United Nations Framework Convention on Climate Change

UNFCCC RESOURCE GUIDE

FOR PREPARING THE NATIONAL COMMUNICATIONS OF NON-ANNEX I PARTIES

MODULE 2 VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

UNFCCC

UNFCCC
United Nations Framework Convention on Climate Change

RESOURCE GUIDE FOR PREPARING THE NATIONAL COMMUNICATIONS OF NON-ANNEX I PARTIES

MODULE 2:

VULNERABILITY AND ADAPTATION

TABLE OF CONTENTS

I. INTRODUCTION

1.1 ABOUT THE MODULE

This module was developed as a prototype guide to assist Parties not included in Annex I to the Convention (non-Annex I Parties) to prepare the vulnerability and adaptation (V&A) section of their national communications.

Although this module can be read alone, it is also the second in a series of four modules that will ultimately form a complete *Resource guide for preparing the national communications of non-Annex I Parties.*[1]

More importantly, this module is intended to act as a supplement to Reporting on climate change: user manual for the guidelines on national communications from non-Annex I Parties, written to support the implementation of Article 8, paragraph 2 (c), of the Convention. The Resource Guide aims to provide an entry point to the considerable additional material produced since the User Manual[2] was first published at the ninth session of the Conference of the Parties (COP 9) in 2003, and is intended to be read as an overarching document, supported by various other sources.

The aims of this module are:

- To provide a brief overview of some of the main methods, tools and data being used by non-Annex I Parties to assess V&A to climate change, including advantages and limitations;
- To emphasize methods, particularly those that are readily accessible and applicable;
- To describe where readers can obtain software, documentation on methods and further information.

After reading this module readers should:

- Understand a number of key ideas relating to V&A, including what vulnerability and adaptation are and the different frameworks and approaches available;
- Have gained greater knowledge of the complexity and difficulties of developing baseline scenarios, as well as an awareness of the suitability of different models;
- Have gained an overview of four key areas which are subject to important effects of climate change and an appreciation for the range and depth of materials available to support Parties in applying V&A tools in these contexts;

- Have enhanced their ability to think holistically about the V&A processes, initiated through the integration process;
- Be aware of the formal requirements for submitting national communications and of what non-Annex I Parties can do with their completed documents to initiate responses, in their respective countries, to adapt effectively to climate change threats.

1.2 KEY SOURCES OF RELATED INFORMATION

Key sources of information used throughout the module are listed below. Further sources are also provided, where appropriate, within each section.

- *"Handbook on vulnerability and adaptation assessment."* <http://unfccc.int/resource/cd_roms/na1/v_and_a/index.htm>. This training package contains technical chapters, PowerPoint presentations and supporting material on methods and tools for V&A assessment. The Handbook provides much of the technical underpinning for this module;
- *"Reporting on climate change: user manual for the guidelines on national communications from non-Annex I Parties."* <http://unfccc.int/national_reports/non-annex_i_natcom/guidelines_and_user_manual/items/2607.php>. Outlines the formal requirements for drafting national communication;
- *"Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to, climate change."* <http://unfccc.int/2674.php>. Excellent source to allow comparison between methods and tools for V&A assessment. Extensive links to source documents. Referred to as the *'UNFCCC Compendium'* throughout this module;
- Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) (comprising three working group reports). <http://www.ipcc.ch/ipccreports/assessments-reports.htm>. A comprehensive, up-to-date scientific summary by sectors and regions of impacts of and vulnerability and adaptation to climate change.

1.3 GETTING STARTED

The remainder of this module uses an open 'learning-centric' approach that combines technical content with supporting references, examples of good practice and tips. Case studies of experiences gained by various countries in the drafting of national communications are also included where appropriate.

A table summarizing some of the key concepts that are important to understand when preparing the V&A section of a national communication is provided at the end of this module. This summary can be a useful tool for readers to test their knowledge, or to refresh their memory about the subject matter covered in this module.

The module is designed in such a way that a reader can start anywhere. However, it may be a good idea to read through chapters 2 to 4, which outline the overall approaches to V&A assessment, before looking at specific subject areas.

[1] Referred to as the Resource Guide throughout this document.
[2] The User Manual can be downloaded in English, French and Spanish from the UNFCCC website <http://unfccc.int/national_reports/non-annex_i_natcom/guidelines_and_user_manual/items/2607.php>.

II. WHAT IS VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE?

"Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases."

IPCC Fourth Assessment Report

As the certainty of future climate changes has grown, so has the realization that many impacts of climate change will be unavoidable. In recent years, the need to conduct thorough impact assessments and carefully plan measures to help reduce impacts of climate change, through adaptation, has become more apparent. As a result, analysing a nation's vulnerability to climate change and the options available to adapt is receiving greater priority on political agendas.

While the reporting of V&A to climate change is a requirement for all Parties to the UNFCCC, potential vulnerabilities to climate change and the scale and cost of adaptation are also being increasingly understood to be matters of mainstream national importance. Climate change impacts are recognized as potentially affecting such areas as national economies, livelihoods, poverty reduction, ecosystems and natural life-support systems.

A good understanding of the terms 'vulnerability' and 'adaptation' is an essential element in dealing with V&A (see BOX II-1).

In considering the definitions of vulnerability and adaptation it is important to understand that:

- The terms apply to any vulnerable systems, whether natural systems (such as coastlines, deserts and rainforests) or human systems (such as settlements, economies and culture);
- Vulnerability to climate change includes long-term changes in average climatic conditions and also climatic variability (such as El Niño/La Niña) and extreme climatic events (such as droughts, heat or cold waves, or hurricanes);
- Assessment of vulnerability to climate change will include consideration of the degree of exposure of systems to climate change and the susceptibility of those systems, including the ability of those systems to cope;
- There will be different degrees of vulnerability depending on the interaction between the magnitude of climate change and the nature of the system being assessed;
- The ability of systems to adapt depends on the ability, or capacity, of those systems to change;
- There will be both positive and negative effects of adaptation.

These aspects of vulnerability and adaptation are discussed throughout this module as a way of stimulating thinking and working towards best practice solutions.

Box II-1. Defining vulnerability and adaptation[a]

Vulnerability	Adaptation
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.	The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

[a] The Intergovernmental Panel on Climate Change (IPCC) has an excellent online glossary of terms. See <www.ipcc.ch/glossary/index.htm>.

III. FRAMEWORKS FOR VULNERABILITY AND ADAPTATION ASSESSMENT

There are many different frameworks and approaches available for V&A assessments. This section outlines some of the established frameworks and considers 'ways of thinking' about their selection in particular contexts (including practical considerations of time, cost and available resources).

3.1 MAJOR VULNERABILITY AND ADAPTATION FRAMEWORKS

Over the past 15 years many V&A frameworks have been developed tailored to the particular needs of the assessment. The recently updated UNFCCC Compendium[3] summarizes these frameworks and the most commonly used of these are shown in TABLE III-1. While providing a survey of the possible tools which can be applied to a number of different situations, the Compendium's main purpose is to direct readers to additional sources of information. It is not concerned with instructing readers on how to use the tools identified.

