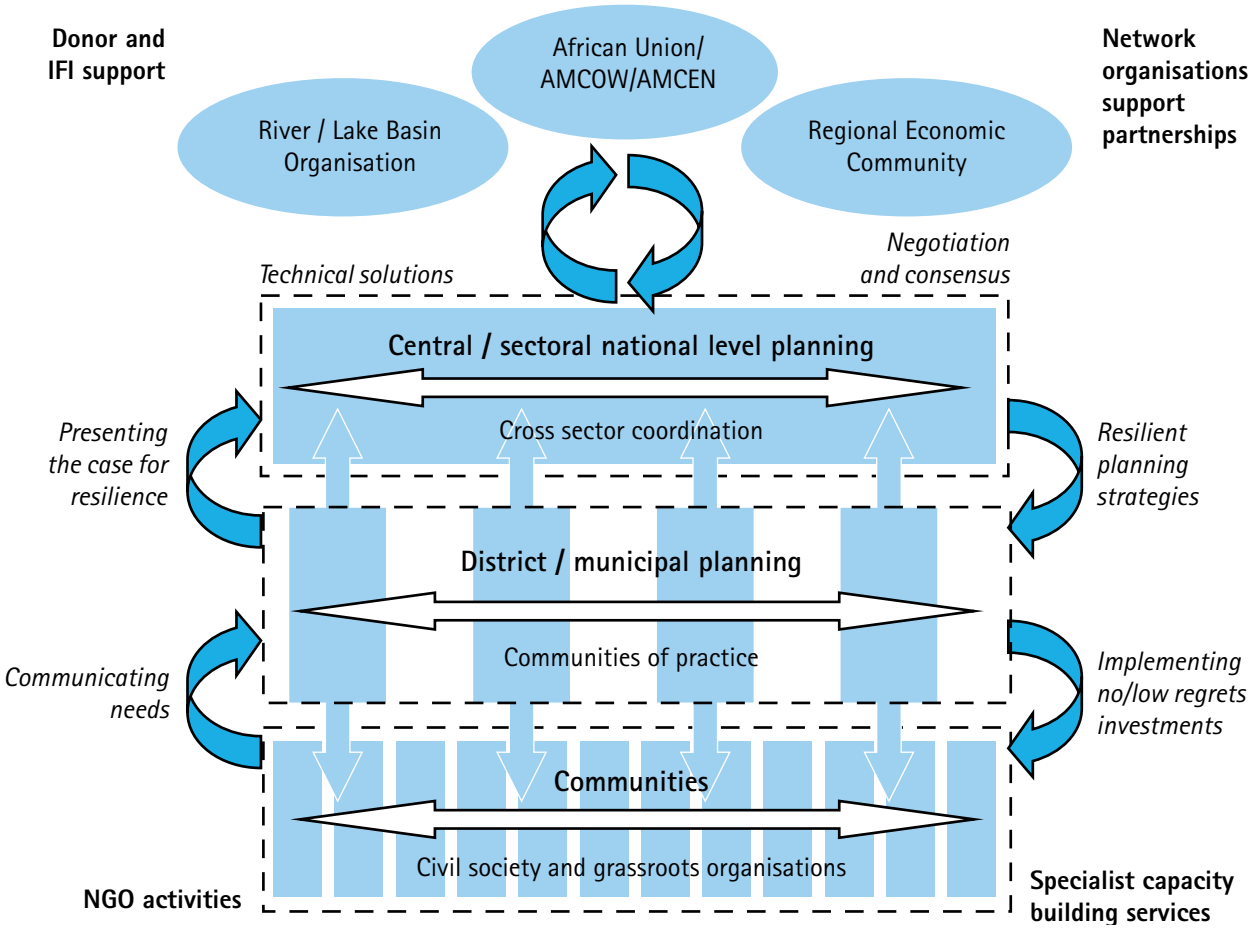


Figure 7.1 Key relationships for building climate resilience

(e.g. farmers, water users, businesses and civil society groups). Hence, the toolkit of measures to carry out the climate resilience agenda needs to include information, stakeholder consultation, and possibly fiscal and financial inducements.

Conversely, lessons being learnt at the local level under pilot schemes, often implemented by NGOs, should be filtered up to higher levels of planning to influence policy direction and budgeting.

7.3 Enhancing the enabling environment for private sector investment

Engaging the private sector for climate resilience offers the potential for substantial investment. This can be achieved by making investment in climate resilience more attractive to the private sector, which requires some form of incentive or risk sharing with public institutions.

The structure of such financial arrangements is highly dependent on the nature of the investments being considered and their marketability. Such arrangements may encompass government-backed contracts for service delivery through guaranteed or performance-related returns. Specialist organisations, such as the Public–Private Infrastructure Advisory Facility (PPIAF), develop models for private sector investment in development, including climate resilient development and green energy.

Ensuring that countries have the capacity to attract foreign investment for green growth requires a suite of measures, many of which are 'no regrets' enhancements to legal and regulatory frameworks that support private investment. Box 7.1 provides some examples of activities being undertaken by the Rwandan Government to attract foreign investment in green growth.

The Clean Development Mechanism (CDM) is an opportunity for African countries to access funding for sustainable development. However, getting the environment right to attract private investors in the CDM is a prerequisite to getting related projects off the ground. Box 7.2 presents some of the key enabling drivers arising from a review of CDM in sub-Saharan Africa by the UNEP Finance Initiative (UNEP-FI).

Box 7.1

Rwanda's Green Growth and Climate Resilience Strategy[1] promotes private sector investment

The Government of Rwanda has adopted a Green Growth and Climate Resilience Strategy. This includes a programme for promoting green industry and private sector development, which proposes ways of improving the energy efficiency of industry – and ways of promoting green industries – to bring win–win benefits of cost savings and mitigation. One plan is to establish a green Special Economic Zone (SEZ) in Kigali, as a flagship for foreign investment in green technologies. In addition, a Climate Innovation Centre is proposed, which would be hosted within the SEZ. This centre would provide coordination and advisory services to accelerate the deployment of low carbon and adaptive technologies by companies and industries.

The strategy also proposes additional actions for supporting green growth through private sector involvement, including:

- clearer tax and import duty exemption rules for all energy-efficient technology components;
- a government-supported microfinance scheme (i.e. loan guarantees or grant-per-unit-financed) to help households purchase renewable energy;
- more flexible pricing arrangements for biogas digesters;
- a government-supported low-interest credit line or loan guarantees for renewable energy businesses and installations;
- an increase in the price paid for renewable energy by Rwanda's Energy, Water and Sanitation Authority (EWSA) to approximately US$0.14 per kilowatt hour;
- an engineering capacity building programme;
- government support for recycling and reuse of waste products with economic value, such as plastics and organic waste for fertilizer and fuel, with an eventual transition to mandatory waste management for households and businesses.

Box 7.2

Examples of success drivers for Clean Development Mechanism (CDM) investment in Tanzania

The UNEP Finance Initiative (UNEP-FI) has recently produced a review of CDM uptake in sub-Saharan Africa[2], commenting on the key drivers of and barriers to success of CDM project development. The CDM, as defined in the Kyoto Protocol, aims to simultaneously promote greenhouse gas reduction activities in developing countries, support socio-economic development locally and foster technology transfer. However, sub-Saharan Africa has lagged behind other regions in developing CDM projects.

The UNEP-FI report presents case studies of successful sub-Saharan African CDM projects and identifies the drivers of success. For the Tanzanian case study these included the following drivers, arising from the overall legislative, institutional and/or regulatory frameworks for private sector investment:

- A dedicated government effort to establish enabling conditions for private sector investment and entrepreneurship; the Business Environment Strengthening for Tanzania (BEST) programme reduces the administrative burden on businesses and enhances public service provision to the private sector.
- A powerful government agency, the Tanzanian Investment Centre (TIC), is specifically dedicated to attracting increased flows of foreign direct investment into the country through the provision of investor guarantees covering diverse risks, among other measures.
- A good track record and reputation with regards to the enforcement of contracts.
- Early development of climate change institutions and targeted capacity building, resulting in substantial support from multilateral and bilateral donors and programmes such as the UNEP Risoe Centre's CD4CDM (Capacity Development for the CDM) and a regional CDM capacity building effort led by UNDP.
- The existence of a dynamic Designated National Authority actively promoting the CDM among private sector players and with permanent connections to other relevant entities, such as the TIC.
- An attractive set of regulatory incentives specifically targeted at renewable energy projects and the creation of a robust institutional framework for small-scale projects.

7.4 Revisiting existing plans and strategies to catalyse these for investment planning

Plans and strategies for natural resources management are continually being developed throughout Africa by governments, international financial institutions (IFIs), regional bodies and NGOs. Some of these plans are implemented while others are shelved. Revitalising or fast-tracking no/low regrets opportunities in these plans can avoid duplication of efforts. Box 7.3 provides some illustrative examples of potential no/low regrets investment opportunities from Kenya's IWRM plan.

When reviewing existing strategies and plans for no/low regrets investment opportunities, the following cross-cutting principles offer guidance on the types of investments that are likely to be no/low regrets:

- Resilience can be enhanced through **sound water and land management practices**. These increase the sustainability of resource management and increase the capacity to adapt to and deal with climatic variability and change.
- Increasing the **adaptive capacity** of institutions, businesses, livelihoods and civil society at all levels is likely to be a no/low regrets investment. One of the primary drivers of adaptive capacity at the community level is the eradication of poverty, such that strategic goals for poverty reduction are closely linked to climate change adaptation.
- **Collecting data, conducting research and presenting evidence** for decision making is a no regrets strategy that contributes to increased confidence among decision makers. The use of simplified climate change scenarios for dissemination and awareness-raising is an example of filtering highly technical information through to decision makers.
- **Innovation and appropriate technology** can improve the efficiency of water management systems, enhancing 'productivity per drop'. But this requires both new ways of thinking and progressive policies to incentivise change.
- **Flexible management of transboundary resources** at the basin level rather than national level will be essential as climate change and development put pressure on resources.
- **'Soft' or 'natural' infrastructure**, such as ecosystems services, sustainable land management, policy, legislation and institutional reform, are often more resilient to climate impacts than 'hard' engineered infrastructure solutions, which may be at risk from climate change in the long term. This does not preclude investments in hard infrastructure to close Africa's infrastructure gap, but it means that selecting the type of infrastructure will require consideration of climate risks.
- **Managing existing variability** in climate is a priority action, as this offers benefits in the short term and may also help in addressing longer-term changes in extremes.
- **Disaster risk management** often offers very favourable cost–benefit ratios and, with climate extremes projected to become more severe, may offer long-term returns.

Box 7.3

Examples of no/low regrets investment opportunities in Kenya's IWRM plan[3]

IWRM plans contain opportunities for no/low regrets investments. Since these plans are often approved at high levels of government, the case for investment is already strong. The Kenyan IWRM plan contains the following strategies for climate variability and change, floods and droughts:

- formulate policies on and strategies for flood and drought management;
- develop early warning systems;
- strengthen the institutional framework for management of floods and drought (human resources, logistics, communications, etc.);
- develop mitigation and post-disaster preparedness mechanisms;
- develop mechanisms for adaptation to climate change, based on local knowledge and experiences from other regions.

7.5 Examples of climate resilient development opportunities

Climate resilient development can encompass investments in infrastructure, institutions and information[4], as described in the bullet points below. Often all are required together to deliver comprehensive solutions. Illustrative examples of potential options are provided in Table 7.1.

- Infrastructure can be developed to mitigate variability in supply, to prevent pollution, to manage flooding or to increase access to supplies. Infrastructure may range from national scale discrete water storage and distribution systems to community scale 'appropriate technology' schemes, such as borehole drilling or rainwater harvesting systems. The large investments frequently required in infrastructure make the level of potential regret particularly important, given the uncertainty around future climate change. However, some types of infrastructure, such as waste management and efficiency gains, are less likely to be impacted by climate change.
- A wide range of institutions, or organisational systems, can be modified to increase the efficiency and equitability of water use, disposal and risk mitigation. This can encompass legal frameworks, institutional roles and capacities. Better management of water within and across sectors offers increased resilience to existing climate variability and improves the capacity to adapt to future climate change.

The IWRM approach to managing water has been widely disseminated and, when put into practice, facilitates the establishment of institutional arrangements required to improve water security. In addition, financial tools can be used to incentivise best practice and to mitigate risk. For example, disaster insurance may provide resilience to extreme events in some circumstances.

- Information is a key tool in building climate resilience, through data collection, research, dissemination and education. Data collection forms the basis for robust and evidence-based decision making. Therefore, investment in data collection is an investment in the confidence that comes with informed decisions, and can also highlight emerging problems. A reduction in hydrometric data collection in recent decades across Africa should be reversed; the establishment of strong and independent institutions for the collection and dissemination of data is required. For example the provision of hydro-meteorological services can yield high returns in offsetting negative climate impacts (see Box 7.4) Information should flow in both directions: local government should be feeding information upwards to present the case for local investment, while central government must pass down centrally-collated information and best practices.

7.6 Final remarks

The process of identifying new and innovative investment opportunities does not require starting from scratch. Earlier steps in the application of the Framework will have mapped stakeholder interests and influences, and will have identified existing plans, programmes and initiatives to build on.

Much can be gained by revisiting existing plans and strategies – IWRM plans, NAPAs and disaster risk reduction plans – to sift out ideas and opportunities that can improve water security and climate resilience, even though they may not have attracted high priority for funding in the past.

Initiatives supporting the greening of economies, promoting low-carbon growth or addressing difficult food/water/energy trade-offs are also likely to stimulate new and innovative ideas. They are likely to be closely allied to water security and climate resilience, while supporting higher-order goals for poverty alleviation, disaster risk reduction, sustainable development, job creation and economic growth.

New opportunities for water security and climate resilience will benefit from creative partnerships that ensure innovation and ideas move beyond individual silos of thinking. As far as possible, the focus should remain on using established platforms and partnerships – broadening these where necessary to strengthen innovation and implementation.

Table 7.1 Water-related interventions and potential climate resilient development opportunities

Water-related intervention	Potential climate resilient development opportunities
Water resources and river basin development and management	• Observational networks • Hydrological data collection, analysis and modelling • Planning studies (including scenario analysis) • Regulation and operational procedures
Inland flood risk management and coastal protection	• Improved planning and regulation • Land management, zoning and regulation • Natural flood storage and restoration of wetlands • Building codes and flood-proofing • Sustainable urban drainage systems • Flood forecasting and emergency response • Public information and awareness
Hydropower and multipurpose storage	• Basin agreements and protocols • Development of new operating protocols for water storage and release • Revision of the regulatory regimes • Enhanced spillway design
Industry, mining, processing and tourism	• Regulation and enforcement • Water efficiency measures • Water reuse • Wastewater management
Household water supply and sanitation	• Tariff reform • Metering and leakage reduction • Water efficiency measures • Use of more marginal water sources • Effective and energy-efficient treatment • Greater recycling and reuse of wastewater • More storage within distribution systems to buffer against irregular flows
Agriculture and irrigation	• Land-use optimisation and management • Changes to existing farming practices • Appropriate irrigation technologies • Recycling wastewater • Recourse to non-traditional water sources
Water quality, habitats and ecosystem services	• Legislation and regulation • Ecosystems management and approaches • Habitat protection • Water quality management • Source control – treatment of industrial effluent and reduction of non-point source pollution • Wastewater treatment and reuse

Box 7.4

Benefits of hydrometeorological services in the Eastern European and Central Asian region[5]

Improved weather- and flood-forecasting is crucial to flood risk management, especially in mitigating the impact of floods. Neglecting weather forecasting and hydrometeorological services can have heavy costs, while investment in such services is highly cost-effective.

It has been stated that the accumulated problems are so numerous that, without massive modernization, networks in some Eastern European and Central Asian countries are on their way to becoming completely dysfunctional. No longer able to count on their own weather services, these countries would be forced to depend on low-resolution forecasts prepared by others, which could miss significant, local, rapid-onset hazards, including floods, frosts and severe storms.

The perils of a weakening forecast capacity have become evident in Russia's system, where the share of hazardous weather phenomena that were not detected and forecast increased from 6% at the beginning of the 1990s to 23% just 10 years later.

Recent research underscores the value of investment in hydrometeorological services. A study in China concluded that expenditures on the meteorological service had a cost–benefit ratio of between 1 to 35 and 1 to 40.[6]

An estimate in Mozambique suggested a cost–benefit ratio of 1 to 70 for investment in the meteorological service, which needed to be rebuilt after that country's civil war. Mozambique experienced directly the consequences of being uninformed and unprepared: when floods swept the country in 2000, it cost Mozambique nearly half its GDP.

Partnerships bring new ideas, better coordination of planning and management, and new implementation approaches. For example, enhancing the enabling environment for private sector investment and involvement may not only bolster investment but also bring enhanced capacity and skills for improved water security.

The expected outputs from identifying new and innovative investment opportunities should include:

- Strengthened partnerships for identification, financing and implementation of no/low regrets investment opportunities; and
- A portfolio of new and innovative no/low regrets investment opportunities for improving water security.

The screening of ongoing development activities (the previous step in the Framework process) and the identification of new and innovative opportunities for climate resilience will combine to result in a broad range of ideas and proposals for no/low regret investments. The next steps in the Framework process – sifting these ideas and options down to a balanced portfolio of priority investments that are demonstrably no/low regrets, justified economically and aligned with wider development objectives – will present a strong case for attracting funding from domestic, private and external financing sources, including specialist climate funds.

Chapter 7 references

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6 Guocai, Z. and H. Wang. 2003. Evaluating the Benefits of Meteorological Services in China. *WMO Bulletin* 52(4): 383–387. cited in World Bank. 2009. *Op cit*.

8 | ENSURING INVESTMENT OPTIONS ARE ROBUST AGAINST UNCERTAINTY IN CLIMATE CHANGE

Key messages

- Dealing with climate variability has long been a staple task of planners in sectors that are influenced by climate variability, such as water managers. But climate change means that historical behaviour cannot be used to predict future behaviour.
- Risk-based decision making is the systematic consideration of probabilities, consequences and values associated with different decision alternatives.
- Risk preference is the level of risk that a decision maker is prepared to accept with regard to the potential negative impact that climate will have on a system. Risk preferences determine the additional investment required to improve system performance or hedge investment to achieve satisfactory performance under a wide range of future scenarios.
- Robust decision making assesses the risks of different strategies by considering their sensitivities under a wide range of future scenarios. This approach helps to identify those choices that are resilient under these scenarios, and hence are 'no/low regrets'.

This chapter supports Phase 2 of the Framework in taking a practical approach to the prioritisation of identified investment opportunities, with a focus on the identification of 'no/low regrets' options using the principles of robust decision making. This approach is flexible enough to accommodate the broad range of planning levels and amounts of investment that the Framework targets, and avoids being prescriptive. Robust decision making involves testing the performance of investment options against a range of future climate change scenarios before defining an acceptable level of risk for the investment.

Recommended sources of further information:

There is a growing literature base associated with decision making under uncertainty, including:

Dessai, S., Hulme, M., Lempert, R. and Pielke, Jr. R. 2009. Climate Prediction: A Limit to Adaptation? In: *Adapting to Climate Change: Thresholds, Values, Governance*. [Adger, W.N., Lorenzoni, I. and O'Brien, K. (eds)]. Cambridge University Press, Cambridge, UK. Available at: http://sciencepolicy.colorado.edu/admin/publication_files/resource-2626-2009.01.pdf

Lempert, R. and Kalra, N. 2011. *Managing Climate Risks in Developing Countries with Robust Decision Making*. World Resources Report, Washington, D.C., USA. Available at: http://www.worldresourcesreport.org

Lempert, R., Nakicenovic, N., Sarewitz, D. and Schlesinger, M. 2004. Characterizing climate-change uncertainties for decision makers: An editorial essay. *Climatic Change* 65: 1–9. Available at : http://www.ambiente.sp.gov.br/proclima/artigos_dissertacoes/artigos_ingles/characterizingclimatechange.pdf

8.1 Overview

Most countries are familiar with the use of sensitivity analysis to explore the impact of uncertainty and risk. However, sensitivity analysis is often treated as an afterthought, checking the reliability of the headline analysis. Robust decision making (RDM) brings the analysis of risks centre-stage in the process of investment option prioritisation. RDM raises the profile of sensitivity analysis by requiring a more explicit treatment of scenarios of assumptions. A range of plausible climate change scenarios is defined and the return of the investment option is estimated for each scenario. This allows investment options to be classified as 'no/low regrets', 'climate change justified' and 'climate change risky' (see Box 8.1 for explanation of these terms), based on which an investment option may need to be revised or rejected.

The main characteristic of an investment option selected using RDM is that it delivers acceptable levels of performance under a range of future climate scenarios. It is not necessarily an optimal decision for one scenario, rather it gives confidence that returns on investment will not be undermined if the future climate turns out to be different than that planned for.

Box 8.1
Characterisation of investments based on climate risk

- **No/low regrets** investments are not affected by climate change or will give acceptable returns whichever climate change scenario materialises. These investments should be a high priority for implementation, as they offer short-term benefits without presenting long-term risks. These include:
  - projects necessary to fully adapt to current climate variability and climate change already happening;
  - projects with a short lifetime relative to the timescale of climate change;
  - projects addressing risks unrelated to climate change; and
  - broader measures for reducing vulnerability and building resilience to shocks.

  No/low regrets does not imply zero costs, nor the absence of trade-offs with other actions; it merely means that climate change will not significantly affect their justification.
- **Climate change justified** investments do not give acceptable returns unless some degree of climate change materialises. Such investments are typically more common in nations with a high capacity for risk management, where existing climate variability is largely managed and action is being taken to invest against potential future changes. This type of investment might include building a water supply reservoir on the basis of potential reductions in river flow due to climate change (see Box 8.2 on risk preferences in UK water supply planning). In the context of the Framework such investments may include:
  - additional investments in 'business as usual' development projects, to hedge against possible future climate change impacts; and
  - modifications to existing assets and systems on the basis of uncertainty over future climate.
- **Climate change risky** investments give good returns without taking climate change into account, but give low returns if climate change materialises. Such investments can occur when climate change is not factored into planning systems and decisions are taken on the basis of historical precedent rather than accepting the uncertainty about future climate. Such investments are not a priority within the Framework.

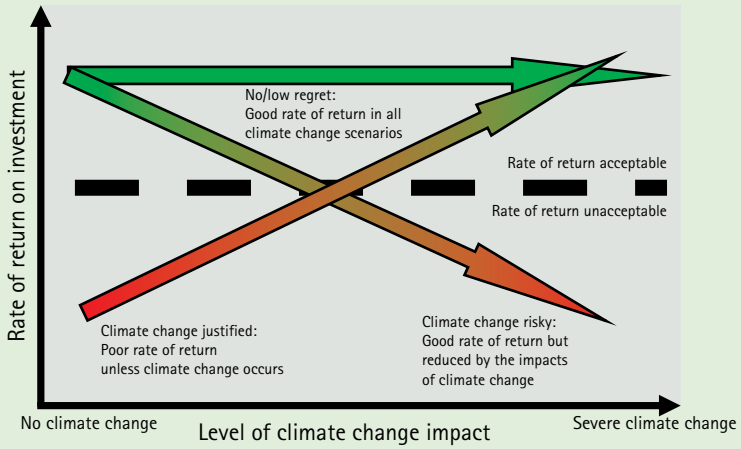


Illustration of rate of returns for no/low regrets, climate change risky and climate change justified investments

Investment options may require revision in order to improve robustness to climate change. Some investment options, such as improved water governance systems, institutional strengthening and capacity development, are likely to deliver benefits across all future scenarios, and therefore to be robust.

Although climate change projections are inherently uncertain, there is a consensus that average temperatures will increase over the coming decades. How rainfall will change is much less certain, but extremes of rainfall and storm occurrence are thought likely to become more severe and frequent in the future.

Therefore it is not possible to simply assume that a single climate future will materialise, and such assumptions have the potential to contribute to maladaptation. A number of future scenarios are required to capture the range of uncertainty. Scenarios can vary in complexity from a small number of simple assumptions about change in rainfall and temperature, to large numbers of projections of future daily resolution time series of environmental variables, such as temperature, rainfall and wind speed, derived from regional climate modelling studies.

The appropriate level of complexity depends on the user requirements. Simple scenarios may be appropriate for risk screening exercises and dissemination, whereas data-rich scenarios are often needed to drive detailed hydrological or agricultural models, which are used for planning and design. Investments in institutional strengthening and collaboration, among others, are unlikely to be influenced by climate and will, therefore, require less rigorous testing than investment in water management infrastructure.

The characteristics of investments for managing risks and adapting to climate change have been summarised in the Intergovernmental Panel on Climate Change (IPCC) Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)[1] and are provided in Box 8.2. This landmark report provides research output that explores the challenge of understanding and managing the risks of climate extremes to advance climate change adaptation, and it promotes no/low regrets investments which align strongly with the aims of the Framework.

8.2 Risk preferences and risk-based decision making

Planning of investment programmes – involving the selection, appraisal and sequencing of projects – has always had to allow for uncertainty over outcomes and deal with risks attached to specific activities. In its simplest form, the base case of the project appraisal contains 'expected values' derived from weighting the size of each possible outcome based on its probability. The standard assumption is that decision makers are

Box 8.2

Key recommendations from the IPCC SREX that align with the Framework objectives

- **Risk sharing** and transfer mechanisms at local, national, regional and global scales can increase resilience to climate extremes.
- **National systems** are at the core of each country's capacity to meet the challenges of observed and projected trends in exposure, vulnerability, and weather and climate extremes.
- Measures that provide benefits under current climate and a range of future climate change scenarios, called 'low regrets measures', are available as starting points for addressing projected trends in exposure, vulnerability and climate extremes. They have the potential to offer benefits now and lay the foundation for addressing projected changes. Potential low regrets measures include:
  - early warning systems;
  - risk communication between decision makers and local citizens;
  - sustainable land management, including land-use planning;
  - ecosystem management and restoration;
  - improvements to health surveillance, water supply, sanitation, and irrigation and drainage systems;
  - climate-proofing of infrastructure;
  - development and enforcement of building codes;
  - better education and awareness.
- Effective risk management generally involves a **portfolio of actions** to reduce and transfer risk and to respond to events and disasters, as opposed to a singular focus on any one action or type of action.
- **Integration of local knowledge** with additional scientific and technical knowledge can improve disaster risk reduction and climate change adaptation.
- An **iterative process** of monitoring, research, evaluation, learning and innovation can reduce disaster risk and promote adaptive management in the context of climate extremes.
- A prerequisite for sustainability in the context of climate change is **addressing the underlying causes of vulnerability**, including the structural inequalities that create and sustain poverty and constrain access to resources.
- The most effective adaptation and disaster risk reduction actions are those that offer **development benefits** in the relatively near term, as well as **reductions in vulnerability** over the longer term.
- Successfully addressing disaster risk, climate change and other stressors often involves embracing **broad participation in strategy development**, requiring the capacity to combine multiple perspectives and contrasting ways of organizing social relations.

'risk-neutral', and will choose the project with a positive rate of return, as measured by net present value (NPV) or economic rate of return (ERR). However, a project with a positive NPV or adequate ERR may entail a risk of loss or other catastrophe, to which decision makers attach high importance.

Benefit–cost analysis can go some way towards accommodating such risk, without abandoning a risk-neutral assumption; for example by including a range of sensitivity tests showing the impact on rates of return of changes in key variables, and by using this data to estimate 'switching values'.[2] However, risk-neutrality is not a realistic way of portraying the attitudes towards risk of politicians who face loss of office, of farmers who face starvation and ruin, or of businessmen who face bankruptcy or legal suits as a result of their actions. The 'risk preference' of these key decision makers and agents should be taken into account. Box 8.3 provides an example, showing how risk preferences on climate change are managed in UK water resources planning.

Box 8.3
Risk preferences in UK water supply planning

In the UK, water supply companies are obliged by law to produce projections of water supply and water demand over a 25-year planning horizon. Projections of supply are based on historic drought events and the trends expected for these under climate change. Projections of demand are based on population growth and behavioural changes that may alter per capita water consumption. The basic aim of the water company plan is to ensure that supply matches or exceeds demand over the 25-year planning period. However, uncertainties exist in both water supply and demand, due to uncertain climate change and future population. Therefore, the companies use a safety margin called 'headroom', which is the required excess of supply over demand over the planning horizon. The climate change component of headroom is calculated on the basis of the uncertainty range of climate change impacts on supply. The risk preferences are, therefore, manifested in the range of climate change impacts that the water resources planners deem possible. If a company is highly risk-averse, the planners may include the full range of climate change uncertainty to give a large headroom, but this may require large investments in infrastructure against a climate future that is at the limit of future climate change projections. Such investments are justified on the basis of climate change materialising. A less risk-averse company may decide that only 50% of the total range of uncertainty will give them sufficient confidence, resulting in less investment but a higher risk of failure in the future. Typically, companies are risk-averse because the cost of investing in water supply is lower than the cost of running out of water during a drought, which has substantial impacts on the wider economy.

Specific decision criteria have been developed and tailored to different risk preferences, such as 'minimax', 'maximin', 'minimum regret' and others (see Winpenny, 1995, for an explanation of these terms).[3] Each of these may be relevant in specific situations. At a political and social level, the notion of 'acceptable risk' is also important, since the general public, and their political representatives often hold different risk perceptions and preferences than technocrats and 'experts'. The 'precautionary principle' is a relevant criterion, in this context.

Dealing with the variability of climate has long been a staple task of water managers, but the spectre of climate change creates uncertainty about both the future mean values and the degree of variability around this, including the likelihood of extreme events. Outcomes are likely to be different from, and outside the bounds of, what could be predicted from historical precedent. Feedback loops and irreversible (or cumulative) processes become more likely, and in these circumstances hydrological risk becomes difficult to assess.

Under climate change, risk preferences and levels of acceptable residual risk need to be assessed for present climate variability as well as potential future variability thereby bringing an added layer of uncertainty and complexity to decision making (see Box 8.4).

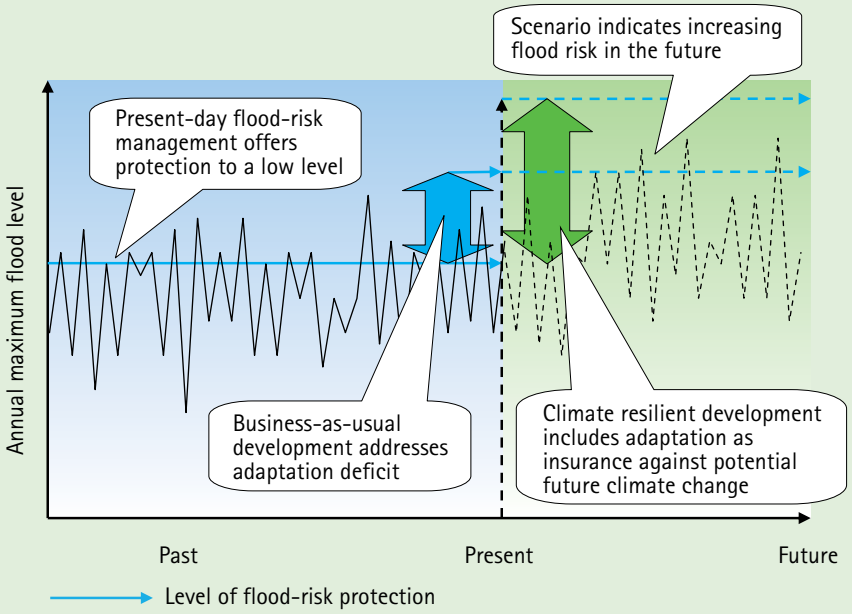
In the past, managers of water systems have dealt with future uncertainty by building safety margins into the infrastructure (i.e. reservoirs, flood defence structures) or by diversifying supplies and distribution networks. This is becoming more costly, due to the growing scarcity of water resources, the escalating costs of such precautionary measures, the growth in demand for water and related services, and the constraints imposed by environmental awareness and policies. Unlike in the past, designing safety margins can no longer take for granted stable baseline conditions. Designing a response for so-called 'zero-infinity' events (those with a very low probability but a very high cost when they occur) has always posed a dilemma for policymakers, which can only get worse in future.

Water managers need to understand the options available to them, the different risks these options entail, and have some means of weighing the trade-offs involved in making choices among them. Some of these risks will be unacceptable such that expensive safety features may be unavoidable, but in other cases the impact of an adverse event may be tractable without excessive cost, or in a more effective way. A systematic consideration of the probabilities, consequences, and values associated with different decision alternatives is called for, this is known as risk-based decision making.

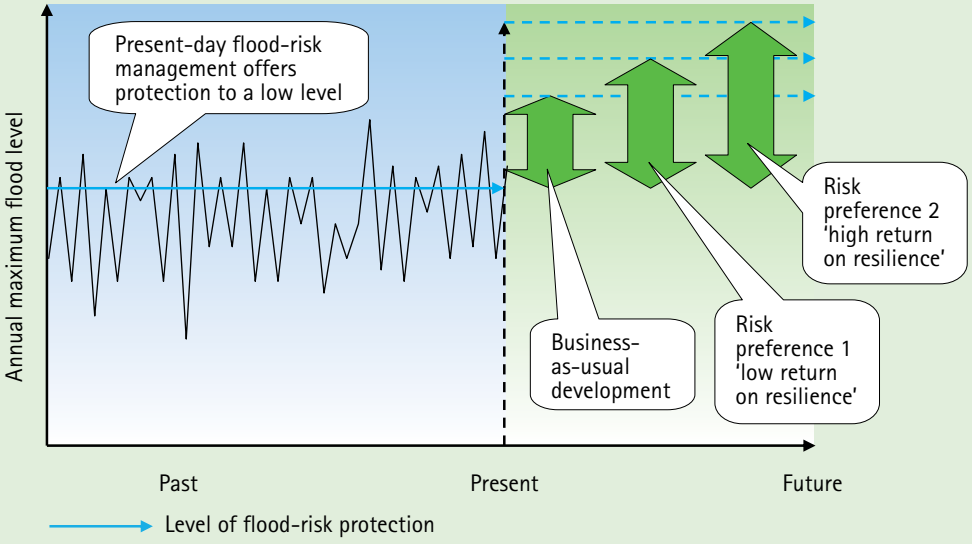
Box 8.4

Development, adaptation and risk preferences

Strong synergies exist between development and adaptation, as illustrated in the example below. In terms of flood risk, business-as-usual development may involve improving flood-risk management to address existing climate variability and flooding problems. This addresses an 'adaptation deficit', that is, the backlog of investment needed to address existing climate conditions to bring risk to an acceptable level. Climate resilient development includes development with an element of adaptation, based on scenarios of potential future flood risk (dashed line). Climate resilience may be conferred by 'hard' measures, such as improving flood defences, or by 'soft' measures, such as flood event management and early warnings.



Risk preferences describe the level of risk that decision makers are willing to adopt, and are often informed by benefit–cost analysis. In the flood risk example, the additional requirements to ensure an adequate level of future protection must be determined. The decision maker could accept the risk of future increases in flood risk, or could invest to bolster flood-risk management against potential future increases. No/low regrets measures, such as flood warnings, will deliver returns whether or not risk increases, whereas raising defences may not be required if climate change projections are inaccurate.



8.3 Approaches to managing climate risk

Climate resilience needs to be aligned as far as possible with existing development aims and processes. The general approach has been described well by Ranger and Garbett-Shiels (2011), as follows:

"*[F]or adaptation to be effective, comprehensive and implemented at the appropriate scale, it is crucial to integrate adaptation planning within existing priorities, planning processes and policymaking... [A]daptation strengthens the case for pushing 'faster and harder' on development priorities... [T]hrough building flexibility into adaptation strategies from the outset, climate resilience even under deep uncertainty should be no more challenging than other areas of policy. A central principle in managing uncertainties is to focus on promoting good development and long term adaptive capacity while avoiding inflexible decisions that could lock in future climate risk in the long term.*"[4]

The above stance has implications for the choice of methods for planning and project selection.

Two broad types of approach – 'science-first' and 'policy-first' – both aim to achieve climate resilient development, but take different routes to get there. Ranger et al. (2010)[5] provide a full discussion of these approaches, but they can be briefly described as follows:

- **The science-first approach** (also called the 'predict-then-act' model) has the basic sequence of first making predictions about uncertain future climatic states, then using familiar analytical methods and decision tools to select suitable adaptation projects. This implies a procedure separate from, and overlying, the existing processes for making national investment and financing decisions.
- **The policy-first approach** reverses the above sequence, starting with a candidate investment and identifying the future conditions under which it would be vulnerable. Steps towards reducing this vulnerability are then identified. The procedure can be incorporated within current sector-specific planning frameworks, without the creation of a separate institutional process. Future uncertainty, which is inherent in climatic predictions, is expressed in terms of its effect on the project's ability to achieve its goals.

The policy-first approach has a number of advantages over the science-first model:

- It starts with the policies, programmes and projects that are already being planned or promoted. In terms of the Framework application, these are represented by the investment opportunities being developed to increase water security and climate resilience. In this way, the policy-first approach is complementary to the stream of programmes and projects being planned to meet the country's wider development and poverty reduction aims.
- It uses existing planning and sector-based institutions and processes.
- It embraces uncertainty, but inverts the logic by asking what future conditions would render the chosen project vulnerable, and then seeking to bolster the project against those eventualities.
- It adopts the vantage point of decision makers who are confronting a specific set of options.
- It encourages decision makers to consider a range of possibilities rather than an elusive single best estimate of future climate.
- It seeks robust decisions that perform well over a range of plausible futures, even though they may not necessarily be the optimal choices for any specific future state.

8.4 Characterising investments based on climate risk

Investments may be broadly classed according to their climate change risks, as outlined in Box 8.1. 'No regrets' or 'low regrets' investments are those which have a high chance of success despite a full range of uncertainties in climate change and other future drivers. No regrets measures act to manage resources in a more sustainable way (e.g. pollution control), demand management and institutional strengthening, and will increase resilience in any given future climate scenario. In terms of infrastructure-based investments, a no regrets solution may be one that delivers benefits under any climate scenario (such as waste-water treatment), or one that addresses a pressing need (such as clean water supply). A low regrets investment may have some climate impact that can readily be mitigated through inexpensive measures, such as phased implementation or design for robustness. Assessing whether an investment is no/low regrets involves testing its performance against potential future scenarios, attempting to ensure minimum risk of failure.

No/low regrets investments include: efficiency savings, demand management, ecosystem protection, pollution prevention, land-use management, institutional and governance reform, resolution of immediate and pressing issues.

Box 8.5 presents examples of investments classified according to their climate risk in the context of urban water infrastructure in Bangladesh.

Box 8.6 provides an example of a no regrets initiative involving better transboundary management of the Zambezi.

Climate change risky investments are those for which short-term returns may be adequate but longer-term climate scenarios

Box 8.5

Examples of no regrets and climate-justified project components in the context of urban water infrastructure in Khulna, Bangladesh[6]

Bangladesh's low-lying urban areas already have a serious drainage problem; during the rainy season sewers often back up. This existing problem would be made worse by the more intense rainfall expected due to climate change. Rising sea levels could delay discharge from drains, and flooding by contaminated rainwater would be detrimental to public health.

Khulna is the third largest city in Bangladesh, with a population of approximately 1 million. The Asian Development Bank has identified projects for improving the urban drainage systems and for developing surface water supplies. A study was carried out into appropriate adaptation options for strengthening the climate resilience of Bangladesh's urban water sector.

The study made climate change projections for Khulna for 2030 and 2050 in conjunction with socio-economic development scenarios, based on several IPCC scenarios, including business-as-usual. For sea-level rise, plausible high projections (+25 cm in 2030 and +40 cm in 2050) and plausible low projections (+10 cm and +20 cm, respectively) were used. Damage from flooding and waterlogging in affected regions was then estimated.

Due to increased river salinity levels and the longer duration of river salinity, the number of days when river water is unsuitable for drinking will increase with climate change. The main options are to enlarge the impounding reservoir so that it could provide an alternative supply for a longer period, or to move the intake point further upstream. An adaptive management approach was taken, whereby the local authority would buy a larger area for the impounding reservoir than would be necessary on the lower salinity scenario, and which could be enlarged as and when required.

Following analysis of various options, with and without the future climate change scenarios, the preferred no regrets project option (i.e. acceptable returns regardless of climate change conditions) would cost US$25.6 million, including improvement of secondary drainage channels, rehabilitation of outlet structures, protection of the link, dredging and re-excavation, removal of encroachment, and the development of recreational facilities for other rivers. The benefits from this option, in terms of the reduction in waterlogging, create a benefit–cost ratio of 2.89 for a 5-year return period and 4.97 for a 10-year return period, at a discount rate of 10% (corresponding to an economic internal rate of return of 34% and 111%, respectively).

Adaptation (climate-justified) options would involve further work on urban drainage infrastructure, to anticipate a scenario of more intense rainfall and higher sea levels than assumed in the base case, plus measures to counter growing salinity. For the latter, the more cost-effective option is the enlargement of the impounding reservoir. A complicating factor is uncertainty over whether increasing salinity is due to climate change or other factors, such as the natural sedimentation of the local river or reduced flow from the Ganges. If it is established that the increase in salinity is due to climate change, the whole cost of the impounding reservoir can be regarded as climate-justified adaptation.

Box 8.6

Transboundary cooperation in hydropower generation in the Zambezi basin as an example of a no regrets initiative[7]

A project is underway to synchronise dam operations in the Zambezi basin, aimed at optimising the benefits for the region in terms of power generation and flood management. The basin is shared by Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe and contains several major dams: Itezhi-tezhi, Kariba and Cahora-Bassa. Operation of these dams is not currently synchronised in any way. The dams are operated to satisfy their primary functions, including water storage, hydropower production, irrigation, institutional water supplies and mining purposes. The synchronisation of releases has been proposed as an option that requires little additional investment but is likely to yield benefits in energy security, flood management and environmental flows. Because it is a management option, not requiring hard engineering, it represents a flexible solution that can be readily amended in the future as climate change impacts occur.

The full potential of dam synchronisation for power generation can only be realised through increasing the connectivity of the regional power pool. Proposed connections include Mozambique–Malawi (reducing Malawi's total reliance on the Shire River), Zambia–Tanzania, Democratic Republic of Congo–Zambia and Mozambique–Zimbabwe. This will give countries the flexibility to buy and sell power as needed rather than relying on conditions of local hydropower facilities, and may also bring the added benefit of allowing greater flexibility in operating dams for flood control and environmental releases.

may pose a risk of poor performance or failure (see Box 8.1). These investments may incur large fixed sunk costs which rely on certain climate characteristics to give a good return on the investment. For example, large dams have the potential for long-term risk due to climate, but may offer very substantial short- to medium-term benefits under most scenarios.

Although no/low regrets investments are more often addressing problems on the 'demand side', this approach does not rule out the development of larger water resources infrastructure schemes, particularly where these are needed to deal with current risks. The key requirement going forward is that these schemes are demonstrably cost-effective and sustainable with respect to a large range of future socio-economic and climate change scenarios.

The key question is whether the projected impacts of climate change are sufficient to merit modifying the investment and, if so, how can the investment be modified to reduce the risk. The broad choices are presented in Table 8.1 (a summary of the discussion in Chapter 6, which also supports Phase 2 of the Framework). These choices can be viewed as risk-reduction methods aimed at raising the likelihood of a successful return on the investment under consideration in all climate scenarios. This is also conceptualised graphically in Figure 8.1.

Climate change justified investments are those that specifically address the future stresses of climate change and would not be required in their absence. In the African context, such investments are rare as funding is typically prioritised for immediate development needs. The main disadvantage of climate change justified investments is that they require a high level of confidence in climate change projections in order to commit resources. In Africa, investments which yield benefits under climate change are likely to be attractive only when they also yield immediate benefits, or co-benefits, in terms of capacity building and natural resources management.

Managing current and future climate risks demands a balanced portfolio of measures, including short-term investments for immediate implementation as well as longer-term measures. Investments in research, monitoring, planning, evaluation and learning will help to underpin actions and responses as changes in climate become more evident. A conversion to robust, risk-based management approaches together with improved governance systems is required.

It will take time for climatic trends to become apparent, but in the meantime action to manage both current and future risks cannot wait. Decisions that will have long-term consequences have to be made based on imperfect predictions about the future.

Table 8.1 Risk management preferences and options

Risk management options	Potential actions
Reduce uncertainties	• Can uncertainties in climate impact be reduced through additional studies?
Do things differently	• Can the design be altered to reduce risks? • Can the investment be implemented in stages to allow for climate change to unfold before making further decisions?
Do different things	• Are there alternative ways of achieving the investment returns with lower climate risks? • Use innovative technologies and approaches to management.
Bear the climate change risk	• Simply understand and plan to minimise the climate change risks, perhaps through insurance.

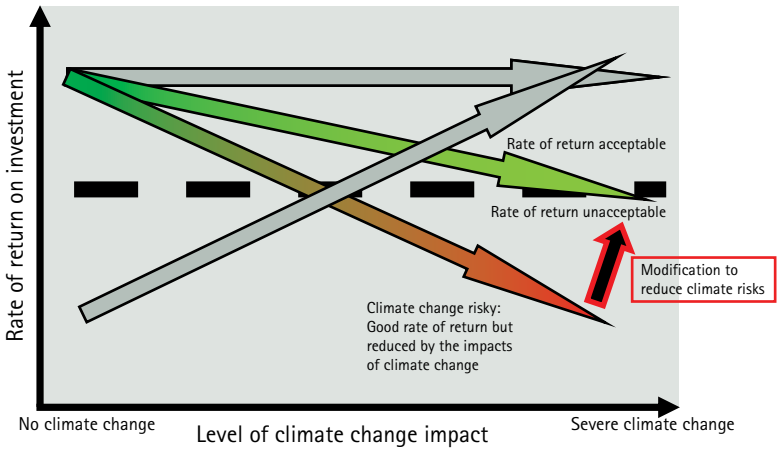


Figure 8.1 Illustration of reducing climate risks to achieve acceptable returns across a range of climate scenarios

8.5 Using robust decision making to identify no/low regrets investments

The discussion so far has highlighted that robust decision making (RDM) is based on a set of principles and that it involves the classification of climate risks posed to proposed investment opportunities. In the context of the Framework, it is important that investment opportunities are classified and prioritised in a clear and well argued manner to make the case for taking these forward for integration in planning systems for implementation.

In this context, RDM is being used to assess how investments perform under multiple climate futures and also to present this information in a usable form for decision makers. Decision makers may be government investment planners or investors themselves (such as the private sector, climate funds, donor agencies or international financial institutions).

The procedures of the RDM analysis are highly dependent on the nature of the investments under consideration and a tiered approach will allow effort to be focused where it is most appropriate. The nature of the RDM analysis will be developed to suit the context of its application. The basic information required for the RDM analysis is the outline investment proposal and the climate and development scenarios with which to test the investment. Guidance on developing climate and development scenarios is provided in Chapter 2.