Current good practice does not mean choosing one particular framework. Rather it is up to individuals to critically assess the strengths and weaknesses of each framework within their particular circumstances. As a result, no one framework mentioned in this module is recommended over any other.

[3] The UNFCCC Compendium is available at <www.unfccc.int/adaptation/nairobi_workprogramme/compendium_on_methods_tools/items/2674.php>.

Table III-1. Established vulnerability and adaptation frameworks

Framework	Year released	Description	Approach
Intergovernmental Panel on Climate Change *Technical Guidelines for Assessing Climate Change Impacts and Adaptations* <http://www-cger.nies.go.jp/publication/l015/972381-1.pdf>	1994	Contain examples of first generation approaches to the assessment of V&A. They have an analytical emphasis and focus on identification and quantification of impacts	Top-down
U.S. Country Studies Program (USCSP) <http://www.gcrio.org/CSP/webpage.html>	1996	Summary reports of various V&A studies undertaken by participating countries	Top-down
United Nations Environment Programme *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies* <http://dare.ubvu.vu.nl/bitstream/1871/10440/1/f1.pdf>	1998	Provides a basic overview to the field of climate impacts and adaptation assessment by sector. Introduces a wide variety of methods available	Top-down and bottom-up
Annotated guidelines for the preparation of national adaptation programmes of action (NAPAs) <http://unfccc.int/files/cooperation_and_support/ldc/application/pdf/annguide.pdf>	2001	Provides some conceptual and procedural oversight for the process of producing a document that identifies urgent and immediate national priorities for adaptation	Bottom-up
United Kingdom *Climate Impacts Programme (UKCIP) Climate Adaptation: Risk, Uncertainty and Decision Making* <http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=62>	2003	Provides guidance to those engaged in decision-making and policy processes. It lays out an approach to integrating climate adaptation decisions and, more generally, climate- influenced decisions into the broader context of institutional decision-making	Top-down and bottom-up

Table III-1. **Established vulnerability and adaptation frameworks** (continued)

Framework	Year released	Description	Approach
United Nations Development Programme *Adaptation Policy Frameworks for Climate Change* (APF) <http://www.undp.org/climatechange/adapt/apf.html>	2004	Facilitating climate risk assessment and management. Second-generation assessment, places the assessment of vulnerability at the centre of the process	Top-down and bottom-up
Australian Greenhouse Office *Climate change impacts and risk management: A guide for business and government* <http://www.climatechange.gov.au/publications/index.html>	2006	Facilitating climate risk assessment and management, aimed at local and governmental bodies, and businesses	Top-down and bottom-up
United States Agency for International Development (USAID) Adapting to climate variability and change; A guidance manual for development planning <http://www.usaid.gov/our_work/environment/climate/pub_outreach/index.html>	2007	Provides guidance on integrating adaptation into development projects. Guides climate risk screening and climate proof project design, aimed at development agencies	Bottom-up

Source: Adapted from Lu X. 2008.
Applying Climate Information for Adaptation Decision-making: a guidance and resource document, National Communications Support Programme, United Nations Development Programme-United Nations Environment Programme-Global Environmental Facility, New York, USA.

TABLE III-1 shows an evolution of V&A frameworks from the early 1990s onwards. Frameworks developed in the mid-1990s, often referred to as 'first generation', focus more on understanding how significant the impacts of climate change will be in order to direct mitigation efforts. These early frameworks were based on climate scenarios generated through general circulation models (GCMs), applied to ecological or biophysical environments.

Over time, growing concern around adaptation measures led to changes in thinking about V&A. This was reflected in the development of 'second generation' frameworks which focus on more holistic impact assessments within adaptation decision-making contexts. However, it is important to note that approaches to V&A assessment are evolving rapidly, with more recent work focused on blending merits of both first- and second-generation approaches. For example, greater emphasis is being placed on socio-economic scenarios, stakeholder participation and strengthening adaptive capacity.

Tip – Consider all frameworks

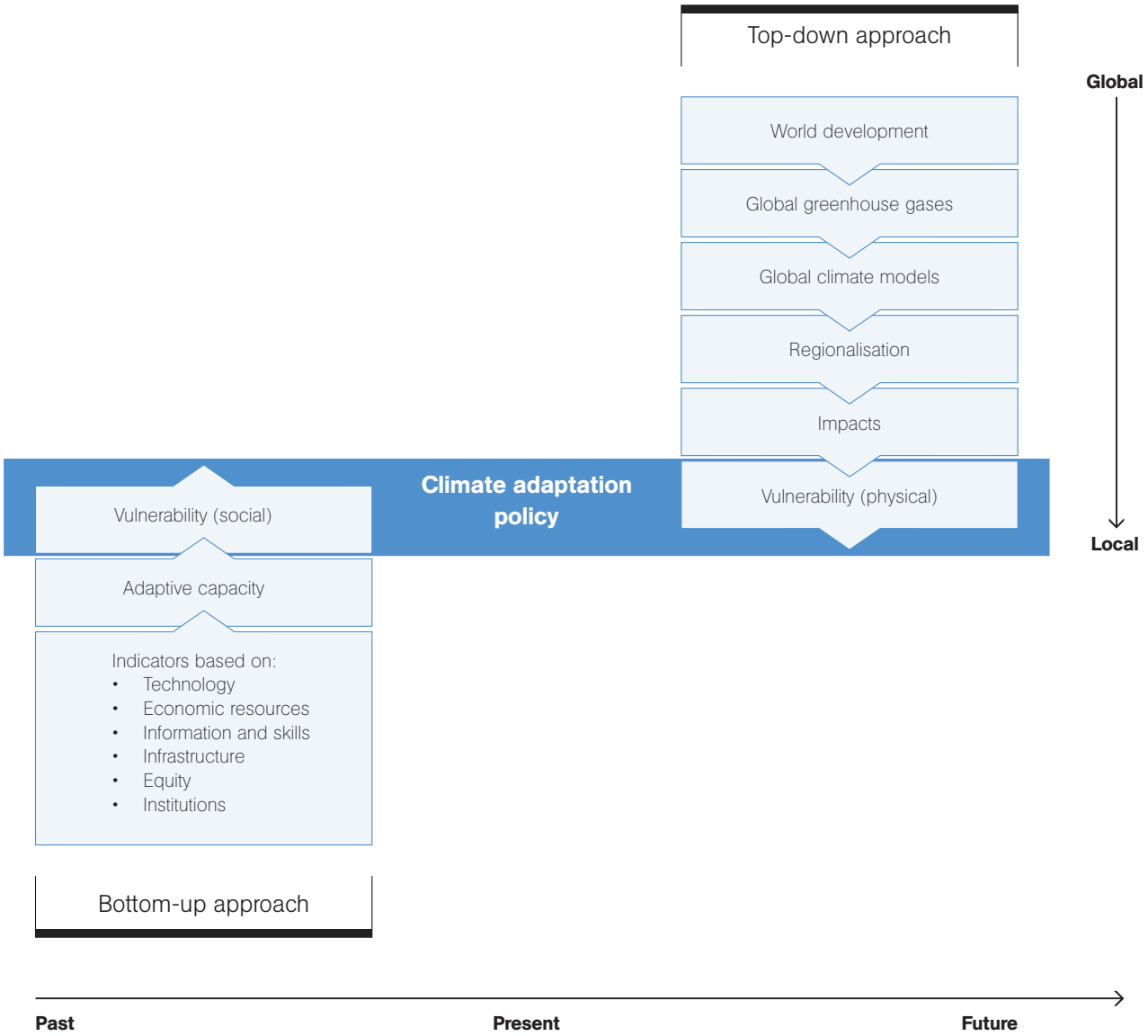
Each of these V&A frameworks is worth considering. Although the 'first generation' frameworks may appear a little out of date, they retain methodological rigour and can be useful in particular circumstances, especially if resources (including data) are limited.