Investments in soft infrastructure, such as policy changes, or in small pilot projects will require a lower level of analysis than major investments in hard infrastructure, which will need a more thorough analysis of the impacts of climate change under different climate and development scenarios. Hard investments are often subject to quantitative impact modelling using specialist tools, such as river models in the case of flood defence construction. It should also be noted that this step is intended as a high-level exercise for prioritisation of investments; when investments are at the feasibility or detailed planning phase, a more thorough and tailored analysis of the impacts of climate and development scenarios should be undertaken.

Unless detailed quantitative modelling is undertaken, assessing robustness to a range of climate and development scenarios is largely a qualitative exercise, which can be carried out through stakeholder consultation and expert elicitation. The aim is to understand potential climate risks and their relative importance. A simple scoring approach can be used, but this should be backed up by an explanation of how scores have been determined in a supporting document.

Table 8.2 presents a highly simplified example of a RDM analysis exercise, to provide an indication of the high-level outputs that can be gained. It should be noted that robustness is only one measure for prioritising investments. The benefits and costs, addressed in Chapter 9 (which also supports Phase 2 of the Framework), are also key considerations for decision making on whether to carry forward an investment for planning. This chapter looks only at risks to investments posed by uncertain future climate conditions.

Table 8.2 can be used as a reference for how to identify climate risks and the appropriate level of risk reduction action required for each investment option before taking it forward for detailed economic analysis.

8.6 Final remarks

Although there is growing consensus in the scientific community about the likelihood of future climate change, there is a wide margin of uncertainty about its impact on particular countries, regions and districts, and its further impact on specific economic sectors, public health and social conditions. Such uncertainty about the future complicates the work of policymakers faced with decisions that will have long-term consequences.

Uncertainty over the impact of climate change should not stand in the way of taking immediate steps to improve climate resilience. RDM is an approach that aims to facilitate decisions that governments will not regret, no matter how the future turns out. These decisions give priority to no/low regrets investments, since these would be the right choice whether or not the predicted climate change takes place.

Some of the benefits of the RDM approach include:

- It can be applied to plans, policies and projects already in place, or being developed, to meet national economic growth and poverty-reduction aims.
- It asks what future conditions would render the investment vulnerable, and seeks to bolster the investment against those eventualities.
- It leads to decisions that perform well over a range of plausible futures, even though they may not be the best for any specific future scenario.
- It can be applied to both hard investments in infrastructure and equipment, as well as soft investments, such as changes in policies and procedures, research and capacity building.

The expected outputs from this step in the process include:

- A report verifying the resilience to climate change (or otherwise) of the portfolio of investment opportunities.
- Categorisation of investments as: (i) take forward for detailed economic analysis; (ii) marginal / require modification; or (iii) not viable.

Table 8.2 Illustrative example of robustness testing investments to reduce flood risk

	Climate and development scenario robustness score					
	Scenario A	Scenario B	Scenario C	Scenario D		
Investment to reduce flooding risk	**No change in flooding**	**20% increase in flood flows**	**10% decrease in flood flows**	**No change in flooding, 30% increase in floodplain population**	**Decision**	**Other risk factors**
Build and maintain flood defences	1 (Flood defences perform as designed)	3 (Increased flooding overtops defences)	2 (Negative impact through wasted investment)	1 (Flood defences perform as designed)	**Reduce risk** (Options to reduce risk under Scenario B are essential before project is acceptable for reappraisal. This could include: over specifying defences, designing for exceedance, designing for future alterations)	Assumes defences are operated to intended design standards
Flood warning	1	1	1	1	**Take forward for investment planning** (Climate change risk is low, no modification needed)	Assumes flood warnings are disseminated and acted upon
Flood plain zoning	1	1	1	1	**Take forward for investment planning** (Climate change risk is low, no modification needed)	Assumes flood plain zoning is enforced
Flood-resilient livelihoods	1	1	1	2 (Additional population may be less resilient to flooding)	**Take forward for investment planning** (Climate change risk is low, no modification needed)	Effectiveness of flood-resilient measures is difficult to quantify relative to other activities

Key to scores: 1 = no climate change impact – no further action needed;
2 = moderate climate change impact – investigate options to reduce climate change impact;
3 = severe climate change impact – reduction of impact mandatory for investment to proceed.

The outcomes of this step in the process pave the way for more detailed economic analysis, which is restricted to those opportunities that are verified as robust against uncertainty in climate change. This step also provides an opportunity for marginal investment opportunities to be revisited or revised should they fall below the threshold for acceptance.

Chapter 8 references

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9 | ECONOMIC APPRAISAL OF INVESTMENT OPTIONS

Key messages

- Economic justification is a powerful tool in arguing the case for investing in identified 'no/low regrets' options.
- A range of tools exist, which will be familiar to financial planners and economists. Cost-effectiveness (CE) and benefit–cost analysis (BCA) are commonly used for financial appraisal.
- Social and environmental benefits should be captured in economic appraisals where possible. Multi-criteria analysis (MCA) offers the potential to appraise diverse costs and benefits without the need to use economic costs, but requires a consensus-based approach.

This chapter supports Phase 2 of the Framework (Identify and appraise options) and outlines the appraisal techniques for assessing the performance of identified 'no/low regrets' investment options. No/low regrets options, selected on the basis of their climate resilience, require appraisal to ensure that they offer sufficient benefits to be considered for integration into budgetary planning for implementation. Because of the diverse nature of no/low regrets investments (i.e. information, institutional, infrastructure) and the different institutional planning contexts across planning scales and countries, a suite of methods is presented and each method has its own niche.

Economic appraisal of investment opportunities also aligns with the Framework's guidance on making the case for climate resilience, and makes use of similar tools. But this chapter discusses appraisal of investments rather than high-level climate risks.

Recommended sources of further information:

The United Nations Framework Convention on Climate Change (UNFCCC) guidance on assessing costs and benefits for adaptation provides a useful introduction to options appraisal in the context of climate change adaptation. It also presents case studies on the application of various techniques.

UNFCCC. 2011. *Assessing the Costs and Benefits of Adaptation Options: An Overview of Approaches*. The Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change. Available at: http://unfccc.int/adaptation/nairobi_work_programme/knowledge_resources_and_publications/items/5136.php

9.1 Overview

In the earlier steps of Phase 2, a portfolio of potential 'no/low regrets' investment opportunities is identified on the basis of both screening ongoing activities for climate risk and also developing new and innovative investment opportunities. In order to make the case for taking these investments forward for financing, the investment returns – economic, social and/or environmental – must be demonstrated and this forms the latter, 'appraise', part of Phase 2.

This section provides examples of appraisal techniques, which may be used to assess the costs and benefits of the identified investment opportunities. It also highlights the wide base of detailed literature on the subject.

Costs and benefits are only one set of criteria by which an investment can be deemed acceptable or not. Examples of other criteria are listed here but are not discussed further, as these are dependent on the institutional contexts in which the decisions are being taken:

- **Effectiveness** – will the investment meet your objectives?
- **Robustness** – is the investment robust under a range of future climate projections?
- **Equity** – does the investment adversely affect other areas or vulnerable groups?
- **Flexibility** – is the investment flexible and will it allow for adjustments and incremental implementation?
- **Sustainability** – does the investment contribute to sustainability objectives, and are the investments themselves sustainable?
- **Legitimacy** – is the investment politically and socially acceptable?
- **Urgency and practicality** – how soon could the investment be implemented relative to constraining timescales?
- **Synergy/coherence with other strategic objectives** – does the investment help to achieve other objectives?

Assessment approaches may be broadly classified into single-criterion and multi-criteria approaches. In the case of single-criterion approaches, the criterion is usually economic and the most common methods are cost-effectiveness and benefit–cost analysis. Multi-criteria analysis (MCA) is intended to aggregate measurements of benefits and costs that cannot readily be measured on the same scale; this requires the subjective weighting of the importance of the benefits and costs to allow their comparison on a common, usually arbitrary scale. Some of the criteria listed above may be included in a MCA, or dealt with as separate issues used to screen options before the MCA.

A single-criterion approach may be used for the valuation of a wide range of benefits and costs outside the immediate financial costs. This requires the conversion of all benefits and costs (e.g. social and environmental) into monetary terms, a process called monetisation.

9.2 Single-criterion methods

The most widely used single-criterion method is **benefit–cost analysis**[i] (BCA) of individual projects in which a threshold value of the result (e.g. size of net present value, benefit–cost ratio, or economic rate of return) is used to select candidate projects. The results would be in terms of economic value in the first instance, but these financial results should also be tested since they affect public finances, and could also determine the response of private agents to the proposed measures. BCA is a well-established method of project appraisal; ample guidance is available on its general use and its specific application to adaptation projects. However, BCA does not address the relative distribution of benefits and costs among different stakeholders, and the choice of discount rate to deal with future costs and benefits is a deeply problematic area. Ensuring that social and economic costs and returns are included in the BCA and agreeing on their monetisation can be difficult but should be attempted. This is especially true in the area of natural resources management where externalities of development are far-reaching.

Another single-criterion is the **cost-effectiveness (CE)** of a range of alternative ways of attaining the desired outcome. This is relevant where a country faces one or a small number of risks from climate change, and is able to identify and cost the different ways of dealing with each of these risks. CE is applicable where it is difficult to quantify benefits. The projects can be arranged on an ascending curve according to their cost per unit of 'benefit'. This is the basis of the adaptation cost curve by the Economics of Climate Adaptation (ECA) Working Group (see Box 9.1), a cousin of the McKinsey Global Greenhouse Gas (GHG) Abatement Cost Curve.[ii]

The ECA Working Group adaptation cost curve approach has pros and cons, as follows:

Pros:

- It encourages 'out of the box' thinking and provides a starting point for discussion about adaptation options.
- It uses a single criterion that can be applied to a wide range of different measures.
- It provides a quantitative system for prioritising options, based on their cost effectiveness.

i This is often, and confusingly, referred to as 'cost-benefit analysis' (CBA), which is exactly the same method but with the numerator and denominator reversed. In interpreting results of such analysis it is important to check whether BCA or CBA is the relevant term.

ii McKinsey & Company is a member of the ECA Working Group.

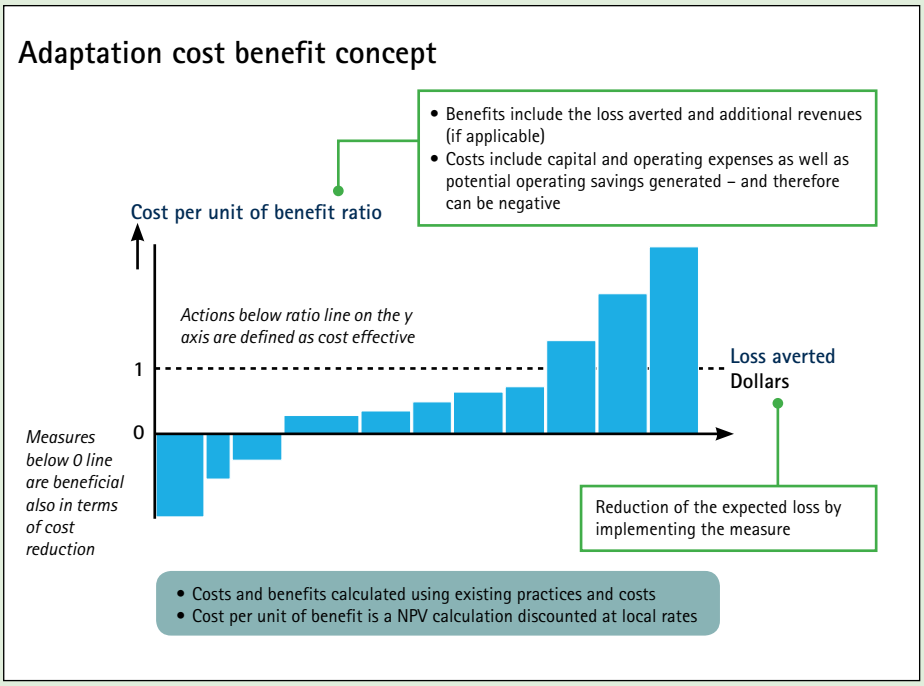
Box 9.1

The Economics of Climate Adaptation (ECA) Working Group adaptation cost curve[1]

This is a methodology for the identification, assessment and ranking of projects for the reduction of climate risk. It can apply to situations where there is a specific overriding climate-related risk that can be addressed by a number of different policy responses. These responses may be alternative or cumulative in nature. The cost curve plots the quantitative impact of the various options on the problem (x axis) against their cost-effectiveness or cost per unit of benefit (y axis).

The approach has been piloted in the following eight regions of different countries, each with a specific climate change-related issue:

- North and Northeast China: drought risk to agriculture.
- Maharashtra, India: drought risk to agriculture.
- Mopti Region, Mali: risk to agriculture from climate-zone shift.
- Georgetown, Guyana: risk from flash floods.
- Hull, UK: risk from multiple hazards.
- South Florida, USA: risk from hurricanes.
- Samoa: risk caused by rise in sea level.
- Central region of Tanzania: risks to health and power from drought.



Taking the results from Tanzania to illustrate the approach, under the 'moderate change' scenario the central region of the country is projected to experience a 10% decrease in annual rainfall and a 25% increase in its variability, resulting in more severe and frequent droughts. The central region has a high incidence of drought-related diseases and poor health conditions (e.g. malnutrition, trachoma, dysentery, cholera and diarrhoea) and supplies 95% of Tanzania's hydropower production.

For various types of intervention for diarrhoea, dysentery and cholera, the analysis plotted the numbers of cases that were treated or prevented against the cost per effective case. Education and the construction of ventilated improved pit latrines were among the interventions that came out well on these measures.

Measures to address the projected shortfall in power production were arrayed in a rising cost curve, plotting cost per unit of power saved or generated against the cumulative impact of each. Some options (energy efficiency and selected demand reductions) would effectively have zero net cost or low net cost (reducing spillage at hydro stations), whereas others (new power plants, reduced transmission losses) would have a relatively high unit cost.

Cons:

- Many options will have a number of important impacts, which cannot be fully reflected in a single cost-effectiveness criterion. This means the curve should not be used for decision making in isolation.
- Options rely on actions by different parties, such as central and local governments, individuals, farmers, businesses and NGOs. Not all of these can be carried out through top-down directives.
- The various parties need to have incentives to implement the options, e.g. private profitability or private cost savings.
- Some options need to be carried out simultaneously rather than sequentially, in order to exploit complementarities or synergies.

Both the BCA and CE criteria need to assess the sensitivity of projects with and without assumptions of climate change. Analyses should include sensitivity tests to understand which assumptions are the most sensitive to change, and should also involve 'switching values' to understand how changing assumptions can lead to changing decisions. The results of BCA can be plotted on a graph,[2] along with a judgement of low or high 'robustness to uncertainties'. Projects with a high BCA and high robustness are to be preferred to those with the opposite characteristics. The more difficult cases, which can only be resolved by informed judgement, are projects with low BCA combined with high robustness, and those with high BCA and low robustness.

9.3 Multi-criteria approaches for investment prioritisation

As the name suggests, MCA is useful where decision makers wish to use a number of different criteria, rather than relying on a single measure such as those used in BCA and CE. MCA might, for instance, include environmental and social impact, effect on jobs, ease of implementation and political feasibility, among others, as well as economic and financial criteria.

Where two or more criteria are used, the scores on the different criteria have to be combined, which normally requires a weighting for each. This in itself can be a contentious issue, requiring expert elicitation or participatory approaches for assignment of weights. Alternatively, one criterion can be selected as the dominant one, subject to each of the others being satisfied to some degree. The UK Government has put together a comprehensive manual on MCA for practitioners, which is a valuable resource for those considering using the technique for decision making.[3] Box 9.2 provides an example of developing criteria for an MCA as part of the National Adaptation Programme of Action (NAPA) options' prioritisation in Bhutan.

Box 9.2

Case study of MCA application for prioritising the National Adaptation Programme of Action (NAPA) options in Bhutan

MCA was applied to determine the prioritisation of adaptation options in the development of Bhutan's NAPA. The MCA was carried out through participation of representatives from the most climate-sensitive sectors, including agriculture, biodiversity, forestry, natural disaster, infrastructure, health and water resources. This ensured that weightings assigned to options were a fair reflection of the views of a broad range of stakeholders.

Initially 17 adaptation options were identified, which were then screened to obtain a total of 9 using the following simple criteria designed to rapidly sift options:

- Climate change risks and the level or degree of adverse effects.
- Demonstrated fiscal responsibility (or cost effectiveness).
- Level of risk associated with choosing not to adapt.
- Complements country goals, such as overcoming poverty, enhancing adaptive capacity or other environmental agreements.

The remaining nine options were subjected to an MCA for prioritisation, whereby the stakeholder group assigned scores of 1–5 on each of the following criteria for each option. The first three criteria represent benefits and the fourth represents costs.

- Human life and health saved/protected by the intervention.
- Arable land with associated water supply (for agriculture/livestock) and productive forest (for forestry/forest products collection) saved by the intervention.
- Essential infrastructure saved by the intervention (e.g. existing and projected hydropower plants, communication systems, industrial complexes, cultural and religious sites and main tourist attractions).
- Estimated project cost.

The results for this scoring were then weighted according to an agreed importance of each criterion as determined by the stakeholder group to give a total score for each option. Finally, the scores were adjusted on the basis of whether the option was local, regional or national to rank the options in order of priority. These priorities were used to make the case for funding the two highest priority options; namely, a disaster management strategy and artificial lowering of Thorthomi Glacier Lake.

In this MCA, the costs of implementation had a relatively low weight (0.2) compared to the benefits (0.8), indicating that achieving beneficial outcomes had a greater value than the costs incurred in doing so.

9.4 Characteristics of decisions, methods and approaches

The characteristics of the decision to be made determine which approach – MCA, BCA or CE – is the most appropriate, as outlined in Figure 9.1. The UNFCCC (2011) has produced more detailed guidance on strengths and weaknesses of each approach in a useful reference manual.[4]

How to communicate the outcomes of the analysis to achieve high-level buy-in is an important consideration. Financial planners and investors may be able to relate more closely to financial arguments than arbitrary scoring metrics. However, the assumptions for monetisation will need to be clearly presented. The results of a MCA will also have to demonstrate clearly that the full range of stakeholders and experts have been consulted in the analysis.

In addition to the results of the economic analysis, the following areas should also be addressed in the analysis and subsequent presentation of results:

- **Future uncertainties** – What is the confidence level for the analysis? What are the main sources of uncertainty (e.g. climate scenarios, economic development pathways, discounted costs, valuation of ecosystems services)? Has sensitivity analysis been carried out?
- **Valuation assumptions** – What has been included and excluded from the analysis? What is the sensitivity in changing monetisation approaches to the decisions being made?
- **Equity** – Are the benefits and costs equitably distributed?

The valuation of ecosystems services is an important consideration when carrying out economic appraisal. Although these are more difficult to assess than economic performance indicators, ignoring their value can lead to unintended negative consequences for ecosystems and those who rely on them, as well as missing important investments centred around safeguarding existing ecosystems services. Box 9.3 discusses the valuation of ecosystems services.

At the highest levels of national accounting, initiatives are underway to ensure holistic accounting of national assets and growth. 'Natural capital accounting' (discussed further in Box 9.4) provides the opportunity for countries to take stock of assets that do not readily fit into existing economic accounting indicators like gross domestic product (GDP).

Another key consideration when planning economic appraisal is the scale of the investment being proposed. In the case of small investments (relative to the budgets of the funding organisations), less detail will be required to demonstrate

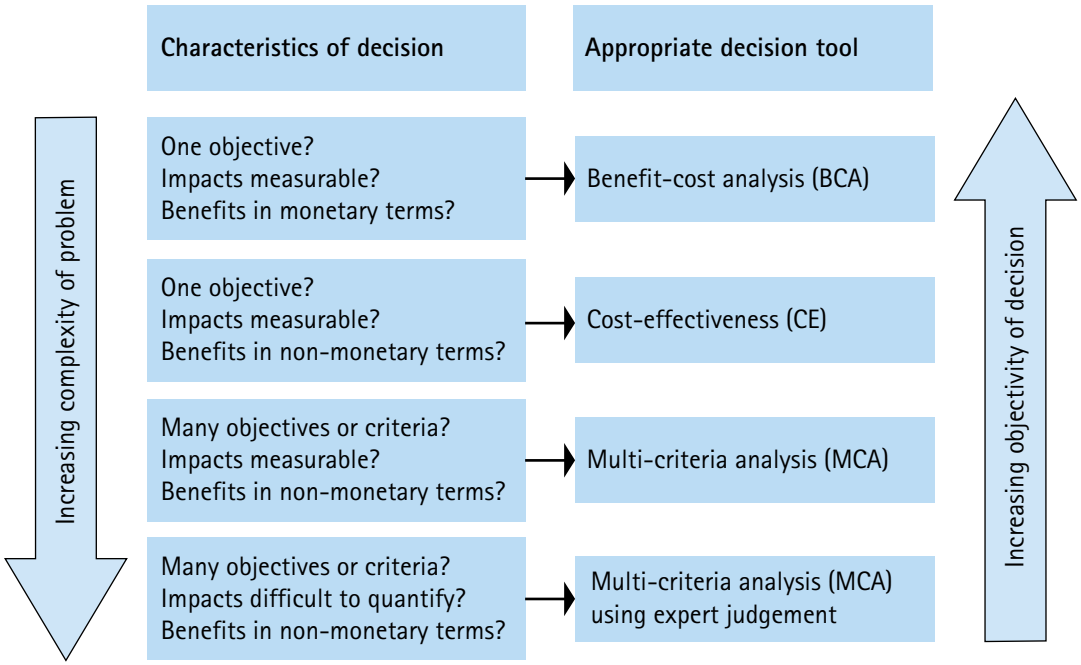


Figure 9.1 Characteristics of decisions and decision making approaches UNFCCC (2011)[5]

Box 9.3

Valuation of ecosystems services

Ecosystems services provide provisioning, regulating, cultural and support services for human society. The Board of the Millennium Ecosystem Assessment has stated that nearly two thirds of the services provided by nature to humankind are found to be in decline worldwide. In effect, the benefits reaped from our engineering of the planet have been achieved by running down natural capital assets. Valuation, including monetisation, of environmental costs and benefits is, therefore, a crucial part of economic analysis for development, especially in the water sector, given the wide-ranging externalities of managing a shared natural resource. It also presents a powerful argument, revealing in economic terms the often unaccounted benefits and costs associated with development activities.

A wide range of techniques exist for valuing ecosystems services, providing both economic and qualitative measures of value. A variety of methods are outlined in a useful reference guide, An Introductory Guide to Valuing Ecosystem Services, produced by the UK Department for Environment, Food and Rural Affairs (Defra).[6] The techniques described in the guide include the following:

- **Revealed preference methods**
  - Market prices;
  - averting behaviour;
  - production function approach;
  - hedonic pricing,
  - travel cost method;
  - random utility models.
- **Stated preference methods**
  - Contingent valuation;
  - choice modelling.
- **Cost-based approaches**
  - Opportunity cost;
  - cost of alternatives/substitute goods;
  - replacement cost method (also known as 'shadow project costs').
- **Methods of eliciting non-economic values**
  - Focus groups;
  - in-depth groups;
  - citizens' juries;
  - health-based valuation approaches;
  - Q-methodology;
  - Delphi surveys;
  - systematic reviews.

Box 9.4

Natural capital accounting[7]

Many countries are looking beyond GDP to help them address the challenges that undervaluation of natural capital has created. What they need is a measure of a country's wealth that includes all of its capital – produced, social, human and natural capital.

At the Summit for Sustainability in Africa, held in Botswana in 2012, 10 African countries endorsed the need to move towards factoring natural capital into systems of national accounting.

Africa has several examples of natural capital accounting already at work, and Botswana is piloting water accounts that its government is using to determine how much water each sector of the economy is consuming and where that limited resource is possibly being overused. Having this information can help the government weigh the economic trade-offs and create effective incentives for water efficiency.