3.2 BOTTOM-UP AND TOP-DOWN THINKING ABOUT VULNERABILITY AND ADAPTATION FRAMEWORKS

Many V&A assessment practitioners have found it useful to think about V&A frameworks as being either 'top-down' or 'bottom-up' approaches (see FIGURE III-1 AND TABLE III-1).

One common way of thinking about the difference between these two is that top-down frameworks were mainly designed to help understand the potential long-term impacts of climate change (using global models), whereas 'bottom-up' frameworks, were designed to focus on adaptation and involve stakeholders primarily at the local level.

Figure III-1. **Features of top-down and bottom-up approaches to assessing vulnerability and adaptation**



Source: Adapted from Dessai S and Hulme M. 2004. Does climate adaptation policy need probabilities? *Climate Policy 4:* p.112.

It is increasingly recognized that the choice between 'top-down' and 'bottom-up' approaches is driven by a sense of where a V&A assessment sits in geographic hierarchy, from individual communities (village, town or environment type) through local (municipality) and regional (state, provinces and districts) to national and then international scales.

National level V&A assessments may be carried out using particular impact-driven frameworks, which may combine with local-scale participatory 'bottom-up' approaches. Local level V&A assessments may be undertaken using NAPA (national adaptation programme of action)-style stakeholder-driven consensus-building processes, linked with additional sector-specific localized detailed V&A assessment.

Consequently, 'top-down' versus 'bottom-up' thinking enables practitioners to 'mix and match' V&A frameworks that apply to different geographic scales (global to local) while also blending adaptation and impact-focused approaches (see TABLE III-1).

A V&A assessment should serve the needs of stakeholders, not the needs of the specialist conducting the study. If possible, stakeholders should be involved in the process, particularly to determine what is to be examined and what adaptation measures should be considered.

A good place to start is to think about questions stakeholders need to have answered through a V&A assessment. BOX III-2 provides some sample questions that may be used as a guide.

Box III-2. Sample questions to think about when initiating a vulnerability and adaptation assessment

- What is of concern – food production, water supply, health, ecosystem loss? (Concerns may be expressed not in climate terms, e.g., extreme temperature, but in consequences of climate impacts for people, e.g., drought, flood, malnutrition.)
- Are there places (areas) that may be particularly vulnerable that may need specific risk assessments?
- Who may be affected – where are they and what groups in society?
- How far into the future is the concern?
- For what purpose is the assessment to be used – raising awareness (education), policymaking?
- What kind of output is needed?

Good practice

Stakeholder-led, outcomes-focused, approaches to V&A assessment, including the lessons learned from the least developed countries' NAPAs, are strongly advocated by many who have been involved in such processes.

In developing lessons learned around stakeholder led V&A assessment, the NAPA process has been particularly valuable. The NAPAs provide a process for the least developed countries, Parties to the Convention, to identify their highest priorities for adaptation. As of October 2008, 38 LDCs have officially submitted their NAPAs to the UNFCCC,[4] using a range of innovative stakeholder engagement processes during their preparation.[5]

3.3 PRACTICAL CONSIDERATIONS ABOUT FRAMEWORK SELECTION

There are many practical considerations that will shape the approach to V&A in national communications, including access to resources (such as money, staff or information); availability of national and/or international expertise; and availability of time. An excellent resource kit produced by the National Communications Support Programme provides guidance on understanding these practical issues.[6] Chapter 2 of this NCSP resource kit includes information on preparing a workplan, timeline and budget, project inception workshop and establishing systems and processes.

The *"Handbook on vulnerability and adaptation assessment"* also provides valuable practical guidance on framework selection and includes an in-depth assessment of the advantages and disadvantages of each approach.

4 A list of submitted NAPAs is available at <http://unfccc.int/2679.php>.
5 For further information about the NAPA process refer to <http://www.napa-pana.org/> or to the UNFCCC "Guidelines for the preparation of national adaptation programmes of action" (decision 28/CP.7). Available at <http://unfccc.int/resource/docs/cop7/13a04.pdf - page=7>.
6 The resource kit The National Communication Process is available at <http://ncsp.undp.org/docs/703.pdf>.

IV. BASELINE SCENARIOS

Baseline scenarios are estimates of changes in future socio-economic and natural conditions not caused by climate change. The aim of this chapter is to introduce some of the issues with developing baseline socio-economic and climate scenarios and to provide an overview of some of the methods used for modelling.

Most V&A assessments consider time frames ranging from 2030 to 2100 and sometimes beyond, and it is reasonable to assume that many socio-economic and natural conditions will change – some gradually and some rapidly. It is tempting to simplify this complex issue by assuming that any adaptation to climate change will overlay present-day social and natural conditions. However, this would not provide a realistic assessment. As a result, it is probable that vulnerability to climate change and the effectiveness of adaptation will change over time.

Tip – Purpose of baseline scenarios

Developing baseline scenarios can be complex and time consuming. The point of the exercise is to understand how future development paths can affect vulnerability to climate change. Developing baseline scenarios should not be so time- and resource-consuming as to divert the V&A assessment from its main focus – addressing climate change.

4.1 SOCIO-ECONOMIC SCENARIOS

The UNDP guidebook, *Developing Socio-economic Scenarios for use in Vulnerability and Adaptation Assessments*[7] details a step-by-step approach to ensuring that efforts expended in developing baseline scenarios are justified.

Four steps are recommended for developing and applying baseline scenarios:

- Step 1: Analyse the vulnerability of current socio-economic and natural conditions to future climate change;
- Step 2: Identify at least one key indicator for each sector being assessed;
- Step 3: Use or develop a baseline scenario about 25 years into the future;
- Step 4 (optional): Use or develop a baseline scenario 50 to 100 years into the future.

It is not necessary to undertake all four of these steps; how many of the steps are taken will depend on the time and resources available. The 2004 UNDP Adaptation Policy Framework[8] stresses that either a qualitative or a quantitative approach can be used, as long as the focus remains on supporting V&A assessments that are relevant to the context in which they are used. This effectively means "including policy-makers and other stakeholders in the process, debating the starting assumptions, and being willing to re-examine categories, assumptions, and data as the analysis proceeds."[9]

Some excellent examples of using national-level planning documents to develop baseline scenarios are provided in the *"Handbook on vulnerability and adaptation assessment"*. Examples include: developing a baseline for agriculture, from Tunisia's Economic Development Plan; using analogues from other countries to help develop vulnerability indicators for Bangladesh; options for developing scenarios of economic growth; and developing a country-level Special Report on Emission Scenarios (SRES) of population growth.

National statistical offices and census organizations are the primary sources of data for developing baseline scenarios.[10] Various data sources are also available internationally (see TABLE IV-2).

Table IV-2. **Sources of baseline data and guidance in data use**

	Description
Baseline and socio-economic scenarios	
Malone EL and La Rovere EL. 2004. Assessing current and changing socio-economic conditions. *In:* B Lim and E Spanger-Siegfried (eds) *Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures.* Cambridge, United Kingdom: Cambridge University Press. pp. 147–163 <http://www.undp.org/gef/undp-gef_publications/publications/apf%20technical%20paper06.pdf>	• Good primary reference on methods and approaches • Excellent general guidance on the process • Good description of indicators and characteristics
Malone EL, Smith JB, Brenkert AL, Hurd BH, Moss RH and Bouille D. 2004. *Developing Socio-economic Scenarios For Use in Vulnerability and Adaptation Assessments.* New York, United States: United Nations Development Programme. <http://www.energyandenvironment.undp.org/index.cfm?module=Library&page=Document&DocumentID=5233>	Good primary resource that describes the concepts and the nature of the process, and gives clear examples for several indicators
Socio-economic data	
Intergovermental Panel Climate Change (IPCC) Data Distribution Centre Socio-Economic Data and Scenarios <http://sedac.ciesin.columbia.edu/ddc/baseline/index.html>	Baseline data for the world regions, compiled from a variety of sources, up to 1998
Nakicenovic N and Swart R. 2000. *Special Report on Emissions Scenarios.* Cambridge, United Kingdom: Cambridge University Press. <http://www.grida.no/climate/ipcc/emission/023.htm>	Primary source for concepts and discussions relating to the Special Report on Emission Scenarios
Center for International Earth Science Information Networks (CIESIN) Socio-economic and Applications Center <http://sedac.ciesin.columbia.edu/>	CIESIN specializes in online data and information management, spatial data integration and training, and interdisciplinary research relating to human interactions in the environment
Indicator sources	
World Resources Institute (WRI). 2008. *World Resources 2008: Roots of Resilience – Growing the Wealth of the Poor.* Washington, DC, United States, WRI in collaboration with the United Nations Development Programme, the United Nations Environment Programme and the World Bank <http://www.wri.org/publication/world-resources-2008-roots-of-resilience>	Source for country-level data on a range of possible indicators

Source: Adapted from *"Handbook on vulnerability and adaptation assessment."*

[7] Malone EL, Smith JB, Brenkert AL, Hurd BH, Moss RH and Bouille D. 2004. *Developing Socio-economic Scenarios for use in Vulnerability and Adaptation Assessments.* Available at <http://www.energyandenvironment.undp.org/undp/index.cfm?DocumentID=5233&module=Library&page=Document>.

[8] Available at <http://www.energyandenvironment.undp.org/>.

[9] Malone EL and La Rovere EL. 2004. Assessing current and changing socio-economic conditions. In: B Lim and E Spanger-Siegfried (eds) Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures. Cambridge, United Kingdom: Cambridge University Press. pp. 147–163. Available at <www.undp.org/gef/undp-gef_publications/publications/apf%20technical%20paper06.pdf>.

[10] For links to statistical sites of the world, visit the Bureau of Labor Resources at <http://www.bls.gov/bls/other.htm>.

4.2 CLIMATE CHANGE SCENARIOS

Robust climate change scenarios are at the heart of successful V&A assessments. This is largely because of the usefulness of the scenarios themselves in shaping and guiding V&A assessments. However, varying levels of certainty in the different climate change parameters produced by climate models will also influence the choice of V&A framework and determine the best methods and tools to use.

Climate change scenarios are generally developed using global climate models, called atmosphere–ocean general circulation models (AOGCM). AOGCMs typically have a horizontal resolution of between 250 and 600 km, which is not detailed enough for country-level V&A assessments. As a result, models need to be 'downscaled' to a finer resolution for use at a regional or national (or subregional) level. Alternatively, specific regional models 'nested' within AOGCMs, referred to as regional climate models (RCMs), can be used.[11]

Model and scenario choice can be complex and technical. There are many different types of AOGCMs and RCMs, each outputting different results. Box IV-3 provides a case study from the application of one type of RCM to the Caribbean.

The IPCC Data Distribution Centre[12] has developed five essential criteria for selecting climate scenarios recommended for use in V&A assessments (see table IV-3). A thorough review of climate models is provided in the IPCC Fourth Assessment Report[13] (Working Group 1 Report), including an overview of the considerable advances in modelling achieved in recent years and an assessment of the uncertainty attached to the various climate variables (temperature, precipitation, etc.) produced by the models.

The IPCC Data Distribution Centre is a valuable resource in searching for data produced by climate models. The site also contains extremely valuable guidelines including:

- General Guidelines on the use of Scenario Data for Climate Impact and Adaptation Assessment (2007);
- Guidelines for Use of Climate Scenarios Developed from Regional Climate Model Experiments (2003);
- Guidelines for Use of Climate Scenarios Developed from Statistical Downscaling Methods (2004).

It is worth regularly checking the IPCC website for updates as new material is continually being developed.

Table IV-3. **Essential criteria for selecting climate scenarios**

Criterion	Description
Consistency with global projections	Consistent with a broad range of global warming projections based on increased concentrations of greenhouse gases
Physical plausibility	Not violate the basic laws of physics. Changes in one region should be physically consistent with those in another region and globally
Applicability in impact assessments	Describe changes in a sufficient number of variables on a spatial and temporal scale to allow for impact assessment. For example, impact models may require input data on variables such as precipitation, solar radiation, temperature, humidity and wind speed at spatial scales ranging from global to site and at temporal scales ranging from annual means to daily or hourly values
Representativeness	Represent the potential range of future regional climate change. Only then can a realistic range of possible impacts be estimated
Accessibility	Easy to obtain, interpret and apply for the purpose of an impact assessment

Source: Adapted from IPCC Data Distribution Centre. 2008. *Criteria for Selecting Climate Scenarios.* Available at <http://www.ipcc-data.org/ddc_scen_selection.html>.

Box IV-3. **Case study: PRECIS-Caribbean initiative**

An interesting case study of experience with the development of climate change scenarios in the Caribbean using a regional climate model was presented at the 2007 workshop of the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention.[a]

PRECIS (Providing Regional Climates for Impact Studies) is one of many available regional climate models.[b] It is unique in that data of a detailed spatial and temporal resolution are provided to a resolution to 50 km^2, 25 km^2 or 10 km^2 areas. PRECIS is both a system and an interface with the user, so the user can apply the model in any area of the world. The limitations with PRECIS are the computation power required, large storage capacity needs for the data collected and human resources for data interpretation or analysis.