Natural capital accounting has been talked about for many years and has gained greater leverage through a UN Statistical Commission approved method known as the System for Environmental and Economic Accounts (SEEA). SEEA provides methods for countries to account for natural resources such as minerals, timber and fisheries. The next step is to expand natural capital accounting to cover ecosystem services, like the storm protection provided by mangroves.

A recent study of mangroves in Thailand shows what a difference this knowledge can make. When you look purely at the timber value of the mangroves, they are valued at approximately US$955 per hectare. Replacing them with shrimp farms would return an estimated US$11,000 per hectare. So, conventional economics would favour conversion to shrimp farming. But when you factor in the mangroves' critical role as storm and flood barriers, their value rises to over US$20,000 per hectare. If this information and this kind of thinking had been presented earlier, the large swathes of mangroves around the Gulf of Thailand that were destroyed for shrimp farming and coastal development might still be intact.

benefits than for substantial investments where the economic analysis will be a large and detailed piece of work in itself.

The economic analysis of investment options also relates closely to the principles of 'robust decision making'. If an investment option's benefits can be categorised as 'no regrets' then the economic analysis will demonstrate benefits under any scenario. However, if the option has some climate risks

associated with it then the economic analysis will have to reflect the benefits and costs under each climate and development scenario to provide the full range of possible returns. For smaller investments it may be appropriate to make qualitative assessments of the changes in benefits and cost under different climate and development scenarios.

9.5 Final remarks

Economic justification is a powerful tool in arguing the case for investing in identified no/low regrets options. A range of tools exist, which will be familiar to financial planners and economists.

CE and BCA are commonly used for financial appraisal. Many investments offer returns to which it is difficult to assign monetary values, but this should not mean that these benefits – often social or environmental – remain hidden to decision makers. In some cases these benefits can be monetised, although this may entail significant additional work.

In cases where monetisation is not possible, MCA offers the potential to compare diverse cost and benefit factors. Studies that monetise the value of ecosystems services can help to address the consistent undervaluation of these services in decision making, which is usually dominated by standard economic appraisal techniques.

The expected outputs from making the economic case for investment options should include:

- An economic analysis report for each component of the no/low regrets investment opportunities portfolio.
- A report ranking the portfolio of investments according to the outcomes of the economic analyses.
- Recommendations grouping investments as: (i) early implementation; (ii) marginal/require modification; and (iii) not viable.
- A briefing note for high-level decision makers and their development cooperation partners.

The outcomes of this step in the process should bring to the table a prioritised set of economically justified and demonstrably no/low regrets investment opportunities, agreed by all key stakeholders, for early implementation. The outputs can be used to communicate the benefits of no/low regrets investments and to help prioritise detailed project preparation. The outputs should be used to influence policymakers so that they can be integrated with existing development plans and budget allocations, and also serve as input for future strategies and plans.

Chapter 9 references

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10 | INTEGRATING NO/LOW REGRETS INVESTMENTS IN DEVELOPMENT PLANNING PROCESSES

Key messages

- In the short term, integration of 'no/low regrets' investments relies on finding the right mechanisms and processes to ensure the investments are carried forward for implementation.
- Network analysis provides a tool for understanding planning systems at all levels, to facilitate targeted integration of no/low regrets investments.
- At the local level, the main tool for integration is implementation of demonstration projects as part of ongoing initiatives in the area. Project preparation facilities may be helpful in developing investment opportunities into bankable projects.
- At a national level, the main tools for early action and integration include mechanisms to influence budget strategy papers (BSPs), medium-term expenditure frameworks (MTEFs) and annual budgetary processes.
- Influencing development cooperation by aligning donor and international financial institution (IFI) development priorities with no/low regrets investments may enhance budget support for implementation.

This chapter supports Phase 3 of the Framework by elaborating on the integration of previously identified no/low regrets investments into existing development planning processes. Integration is a short-term goal to ensure early uptake of the investments and some early wins on the ground. The longer-term goal is to ensure that water security and climate resilience are mainstreamed in development planning.

Recommended sources of further information:

Integration of no/low regrets investments into development planning is a novel angle on development planning which bridges governmental and non-governmental planning and implementation systems. The literature is limited, but this Stockholm Environment Institute report describes the entry points at different planning levels for the integration of investment opportunities.

Lebel, L., Li, L., Krittasudthacheewa, C. et al. 2012. *Mainstreaming Climate Change Adaptation into Development Planning.* Adaptation Knowledge Platform, Bangkok, Thailand and Stockholm Environment Institute, Stockholm, Sweden. Available online at: http://www.climateadapt.asia/upload/publications/files/4f66f3868a813Mainstreaming_climate_change-v6_for_Web.pdf

10.1 Overview

Phases 1 (Understand the problem) and 2 (Identify and appraise options) of the Framework result in the development and selection of no/low regrets investments. In Phase 3 (Deliver solutions), short-term action is needed to integrate investments into existing planning systems and instruments, in order to ensure that the investments are carried forward for implementation. In addition, a more strategic adjustment of the planning processes themselves is needed, to ensure that in future decisions take climate risks into account for improved climate resilience. This is known as mainstreaming and is described further in Chapter 12, which also supports Phase 3 of the Framework.

The Framework does not aim to produce a separate investment stream for climate resilience; instead it envisions implementation of investments through existing planning instruments. This avoids fragmentation of responsibility and spending while raising climate resilience on the agenda of implementing agencies.

The integration process requires two steps:

1. Understanding the planning and implementation processes.
2. Identifying appropriate entry points for no/low regret investments, and building an action plan for transferring ownership of the investments.

10.2 Network analysis: a tool for understanding planning systems

To locate entry points for integrating investments, an understanding of the planning processes related to land and water management is needed. A network analysis allows the relationships between planning authorities, service providers and users to be quantified and displayed visually. For example, a network analysis for water management at a national level would be a complex web linking ministries of finance, environment, water and agriculture, water supply companies, user groups, NGOs, IFIs, regulating and legal bodies and river and lake basin organisations (RLBOs). In addition, the key strategy documents may be integrated into the network analysis, including the BSP or poverty reduction strategy paper (PRSP). Network analysis can be used to map the interactions between individuals, groups, organisations or planning instruments. The analysis is highly scalable allowing it to be applicable from the community level right up to the transboundary level of interaction. Further information on network analysis is available in a 2007 World Bank report by Holland.[1]

Network analysis can be used to answer the following questions:

- How are decisions taken?
- Which groups or individuals are the major players in decision making and which are less influential?
- Which direction do information, finance and influence flow in the network?

Network analysis provides the information needed to target the integration of investments for water security and/or climate resilience, as well as raising understanding amongst planners of how their roles fit into the wider network of decision making. The network to be analysed will depend on the context of the application of the Framework; it might be a sector at the national level, a river/lake basin, an urban centre or a group of communities.

It is also important to note that network analysis should accommodate both water consumers and legal/governance institutions. Much of Africa's economic growth is underpinned by industrial development and agriculture, both of which can be substantial water users and are exposed to climate risks. Therefore, planning efforts for the implementation of no/low regrets investments may also need to be targeted towards users and user associations rather than aimed entirely at centralised government planning.

Box 10.1 provides more information on network analysis as a tool for understanding planning processes.

10.3 Entry points for integration of investments

Entry points for integrating no/low regrets investments depend on the planning level of the investments identified (transboundary, national, sub-national or local) and the institutional arrangements within the selected location. Investment opportunities are likely to be diverse, see Box 10.2, and knowledge of the planning system and its instruments is crucial if these are to be integrated successfully into the most appropriate systems for financing, implementation, and beyond.

10.3.1 Transboundary-level entry points

No/low regrets investment opportunities at the transboundary level require collaboration across national planning systems. Regional Economic Communities (RECs) offer a platform for investment planning at this scale, while RLBOs can provide technical assistance for planning or coordinating investments. Learning whether transboundary planning systems exist and how suitable they are for integration of no/low regrets investments is a first step. For example, the Eastern Nile Subsidiary Action Program is a joint investment programme run by Sudan, Ethiopia and Egypt to identify and implement investment projects and programmes in the Eastern Nile basin. The Southern African Development Community (SADC) Regional Strategic Water Infrastructure Development Programme is another such programme for identifying and planning investments. Although

Box 10.1

The application of Net-Map, a network analysis tool, for the White Volta Basin Board, Ghana[2]

The White Volta Basin Board (WVBB) in Ghana is a multi-stakeholder body for coordination of water resources management in Northern Ghana and Burkina Faso. It includes many representatives from government agencies involved in resource management, as well as NGOs and traditional authorities.

Network analysis, conducted using Net-Map[3], was carried out for the WVBB driven by the newly created Board's need to better understand the governance environment in which the Board operates and to inform its institutional development. Each of the Board's representatives had a detailed knowledge of their 'corner' of the network but lacked a 'bigger picture' view of the network as a whole.

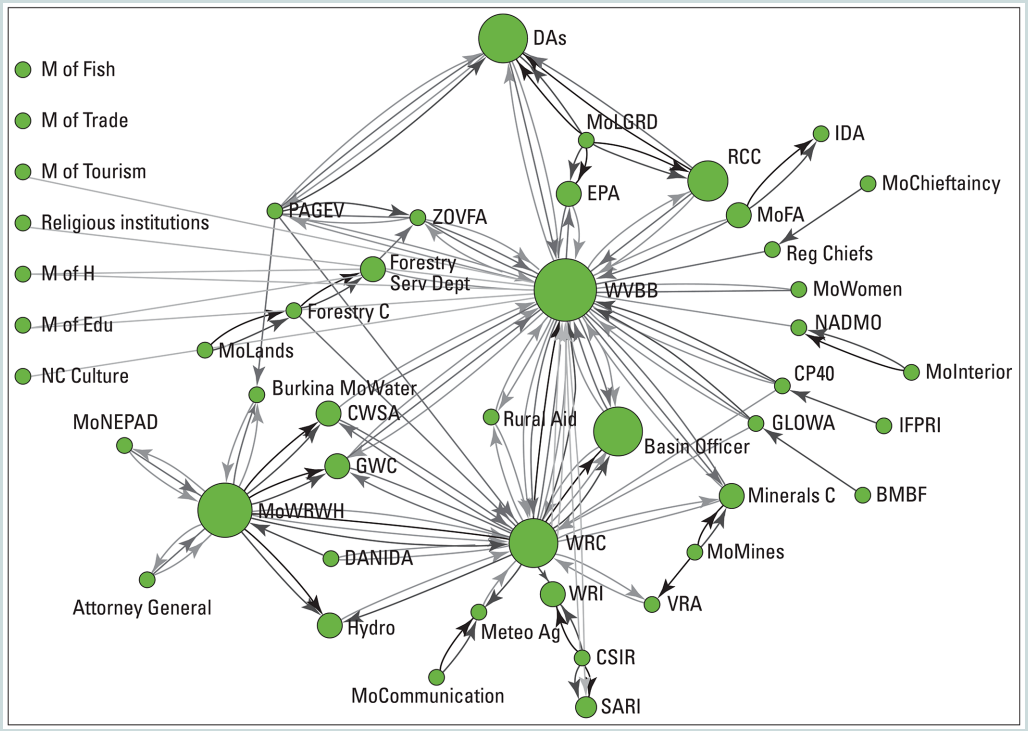
Network analysis was carried out in a participatory manner using the following steps to build network influence maps indicating flows of funding, advice and command:

- individual interviews with all 17 board members;
- feedback and discussion with the entire Board;
- drawing Net-Maps with small working groups of Board members (plus one external group of actors seen as powerful in the individual networks);
- feedback and discussion with the entire Board;
- development of a 'common influence network map' and 'strategic influence network planning' with the whole Board.

The process of developing the network influence map contributed to a common understanding of the network among all the actors involved. Once the influence network map was agreed upon it was analysed to draw the following conclusions:

- The Board is a marginal actor in terms of the funding network and command network, indicating that it cannot achieve its aims through these flows. However, it is centrally placed in the advice network, indicating that this is the mechanism most appropriate for the Board's activities.
- The Board has a high degree of centrality in the advice network, providing the sole link between many diverse actors. This makes the network vulnerable to the collapse of the Board at its centre.

The influence network map was also used to define a group of high-influence stakeholders who should be priority targets for the Board's activities. Low-influence actors were also identified by the Board as good potential targets for increasing influence in the future.



The figure shows a network analysis for the White Volta Basin Board (WVBB) in Ghana.[4]

Box 10.2
Examples of no/low regrets investments

Examples of no/low regrets investments at different levels.

Transboundary-level

- Data sharing.
- Developing decision support systems for water management.
- Disaster risk reduction through management of residual risks, such as disaster risk insurance.

National-level

- Carrying out comprehensive climate risk assessments to inform strategic planning, centrally or by sector.
- Building links between research organisations and policymakers for land and water management.
- Review of planning regulations and systems through a 'climate risk lens' to understand how guidance or regulation could accommodate climate change and climate risks.

Sub-national-level

- Review of climate risks posed to sub-national infrastructure systems (water supply, transport, power).
- Municipal flood-risk management strategy development.
- Drought management planning at basin level.

Local-level

- Land and water management demonstration projects to improve livelihoods and generate lessons.
- Income diversification and micro-finance to improve resilience of communities.
- Review of the distribution of climate risks across communities, focusing on vulnerable sections of the community.

these organisations focus on hard infrastructure they could be potential targets for integrating no/low regrets investments that could complement hard infrastructure through improving risk management.

10.3.2 National-level entry points

No/low regrets investments at the national level are more likely to be focussed on the governance of land and water management, with the broad aim of reducing climate risks through improved understanding and management of risks rather than developing hard infrastructure solutions. The key challenge is to ensure that a strong case for investment is made to a high-level audience, thus raising the demand for investments in knowledge and systems to better manage natural resources and climate risks. This will give the impetus for no/low regrets investments to be integrated within national-level planning tools, such as the MTEF and BSP. In addition, network analysis should reveal donor and IFI interests in water security, which may provide opportunities for integration of no/low regrets opportunities in donor strategies, such as the World Bank Country Assistance Strategies.

10.3.3 Sub-national (municipal, basin or district)-level entry points

Sub-national investments are likely to focus on the specific climate risks and management processes in the municipalities, districts or basins in which the Framework is being applied. Investments may be integrated into sub-national planning services, such as flood plain zoning for urban development or regulated service delivery organisations such as water supply companies. The success of integration into planning systems at this level is highly dependent on the nature of the strategic planning and delivery of investments. Pilot projects may be valuable at this level to build capacity amongst sub-national planners, highlight best practice in land and water management, and promote the uptake of climate finance and other innovative sources of finance.

10.3.4 Local- or community-level entry points for integration of investments

Local-level investments are likely to focus on the demonstration of best practices in climate resilience for communities and livelihoods. These should ensure that a clear emphasis is placed on the local systems of decision making and governance, to establish a longer-term shift in decision making to accommodate climate risks and longer-term land use planning. Such investments could contribute to additional climate resilience measures as part of ongoing development initiatives at a local level where these are already underway. Ensuring higher-level representatives of government are aware of (or involved in) the outcomes of local-level investment will facilitate the transfer of lessons to wider planning policy as a mainstreaming co-benefit.

10.4 Influencing resource allocation to no/low regrets investments using national planning instruments

Undertaking a network analysis will reveal the institutions and planning instruments that can be targeted for integration of no/low regrets investments. At the sub-national level, planning systems may vary considerably. To some extent at the national level, African countries use similar planning instruments, such as BSPs and MTEFs; guidance on influencing these is provided here.

National- and sector-level strategies are key tools for shifting resources into line with policy. Strategy formation has its own

3–5-year cycles and each strategy will be at a different stage in different countries. The inclusion of already identified no/low regrets investments to influence those strategies that are due for revision in the near future, and focusing on priority sectors (which vary from country to country), will help to ensure resources are targeted towards water security and climate resilience.

Central ministries (e.g. economic planning and finance and/or the office of the prime minister) play a key role in allocations and arbitration among sectors. This includes the budget process, which determines how much funding is received by sectors affected by water security and climate change. Presenting a well argued and economically justified case for sector investments in no/low regrets investments that support national development goals is essential.

The national budget process is an important tool for promoting water security and climate resilience. While the national development strategy provides broad guidance, the national budget process is where the hard decisions over resource allocation – both recurrent and development spending – take place. Claiming climate resilience benefits in promoting sector or cross-sector strategies should provide opportunities to influence budgeting if the ministry of finance is fully engaged in the process.

Sector strategies should include funding strategies that are justified by climate change to some extent. A good sector strategy includes a systematic financing plan, including contributions from government, donors and the private sector. Many donors favour programmes that are no/low regrets and there are funding channels that are exclusively available for climate-related programmes.

10.5 Influencing development cooperation to incorporate no/low regrets investment priorities

Water security and climate resilience are likely to be important issues for most donors. Government leadership in placing more priority on these issues and increasing harmonisation and cooperation under the principles of the Paris Declaration provide opportunities to influence and maximise the use of external development cooperation. Opportunities exist for aligning no/low regrets investments with donor priorities through budget support. This requires both the demand from the government for the no/low regrets investments and the alignment of donor commitments with government priorities.

General budget support (GBS) has become increasingly important, but has so far largely ignored water security and climate resilience. The Paris Declaration calls on donors and governments to make it possible for donor support to be provided through budgets, either through the central budget, as GBS, or sector budget support. GBS is normally provided by phased disbursements from donors into central revenue, with each tranche being dependent on progress against a set series of indicators, which may include reforms or socio-economic progress. To date, most of the indicators have been related to economic performance or the main health and education targets set under the Millennium Development Goals. Water and the environment have not featured prominently amongst the GBS indicators, although one of the functions of the Global Climate Change Alliance, funded by the European Commission (EC) and a group of bilateral donors, is to 'climate proof' GBS from the EC, amongst other EC programmes. Provision of timely data on high-level indicators on water security and climate resilience helps to encourage governments and donors to include these indicators among the GBS conditions. Some of the key lessons learned from a review of GBS are outlined in Box 10.3.

There should be opportunities for sector budget support to promote water security and climate resilience, but to date there is almost no experience with this. Sectoral budget support (e.g., sector wide approaches, or SWAps) also provides opportunities for increasing the profile of water security and climate resilience (see example in Box 10.4). However, most SWAps in Africa have been in support of the education and health sectors. There is some experience in SWAps for agriculture – generally focused on institutional strengthening rather than agricultural water management – but little or no experience in the water sector.

Box 10.3
Lessons learned from general budget support (GBS)

A recent review of GBS reached a number of conclusions that have important implications for water security and climate resilience[6]:

- GBS is linked to national strategies and can therefore help to overcome the natural inertia of government and to shift resources to sectors that are becoming higher priorities, such as water.
- The success of GBS in promoting sectoral shifts is dependent on political commitment.
- GBS is more effective than uncoordinated project support at ensuring that government policy commitments are met.
- GBS can help promote cross-sectoral policies, but this is dependent on political commitment and has only been achieved in a few cases.
- GBS encourages a long-term approach to development that should favour sectors such as water security and climate resilience, which depend on taking a long-term outlook.

Box 10.4

Sector budget support in Mozambique

Mozambique has one of the longest experiences with budget support. The framework agreement for general budget support was based on its PRSP (the PARPA), which committed 65% of budget resources to the four priority sectors (education, health, roads, and water and agriculture).

In addition to general budget support, Mozambique also has long experience with PROAGRI, one of the most comprehensive SWAp schemes in Africa. The experience with PROAGRI shows that donors can provide sustained SWAp, but that this tends to be more appropriate for institutional strengthening than investment. As a result, it can lead to an imbalance in expenditure between building capacity and delivering benefits.

Where full sector budget support is not possible, there should be opportunities for arrangements involving pooled funding. Government and donor pooled funding can include trust funds. Examples include:

- In Zambia, a Devolution Trust Fund was formed in 2002 to coordinate donor funding for water supply and sanitation, with 95% donor funding. The activities of the Trust Fund were recognised under the Fifth National Development Plan.
- In Zimbabwe, a programme of support to water supply and sanitation has been funded from the multi-donor Zim-Fund, which was created to support many sectors and is managed by the African Development Bank (AfDB).

In such instances, and extending the remit further, trust funds could potentially be earmarked for water security and climate resilience and directed toward the funding of no/low regrets investments.

10.6 An action plan for integration of investments in planning systems

The final stage in integrating investments is the development of an action plan in partnership with targeted organisations/institutions that provides a common view of the way forward for integration, including measurable targets where possible. The issues discussed in the previous sections should be taken into account in formulating the action plan and the following principles may also be helpful:

- **Ensure high-level political support** for integrating investments into relevant planning bodies and detailed planning processes. This provides a driver for planning authorities to carry through investments to the implementation phase.
- **Understand the planning process** and find entry points to influence it at whichever planning level the Framework is being applied. Entry points may include:
  - transboundary basin investment plans;
  - national-level annual budgetary processes or medium-term investment plans (such as BSPs or MTEFs);
  - donor assistance and investment strategies (such as World Bank Country Assistance Strategies or AfDB Country Investment Plans);
  - sector-wide, municipal, district or basin investment plans and strategies;
  - local-level initiatives and ongoing programmes of action.
- **Identifying 'windows of opportunity'** for detailed planning and implementation of investments within existing plans and strategies (e.g. alongside the planned upgrading of existing infrastructure) or integrating longer-term investments in strategies under review (e.g. strengthening of RLBO mandates).
- **Maintaining support** to planners through partnerships and capacity building to catalyse integration and capitalise on new skills and partnerships.

10.7 Project preparation facilities

The planning of projects can be assisted through project preparation facilities (PPFs), which provide the expertise to move from outline investment opportunities to bankable projects (see Box 10.5).

10.8 Final remarks

Integration of no/low regrets investments into existing development planning is the immediate short-term goal as it will lead to early action and benefits on the ground. In the longer term, the goal is to ensure that water security and climate resilient development are mainstreamed into national, sub-national and transboundary policy and strategy formulation and implementation.

Integration is highly dependent on the planning level of Framework application. Local-level no/low regrets investments are integrated with both local priorities and higher-level

Box 10.5

The use of project preparation facilities

PPFs provide support to project sponsors undertaking the following six phases of project preparation:

- Phase 1: Enabling environment
- Phase 2: Project definition
- Phase 3: Project feasibility
- Phase 4: Project structuring
- Phase 5: Transaction support
- Phase 6: Post-implementation support

The development of no/low regrets investments may have already progressed substantially during application of Phases 1 and 2 of the Framework. However, the support provided by PPFs can be extremely valuable in securing bankable projects.

The Infrastructure Consortium for Africa has produced a guide to infrastructure for PPFs in Africa.[5] The guide presents 23 PPFs and highlights critical information such as which phases of project preparation they can assist with, applicable sectors and the conditions associated with the support.

government objectives. These can take the form of pilot projects, to improve water security and climate resilience and to learn lessons for wider application. National-level integration involves influencing budget strategies to incorporate priority areas for investment.

The expected outputs from this step should include:

- A summary report on the network analysis, detailing the structure of the planning system into which investments will be integrated.
- Identification of target institutions/organisations for integrating no/low regrets investments and an action plan for achieving this with measurable objectives.

The outcomes of this step will move investments from opportunities to commitments that are integrated with ongoing development planning processes. As a result, there is greater ownership of the investments and a more tangible route toward implementation. In combination with the robust decision making and economic analysis, this integration process will give investors the confidence to support these investments.