In attempting to address some of these limitations, some countries in the Caribbean have collaborated to share human and financial resources, experiences and results from this modelling. The Community Caribbean Climate Change Centre (CCCCC) provided strong support and was directly involved, and the PRECIS model developers continue to provide ongoing support.

An important outcome of the initiative is the data sharing and integration between countries. The CCCCC is also facilitating online access to results to the region.[c]

[a] UNFCCC. 2007. *"CGE Workshop - Exchange of experiences and good practices among non-Annex I Parties in preparing national communications and on cross-cutting issues."* Available at <www.unfccc.int/national_reports/non-annex_i_natcom/cge/items/4100.php>
[b] For further information see <www.precis.metoffice.com/>
[c] Website available at <www.precis.insmet.cu/Precis-Caribe.htm>

Tip – Historical climate data

Always check with national meteorological services if data on historical climate variables have been collected. This can be critical for validating past climate change models in order to be able to better predict future changes.

In addition to the use of climate models, there are other approaches to developing climate change scenarios to support V&A assessments. These alternative approaches include:

- Past climate analogues (using observed historical climate changes as an indicator of potential future changes);
- Spatial analogues (using maps to show how a location could change in the future);
- Using incremental arbitrary changes (to assume simple increments of changes in climate variables).

Discussion on the benefits and limitations of each of these approaches is provided in the *"Handbook on vulnerability and adaptation assessment"* and in the IPCC *General Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment*.[14]

[11] Intergovernmental Panel on Climate Change. 2007. *General guidelines on the use of scenario data for climate impact and adaptation assessment.* Available at <www.ipcc-data.org/guidelines/TGICA_guidance_sdciaa_v2_final.pdf>.
[12] <www.ipcc-data.org>
[13] The Fourth Assessment Report can be accessed at <http://www.ipcc.ch/ipccreports/ar4-wg1.htm>.
[14] Available at <www.ipcc-data.org/guidelines/TGICA_guidance_sdciaa_v2_final.pdf>.

V. SELECTED METHODS AND TOOLS

Numerous methods and tools exist for assessing V&A in specific environmental, economic and social settings. The unique context of the area being considered will determine the importance of undertaking V&A analyses individually in each of these settings and the most appropriate methods to be used.

This section presents an introduction to the specific methods, tools and analytical approaches that can be used to conduct V&A assessments in four key areas – coastal resources, water resources, agriculture and human health. Climate change will probably cause major changes in these areas.

Box V-4 lists four main sources of information that may be useful for a comprehensive and in-depth review of the potential vulnerabilities and adaptation measures.

The methods and tools presented in this chapter cover a wide variety of modelling approaches and techniques. However, as with all climate change V&A models, impact assessment models need to be calibrated and validated. It is also important to consider the evident data limitations and uncertainty with the models applied.

Box V-4. Resources for vulnerability and adaptation assessment

Readers can start to develop their knowledge of the various methods and tools available for V&A by referring to these sources in the following order:

1. PowerPoint presentations, case studies and relevant chapters in the "Handbook on vulnerability and adaptation assessment;"
2. Relevant chapters from the IPCC Fourth Assessment Report. These provide a comprehensive, up-to-date scientific summary of impacts of climate change, including current and key future vulnerabilities, costs and economic considerations, adaptation practices and constraints, as well as key uncertainties and research gaps;
3. The UNFCCC Compendium summarizes the suite of V&A assessment methods and tools applicable to each of four key settings - coastal, freshwater, agriculture and human health. It provides useful consistent information on each tool, allowing for effective comparison.

The references and links to further sources of information cited in the sources above will provide an extensive reading list.

5.1 COASTAL RESOURCES

Coastal resources comprise all the natural ecological and physical systems within the coastal zone, including coral reefs, inter-tidal wetlands, beaches and deltas, mangroves and estuaries. The term can also be used to refer to the economic and subsistence value of these systems, for example through activities such as fishing, recreation and transport.

The coastal zone is regarded as one of the most vulnerable areas on the planet and is increasingly the focus for V&A assessments relating to climate change. Sea level rise is now accepted as an inevitable consequence of global warming. Impacts of climate change will include increases of sea surface temperatures, greater variability in the patterns of rainfall and run-off, changes in the frequency, intensity and duration of storms, and changes in ocean chemistry (particularly acidification).

These changes have different degrees of physical and ecological effects on coastal systems, including permanent inundation, increased flood and storm damage, permanent loss of wetlands, coastal erosion, saltwater intrusion, coral bleaching and rising water tables. Some of the key findings related to coastal systems are summarized in TABLE V-4, according to the degree of certainty that they will occur. An important conclusion of the IPCC Fourth Assessment Report is that the drivers of climate-induced changes on the coast will vary considerably at regional and local scales, but the IPCC concluded that "impacts [on coastal zones] are virtually certain to be overwhelmingly negative".

Table V-4. **Key findings of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change for climate change and coastal and low-lying systems**

Confidence level[a]	Key finding
Very high	Coasts are experiencing the adverse consequences of hazards relating to climate and sea level
	Coasts will be exposed to increasing risks, including coastal erosion, over coming decades due to climate change and sea level rise
High	Adaptation of the coasts of developing countries will be more challenging than of coasts of developed countries, due to constraints on adaptive capacity
	Adaptation costs for vulnerable coasts are much less than the costs of inaction
	Sea level rise, which is unavoidable, even in the longer term, frequently conflicts with present-day human development patterns and trends

Source: Adapted from Nicholls RJ, Wong PP, Burkett VR, Codignotto JO, Hay JE, McLean RF, Ragoonaden S and Woodroffe CD. 2007. Coastal systems and low-lying areas. *In:* Parry ML, Canziani OF, Palutikof JP, van der Linden PJ and Hanson CE. (eds). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom: Cambridge University Press. pp.315–356.

[a] The degree of confidence in a particular prediction being correct. Very high confidence means at least a 90 per cent chance of the finding being correct. High confidence means around an 80 per cent chance of the finding being correct. Confidence is based on expert judgement and extensive knowledge of related literature. For further information about confidence levels, refer to the Working Group II contribution to the IPCC Fourth Assessment Report or related glossary, available at <http://www.ipcc-wg2.org/>.

A range of tools and methods (15 in total) applied globally to support V&A assessment of coastal resources is described in the UNFCCC Compendium. A brief analysis of a selection of these tools is shown in TABLE V-5. The methods and tools are generally used to establish the current physical condition of the coast, to consider the variability of each condition in the face of ongoing natural environmental factors, and to evaluate the likely response.

Since the early 1990s, thinking around the terminology used to describe adaptation options in coastal zones has evolved considerably. Initially, three main groups of options were considered: retreat (e.g. property relocation), accommodation (e.g. natural disaster management) and protection (e.g. hard and soft engineering options). While these options still remain valid today, adaptation is increasingly being described in ways that allow a direct link to be made into a nations current coastal management system.