Chapter 10 references

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3 Further information on Net-Map is available through the Small Reservoirs Toolkit (available at: http://www.smallreservoirs.org) and in Schiffer, E. and Hauck, J. 2008. *Net-Map (Influence Network Mapping) – Theory. Small Reservoirs Toolkit.* Available at: http://www.smallreservoirs.org/full/toolkit/docs/IVb%2002%20Networking%20Mapping_MLA.pdf

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11 DEVELOPING FINANCING AND INVESTMENT STRATEGIES

Key messages

- The cost of water security for Africa will be tens of billions of dollars annually. In round figures, the range is US$30–50 billion for capital investment, and US$5–15 billion on annual budgets. This is far more than what is currently being spent.
- Climate proofing could add another US$10–15 billion annually to these figures.
- Recent global financial events have affected funding for water. There has been a decrease in commercial bank loans, bond issues and private equity, and greater reliance on state budgets, lending from international financial institutions (IFIs) and loans from the non-Organisation for Economic Co-operation and Development (OECD) emerging markets.
- Historically, relatively little financing for adaptation has been directed towards Africa, although recent data suggest this trend may finally be changing.
- A valuable niche for climate finance is to support early stages of the adaptation project cycle, including plans, project preparation, innovation and piloting. A move towards this would be a positive step, providing access to larger amounts of money, especially IFIs and non-OECD emerging market lenders, for implementing and replicating projects at the scale required.
- Some market lenders focus resources towards investments in key production sectors, such as power, minerals, land and agriculture. Because these sectors are often water-intensive they can also benefit from improvements in water security.
- The private sector is recognised as a driver to improve water security and climate resilience, and planners should explore ways to stimulate and benefit from this.
- There is no set funding recipe for financing strategies. Therefore, pragmatic arrangements are required, depending on the availability and appropriateness of different funding sources.

This chapter supports Phase 3 of the Framework with a discussion of the approaches to developing investment and financing strategies. Sources of conventional and specialist climate finance are identified. In most African countries the prospects for water finance – compared with those a decade ago – lie less with commercial bank loans, private equity and bonds, and more with host government budgets, lending from IFIs and finance from other emerging economies, especially China. The impact of these new funds is starting to be felt.

Recommended sources of further information:

The Overseas Development Institute (ODI) has produced a series of briefings on the current trends in climate finance in sub-Saharan Africa and its future needs.

Nakhooda, S., Caravani, A. Bird, N. and Schalatek, L. 2011. *Climate Finance in Sub-Saharan Africa*. ODI/Heinrich Böll Stiftung Available at: http://www.odi.org.uk/resources/details.asp?id=6151&title=climate-finance-sub-saharan-africa

The EU Water Initiative Finance Working Group (EUWI-FWG) has produced a primer on conventional principles for water financing including tariffs, taxes, transfers and repayable funding sources. It includes a discussion on the application of each funding source and a discussion on leveraging finance.

EU Water Initiative Finance Working Group (EUWI-FWG), 2011, *Financing for Water and Sanitation A Primer for Practitioners and Students in Developing Countries*. Available at: http://www.gwp.org/en/gwp-in-action/News-and-Activities/Financing-water-resources-management/

11.1 Overview

Adapting to climate change and building water security and climate resilience into growth and development activities requires higher levels of investment than at present. Innovative approaches to financing are needed to make sufficient funding available, and financing strategies will benefit from a blend of traditional water finance sources alongside specialist climate finance.

A key step in Phase 3 (Delivering solutions) is to develop financing strategies for the portfolio of 'no/low regrets' investments identified earlier, and for these to be integrated into existing development planning processes.

In most African countries, the prospects for water finance – compared with those a decade ago – lie less with commercial bank loans, private equity and bonds, and more with host government budgets, lending from international financial institutions (IFIs) and finance from other emerging economies, especially China. The impact that this is having on investment in Africa's development and growth is discussed.

No/low regrets investments have the potential to attract finance from a wide range of sources, including conventional sources as well as emerging climate adaptation financing streams. Some no/low regrets investments, such as protecting natural carbon sinks or green energy development, may also qualify for mitigation funding.

Climate finance is a potential source of funds for establishing an enabling environment for water security and climate resilience, as well as for supporting upstream water infrastructure project preparation. Blending climate finance with traditional water finance from Official Development Assistance (ODA) and the private sector is a good strategy. However, since circumstances vary widely, financing strategies should be judged pragmatically by whether they deliver sufficient affordable funding of the right type.

11.2 The cost of water security and climate resilient development

Financing for water was broadly addressed in the 2003 Report of the World Panel on Financing Water Infrastructure.[1] The conclusions were that, globally, the following measures were required: a doubling of the level of investment, expansion of all existing sources of finance, find 'clever' ways of combining funding sources, address the specific risks of funding water, and give special attention to the financing needs of sub-sovereign and decentralised bodies. The report encourages pragmatism in the search for and use of finance from a range of different sources, and this remains as valid today as it was then.

The water infrastructure investment requirements projected by the African Regional Paper for the 5th World Water Forum in 2009 amount to between US$46 and US$51 billion annually, over the period up to 2030.[2] Associated annual recurrent costs would range from US$4 to US$8 billion.

The Africa Infrastructure Country Diagnostic (AICD) project has undertaken a parallel exercise, building from national data.[3] These data are not directly comparable to those in the African Regional Paper since the period of analysis is shorter (2006–2015) and the analysis uses different databases and assumptions; the assumption is that over a period of 10 years running up to 2015, the continent should be expected to address its infrastructure backlog, keep pace with the demands of economic growth, and attain a number of key social targets for broader infrastructure access. The AICD estimates cover a more limited group of sub-sectors (water supply, sanitation, irrigation and multipurpose storage), totalling US$31 billion for investment and US$14 billion for recurrent costs, both in annual terms.

The AICD also reports estimated actual levels of spend for each sub-sector annually from 2001 to 2006. These illustrate the substantial financing gap between actual and required levels of investment in infrastructure which must urgently be addressed to achieve development commitments.

The cost estimates published by these two research teams are summarised in Table 11.1, broken down by major item of water infrastructure.

The cost estimates presented above make no allowance for the additional cost of adapting Africa's water infrastructure for climate resilience. World Bank estimates are now available for this additional cost,[5] although the following caveats should be noted:

- The costs depend on which scenario of future climate change is selected. The World Bank authors use two alternative scenarios[i] representing the 'wettest' and the 'driest' outcomes for the end of the 2010–2050 period (the analysis presented in Table 11.2 below uses the former scenario, which does not differ greatly from the latter).
- The difference between 'adaptation' and 'development' spending is not clear-cut, particularly in countries unable to cope even with existing climatic variations. The estimates made by the World Bank and presented here focus on the cost of adjusting to future climate change; conceptually, this should also deal with adaptation to current variability.[6]
- Only costs falling on the public sector are included. 'Autonomous' or 'spontaneous' adjustments undertaken by

i Based on Global Climate Models from the National Centre for Atmospheric Research ('wettest' scenario) and the Commonwealth Scientific and Industrial Research Organisation ('driest').

Table 11.1 Cost estimates of African water infrastructure (US$ billion, annually)

	African Regional Paper (African Development Bank) Annual spending needs 2009-2030		Africa Infrastructure Country Diagnostic (AICD) Annual spending needs 2006-2015		Africa Infrastructure Country Diagnostic (AICD) Estimated annual spend 2001-2006	
	Investment	Operations & Maintenance	Investment	Operations & Maintenance	Investment	Operations & Maintenance
Water supply	1.4	2.3	11.6	5.5	4.6	3.1
Sanitation	3.5	2.2	3.9	1.4	n.a.	n.a.
Wastewater	5.0	n.a.	n.a.	n.a.	n.a.	n.a.
Desalination	1.0	n.a.	n.a.	n.a.	n.a.	n.a.
Irrigation and agricultural water management	4.5–5.5	1.5–3.5	2.9	0.6	0.3	0.6
Hydropower and multipurpose water storage (MWS)	Hydro: 20.0 MWS: 15.0	n.a.	13.3 (27.6 power sector total)	7.0 (14.1 power sector total)	(4.6 power sector total)	(7.0 power sector total)
Total	**46.4–51.4**	**4.5–8.0**	**31.7**	**14.5**	**9.5**	**10.7**

n.a. = not available. Sources: [4].

private agents (households, farmers, businesses) using their own financial resources are not costed in.

- Climate change will create gainers as well as losers, both within and between countries. Uncertainty as to if and how gainers may compensate losers for gross costs is not considered.

With the above qualifications, the estimated additional costs of adapting water infrastructure to be climate resilient in sub-Saharan Africa are presented in Table 11.2.

A separate study of the costs of 'climate proofing' the Millennium Development Goals (MDGs) in Africa found that:

Table 11.2 Annual additional costs of adapting the water infrastructure to climate change in sub-Saharan Africa, 2010–2050: gross undiscounted costs under NCAR 'wettest' scenario

Adaptation investment	Annual cost in US$ billions (2005 values)
Water infrastructure (including urban drainage, water and sewage treatment)	0.6
Coastal zone protection and residual damage	3.9
Water supply and riverine flood protection	0.4
Raw water supply (including storage, desalination etc.)	6.2
Irrigation efficiency measures	0.2
Irrigation expansion	0.6
Total above items	**11.9**
Total all adaptation measures in all sectors	18.9
All adaptation measures as % of GDP	0.6

"*[T]he external financing needed for 'climate resilient' MDGs is about 40% higher than the external financing for the MDGs alone.*"[7]

For the water and sanitation category the extra external public funding needed to climate-proof these investments is estimated to lie in the range of US$2.9 to US$7.2 billion annually, compared with the original MDGs cost of US$7.9 billion annually for 2010–2020, of which ODA totalling US$5.8 billion was assumed necessary.

11.3 Recent trends and new opportunities in water financing

11.3.1 Global financial context

The global financial turmoil since 2007 has affected Africa's external financial environment,[8] but the region has weathered these events better than some others and its immediate prospects are for levels of economic growth that are high by recent standards. However, great disparities between countries and differences among the various water categories (i.e. households, irrigation, hydropower, wastewater, etc.) limit what generalisations can be made.

Compared to a decade or so ago, the prospects for water finance for most African countries lie less with commercial bank loans, private equity and bonds, and more with host government budgets, lending from IFIs, and finance from other emerging economies – especially China.

Some observers note an emerging pattern of specialisation, with three broad types of finance for African infrastructure: **private**

equity participation gravitates towards commercially profitable sectors, especially information and communications technology (ICT); **financiers from emerging markets**, mainly China, favour productive infrastructure, such as power generation and railways; while **traditional ODA** funds support public works, including roads and water supply, alongside other sectors.[9]

The relative importance of ODA is likely to fall due to fiscal difficulties faced by many donor agencies, but this impact may be delayed due to the lag between commitments and disbursement of funds. However, some leading IFIs (e.g. World Bank, African Development Bank, European Investment Bank) have announced new resources and special facilities, partly to respond to the global downturn and partly to address climate resilience and the African infrastructure deficit. In recognition that large infrastructure projects tend to need combinations of finance from different sources, the EU–Africa Infrastructure Trust Fund has been set up as a mechanism for blending finance of different types, from different sources.

The impacts of new funds for climate adaptation and resilience are starting to become increasingly important and provide additional investment funds for water security and climate resilience (see examples in Box 11.2). Proposals for the Green Climate Fund (GCF) to move towards a better balance between mitigation and adaptation, and for financial inputs to diversify beyond developed country members of the UNFCCC Conference of Parties (COP) to a variety of other sources (including public, private and other alternative sources) will further increase funding opportunities.

11.3.2 Climate finance

Globally, the landscape of climate finance is highly fragmented. Although to date the overwhelming proportion of existing climate funds and the funding flows are directed at mitigation (i.e. clean energy production and use, and the creation, preservation and enhancement of carbon sinks), Africa's large adaptation deficit, vulnerability to climate change, and relatively small global emissions suggest a more urgent need to finance adaptation activities.

Historically, very little financing for adaptation has been directed towards the region, Climate Fund Update data for 2011 suggested that this trend may finally be changing in absolute terms: between 2004 and 2011, funding of US$328 million was approved for 75 adaptation projects and US$132 million was disbursed – which represents about 30% of finance disbursed for adaptation globally (out of a total of US$439 million) – through dedicated climate financing instruments.

Some of the main adaptation funds for African water are outlined in Box 11.1.

Box 11.1

Examples of adaptation funds for African water-related projects[10]

Global Climate Change Alliance
(US$225 million deposited as of April 2012)

An EU initiative for Least Developed Countries (LDCs), Small Island Development States and African countries affected by drought, desertification and flooding, e.g. Mozambique project for "Mainstreaming climate change into policies and strategies".

International Climate Initiative
(US$841 million deposited as of April 2012)

A German Government scheme, operational since 2008, funded from revenues of EU emissions trading. Although its main focus is mitigation, the scheme also assists development and implementation of adaptation strategies and ecosystem adaptation; with GIZ and KFW the implementing agencies. Examples of their projects are development of climate scenarios for the Congo Basin; and, more generally, preservation of natural carbon sinks, and conservation of forests and ecosystems.

Adaptation Fund
(US$258 million deposited as of April 2012)

Created under the Kyoto Protocol, and operational since 2009, this fund is financed from a 2% levy on clean development mechanism receipts plus direct support from developed country budgets. For direct access, potential recipients need to create national implementing entities or alternatively access the Fund through accredited multilateral implementing entities, which include international agencies such as UNDP, UNEP, World Food Programme etc. A total of 17 projects (2 in Africa) have been approved for funding, to a value of approximately US$104 million. Water management projects are the highest in terms of concept endorsement and proposal approval.

Least Developed Countries Fund
(US$379 million deposited as of April 2012)

This fund has been operational under the GEF since 2001 to develop NAPAs, and to implement projects arising from them, in LDCs. Nearly all the finance it provided has been used for the preparation of NAPAs.

Special Climate Change Fund
(US$170 million deposited as of April 2012)

Created in 2001, and administered by GEF on behalf of UNFCCC COP, this fund is mainly intended for adaptation projects in water and coastal zone management, and on coping with drought, through capacity building and technology transfer. Pledges continue to accumulate. There are currently 15 approved projects at a value of approximately US$68 million.

Although many projects funded by the aforementioned facilities are relatively small (approximately US$2–10 million), they often target early stages of the adaptation project cycle and are, therefore, intended to tap larger volumes of money from other sources for implementing and replicating projects at the scale required.

Examples of projects targeting water-related needs and priorities that have been funded through climate finance are presented in Box 11.2. These examples demonstrate a multi-pronged approach to improving climate resilience through combinations of institutional, informational and infrastructural (or technological) interventions.

Certain water activities could benefit from mitigation funding. The treatment of freshwater and wastewater is highly energy-intensive, and generally very inefficient in terms of energy use. The transmission of bulk water and its distribution to consumers are also energy-intensive and energy-inefficient processes. Wastewater treatment and disposal is a major source of methane – a potent greenhouse gas. The high rates of leakage and waste in typical urban water systems translate into further energy waste and underline the same message: water consumption has a high carbon footprint, and measures to address this should be economically and financially efficient, and should qualify for mitigation funding too. The reuse of treated wastewater for agriculture, municipal use and power station cooling may also be considered part of mitigation, insofar as the net effect may be to reduce the use of energy for the distribution and treatment of water and wastewater. Some of these activities, which fit into the mitigation agenda, are also potentially 'no regrets' projects.

In addition, the preservation of forested watersheds, wetlands and other ecosystems that are necessary for abstraction of freshwater and assimilation of wastewater, would also feature in mitigation insofar as they qualify as carbon sinks.

11.3.3 Emerging market development partners

Several emerging economies are now major players in financing African infrastructure – including water – with combined resource flows comparable in scale to traditional ODA.[11] These non-OECD sources include China, India and the Gulf States, with China by far the largest.

Non-OECD[ii] emerging market countries provided US$2.6 billion of finance for African infrastructure annually between 2001 and 2006, mainly for power (including hydropower) and transport, and directed mainly at producers of oil and other natural commodities.[12] There have also been major deals for the purchase

Box 11.2

Examples of the use of climate funds to improve water security and climate resilient development

Eritrea

Eritrea is particularly vulnerable to climate change. Current adaptive capacity is low and the country has Africa's highest level of food insecurity, accompanied by high levels of malnutrition. Finance from the Adaptation Fund (approximately US$6.5 million) has been used to promote increased food security through ecologically sustainable and climate resilient improvements in agricultural production. This programme is aligned with the priorities set out in Eritrea's National Adaptation Programme of Action (NAPA), as well as with its Interim Poverty Reduction Strategy Paper (PRSP), and increases community climate resilience and adaptive capacity through a range of measures, including:

- increased water availability and erosion control through floodwater harvesting and irrigation technologies;
- enhanced climate resilient agricultural and livestock productivity;
- improved use of climate risk information and climate monitoring to raise awareness of and enhanced community preparedness for climate change hazards; and
- use of knowledge management systems to share lessons learned and influence policy.

Honduras

Funding from the Adaptation Fund (approximately US$5.6 million) is being used to increase resilience to climate change by addressing the water-related risks to some of Honduras' most vulnerable urban populations. Pilot activities – and an overarching intervention to mainstream climate change considerations into the water sector – provide a focus for the implementation of the project. Activities include:

- strengthening of relevant institutional structures (e.g. the National Water Authority) for mainstreaming climate change risks into the management of water resources as well as into national planning, public investment budgeting and decision making processes;
- piloting comprehensive measures to safeguard the water supplies of Tecucigalpa City and environs in response to existing and projected water scarcity and to the vulnerability of the city to hydrometeorological hazards, in order to reduce climate change risks;
- targeted capacity building and outreach efforts to enable stakeholders at all levels to effectively respond to long-term climate change impacts.

ii Strictly, this should be non-DAC, since Korea (an OECD member) is taking steps to secure food supplies through major land development schemes in certain African countries.

and development of agricultural land. A number of schemes have involved development of infrastructure for water storage, hydropower and irrigation systems. Although water is rarely the main target sector, it often features within other projects or as one element in a mixed programme. For instance, since 2002 China has provided over US$15 billion in soft loans to Angola, including over US$1 billion for irrigation and water treatment systems.[13]

More than 35 African countries are engaging with China on infrastructure finance deals (mainly through the China Export-Import Bank), which are offered on intermediate terms between fully concessional and fully commercial rates. A number of deals are financed under the **Angola Mode**, whereby repayment is effectively made via exports of natural resources. Hydropower projects are common targets, and many of the large dams being built, or recently completed, in Africa have received funding from China.

India, the Gulf States, other East and Southeast Asian countries, Russia and Brazil have also been active in Africa. Their motive is usually a strategic interest in securing access to oil, food and other commodities, though general commercial motives are also present. As with China, water infrastructure is rarely the main focus but it is often an element in development programmes for power, land and agricultural, where water intensive processes would benefit from improvements in water security. The AICD project estimates that between 2001 and 2006, finance from China, India and the Gulf States for water supply and sanitation averaged US$160 million annually.

From the African viewpoint, this type of emerging market finance has both pros and cons. In its favour, large sums are available as part of turnkey projects for the construction of dams and other major water-related projects, promising speedy implementation, with less conditionality than from the major IFIs, and on terms superior to those available from fully commercial sources. Disadvantages include the fact that the funding is tied to procurement in the funding country, its terms are less advantageous than ODA, much of the implementation is done by expatriate workers, and less emphasis is placed on social and environmental conditions, compared with the normal requirements of donors and IFIs.

11.3.4 The private sector

The role of the private sector is often perceived to be associated with mitigation action, for example to reduce or offset carbon emissions, whereas adaptation calls for a greater relative role in public actions. However, the private sector has a role to play in both mitigation and adaptation[14].

The private sector can contribute to water security and climate resilience, and planners should consider ways stimulate this. The business sector is becoming increasingly aware of the challenge facing global water resources, and the need to carefully manage these resources. For example, the 2030 Water Resources Group, a global group of leading organisations from the private and social sectors, has identified pathways for the private sector to contribute to solutions in the water sector, recognising that financial investments from the private sector can be a key engine for change.[15] In some instances, private sector organisations have collaborated with water supply agencies to improve supply systems. By contributing to maintenance and repair of supply networks in small towns, the companies not only improve the systems for other users but also gain greater security for their own supply chain and operations.

Water scarcity and climate change are increasingly recognised as major short- and long-term business risks in water-dependent sectors. Coupled with strengthened corporate social responsibility (CSR), the private sector is becoming part of the solution to water scarcity, not just one of the drivers. New partnerships are being established; for example, SABMiller, WWF and the German development agency GIZ have formed the Water Futures Partnership to explore water-related risks to operations and the environment, and to identify necessary actions to manage these long-term problems (see Box 11.3). Investment in improved water-use efficiency, water reuse and water treatment technology were all identified as measures to reduce water scarcity and to improve the environment.

Box 11.3

The Water Futures Partnership[16]

SABMiller, WWF and the German development agency GIZ, through their collaboration as the Water Futures Partnership, have published a report: *Water Futures: Addressing Shared Water Challenges Through Collective Action* (2011). The report highlights the immediate water risks impacting both SABMiller's operations (the company is one of the world's largest brewers) and river habitats in a number of countries, and the necessary actions to manage the long-term problems. The Water Futures Partnership aims to serve as a catalyst for change, by inspiring others to act to protect ecosystems and, in doing so, secure global water supplies.

The report, which mapped water footprints in Peru, South Africa, Tanzania and Ukraine, identifies the critical water challenges in each country and how they impact SABMiller's operations. For example, water scarcity in Ukraine will be exacerbated by climate change, while areas such as the Donetsk region suffer large-scale pollution of rivers and aquifers due to mining and steel manufacture. Climate change and the reliance on glaciers for water supply are having an impact on water availability in Peru, and the over-use of agrochemicals has resulted in the pollution of irrigation channels and surface water bodies.

Faced with climate change, inadequate infrastructure and population growth, the Water Futures Partnership recognises that SABMiller cannot respond to these challenges alone. It is critical that a collaborative approach is taken, in a way that attracts the support of all relevant stakeholders.

11.3.5 Insurance and catastrophe risk finance (CRF)

One of the more likely consequences of climate change is an increasing frequency of natural disasters due to extreme weather events, such as floods, droughts, coastal surges and severe rainstorms. Due to the growth of populations and the growing concentration of economic activity in vulnerable areas (e.g. coastal cities, floodplains, and semi-arid farming regions), the potential severity of the impact of such natural disasters is increasing.

Public authorities and private agents are limited in their ability to prevent or mitigate damage from these events and often it is more rational to understand and accept the risks and to compensate the victims after the event. Businesses and individuals (i.e. households and farmers) can be encouraged, or obliged, to insure themselves against extreme climatic events. In some countries, index-linked insurance against drought has been a successful measure to protect small farmers.[17]

The alternative to conventional insurance and post-disaster compensation, which is often costly and inefficient, is catastrophe risk finance (CRF), which deals with disaster risk management in a 'before the event' (or *ex ante*) pro-active way, for example based on forecasts rather than actual results. Box 11.4 provides an example.

The disaster risk management framework being promoted by donors and IFIs includes better early warning systems, improved institutional capacities for disaster preparedness, investments for the mitigation of risks to essential infrastructure, and the use of innovative risk financing products. Insurance is part of the solution for both private (as previously noted) and public risks. Governments also have the option of insurance: CRF entails a government's assessment of its contingent liability to natural disasters, arranging risk transfer to competitive insurance and re-insurance markets, and financing sovereign risk.[19]

Box 11.4

Southern African Development Community (SADC) Weather Risk Insurance[18]

In response to the recurring climate-related food security issues experienced in SADC countries, the World Bank has conceptualised before the event (or *ex ante*) risk management framework for weather risk in the SADC region. The role of weather-risk management techniques for agriculture and food security regimes in SADC countries was analysed, using Malawi as a case study.

The framework explored ways to better predict food emergency situations, how these techniques could work in SADC countries, and what benefits for drought-exposed parties at macro, meso and micro levels would be. The work set the risk management aspects into a broader food security framework and discussed policy options that could improve prevention and *ex ante* management of food crises.