In coastal V&A, there has also been an increasing trend towards assessing the practical options for climate change adaptation by applying broad V&A frameworks (as discussed in CHAPTER 3), complemented with specific tools. This enhances the ability to mainstream the results of coastal V&A assessments into existing government systems aimed at managing coastal zones (see CHAPTER 8).

Table V-5. Strengths and limitations of selected tools for vulnerability and adaptation assessment of coastal resources

Method	Strengths	Limitations
United Nations Environment Programme handbook methodology	Accessible, straightforward approach for regional/national scale	Designed to assist developing countries. Useful for pilot studies to provide input for more detailed assessments
Shoreline planning method	Widespread application around the world's coasts in coastal management	Requires customizing to individual coastal zone management administrative systems
Coastal vulnerability indices (CVI)	Generally easily calculated and employed for rapid vulnerability assessment	Requires customizing of variables for case-by-case use
Community vulnerability assessment tool (CVAT)	Supports the linking of environmental, social and economic data in the coastal zone	Requires customizing to environments with different suites of hazards. Access to appropriate data not always available
Dynamic interactive vulnerability analysis (DIVA)	Provides an overview of climatic and socio-economic scenarios and adaptation policies on regional and global scales	Provides course-scale resolution of potential coastal impacts at a national scale. Limited ability to customize using national data
CoastClim and SimClim	Useful decision support aid for changed climate conditions, including coastal erosion and inundation	Coastslim uses a single method for simulating future coastal change
Smartline	Cost effective and rapid geomorphic mapping of coastal sensitivity	Adaptation to local and site– specific scale will require testing and validation
Community vulnerability and adaptation assessment and action	Innovative approach that uses local experiences in relation to climate variability, change over time and extreme events	Modelling and scenario generation play a part in the process, although not as a starting point. Can be difficult to gain access to relevant skills and expertise

Source: Coastal Zone Management. 2008. *Coastal Vulnerability and Adaptation Assessment: A Contribution to the Compendium of Coastal Resources Tools and Methodologies.* (unpublished report. Available at <www.coastalmanagement.com>)

5.2 FRESHWATER RESOURCES

Without access to freshwater, human settlement cannot exist. All countries therefore need to assess the potential impacts of climate change on freshwater resources and the options to adapt to those impacts.

It is predicted that climate change will alter the hydrologic cycle in a manner that will probably result in major impacts on water availability and water quality. Some of the major potential changes to water resources are listed in TABLE V-6.

The *"Handbook on vulnerability and adaptation assessment"* stresses that climate change will inevitably challenge existing water management practices. This is expected to be particularly apparent in countries with limited financial and institutional resources and less experience in planning for long-term water demand.

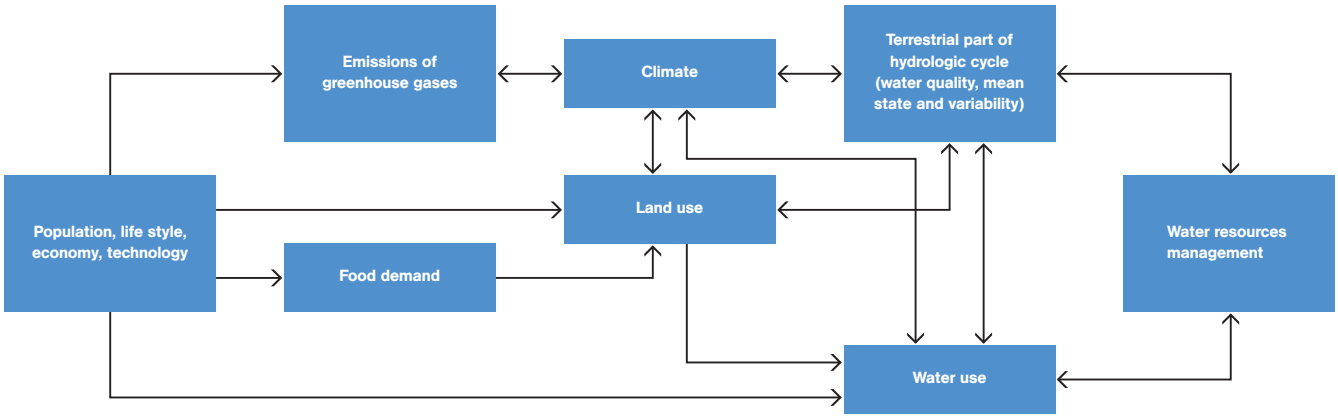
Table V-6. **Key findings of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change for climate change impacts on freshwater resources**

Confidence level[a]	Key finding
Very high	The impacts of climate change on freshwater systems and their management are mainly due to the observed and projected increases in temperature, sea level and precipitation variability
	Climate change affects the function and operation of existing water infrastructure as well as water management practices
	Adaptation procedures and risk management practices for the water sector are being developed in some countries and regions that have recognized projected hydrologic changes with related uncertainties
High	Semi-arid and arid areas are particularly exposed to the impacts of climate change on freshwater
	Higher water temperatures, increased precipitation intensity and longer periods of low flows exacerbate many forms of water pollution, with impacts on ecosystems, human health, water system reliability and operating costs
	The negative impacts of climate change on freshwater systems outweigh its benefits

Source: Adapted from Kundzewicz ZW, Mata LJ, Arnell NW, Döll P, Kabat P, Jiménez B, Miller KA, Oki T, Sen Z and Shiklomanov IA. 2007. Freshwater resources and their management. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ and Hanson CE. (eds), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom: Cambridge University Press. pp.173–210.

[a] The degree of confidence in a particular prediction being correct. Very high confidence means at least a 90 per cent chance of the finding being correct. High confidence means around an 80 per cent chance of being correct. Confidence is based on expert judgement and extensive knowledge of related literature. For further information about confidence levels, refer to the Working Group II contribution to the IPCC Fourth Assessment Report or related glossary, available at <http://www.ipcc-wg2.org/>.

Figure V-2. **Relationships between human activities and freshwater resources**



Source: Adapted from Kundzewicz ZW, Mata LJ, Arnell NW, Döll P, Kabat P, Jiménez B, Miller KA, Oki T, Sen Z and Shiklomanov IA. 2007. Freshwater resources and their management. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ and Hanson CE. (eds). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge, United Kingdom: Cambridge University Press. p.175.

Box V-5. **Integrated water resource management models**

Integrated water resource management (IWRM) is a systematic approach that considers both demand and supply processes and actions. Stakeholders are closely involved in this approach. IWRM also facilitates adaptive management through continuous monitoring, review and improvement. A number of models can be used in IWRM. The links to some of these are listed below.

Watershed hydrology
WEAP21: http://www.weap21.org
SWAT: http://www.brc.tamus.edu/swat/
HEC-HMS: http://www.hec.usace.army.mil/
MIKE-SHE: http://www.dhisoftware.com/mikeshe/
HYMOS: http://www.wldelft.nl/soft/hymos/int/index.html

Hydraulic simulation
HEC-RAS: http://www.hec.usace.army.mil/software/hec-ras/
MIKE21: http://www.dhisoftware.com/
Delft3d: http://www.wldelft.nl/soft/intro/

Water resource management models (planning and operation)
WEAP21: http://www.weap21.org
Aquarius: http://www.fs.fed.us/rm/value/aquariusdwnld.html
RIBASIM: http://www.wldelft.nl/soft/ribasim/
MIKE BASIN: http://www.dhisoftware.com/mikebasin/Download/

Source: Adapted from *"Handbook on vulnerability and adaptation assessment."* Available at <http://unfccc.int/resource/cd_roms/na1/v_and_a/index.htm>.