Weather-risk management addressing large-scale systemic drought risk can allow operators at all levels to better manage their risk and improve investment decision making. At the national level, the predictable instant availability of cash would improve the emergency risk management process and lower costs for national governments and donors alike. At the farm or village level, producers could protect their incomes and vital assets against severe weather shocks affecting the entire portfolio.

11.4 Infrastructure funding

Africa is currently spending around US$45 billion annually on public infrastructure of all kinds[iii], split between capital investment and recurrent operations and maintenance. These levels of spending represent 5–6% of GDP on average, and 10% or more for many low-income countries.

IFI lending for African water infrastructure is rising in response to efforts to boost available resources and the creation of specialised facilities (e.g. the ACP Water Project Preparation Facility, co-financed by the EU Water Facility and EIB). Despite these, planning and project preparation for the kind of activities necessary for climate resilience are a particular bottleneck, and the many specialised climate funds and facilities that continue to emerge in the evolving climate finance architecture can play role in addressing these bottlenecks.

Perhaps one of the best uses of climate financing is as an 'upstream' source of funding. Climate finance is a potential source of funds for supporting water infrastructure project preparation, for improving the enabling environment, and for supporting capacity development. Although climate financing is unlikely to be available for major infrastructure, modification of existing infrastructure to manage future climate risks and increase climate resilience is a valid adaptation measure.

Overall, blending climate finance with traditional water finance from ODA and the private sector is a good strategy.

iii Information and communications technology, power, roads, railways, ports and shipping, airports and air transport, irrigation, water supply and sanitation.

11.5 Considerations in financing water security and climate resilient development

The circumstances for financing water security and climate resilient development vary widely, and thus financing strategies should be judged pragmatically by whether they make sufficient affordable funding available. The following 'rules of thumb' apply:

- 'Public goods', such as strategic water storage and flood-risk management, need public initiative and financing.
- Other kinds of water services for which users could be expected to pay, such as household, agricultural and industrial water supplies, should be able to attract a wider range of funding sources, including commercial loans and equity.
- Subsidies and taxes are needed to compensate for market failures and externalities. Examples of this are payments for environmental service schemes to reward farmers for careful husbandry of watersheds, or pollution charges to discourage release of untreated effluent in water bodies.
- Bridging a financing gap requires a systematic approach. Such an approach could involve minimising costs and fixing realistic service standards, then maximising internal cash flow from tariffs, taxes and transfers (the '3Ts') – the transfers being external transfers from ODA and philanthropic sources (including corporate social investment). The cash flow created can be used to tap repayable funds in the shape of loans, bonds and private equity.
- Insurance policies should be used to deal with residual climate risks which it is not feasible or rational to mitigate.
- Some public goods can also be financed by philanthropic investment (from the Gates Foundation, for example) and CSR investors.

Box 11.5

Flood-risk management (FRM) as a public good

FRM is an example of a public good – a service that has to be provided by public authorities, which is neither feasible nor profitable for private agents to supply. For this reason FRM is normally implemented by public bodies, which can finance themselves and recover costs in various ways, including charges levied on beneficiaries. Public bodies implementing FRM also need to compel private agents to comply with certain measures in the public interest, thus shifting costs and the financing burden to the private sector.

Some FRM measures naturally fall to public authorities to implement and finance (e.g. dams, river improvements and major embankments). Other measures (e.g. zoning, development regulations and building codes) displace costs – and financing – onto private developers and householders. Some of the latter types of costs are financial, others are 'opportunity costs' in the form of benefits foregone. Compensation for flood damage and restoration of property and infrastructure are also FRM measures, and the related costs can be partially shifted onto private individuals through insurance requirements.

Irrespective of how the initial capital costs of FRM are financed, subsequent costs can be recovered wholly or in part from beneficiaries and users, in the form of property taxes and development levies, for example. Certain types of FRM, such as flood-proofing individual buildings, have a sufficient element of private benefit to make them eligible for private funding and implementation, with the possibility of public subsidy to cover any external social benefits.

11.5.1 Public finance for public goods

Whether the investment is a public good or a private good will influence the choice of financing source. In theory, a public good is a product or service that is:

- 'Non-excludable': Once it is provided, it is impossible to exclude any user from enjoying its benefits. This implies that a private provider would be unable to enforce payment from users (the 'free rider' issue).
- 'Non-rival': One person's use has no effect on the amount available for others. Thus there is no economic case for charging for it, i.e. using price to limit or ration the quantity used would be pointless and would result in sub-optimal use.

Using this distinction, some aspects of water constitute public goods, including policy-making, data collection, hydrological monitoring, protection of wetland biodiversity, flood protection (Box 11.5) and strategic water storage against droughts, among others. Private, commercially-motivated finance is unlikely to be attracted to these services, since it is not feasible to charge beneficiaries. To complicate matters, certain water services are not public goods, even though they are widely provided by the public sector. These include piped water supply and wastewater removal from individual households, and the supply of irrigation water to individual farmers through managed systems. Municipal wastewater treatment is, however, a public good, but is capable of being funded and implemented by private investors through Build-Own-Operate-Transfer (BOOT) and similar concession arrangements.

11.5.2 Market failures and externalities

Cutting across the public/private goods dichotomy are the closely-related issues of market failures and externalities, which also justify public intervention through taxation and subsidies. Where water services are clearly private goods (e.g. urban piped supplies), their supply conditions may entail 'market failure', such as natural monopoly, strong economies of scale and externalities. This is not an argument for public rather than private provision, but rather a case for regulation and the correction of specific market failures by public action, through subsidy and/or taxation.[20]

11.5.3 Private goods and merit goods

In contrast to public goods, there is no overriding reason why private goods should not pay for themselves. The main exception to this is the provision of 'merit goods', i.e. those which society deems that individuals should have, even if they are unwilling to pay for them, such as basic sanitation or protection against flooding. Affordability is also an issue, since water and its services are widely used by poor households, small-scale farmers and informal producers. With these important qualifications, in principle providers of water services should aim for self-financing, with the consequence that across-the-board public subsidies should be reduced, and savings should be used to finance genuine public goods, the correction of market failures and externalities, and to provide subsidies to deserving projects and social groups.

11.5.4 Bridging the financing gap

Working at either a sector or project scale, the financial gap between what is required and what is currently being spent can be bridged by a combination of actions in line with the approaches used in the AICD project.[21] These strategies for bridging the financial gap are separated into the three broad types:

- use of efficiency measures and fine-tuning of investments;
- enhancing the flow of basic revenues (the so-called 3Ts – see subsection below); and
- using these basic revenues to tap repayable financial sources, with the help of risk-sharing and risk mitigation instruments.

There is also a fourth category: insurance. This would be appropriate for large, but less likely, risks for which 'before the event' (or *ex ante*) precautions would be prohibitively costly. It would also be appropriate to cover citizens against the residual risks after all feasible public actions have been taken.

The real scope for each of these actions, and the balance among them, will vary according to the circumstances and nature of the investment. Illustrative examples of financing strategies for different water-related investments are given in Table 11.4.

11.5.5 The 3Ts

For water services consisting of private goods generating their own revenues, a financing principle that is gaining favour is that of the '3Ts', namely tariffs, taxes and transfers. If the basic revenues from the 3Ts are inadequate, then other sources – loans, bonds and equity – which have to be serviced and repaid, are not feasible.

- Tariff revenue is the foundation of future cash flows, and is normally the main source of funding for recurrent operations and maintenance expenses. In well-managed services with a good revenue base (e.g. in most large urban areas), tariff revenues can contribute to investment costs too, though in Africa this is the case only in a minority of utilities.
- Tax-funded subsidies are widely used to supplement tariff revenues, especially for rural services and public irrigation schemes. The effectiveness of subsidies can be increased, and their cost to public finance reduced, by targeting them to specific groups of deserving consumers, or as part of a performance-related agreement between the government and the water utility.
- Transfers originate from ODA provided by foreign governments, and also from national or international charities.

The relative importance of user charges varies between categories of water users. It tends to be high for urban household water supply, industry and commercial users and sales of hydropower, less for rural consumers, and low for farmers and wastewater services. With this qualification, user charges are potentially the most sustainable, predictable and controllable part of the 3Ts.

Budgetary transfers can normally only be programmed several years ahead as part of government MTEFs, although commitments can be rolled over. The same is true of ODA, for which agreements tend to be made 3–5 years in advance, in line with the budgets of donor agencies (longer-term commitments are possible for some of the poorest countries).

11.5.6 Attracting repayable sources of funds

Basic revenues can be used to attract repayable funds of three main types: loans, bonds and equity.

There are various kinds of loans. Short-term loans to cover working capital requirements and to cushion irregularities in cash flow are normally available from local banks. Medium- and long-term bank lending for the development of water infrastructure is uncommon in Africa, and where it arises tends to need government guarantees. Lending from IFIs such as the World Bank and African Development Bank is more attractive since the terms are generally more appropriate to the cash flow of the underlying assets. For local and community projects, microfinance is another source of funding, especially for schemes with a short payback period.[22]

Finance from emerging markets tends to be on intermediate terms between fully commercial loans and 'soft' loans from members of the OECD's Development Assistance Committee (DAC). Bond issues for municipal water projects are unusual in Africa, and the few cases that have occurred so far have

depended on credit enhancement of various kinds, such as external guarantees. Sharia-compliant *sukuk bonds* are another variant, in which repayments are linked to returns on the underlying asset.

Private equity has been involved in water supply concessions in several African countries, mainly in West Africa. There has also been private involvement in hydropower development, e.g. the Bujagali plant in Uganda, and more widely in the form of Independent Power Producers (as described in the 2010 AICD project report, Chapter 8[23]). Private concessions have also been awarded for irrigation projects in Morocco and Egypt.

Complex multi-purpose projects (e.g. combined power, water supply and flood control) may lend themselves to private–public partnerships (PPPs) of various kinds, with risks shared among the different stakeholders and finance from equity or loans on the balance sheets of the private partners. Guarantees from national (sovereign) or external agencies (e.g. AfDB or EIB) or private insurers may be taken up to enhance a borrower's creditworthiness. At a greater level of complexity, 'structured finance' is another option.[iv]

The allocation of risk is particularly important for major dam projects. Many irrigation schemes depend on the construction of multi-purpose dams and reservoirs whose main revenues come from the sale of hydropower. The success of PPPs depends on risk being borne by parties best able to manage it. This has been the justification for involving private investors and operators in the design, construction and operation of major capital projects. However, in a number of hydropower projects the risks (e.g. geological, resettlement) proved too serious for private partners to bear and greater responsibility for such matters has had to be accepted by public sponsors in order to make the project bankable.[24]

11.6 Examples of financing strategies for water security and climate resilience

Examples of financing strategies for different water-related investments are summarised in Table 11.3.

iv Structured finance instruments can be defined through three key characteristics: (1) pooling of assets (either cash-based or synthetically created); (2) tranching of liabilities that are backed by the asset pool; and (3) de-linking of the credit risk of the collateral asset pool from the credit risk of the originator, usually through use of a finite, stand-alone special purpose vehicle (SPV).

11.7 Final remarks

Recent studies of the cost of achieving water security for Africa have produced estimates of tens of billions of dollars annually. In round figures, the range is US$30–50 billion for capital investment, and US$5–15 billion on annual budgets. These estimates exclude the cost of 'climate proofing' this expenditure, which could add another US$10–15 billion annually to those figures.

Financing water for climate resilience is bound to be an art rather than a science. The needs and circumstances vary widely, and financing strategies should be judged pragmatically, by whether they deliver sufficient affordable funding of the right type. This chapter reviews a few helpful principles for building a financing strategy, including the increased interest in specialized climate finance.

Most water investments would be eligible for adaptation funding. Along with the GCF, a number of funds exist which could potentially support projects of water adaptation, and a niche for climate finance is to support early stages of the adaptation project cycle. This can include planning, project preparation, innovation and piloting, as steps towards tapping into larger volumes of money from elsewhere for implementing and replicating projects at the scale required.

Some types of investment in water security would be eligible for mitigation finance (e.g. energy efficiency projects in water treatment and distribution, wastewater reuse), while other water projects would benefit indirectly from mitigation schemes (e.g. watershed, wetland and ecosystem conservation for 'carbon sink' purposes).

The expected outputs from this step in the Framework process should include:

- An inventory of relevant climate adaptation funds, including information on how to access the funds and what the funds can be used for.
- Mapping of the portfolio of no/low regrets investments options onto appropriate climate funding options.
- Detailed and innovative financing strategies developed for priority no/low regrets investments.

The outcomes of this step in the process should facilitate access to funding and may include bringing together project/programme proposers with the relevant financing bodies through round table discussions and meetings. The aim is to move priority investments forward for early implementation.

Table 11.3 Financing strategies for water-related investments

Water-related intervention	Minimising the financial gap	Enhancing the 3Ts: cost recovery, public budget transfers and ODA	Tapping repayable sources of finance	CRF (including insurance)
1 Water resource development (WRD), river basin management	Fair apportionment of costs amongst all beneficiaries (including transboundary parties and downstream users) Subsidies for catchment management and protection Cost-effective environmental stewardship	Sale of goods and services arising from WRD Cross-subsidy from bundling of revenues from different services Levies on water users; state budgets and ODA to cover public goods Retention of revenues by responsible WRD agency	IFIs Emerging non-OECD market lenders and sovereign wealth funds Commercial lenders Public guarantees	
2 Flood-risk management and control	Negotiated contributions to cover capital costs from major beneficiaries (e.g. property developers) Cost-sharing from multi-purpose schemes or transboundary projects Subsidies (e.g. for upstream catchment management) Taxes and surcharges on inappropriate development in the floodplain	Levies on property owners Surcharges on water bills for flood management services Charges and fees for use of associate facilities/attractions (e.g. sport, recreation, tourism)	As above	Promoting commercial insurance State-run flood risk insurance
3 Hydropower and multipurpose schemes	Cost-effective adaptation of existing infrastructure (e.g. to anticipate future climate risks)	Public financial backing is unavoidable for strategic purposes (e.g. water storage against drought and floods) Cross-subsidy from power to other uses	Financing packages including funds from different sources – with appropriate allocation of risk being crucial; to include IFIs, non-OECD lenders, commercial loans and equity Private–public partnerships (PPPs)	
4 Water use by industry, mining, agricultural processing, tourism	Substantial contributions to capital costs should be expected from these enterprises for large projects involving public infrastructure	Full-cost pricing of public supplies Abstraction charges Pollution charges	Self-financing Equity from public investment corporations and development banks	
5 Urban household water supply and sanitation	Reducing waste and losses in distribution Setting realistic service standards	Improving rate of bill collection with progress to full cost recovery Tariff subsidies targeted to specific need ODA in appropriate forms (e.g. linked to connection subsidies) Surcharge on water bills (e.g. for sanitation services) Co-funding for NGOs in slums	Better commercial performance (linked to autonomy) of utilities makes them more creditworthy for loans of all types Bond issues Public–private participation	
6 Small town and rural water supply and sanitation	Household/community contributions (in cash or kind) Choice of sustainable standards, service options and products	Public subsidies Operations and maintenance cost recovery Co-funding for NGOs	Grants and concessional loans Microfinance Commercial lending for small private operators	
7 Irrigated farming	For public command areas, modernising and efficiency improvements for existing systems Cost-effective selection of new projects	Water abstraction charges Realistic levels of cost recovery as part of programmes for more reliable and efficient service	IFIs and non-OECD sources Some scope for PPPs Microfinance	Weather-risk insurance products
8 Wastewater collection, treatment, reuse and disposal	Choice of appropriate solutions, with realistic phasing (e.g. condominal systems) Decentralised wastewater treatment Recycling treated used water to farmers	Charging for recycled water Water tariff supplements to cover wastewater services Earmarking proceeds of pollution charges for wastewater management	Private concessions (BOTs, BOOTs, etc.) with 'take or pay' deals	
9 Water pollution control	Obligations on polluters to limit or pre-treat effluent	Pollution charges Fines on offenders Payments for ecological services		
10 Water-dependent ecosystems and habitats	Minimising impact on 'water' budgets by drawing on agricultural and other sectoral funding Tapping into carbon offset funding schemes	State budgets for public goods NGOs (including 'debt for nature' swaps) Payments for ecological services	Restoration grants and loans	

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12 | MAINSTREAMING CLIMATE RESILIENCE IN DEVELOPMENT PLANNING

Key messages

- Mainstreaming aims to integrate the links between water security and climate resilience into growth and development policymaking, budgeting, and implementation processes at all levels.
- Changes in development planning guidelines and procedures will be required to reflect improved, evidence-based decision making, with the application of climate impact and screening procedures emphasised as part of investment portfolios.
- Multi-stakeholder forums need to bring in stakeholders from non-water ministries (energy, health tourism, trade, agriculture and others) to agree common approaches and to minimise duplication.
- Processes to mainstream climate resilient development should capture community perspectives and indigenous knowledge as part of the process to identify problems and solutions.
- At a regional level, climate resilient programmes need to be integrated into river basin development plans and REC plans for economic development.
- It is more efficient and effective for climate resilience to be integrated within ongoing development activities, rather than as a parallel stream of activity.

This chapter supports Phase 3 of the Framework by elaborating on the mainstreaming activities that can lead to a longer-term shift towards making development planning more climate resilient. Such changes may need to overcome institutional inertia and other political drivers. However, mainstreaming the principles and concepts of climate resilience into development planning processes will undoubtedly yield long-term benefits in terms of sustaining development efforts and attracting funding for growth and development.

Recommended sources of further information:

The Organisation for Economic Co-operation and Development (OECD) has produced a policy guidance document that is the benchmark for confronting the challenge of integrating adaptation within core development activities.

OECD. 2009. Integrating Climate Change Adaptation into Development Co-operation: Policy Guidance. OECD Publishing, Paris, France. Available at: www.sourceoecd.org/development/9789264054769

The United Nations Economic Commission for Africa (UNECA) has produced a framework for mainstreaming regional integration. Although this focuses on the activities required to achieve integration between nations, many of these relate closely to the process of actively influencing strategies, policies, plans and planners which are applicable more widely for mainstreaming climate resilience.

United Nations Economic Commission for Africa (UNECA) and Centre for Studies on Regional Integration of the Eduardo Mondlane University. 2009. *A Framework for Mainstreaming Regional Integration in National Development Plans in the Southern African Development Community (SADC).* Available at: http://repository.uneca.org/handle/10855/15988?show=full

12.1 Overview

As a long-term goal, water security and climate resilience should be mainstreamed into general economic development planning processes. This can be achieved by striving for government policies, financial priorities and planning that take account of the implications of climate on water resources development, water-related risks and water use. Government policies should encourage all economic decision makers, both public and private, to consider water security and climate resilience when making decisions.

Mainstreaming involves the integration of policies and measures to address water security and climate resilience into ongoing sectoral and development planning and decision making. This ensures the long-term sustainability of investments, as well as reducing the sensitivity of development activities to the current and future climate. It is a more efficient and effective use of financial and human resources than designing, implementing and managing policies for water security and climate resilience separately from ongoing development activities.[1]

Mainstreaming, and building national and regional capacity to facilitate government efforts to incorporate water security and climate change considerations into planning and policymaking, is a valid and entirely beneficial use of climate-related funds, both internal and external funds.

Efforts to mainstream water security and climate resilience into development planning are still at a relatively early stage in most countries. The approach should reinforce existing development planning priorities – such as poverty reduction, sustainable economic growth and achievement of the Millennium Development Goals (MDGs) – and encourage experts and practitioners from across the water, climate and development sectors to come together and add value to existing processes.

The United Nations Environment Programme (UNEP) has proposed three core components for mainstreaming.[2] Each has associated tactics, methodologies and tools that can be used to support mainstreaming champions and practitioners:

- Find the **entry points** and **make the case**. This is concerned with setting the stage for mainstreaming and entails understanding the links between water, climate and development priorities, as well as understanding the governmental, institutional and political contexts and needs, to define priorities on which to focus. This aligns closely with activities in Phase 1 (Understand the problem).
- Mainstream water security and climate resilience policy processes. This focuses on **integrating adaptation issues into an ongoing policy process**, such as a national development plan or sector strategy. Such efforts are based on country-specific evidence, including impact, vulnerability and adaptation assessments, socio-economic analysis, and demonstration projects. These activities follow on from work carried out in Phase 2 (Identify and appraise options).
- Meet the implementation challenge. This aims to ensure the mainstreaming of water security and climate resilience into **budgeting and financing, implementation and monitoring**, and to **establish mainstreaming as standard practice**. Stakeholder engagement occurs throughout, from inception through policy development, implementation and monitoring.

The order in which different activities are undertaken depends largely on a country's particular priorities and needs, how advanced existing systems are, and where they are in the timeframes and phases of different national and sectoral development cycles.

12.2 The role of the Framework in mainstreaming climate resilience

Application of the Framework contributes in itself to mainstreaming. The tools and methods recommended within the Framework support making the case for climate resilient development, carrying out impact assessments, identifying no/low regrets investments, and ways of integrating these into financing and implementation processes. The application of the Framework therefore helps to build a decision-making environment that is better able to respond to a longer-term commitment to climate resilience. Examples of the synergy between the application of the Framework and mainstreaming activities are summarised in Table 12.1.

12.3 Influencing national development strategies and sector plans to include climate resilience

Strategy formulation and budgetary planning processes are potential entry points for mainstreaming climate resilience. Table 12.2 identifies some of the key high-level planning instruments that can be influenced to raise the profile of climate resilience. This is achieved by ensuring that climate risks are considered when delivering on priorities, and that climate change adaptation is included where required.

In the short term, any ongoing national strategy formulation should include water security and climate resilience as a cross-cutting theme. If this does not happen, the chance may be lost for a further three to five years. The main tool for change is the national development strategy. This is typically updated every three to five years; ensuring that climate change is included in these strategies is vital.

Table 12.1 Key mainstreaming activities, and the phases of the Framework that support them

Mainstreaming activity	Supporting phases within the Framework
Influence national development strategies and sector plans to include climate resilience	Supported by Phase 1 (Making the case for climate resilience)
Set up cross-sector strategies for climate resilience, building on the principles of integrated water resources management (IWRM)	Supported by Phase 1 (Making the case for climate resilience) Informed by Phase 1 (Vulnerability and impact assessments) Supported by Phases 2 and 3 (Identification of priority investments and Financing strategies)
Set up new budgeting instruments and influence existing budgeting processes for allocation of funding for highly vulnerable sectors and areas	Informed by Phase 1 (Vulnerability and impact assessments) Supported by Phases 2 and 3 (Identification of priority investments and Financing strategies)
Monitor policy effectiveness and promote regular revision of plans and strategies to improve flexibility	Supported by Phase 4 (The Framework's lessons learnt and monitoring and review process)
Promote strong central coordination for cross-sectoral planning	Supported by Phase 2 (Identification of new and innovative investment opportunities) Supported by stakeholder engagement to identify champions
Continual capacity development of functional and technical capacity at the institutional, organisational and individual levels	Supported by all phases of the Framework in a 'learning by doing' philosophy

Table 12.2 Institutional planning instruments that offer potential entry points for mainstreaming climate resilience[3]

Planning level	Entry points
National government and cross-sector ministries	Poverty reduction strategy papers National development plans MDG-based national development strategy National budget allocation process or review (e.g. medium term expenditure framework, public expenditure review)
Sector ministries	Sector strategies, plans and policies (e.g. agricultural sector plan) Preparation of sector budgets Public expenditure reviews
Sub-national authorities	Decentralisation policies District plans Preparation of sub-national budgets

Existing sector strategies are likely to need to be made more climate resilient when they are updated. If a strategy is already several years old, then the increased interest in climate sensitivity may justify bringing forward the new strategy. Sector strategies should be based on analysis of the impacts of climate change on the sector, evidence-based, and ideally set within cross-sectoral and transboundary perspectives.