Currently, the challenge is to combine climate change scenarios with the numerous other considerations of long-term water planning. The interaction between human activities and freshwater resources (both quantity and quality) and their respective management is shown in FIGURE V-2.

V&A assessments of freshwater resources include consideration of changes in precipitation frequency and intensity, changes in average annual run-off, hydrologic impacts on coastal zones, changes in water quality, changes in water demand and groundwater changes.

Simulation models are tools that can be used to analyse the effects of a changing climate on rainfall run-off. Many of these models attempt to capture the physical mechanisms of the production of run-off across the landscape. To achieve this, precipitation is broken down into evapotranspiration, run-off to the river network and recharge to groundwater systems.

Eleven tools for freshwater assessment are listed in the UNFCCC Compendium. These are all mathematical models and incorporate analysis of regional water supply and of demand on water systems. Other models are available for assessing infrastructure, operational and demand management measures, and basin-scale solutions, with a view to optimizing the allocation of water resources. Many of the tools detailed in the UNFCCC Compendium can be used within an integrated water resource management framework (see BOX V-5).

5.3 AGRICULTURE

Due to the increased inter-connectedness of food production and supply mechanisms, impacts of climate change on agriculture systems affect everything from smallholder and subsistence farmers to larger scale distribution systems. Developing an understanding of the implications of climate change on agricultural systems is vital to ensuring food security for non-Annex I Parties.

There are two key types of driver of agricultural response to climate change – biophysical and socio-economic.

Biophysically, crop production is affected by changing meteorological variables such as temperature, precipitation, run-off and groundwater characteristics and levels of atmospheric carbon dioxide.

Socio-economic factors, such as changes in farming practices and production activities, rural–urban migration, and changes in economic factors (tariffs and subsidies), also influence crop productivity, resulting in price changes and shifts in comparative advantage.

When combined, biophysical and socio-economic effects can result in changes in the mix of crops, and hence in the type of farming and rural land use, and changes in production, farm income and rural employment, as well as impacts on rural income, contribution to national gross domestic products and agricultural export earnings.

Various tools are available to assist in V&A assessment in the agriculture sector, ranging from sector-wide economic analyses to farm-level crop modelling. Each of these tools and approaches was designed to provide specific information on different types of impacts. For example, crop process models can address the impact of various management and climate change scenarios on single crop species, multiple crop species or entire ecosystems.

Other tools available are specific to particular ecological factors or processes or are used to support broader strategic adaptation decisions. Economic models assist users in evaluating the economic impacts of changes in land values, supply and demand of produce, and commodity production resulting from climate change.

Tip – Data used for modelling agricultural impacts of climate change

The availability of suitable data is the basis of any modelling process. Local agricultural departments are often a good place to start sourcing data. Often, such departments have data on historical agricultural production and climatic conditions. They may also be able to provide guidance on how to select and calibrate appropriate climate change models.

Most studies of the impacts of climate change on agriculture require a quantitative description of the exposure unit and information on the current (baseline) agricultural system. Data are also needed for projecting future (baseline case) conditions in the absence of climate change (see CHAPTER 4). Specific data requirements will vary with the scope of the study and the method selected.

A range of data sources are available at both the national and international level. Nationally, data can be sourced from experimental agricultural and extension services through agricultural universities or ministries of agriculture. International organizations, most notably the Food and Agriculture Organization of the United Nations (FAO), are an important source of data.[15]

The *"Handbook on vulnerability and adaptation assessment"* considers two broad types of adaptation in agricultural systems – farm-based and policy-based. Most adaptation to climate change will probably be undertaken at the farm level, but encouraging a policy response is also vital in the process, as this will affect the speed and extent of adoption and implementation by the community. This can be thought of as combining 'bottom-up' and 'top-down' approaches to adaptation, as detailed in CHAPTER 3.

Many adaptation measures will probably occur on their own, without the need for conscious responses by farmers and agricultural planners. However, in some parts of the world, especially in non-Annex I Parties, the rate and magnitude of climate change may exceed those of any normal changes in agriculture. As a result, specific technologies and management styles will need to be adopted to avoid serious consequences.

The capacity of the agriculture sector in non-Annex I Parties for adaptation is constrained by development pressures – for example, agricultural systems that are often poorly adapted to local conditions or rapid population growth. Some of the key limits to adaptation of agricultural systems are addressed in the IPCC Fourth Assessment Report, including limits in technology, as well as social, political and cultural limits.

[15] <http://www.fao.org/corp/statistics/en/>.

5.4 HUMAN HEALTH

One of the most serious areas to address in V&A assessment is the potential direct and indirect impact of a changing climate on human health. Human life is vulnerable to changing weather patterns, all of which impact water, air and food quality and quantity, as well as other factors. Effects on human health are projected to progressively increase in all countries and regions. A summary of some of these predicted impacts is shown in TABLE V-7.

Modelling adaptation strategies in the health sector is an emerging field. Consequently, the number of tools and approaches explicitly designed for this purpose is limited. Some examples[16] of tools include:

- MIASMA (Modeling Framework for the Health Impact Assessment of Man-Induced Atmospheric Changes);
- Environmental Burden of Disease Assessment;
- CIMSiM and DENSiM (dengue simulation model);
- LymSiM (Lyme disease agent simulation);
- Mapping Malaria Risk in Africa (MARA) Low-end Information Tool (LITe).

[16] Refer to the *"Handbook on vulnerability and adaptation assessment"* and UNFCCC Compendium for further information on these and other tools.

Table V-7. **Key findings of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change for climate change and human health**

Confidence level[a]	Key findings and impacts
Very high	Mixed effects on malaria. In some places the geographical range will contract, elsewhere it will expand and the transmission season may change
High	Increased malnutrition and consequent disorders, including those relating to child growth and development
	Increase in the number of people suffering from death, disease and injury from heatwaves, floods, storms, fires and droughts
	Continue to change the range of some infectious disease vectors
	Increase cardio-respiratory morbidity and mortality associated with ground-level ozone
	Bring some benefits to health, including fewer deaths from cold, although it is expected that these will be outweighed by the negative effects of rising temperatures worldwide, especially in developing countries
Medium	Increase the burden of diarrhoeal diseases
Low	Increase the number of people at risk of dengue fever

Source: Adapted from Confalonieri U, Menne B, Akhtar R, Ebi KL, Hauengue M, Kovats RS, Revich B and Woodward A. 2007. Human Health. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ and Hanson CE. (eds). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* Cambridge, United Kingdom: Cambridge University Press. pp.391–431.