Sector strategies should include regular monitoring and evaluation. This should be used to provide an update on climate resilience. Sector strategy documents are subject to regular review in advance of the start of the budget cycle, either formally or informally. Line ministries should ensure that these reviews include an assessment of the effectiveness of climate change-justified programmes, the latest evidence on climate change scenarios, and high-priority sectoral climate risks.

In the short term, quick wins can be gained by influencing any ongoing work on local development strategies. In the mid-term, climate sensitivity should be built into the preparation of new local development strategies. The strong participatory processes for many local development strategies should include an assessment of the current level of water security and climate resilience, and of the most appropriate adaptation options.

12.4 New budgeting instruments and existing budgeting processes

Influencing budgeting to allocate funding for climate resilience is a key activity for ensuring the implementation of programmes and projects that deliver benefits on the ground and enhance decision making. This can build on the previous chapter of this document, in which no/low regret investments are integrated into planning systems by using this as evidence to change the longer-term budget allocation systems. This ensures that identification and funding of no/low regret investments becomes standard practice.

Climate resilience should be included as one of several key themes in budget strategy papers and medium-term budget frameworks, or their equivalents. These are the starting points for influencing the annual budget. Most countries now have a budget cycle that starts with some form of strategic guidance. This generally starts with a budget strategy paper that gives general principles. This is then combined with a medium-term budget framework or medium-term expenditure framework to give three-year indications of sectoral ceilings, based on the principles from the budget strategy paper. It is important to influence these documents so that they request line ministries to explain how their budget proposals will promote water security and climate resilience. Furthermore, the recurrent cost implications of projects for climate resilience should be logged, and be affordable.

The temptation to set up separate budget lines for climate change should be resisted. As new or additional international finance becomes available to assist country efforts to respond to climate change, this finance needs to be integrated into national policy, planning and budgetary systems. The challenge is to secure a comprehensive, cross-government approach that delivers a coherent national response to climate change, involving both the public and private sectors.

At the sub-national scale, 'block grants' should be made climate resilient. Many local governments manage programmes in which grants are delivered to low-level administrative units (such as villages and communes), who decide how the funds are used. The procedures and principles governing the use of these grants should be updated to ensure that the local leaders and/or officials are aware of the potential impact of climate change.

12.5 Cross-sector strategies for climate resilience

Strategies that bring together the various sectors involved in water security and climate resilience play an important role, demonstrating the links between existing sector strategies. These strategies will not be associated directly with spending plans; rather, they should refer to the sector strategies and their associated spending plans, and present the vision for coordination between these plans.

Mainstreaming climate resilience into development planning processes requires action across a range of planning levels and sectors. Central governments must direct and drive this process, but their actions have to be implemented by a hierarchy of actors and agencies, each with their own constraints and agendas. Many governments have delegated responsibility for water issues to lower levels of administration, thereby defining the scope for their own centrally driven initiatives. This approach requires a sufficient degree of consultation and negotiation between the parties to reach a consensus.

Many of the principles and practices underpinning other cross-sectoral strategies – for example, IWRM (see Box 12.1) – are equally valid for integrating and mainstreaming climate resilience in development planning.

Many African countries have IWRM strategies in place or under preparation, resulting in the establishment of cross-sectoral coordination mechanisms. Also, coordinated working practices have become the norm in planning and strategy formulation. Figure 12.1 shows the status of IWRM plan implementation by region in Africa in 2012. The Fourth World Water Development Report[4] has updated this progress mapping noting that the proportion of surveyed countries with IWRM plans has increased from 38% to 64% between UN-Water surveys in 2008 and 2011 indicating that IWRM planning is progressing, albeit behind target.

12.6 Strong central or supranational coordination for cross-sectoral planning

Countries that do not already have effective cross-sectoral organisations concerned with water and/or the climate will need to address this issue. In the short term, informal

Box 12.1

Principles and practices from IWRM that apply to mainstreaming climate resilience

- Integration is essential across planning levels and sector interests.
- Clear diagnosis of national, sectoral, and local levels is required.
- Sector strategies should address broader national development goals (e.g. growth, poverty).
- Planning should be based on existing institutions and processes.
- Roles and responsibilities must be carefully defined at an early stage.
- Wide stakeholder participation is necessary to help manage contentious issues.
- 'Soft' solutions must be adopted as well as 'hard' solutions.
- Capacity development must underpin implementation.
- Individual 'champions' can be influential.
- Continuous communication is invaluable.
- Transboundary dimensions to climate adaptation are important.

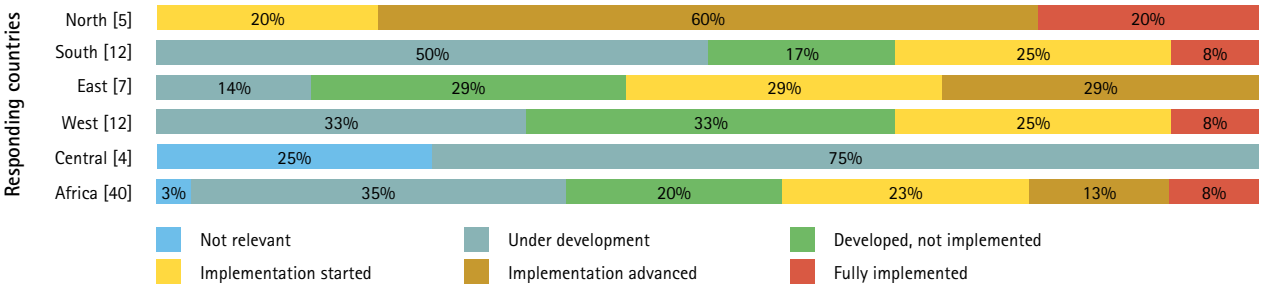

Figure 12.1 IWRM progress around Africa in 2012[5]

coordinating bodies may suffice but in the medium term, water and the climate could be coordinated and championed by a more formal body. In most cases, it is not effective to rely on one line ministry to coordinate others. For some countries, a central 'apex' body – one that is independent of sectoral pressures and with the convening powers to bring together sectors (such as the ministry of finance, the ministry of economic development planning, and the prime minister's or vice president's office) – may be useful in facilitating coordination. It could also usefully extend its remit to cover climate resilience. Box 12.2 provides an example of using a central ministry to integrate sectors for national development planning in Zambia.

Box 12.2

Integrating water and climate resilience in Zambia's national development planning

In early 2010, Zambia embarked on its Sixth National Development Planning process, which was adopted and released in January 2011. The process was coordinated by the Ministry of Finance and National Planning, working alongside other line ministries. The process was structured to reflect national government strategies sectorally, and to provide an integrated picture of the national economic development and social trajectory.

Each of Zambia's sector strategies was convened by a sector-specialist group, with cross-linking input from other sectors. Thus sector strategies and action plans were cognisant of, and integrated with, cross-sectoral issues. A consolidated strategy and action plan was convened by the relevant ministry for each sector, drawing together each of the sector strategies. This provided a second layer of integration and consolidation.

Climate change and water featured strongly in the process, and were well represented in the published Sixth National Development Plan. Strategies that built resilience to climate change were evident in many sectors, including environment, energy, transport, health, water and sanitation, agriculture, livestock and fisheries, mining, tourism, information and communications technology, natural resources, and local government and decentralisation. The effort built on earlier processes, for example IWRM being integrated into Zambia's Fifth National Development Plan.

At the transboundary level, many African RECs are starting to play an important role in promoting cooperation over climate resilience, mobilising funds and representing member states internationally. Most RECs now have some form of institutional capacity for coordinating work on climate change, including water security and climate resilience. RECs can also provide momentum and guidance for national strategies.

The political goodwill for cooperation that is embodied in RECs is an important force in supporting RLBOs. It helps to reduce the risks of conflict, and the emerging philosophy of RLBOs towards benefit sharing can further enhance water security and climate resilience.

RECs can mobilise and administer special funds for water security and climate resilience. These funds do not generally involve large amounts, but can unlock other sources of investment funding with sufficient resources to have an impact on climate resilience. RLBOs can also mobilise additional funding for water security. For example, RLBOs have provided about one-quarter of the funding provided by the African Water Facility, including those for the Volta, the Niger, Lake Chad, Lake Victoria, the Congo, the Kayanga-Geba and the Songwe.

12.7 Policy effectiveness and regular revision of plans and strategies

Monitoring policy effectiveness is strongly linked to the monitoring and evaluation of the activities in Phase 4 of the Framework. The key message here is to ensure that policies, strategies and guidance are regularly monitored and refreshed, and respond to external drivers. National development strategies are periodically refreshed and updated, which filters down into sector planning and budgeting. This ensures that new ideas and

priorities, such as climate resilience, can be included in the day-to-day operation of planning systems. For example, guidelines for spatial planning should be periodically reviewed to include emerging priorities, such as the impact of climate change, as a consideration for long-term planning. Improving the flexibility of how guidance is set will require a government-level commitment to continually improve decision making.

12.8 Development of functional and technical capacity at institutional, organisational and individual levels

Capacity development requirements for mainstreaming are multifaceted, requiring action across several dimensions, and should be based around needs assessment and gap analysis, with an emphasis on strengths and opportunities to build on. Box 12.3 provides a set of typical questions behind an assessment of capacity building needs.

Capacity development will require action across several dimensions and levels. These will include:

- **Coordination between organisations and agencies.** This is the high-level institutional environment in which organisations operate, including coordination between agencies, policy and strategy formulation, setting organisational mandates, regulation, and high-level economic planning. This can be focused at the national level or sub-national decentralised planning systems.
- **Organisational operations.** This reflects the management systems within organisations, such as internal communications, technical capacities, links with external organisations (lines of reporting and funding), internal decision making, budgetary planning, and staff and resources management and development.
- **Individual level.** This reflects the capacities of staff within organisations to be aware of and understand climate change and its implications for their area of work and other linked areas, in addition to improving technical skills, communication skills and adaptability.

Box 12.4 provides some examples of capacity development objectives at different levels.

Central governments and supportive donor agencies must take account of the constraints in the capacity of lower-level actors. Many of the measures taken will have to be implemented by parties that are not under the direct control of central government (e.g. farmers, water users, businesses, civil society groups). Hence the toolkit of measures to carry out the climate-resilience agenda needs to include information, stakeholder consultation, and possibly fiscal and financial inducements.

Box 12.3
Guiding questions for assessing institutional and capacity development needs in government[6]

Institutional development needs:

- Which government organisations are relevant to mainstreaming climate change adaptation and mitigation? What are their mandates?
- What are the budget allocations of these organisations?
- Are there overlapping mandates? Are any specific mandates missing?
- How do government organisations coordinate and make decisions about adaptation and mitigation issues? Are there any coordination gaps? Do the mechanisms in place need to be strengthened? How?
- Have there been (recent) institutional changes? Are institutional changes necessary to mainstream climate change adaptation and mitigation? How can these changes be fostered?
- What planning and programming mechanisms are in place? What are the operating procedures of the government organisations? Do some mechanisms and procedures need to be strengthened? How?

Capacity development needs:

- What issues relevant to climate change mainstreaming could capacity development address?
- What are the priority capacities (functional capacities, such as resource mobilisation, monitoring, and technical capacities, such as sector-relevant expertise) to be developed to address these issues?
- For priority capacities, what is the current baseline (including 'capacity assets' i.e. strengths and opportunities on which to build capacity development efforts)? What are the needs (gaps and weaknesses to be addressed)? What are the objectives to be achieved?
- What are the best ways of involving stakeholders in the capacity development effort, and of delivering capacity development?

Box 12.4

Examples of capacity development objectives at institutional, organisational and individual levels[7]

Institutional level

- Improved political commitment and enabling environment for mainstreaming climate change.
- Improved policy, legal and regulatory frameworks in support of climate change adaptation and mitigation.
- Actual integration of climate-related considerations in national and sector policies, strategies and programmes.
- Improved inter-agency coordination and collaboration frameworks on climate-related issues.
- More resources allocated to adaptation and mitigation measures in the national budget.
- Upgraded knowledge and information systems that can track climate trends and the response to climate-related challenges, including policy and institutional change.
- The actual implementation and outcomes of climate-related measures in policies, strategies, programmes and projects.

Organisational level

- Defined organisational mandates, structures and functions for mainstreaming climate change.
- Strengthened management, planning and operational frameworks for mainstreaming climate change.
- Strengthened administrative and budgetary systems and procedures for mainstreaming climate change.
- Strengthened personnel management and human resources development in relation to the management of climate-related issues.

Individual level

- Increased awareness of climate change and its implications, including changed attitudes, beliefs, values, motivation and commitment.
- Expanded knowledge and understanding of priority topic areas.
- Improved skills and changed behaviours with regard to mainstreaming climate change, including technical, scientific, planning, research, information management, information and communication technologies, and interdisciplinary communication and collaboration skills

12.9 Final remarks

Although governments should show leadership, action will be required by all stakeholders – public, private and other – to mainstream water security and climate resilience for growth and development.

It requires a strong, government-led approach across a number of areas including: setting priorities; national policies and strategies; sectoral and development planning; decision-making and appraisal processes; and stakeholder engagement. Ultimately, mainstreaming is more efficient and effective than designing, implementing and managing policies for water security and climate resilience separately from ongoing development activities.

Mainstreaming is a change process, and as with all change, it takes time and needs catalysts to help make that change. The Framework is one of many tools that will help catalyse and facilitate change.

The expected outputs from this step should include:

- Improvements in policies, institutional arrangements and management instruments.
- Increased funding for water security and related climate change programmes.
- The application of tools and approaches for improved water security and climate resilience.

Ultimately, mainstreaming should lead to an increased availability of water of acceptable quantity and quality for all beneficial uses, and reduced vulnerability to climate risks through an increased capacity and ability of regions, countries and communities to adapt to climate change. In short: a water-secure world that is based on sound sustainable development principles that support growth and development.

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13 | LEARNING LESSONS, MONITORING AND EVALUATION

Key messages

- Learning lessons about the application of the Framework will:
  - identify what worked well and which areas need strengthening;
  - help to tailor the Framework to national/basin contexts and actors;
  - highlight successful partnerships that should be built upon;
  - provide a forum for consensus on the way forward;
  - disseminate good practice for future related initiatives.
- Monitoring and evaluation is a vital step in assessing the value that applying the Framework has added, and is most effective if it is built around existing monitoring processes and indicators, rather than new mechanisms.
- Expenditure monitoring and review can be a valuable tool for understanding the realities of implementing investments.

This chapter supports Phase 4 of the Framework and provides further information on learning lessons, monitoring and evaluation. These crucial aspects provide feedback for future applications of the Framework, ensure actual progress is measured against planned outputs, outcomes and progress, and tracks longer-term changes in decision making processes.

Recommended sources of further information:

The International Institute for Environment and Development (IIED) has produced a working paper that presents a coherent framework for climate change adaptation programming. This includes potential indicators, or indicator categories/types, for tracking and evaluating the success of adaptation support and adaptation interventions. A synthesis of ongoing adaptation funds' results frameworks is presented.

Brooks, N., Anderson, S., Ayers, J., Burton, I. and Tellam, I. 2011. *Tracking Adaptation and Measuring Development*. IIED Climate Change Working Paper No 1. IIED, London, UK. Available at: http://pubs.iied.org/10031IIED.html

13.1 Overview

Monitoring and evaluation is a vital step in assessing the value that applying the Framework has added, and provides feedback for future iterations and applications. It should not be viewed as the closing of a process; rather, it is a link back to the start of the Framework cycle. This also ensures application of the Framework is not seen as a one-off, but is a continual process of understanding problems, identifying and appraising options, delivering solutions, and making progress towards a more water-secure world.

Areas for attention include:

- Learning lessons from the application of the Framework. This identifies what worked well and what didn't, can propose improvements for upscaling and repeating the process, and reinforces the mainstreaming of water security and climate resilience in development planning processes.
- A review of the Framework process while it is still fresh in stakeholders' minds offers the chance to identify successes and areas for improvement.
- Setting a monitoring and evaluation process helps track progress and evaluate impacts and outcomes in the short, medium and long term.

The Framework is not an end in itself; rather it is a tool to help users work towards improving water security and climate resilient development. Applications of the Framework are anticipated at a range of levels and across many different contexts and settings. An indicative monitoring framework is therefore appropriate here, with users defining more specific outputs and outcomes according to their particular applications.

13.2 Lessons from applying the Framework

Learning lessons from application of the Framework offers the chance to identify successes and areas for improvement. Strengths, weaknesses, opportunities and threats (SWOT) analysis provides a system for rapidly assessing application of the Framework process and resulting outcomes. Analysis can be carried out in a participatory manner, for example through workshops, interviews or questionnaires. This will strengthen feedback from different stakeholder perspectives and can identify ways to improve future applications of the Framework. Similarities with other multi-stakeholder, cross-sector processes can be beneficial in identifying potential areas for investigation (see Box 13.1).

Box 13.1
Example findings from a lessons-learned review

The Global Water Partnership has conducted a high-level lessons-learned review of their programme for national integrated water resources management planning in Africa, carried out over the period 2005–2010.[1] Stakeholders identified key lessons that they considered essential steps in facilitating a successful planning process. These included:

- A suitable **entry point** in the national development context helps add value and minimises duplication.
- **Champions** are crucial, and they should be wisely selected and valued.
- **Integrating with national development priorities** and frameworks increases the chances of success.
- Institutional arrangements for **coordination and financing** should build on existing processes and institutions.
- Clarification of **roles and responsibilities** at an early stage helps build trust, transparency and accountability, but can take time.
- **Institutional memory** enhances the sustainability of development processes.
- **Stakeholder partnerships** provide a neutral platform for dialogue and resolving water security challenges.
- **Capacity building** enhances knowledge sharing and implementation capacity.
- **Communication and advocacy** are important for ensuring understanding of goals, progress and achievements.

13.3 Monitoring plan for each phase of the Framework

Table 13.1 provides a summary of the outputs from each phase of the Framework and associated outcomes. These can form the basis of a monitoring programme for application of the Framework.

13.4 Setting a monitoring and review process

Applying the Framework is not a completely new process; rather, it strengthens and refines existing processes to build climate resilience into growth and development. In a similar manner, processes for monitoring and evaluating application of the Framework, and the outputs and outcomes that derive from its use, should also build on existing processes.

Table 13.1 Expected outputs and outcomes for each phase of the Framework

Step in the process	Outputs	Outcomes
Phase 1: Understand the problem		
Making the case	• A short briefing note or similar that identifies the high-level commitments, which are aligned with improvements and investments in water security and climate resilience. • A macro-economic appraisal of the benefits of water security and climate resilient development, including the costs and detrimental results of inaction. • A summary for policymakers on the scientific evidence for climate change and its impacts, in a format that can be readily digested by non-specialists. • Strengthened government commitment to protect their development goals and ambitions against derailment by water and climate impacts.	The outcomes of this step should encourage high-level advisors and decision makers to increase the priority status of water security and climate resilient growth and development, with planners and practitioners mandated to use and benefit from the Strategic Framework approach.
Gaining stakeholder perspectives	• A stakeholder analysis report that includes the primary and secondary stakeholders, their roles and responsibilities, and their respective interests and influences. • Recommendations and agreement on the multi-stakeholder platform(s), strengthened and supplemented where necessary, for detailed application of the Framework throughout its full cycle. • Identification of leaders and champions who can drive the Framework application forward, and clear insight on how horizontal and vertical integration will be achieved.	The outcomes of this step not only identify key stakeholders and their interests, but also provide a foundation for many other steps in the application of the Framework. These include an inventory of stakeholders to feed into the participatory approaches to identifying investment opportunities under Phase 2.
Climate impact and vulnerability assessments to inform decision makers	• A review report identifying the existing body of evidence and ongoing research efforts into existing and future climate impacts and vulnerabilities, the headline findings of this body of evidence, and gaps in the evidence. • Proposals for additional assessments to address knowledge gaps and strategic areas for capacity building to improve the long-term generation of evidence. • Application of selected impact and vulnerability tools, if timescales and budget allow, for pilot basins or sectors. • A short briefing note for policymakers that identifies synthesises evidence on vulnerability, impacts and ongoing adaptation initiatives.	The outcomes of this step will set the scene for the identification of water security and climate resilient investments in Phase 2 of the Framework, providing technical evidence on priority climate impacts and vulnerabilities to be addressed. It should be noted that the outcomes of the analyses support a wide range of subsequent steps in the Framework process, including identifying opportunities for building climate resilience into ongoing development activities, identifying new and innovative investment opportunities, and ensuring investment options are robust against uncertainty about climate change.
Phase 2: Identify and appraise options		
Identifying opportunities for building resilience into ongoing development activities	• An inventory of existing projects, programmes and systems that may be impacted negatively by future climate variability and change. • Categorisation of existing projects, programmes and systems at risk, according to their degree of climate sensitivity. • Identified options and opportunities to reduce risks from climate change for existing projects, programmes and systems. • A portfolio of investment opportunities that will directly influence and benefit ongoing activities.	The outcomes of this step will not only contribute to reducing the climate risk of existing projects, programmes and systems, but will also help to strengthen the capacity of planners and others through 'learning by doing' in the integration of climate risks and climate change into decision making.
Identifying new innovative investment opportunities	• Strengthened partnerships that enable identification, financing and implementation of no/low regrets investment opportunities. • A portfolio of innovative no/low regrets investment opportunities for improving water security.	The outcome of this step provides a portfolio of opportunities for climate resilience, based on seeking innovation through partnerships and carrying forward many of the activities for climate resilience that are proposed in existing plans and strategies, but are not currently planned for implementation. These combine with the previous chapter's screening of ongoing development activities to reduce risks, and form a comprehensive package of investment opportunities.

Table 13.1 Expected outputs and outcomes for each phase of the Framework (continued)

Step in the process	Outputs	Outcomes
Phase 2: Identify and appraise options (continued)		
	• A report verifying the robustness to climate change (or otherwise) of the portfolio of investment opportunities. • Categorisation of investments under the following headings: (i) take forward for detailed economic analysis; (ii) marginal/require modification; or (iii) not viable.	The outcomes of this step pave the way for more detailed economic analysis, which is restricted to those opportunities that are verified as robust against uncertainty about climate change. This step also provides an opportunity for marginal investment opportunities to be revisited or revised, should they fall below the threshold for acceptance.
Economic appraisal of investment options	• An economic analysis report for each component of the no/low regret investment opportunities portfolio. • A report ranking the portfolio of investments according to the outcomes of the economic analyses. • Recommendations on investments for: (i) early implementation; (ii) marginal/require modification; or (iii) not viable. • A briefing note for high-level decision makers and their development cooperation partners.	The outcomes of this step should bring to the table a prioritised set of economically justified and demonstrably no/low regret investment opportunities, agreed by all key stakeholders, for early implementation. The outputs can be used to communicate the benefits of no/low regrets investments, and to help prioritise detailed project preparation. The outputs should be used to influence, be integrated with existing development plans and budget allocations, and serve as an input into future strategies and plans.
Phase 3: Deliver solutions		
Integrating no/low regret investments into development planning processes	• Summary report of network analysis, detailing the structure of the planning system into which investments will be integrated. • Identification of target institutions and organisations for integrating no/low regrets investments, and an action plan for achieving this with measurable objectives.	The outcomes of this step will move investments from opportunities to commitments that are integrated with ongoing development planning processes. Integration provides development planners with ownership of investments, providing a route to implementation and, in combination with the robust decision making and economic analysis, will give investors the confidence they are looking for to support these investments.
Developing financing and investment strategies	• An inventory of relevant climate adaptation funds, how to access the funds, and what the funds can be used for. • A mapping of the portfolio of no/low regret investments options onto appropriate climate-funding options. • Detailed and innovative financing strategies developed for priority no/low regret investments.	The outcomes of this step should facilitate access to funding and may include bringing together project and programme proposers with the relevant financing bodies, through roundtable discussions and meetings. The aim is to move priority investments forward for early implementation.
Mainstreaming climate resilience in development planning.	• Improvements in policies, institutional arrangements and management instruments. • Increased funding for water security and related climate change programmes. • Application of tools and approaches for improved water security and climate resilience.	Ultimately, mainstreaming should lead to an increased availability of water of an acceptable quantity and quality for all beneficial uses, and reduced vulnerability to climate risks, through an increased capacity and ability of regions, countries and communities to adapt to climate change. In short, a water-secure world based on sound sustainable development principles that support growth and development.
Phase 4: Monitor and move forward		
Learning lessons, monitoring and evaluation	• Definition of a detailed monitoring and evaluation process for each phase of the Framework application. • A logical framework detailing planned output, outcomes and impacts, and specific, measurable, attainable, relevant and timely (SMART) targets for monitoring and evaluating progress. • Baseline data and strengthened monitoring data and information. • Periodic progress reporting and a review process, on completion of each phase. • A lessons-learned report.	The outcomes of this step will set the scene for future applications of the Framework, and identify improvements to the process. It will also provide monitoring results to demonstrate wider progress towards water security and climate resilience.

The Framework is a tool to help achieve overall goals, rather than a goal in itself. Application and use of the Framework aims to achieve objectives that ultimately impact on short-, medium- and long-term goals:

- The long-term goal is for a water-secure world based on sound sustainable development principles that support growth and development. Benefits will include populations impacted positively by improved water security and reduced vulnerability to climate risks.
- In the medium-term, this requires an increased availability of water of acceptable quantity and quality for all beneficial uses, and increased capacity and ability of regions, countries and communities to adapt to climate change.
- In the short-term, this is achieved through (among other things): improvements in policies, institutional arrangements and management instruments; accessing funds for water security and related climate change programmes; applying tools and approaches for improved water security and climate resilience; developing no/low regrets opportunities and making plans for their integration into strategy documents; and the successful implementation of projects on the ground.

13.4.1 Using a logical framework approach

A logical framework approach to monitoring and evaluation establishes a hierarchy of impacts, outcomes and outputs alongside verifiable indicators, means of verification and assumptions to track progress. Indicators should be SMART (specific, measurable, attainable, relevant and timely). Tracking progress requires a baseline to be set, which is normally the status of the indicator at the onset of the intervention – in this case, prior to application and use of the Framework. Quantitative indicators are usually preferred, but a narrative that draws together quantitative and qualitative findings is often more informative to high-level decision makers. A range of assumptions will need to be met to secure the outcomes and outputs, and these should be clearly identified.

In addition to the routine monitoring, improved evaluation should also promote water security and climate resilient development. This is a more complex activity than monitoring and it is less easy to present standard methodologies. Evaluation can be based on benefit–cost analysis where possible, while using qualitative or indicator approaches where appropriate. The benefits to be evaluated should include social and environmental benefits and be based on the extent to which people experience reduced vulnerability.

13.4.2 Indicators for water security and climate resilience

The impact of programmes on water security and climate resilient development should be monitored using the existing monitoring mechanisms in national planning systems, thereby reinforcing the mainstreaming of water security and climate resilient development. Existing systems vary greatly from country to country and should be adapted accordingly. Overall, countries should aspire to have a results-based budgeting system, in which each government department should declare a few key indicators against which progress will be monitored. Many countries already have high-order monitoring indicators associated with their national strategies (e.g. poverty reduction strategy papers) that provide a foundation for monitoring impacts.

Within sectors, there is more scope to define more detailed monitoring indicators as part of normal management information systems. This should be done as part of the sector strategy. Where possible, indicators should build on existing monitoring data and systems, or only be included if there are mechanisms in place to collect the data. Some investment in surveys may be required to produce baseline values for indicators of water security and climate resilient development, where these have not been collected on a routine basis. The temptation to specify too many indicators should be avoided, as this may introduce unrealistic and costly information collection processes.

As with any implementation process, monitoring indicators should be regularly reported and implementation outcomes evaluated. Indicators are likely to be specific to the characteristics of the investment strategies, and are usually developed in consultation with the agencies involved in funding the investments.

Box 13.2

Adaptation Fund output indicators[2]

- Projects that conduct and update risk and vulnerability assessments.
- Early warning systems developed.
- Number of targeted institutions with increased capacity to reduce risks.
- Number of people suffering losses from extreme weather events.
- Number of local risk-reduction actions or strategies.
- Health and social services responsive to climate risks.
- Physical infrastructure improved to deal with risk.
- Ecosystem services maintained or improved under climate change.
- Number of natural resource assets with improved resilience.
- Percentage of households and communities with more secure livelihood assets.
- Percentage of targeted population with sustained climate resilient livelihoods.
- Number of policies introduced or adjusted to address climate change risks.

The Adaptation Fund uses a mix of results indicators, which refer to climate resilience and to progress with mainstreaming climate resilience into planning (see Box 13.2).

Similarly, for mainstreaming, IIED[3] proposed five high-level indicators:

- The number of programmes using climate information in design.
- The performance of national planning systems in conducting adaptation.
- The proportion of programmes modified in design to become more climate resilient.
- The number of mechanisms that target climate-vulnerable people.
- The use of a regulation that requires effective screening.

While it is useful to monitor the mainstreaming process, this should not be treated as an end in itself; the main focus should be on monitoring the impact of programmes.

13.4.3 Patterns of expenditure

Patterns of expenditure can be a useful monitoring tool. Reporting on trends in the proportion of expenditure that is, for example, related to water security and/or represents no/low regrets can be a good starting point. Some more sophisticated indicators may also be available, such as the proportion of programmes that have been adapted to reduce climate risks.

There is good experience in Africa with using public expenditure reviews to prepare for a major sectoral policy initiative. These are often focused on one sector or cross sector, but may also be countrywide. In general, public expenditure reviews present: what was planned to be spent (the budget); what was actually spent (in terms of expenditures); what was achieved (outputs); and whether these achievements met policy objectives (outcomes).

In the case of climate change actions, climate change public expenditure and institutional reviews have been instigated in some Asian countries to provide a specific focus on the integration of climate change-related expenditures in the national budget. These reviews have an important process function, acting as a starting point for longer-term, government-led stakeholder dialogue, and learning involving the public and private sectors, academia, civil society and international development partners.

One difficulty is that climate change actions are not limited to one or a few sectors, but represent new and additional incremental costs that are incurred across the whole economy. Initially, it is possible to identify one or more sectors that are particularly climate sensitive for preliminary review. A climate change public expenditure and institutional review would typically identify the level of integration of climate change-related expenditures in the national budget, and provide future trend analysis for budget allocation and execution.

At present, it is too early to make a meaningful assessment on outcomes or the impact of climate change expenditure, and the emphasis is better directed towards highlighting the management and information systems that need to be put in place for future reviews to be undertaken with confidence.

13.4.4 Water indicators

Water indicators are an increasingly important influence on decisions about development strategies. Indicators convey information about current conditions and trends, as well as the causes and consequences of investment decisions and institutional reforms. The proliferation of indicators has also proven controversial due to embedded assumptions and data limitations, particularly in drawing connections between water and development.

The prevalence of indicators demonstrates the adage that 'what gets measured gets managed and improved'. Without an understanding of baseline conditions, trends and the effectiveness of investment decisions, it is difficult to assess strategies aimed at improving water resource management and development outcomes. Indicators, particularly quantitative metrics, aim to:

- **Make things less complex.** Indicators provide a quantitative basis for decision making to cope with complexity and heterogeneity. Simplification can reduce attention on local conditions and uncertainty about causal dynamics between water and development.
- **Inform and legitimise decisions.** Indicators are perceived as objective evidence for decision making, particularly for politically contentious decisions. Therefore, legitimacy needs to be developed through credible forums, in which diverse stakeholders have input and build confidence in values embedded in the indicators used to inform decisions.
- **Measure change.** Indicators are used to track changes in water security, development and the relationship between them. This information underpins decisions about investments and assessment of their performance.
- **Communicate.** Indicators distill complex information and cause-and-effect relationships into a format that is accessible to a diverse range of stakeholders and experts. They are therefore political and planning devices used to frame problems and assess alternative solutions.

Water security indicators need to connect indicators of basic water needs ('small' water challenges) with indicators of water sharing and risk management at national and transboundary levels ('big' water challenges). Indicators have been developed to capture an expanding range of water security challenges at

multiple scales. There has been an evolution from indicators of basic needs and food security (e.g.the Falkenmark Water Stress Index and the Gleick Basic Water Requirements) to more complex composite indices (e.g. the Water-Poverty Indicator) or specialised indices to address risk, water sharing and variability (e.g. Basins-at-Risk). Table 13.2 provides examples of water indicators and their diverse purposes and sub-components.

The African Ministers' Council on Water (AMCOW) is already engaged in a process of collaborating with regional bodies and partners to develop a harmonised, pan-African methodology and knowledge management and information system for monitoring and evaluation in the water sector, as part of a push for better country performances in achieving the Africa Water Vision 2025 and the Millennium Development Goals (MDGs). The emphasis is on strengthening and harmonising existing water and sanitation monitoring initiatives across the continent. The initiative recognises that water sector monitoring and evaluation is deficient in many African countries, and needs to go well beyond monitoring progress toward the MDGs. It would be beneficial if this system also adopted a set of common high-level indicators for water security and climate resilient development, to enable benchmarking across different countries and/or regions.

Table 13.2 Indicators of water security

Indicator	Challenges	Scale	Components (Data)	Thresholds
Drawers of water[4] **Drawers of water II[5]**	Basic needs	Urban/rural sites	Water-use behaviour Cost of water Factors affecting use Environmental health effects of use	n/a
Falkenmark Water Stress Indicator[6]	Basic needs Food security	Country	Annual renewable water resources Population Sample of water use by country	m^3/person/year Stress (1000-1700) Scarcity (500-1000) Absolute scarcity (<500)
Basic Human Needs Index[7]	Basic needs	Country	Domestic water use Population	50 litres/person/day Minimum drinking water (5) Basic sanitation (20) Basic bathing (15) Basic food prep (10) All have ranges
Relative Water Scarcity[8] **Economic water scarcity[9]**	Basic needs Food security	Country Country/ regional/ admin units	Water demand Water availability	Physical scarcity 75% of available water withdrawn Economic scarcity Malnutrition despite < 25% of available water withdrawn
Water Poverty Indicators[10]	Basic needs Food security Managing risk Protecting ecosystems	Country/ community	Measures of access Water quality and variability Water for food and other productive purposes Capacity to manage water Environmental aspects	Weighted index of components for each category
Seasonal Storage Index **Interannual Shortfall Index[11]**	Managing risk	Country	Food production requirements Water balance estimate Intra-annual variability Inter-annual variability	n/a
Virtual water/water footprinting[12,13]	Food security Sharing water	Country	Internal water use External water use	n/a
Basins at risk[14]	Sharing water	River	Event data on conflict and cooperation	Event intensity scale
Water Security Threat Indices[15]	Basic needs Protecting ecosystems	8 km and 0.5 degree grids	Catchment disturbance Pollution Water resource development Biotic factors	Domestic, industrial and agricultural demand is 40% of local discharge

13.5 Emerging indices and tools

High-level indicators are being developed for private-sector investment in adaptation and also for identifying business risks relating to water. This section discusses two such indicators: the Global Adaptation Institute Index[16] (GAIN) and the World Resources Institute Aqueduct Water Risk Atlas.[17] Both are dimensionless, composite, weighted indices based on the aggregation of a wide range of measures relating to vulnerability and climate risk. They are also delivered in a user-friendly format via interactive websites that offer regular updates.

In the context of monitoring and evaluating the Framework, these indices are important in representing how the business community perceives climate risks and adaptive capacity across countries. Demonstrating successful management of such risks, and improving indicator scores, will make countries more attractive places to invest in the medium to long term. Countries should be aware of such indices and aim to improve their rankings in the long term.

The GAIN Index is an example of a high-level indicator that offers information on a country's relative vulnerability and its readiness to undertake adaptive actions (see Box 13.3). The developers of the GAIN Index recognise that despite expanding resource commitments from international institutions, public funding alone is not the solution and the private sector will play a key role in providing the necessary additional resources. The GAIN Index therefore offers information on a country's vulnerability and its readiness to undertake adaptive actions to prioritise and evaluate these needed investments.

Climate-related risks and climate change can jeopardise water use by private companies over long time periods. The Water Risk Atlas, which is still being developed, will provide geographical and sector-specific water risk context to companies and their investors (see Box 13.4). In the context of the Framework, this will represent an external view of business risks due to the climate. It will provide both a mechanism to highlight existing areas for risk-reduction investments and a means to track private investors' views of business risks due to the climate.

Indices and tools such as the two described above not only serve to highlight risk profiles and progress on vulnerability and readiness, but can also be used to strengthen the case for investment in water security and climate resilience among high-level decision makers and their advisors.

Box 13.3
The Global Adaptation Institute Index

The GAIN Index summarises a country's **vulnerability** to climate change and other global challenges on the one hand, and its **readiness** to improve resilience on the other. It aims to help businesses and the public sector better prioritise investments, for a more efficient response to the global challenges ahead.

Vulnerability

The GAIN Index's vulnerability analysis seeks to capture exposure to climate-related hazards, sensitivity to their impacts, and the ability to cope with those impacts. It uses 24 indicators to measure three sectors that underlie human well-being – water, food and health – and three infrastructure sectors – coastal, energy and transport.

Readiness

This measures a country's ability to successfully absorb additional private-sector investment resources and apply them effectively towards increasing resilience to climate change and other global challenges. It uses 14 indicators to measure three categories of readiness: economic, social and governance.

The GAIN Index trend is generated by assessing a country's improvement or decline over the average of the past three years, compared to the average of the 3 years prior to that:

- A positive result shows that the improvement is better than average.
- An equal result shows positive improvements that are below average.
- A negative trend shows a declining score.

13.6 Final remarks

Review, monitoring and evaluation are an integral part of any decision-making cycle, and help to reinforce the message that progress towards water security and climate resilient development is a continual and iterative process. The manner in which review, monitoring and evaluation take place will depend largely on a country's existing systems and their individual needs and priorities. Integrated with existing systems, review, monitoring and evaluation also ensures practices are mainstreamed, rather than occurring as parallel or one-off activities.

The outputs of this step should be based on the particular context and setting for the Framework application, and include:

Box 13.4

The World Resources Institute Aqueduct Water Risk Atlas

The risk maps generated by the Water Risk Atlas will help companies understand the intricacies of water risk, and in turn manage their exposure to such risk. When completed, the Atlas will include a global map for current and future water scarcity and water quality, as well as detailed, multi-variable risk maps for the most water-stressed, economically significant river basins around the world. The maps are developed by aggregating and weighing various indicators that drive water risk. These indicators go beyond physical data (such as water supply) to capture local regulatory structures, and even potential reputational impacts.

Since different companies in different sectors are exposed to different types of risk, the Water Risk Atlas was built to be as flexible and transparent as possible. Users can create risk profiles and adjust the weight and priority given to risk categories, drivers, or even individual indicators, to reflect their unique circumstances. The World Resources Institute is convening water experts from a wide range of companies and organisations to construct standardised risk profiles that capture the water issues most pertinent to specific sectors.

- Definition of a detailed monitoring and evaluation process for each phase of the Framework application.
- A logical framework detailing planned output, outcomes and impacts, and SMART targets for monitoring and evaluating progress.
- Baseline data and strengthened monitoring data and information.
- Periodic progress reporting and a review process, at completion of each phase.
- A lessons-learned report.

The outcomes of this step will set the scene for future applications of the Framework, and improvements to the process. They will also provide monitoring results to demonstrate wider progress towards water security and climate resilience.

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Tool and method finder

	Tools and methods	Section	Page	Brief description
Setting the context	Framework for water security and climate resilient development	1.2	p2	The Framework is a tool to help users to identify and develop 'no/low regrets' investment strategies, to integrate these into planning processes, and to adapt future development planning activities to make them more resilient to climate change and variability.
	Climate and socio-economic scenarios	2.2–2.3	p7/8	A frequently used approach is to identify the main climate and socio-economic drivers of change as dimensions, for example considering 'wet' and 'dry' future climate scenarios and 'high' and 'low' future economic growth. This is a useful and relatively simple framework for capturing uncertainty ranges.
	Regional down-scaling	2.3	p9	Downscaling climate change data from global models provides more detail for Africa and its sub-regions. Information at this regional level is needed by scientists in disciplines affected by climate change (e.g. hydrologists), as well as decision- and policymakers, and by those assessing climate change impacts, adaptation and vulnerability.
Phase 1: Understand the problem	Macro-economic analysis of climate change	3.3	p17	High-level studies to assess the impacts and economic costs of climate change, considering key sectors of the economy as well as non-market sectors such as health and ecosystems. Can be used to analyse the costs and benefits of adapting to climate change effects over different timescales.
	Policy papers and briefs	3.4	p17	Policy papers and briefs are often used as communication tools to engage with high-level decision makers; they provide a persuasive argument justifying the recommendations presented in the paper. Policy papers are generally more comprehensive while policy briefs are more succinct.
	Stakeholder analysis	4.3	p29	A well established tool that provides a systematic approach to understanding the interests and influence of identified stakeholders in water security and climate resilience. Stakeholder analysis is used to appraise roles, responsibilities and interests of stakeholders, and to identify stakeholders to engage with for application of the Framework.
	Climate impact, vulnerability and adaptation assessments (general)	5.3	p36	Assessment methods may be classed broadly into impact, vulnerability, adaptation and hybrid approaches. These assessment methods may incorporate risk assessments to varying degrees. The requirements of impact, vulnerability and adaptation assessments are highly dependent on a number of factors, such as: the end purpose of the assessment, the geographical scale of application, and the resources and data available.
	Rapid impact and vulnerability assessments	5.5	p38	Rapid assessments are useful where time and resources are limited and can also be used to provide the initial evidence to target more detailed studies of hotspot areas or sectors. Rapid assessments can involve reviewing existing work, engaging with stakeholder to understand local issues and expert elicitation to provide evidence without detailed studies.
	Sector specific climate impact modelling techniques	5.7	p41	Specific tools exist for modelling climate change impacts on water resources, agriculture, energy, infrastructure, ecosystems, natural hazards and others. These tools can often be tailored or adapted to address specific problems of questions.
	Community-level vulnerability assessments	5.8	p47	Community-level vulnerability assessments take a bottom-up perspective of climate vulnerability to identify, at a very fine scale, the particular climate challenges and vulnerabilities facing households and livelihoods. The approaches require site visits and intensive engagement with local stakeholders but the results can often provide a detailed understanding of the drivers of climate vulnerability.
	Hotspot analysis	5.9	p47	Vulnerability or impact mapping can take a top-down view, looking at spatial datasets, to create indictors that can be mapped to identify hotspots for targeting investment in resilience. Hotspot analysis will usually consider a combination of factors such as exposure and sensitivity to the climate hazard, as well as consideration of adaptive capacity.
	Multi-sector approaches	5.10	p50	Multi-sectoral evaluation of water resources development and management options and scenarios from both national and basin-wide perspectives. The use of integrated models allows a range of socio-economic and climate change scenarios to be assessed across short- and long-term timeframes.
	Assessing adaptive capacity	5.11	p52	Assessing adaptive capacity requires simple indicators to represent complex social decision making processes and physical systems. Frameworks such as the Africa Climate Change Resilience Alliance (ACCRA) local adaptive capacity can be used as tools to build indicators of adaptive capacity.

	Tools and methods	Section	Page	Brief description
Phase 2: Identify and appraise options	Climate risk screening	6.3	p57	Screening is used to rapidly assess existing and future climate risks posed to existing assets, ongoing programmes and planned projects and programmes. The results of a climate risk screening exercise can be used as a basis for identifying risk reduction measures and prioritising no/low regret options for investment.
	Strengthening partnerships across sectors and levels	7.2	p66	Strengthening partnerships, whether existing or new, can serve to generate new and innovative thinking on opportunities for investment. For example, partnerships across sectors yield benefits through coordinated planning and management of natural resources and climate risks and those spanning planning levels can be used to upscale pilot schemes and ensure that different levels of planning are in dialogue.
	Revisiting existing plans and strategies	7.4	p69	Reviewing the existing and continually growing body of strategies and plans is a means to rapidly identify investment opportunities for revitalisation which may otherwise remain shelved
	Characterising investments (based on climate risk)	8.4	p77	Investments may be broadly classed according to their climate change risks. No/low regrets investments are those which have a high chance of success despite a full range of uncertainties in climate change and other future drivers. Assessment for no/low regrets invesments involves testing its performance against potential future scenarios, and ensuring minimum risk of failure.
	Robust decision making approaches	8.5	p80	Robust decision making is an approach to assist in determining the performance of investment options under different future climate and socio-economic scenarios. It identifies options which are susceptible to climate risks and those which will perform well regardless of climate uncertainty. It can be used to prioritise investments prior to economic appraisal.
	Economic appraisal - single and multi-criteria methods	9.2–9.3	p84/86	Benefit-cost analysis and cost effectiveness are tools used to assess the financial viability of investments - a vital step in investment planning. Multi-criteria analysis can be used to assess the costs and benefits of investments in which it is difficult to assign monetary values, such as social wellbeing or ecosystems services
Phase 3: Deliver solutions	Planning system analysis and entry points for investments	10.2–10.3	p92/93	Network analysis can be used as a tool to used to understand planning and decision making processes and to identify entry points for integrating no/low regrets investments into the planning system.
	Project preparation and facilities to support preparation	10.4	p94	The development of no/low regrets investments is progressed substantially during earlier phases, but Project Preparation Facilities can provide assistance in moving appropriate investment opportunities forward and into bankable projects.
	Influencing resource allocation for no/low regrets investments	10.5–10.6	p95/96	Investment opportunities for climate resilience can be built into national planning instruments, such as budget strategy papers, and sector strategies can be influenced to include climate resilient development investment opportunities. In a similar manner development cooperation strategies can be targeted by aligning investment opportunities with the strategic aims of donors.
	Developing financing strategies for water-related investments	11.1/11.5	p99/105	Financing strategies are essential tools in the investment planning process. A wide range of financing options exist from traditional sources as well as emerging specialist climate finance.
	Mainstreaming climate resilience in development planning	12.3–12.7	p112/115	Mainstreaming aims to integrate the links between water security and climate resilience into growth and development policymaking, budgeting, and implementation processes at all levels. Influencing these processes is central to achieving long-term climate resilience.
	Capacity development	12.8	p116	Building functional and technical capacity in water security and climate resilience is a key tool for mainstreaming. Improving individual, organisational and inter-organisation coordination can all improve the long-term consideration of climate risks and climate change in the planning process.
Phase 4: Monitor and move forward	Lessons learned reviews	13.2	p120	A lessons-learned review is a tool which can be used to identify potential improvements in the application of the Framework in other regions or in further iterations. It provides a chance for a formal appraisal of the achievements and limitations of the Framework's application.
	Monitoring and evaluation systems	13.3–13.4	p120/123	Monitoring and evaluation systems, such as logical frameworks are an important tool for ensuring that the application of the Framework achieves its aims and that activities arising from the Framework are followed up.
	Monitoring and evaluation indicators	13.4–13.5	p120/23	Indicators are tools used within monitoring and evaluation systems to measure progress and achievement of targets. Indicators range from specific indicators for Framework outcomes, such as strategies influenced, to high level indicators, such as patterns of expenditure.

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