[a] The degree of confidence in a particular prediction being correct. Very high confidence means at least a 90 per cent chance of the finding being correct. High confidence means around an 80 per cent chance of being correct. Medium confidence means around a 50 per cent chance of being correct. Low confidence means around a 20 per cent chance of being correct. Confidence is based on expert judgement and extensive knowledge of related literature. For further information about confidence levels, refer to the Working Group II contribution to the IPCC Fourth Assessment Report or related glossary, available at <http://www.ipcc-wg2.org/>.

Tools for health assessment differ considerably in their scope and application. Some, such as MIASMA and Environmental Burden of Disease Assessment, facilitate the investigation of multiple diseases or the overall disease burden and how this burden responds to various environmental stressors. Others, such as CIMSiM and DENSiM, LymSim and MARA LITe, are more focused and model the health impacts or transmission dynamics of particular diseases.

These models assist in identifying high-risk areas and are particularly useful for countries where diseases such as malaria, dengue fever or Lyme disease are currently endemic.

In situations where capacity or resources to use the above models are limited (or in contexts where modelling is not warranted), qualitative approaches, based on expert judgment, can be used to estimate potential impacts. The World Health Organisation publication *Methods of assessing human health vulnerability and public health adaptation to climate change*[17] provides excellent guidance on the structured application of qualitative approaches.

[17] Available at <www.euro.who.int/document/e81923.pdf>.

Tip – Key questions for human health

Key questions when addressing the impact of climate change on human health include:

- What climate-sensitive diseases are prevalent in the country or region? What is the current burden of these diseases?
- What factors other than climate should be considered? For example, water or sanitation.
- What data are available?
- Are health services able to satisfy current demands? What issues are there with the ability to meet current demands?

VI. INTEGRATION

The term 'integration' in climate change V&A assessment refers to a coordinated and holistic approach to the development and implementation of adaptation options or strategies. The main aspects of integration are explored in this chapter.

When considering integration in the context of V&A, the interaction of various climate change impacts across sectors or within a particular region (some of which were described in previous chapters) needs to be considered, along with the overall impact on national sustainable development goals and objectives.

Integration can also be viewed as a 'way of thinking' and can be useful for examining total vulnerability and ranking vulnerabilities to climate change.

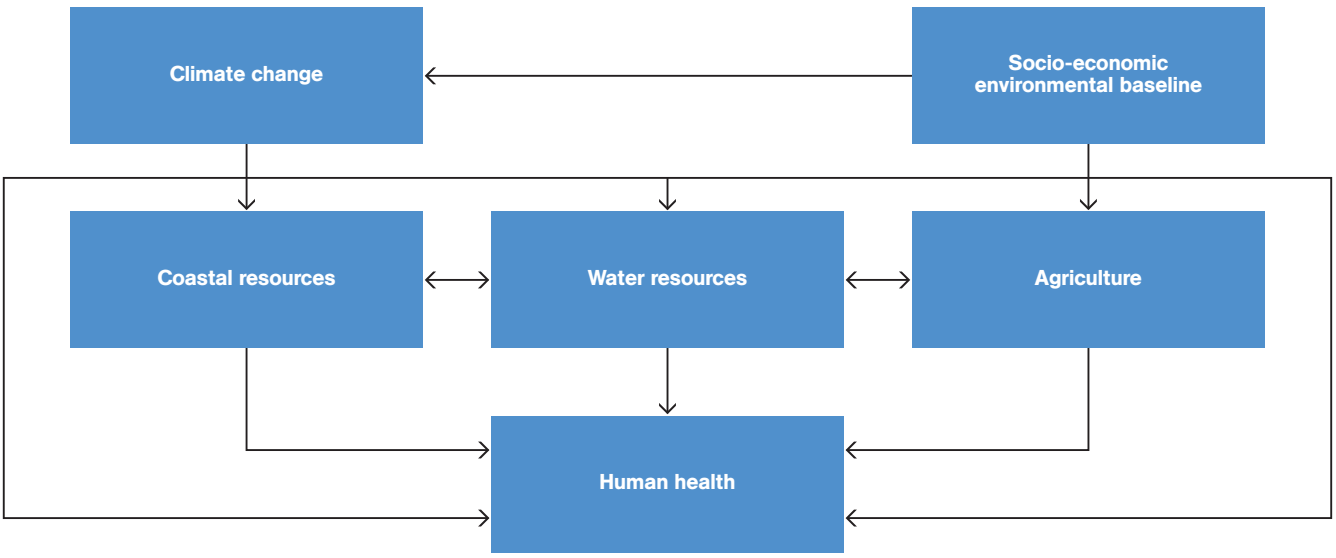
The *"Handbook on vulnerability and adaptation assessment"* provides guidance on two types of integration of climate change adaptation strategies – cross-sector and multi-sector.

6.1 CROSS-SECTOR INTEGRATION

Cross-sector integration links two or more related sectors and is a good way to initially approach integration.

Various qualitative methods, including expert judgement, can be used to compile simple descriptive tables identifing the links among sectors and hence the suitability of adaptation strategies. Simple schematic diagrams also help to display relationships between sectors, as shown in FIGURE VI-3. Such tools can be used to model relationships and promote thinking about the cross-sectoral implications of climate change.

Figure VI-3. **Simple schematic diagram of qualitative cross-sectoral relationships**



Source: Adapted from *"Handbook on vulnerability and adaptation assessment."*

A quantitative approach to cross-sector integration involves linking models and tools for related sectors or applying models that integrate across sectors. This approach is commonly used to analyse climate change impacts and adaptation measures between freshwater resources and agriculture (see SECTIONS 5.2 and 5.3).

6.2 MULTI-SECTOR INTEGRATION

Multi-sector integration is concerned with a much broader scale, generally an entire economy or system. The aim is to assist in understanding how a society as a whole may be affected by climate change. To achieve this, approaches need to be as comprehensive as possible, covering many affected sectors, regions and issues.

Integrated assessment methods and economic models can be used in this type of approach. Complex macroeconomic models estimate how the cost of damage from, or adaptation to, climate change will influence a country's economy. Such models are expensive and so have generally been used by Annex I Parties to date. However, as they become more widely available and their assumptions are tested further, it is likely that non-Annex I Parties will use them more widely.

The "Cross-cutting issues and multisector approaches" chapter of the UNFCCC Compendium provides a listing of cross-sectoral and multi-sectoral tools, including decision-support tools and stakeholder-driven approaches.

VII. COMMUNICATION

This chapter is focused on good practice, to ensure that national communications are well organized, provide information that is clear, easy to understand and is well presented. National communications should also target non-technical and technical audiences using synthesized information and technical appendices.

The purpose of a V&A section of a national communication is to present the result of V&A assessments, and provide information on how these results can be used to determine what are the greatest vulnerabilities and most urgently required adaptation measures.

The *"Handbook on vulnerability and adaptation assessment"* stresses the importance of ensuring that national communications are effective in communicating first the requirements of the Convention and then to key stakeholders, providing maximum benefit to policymakers. Key stakeholders include those involved in developing national communications and, increasingly, those who can contribute positively to mainstreaming (see CHAPTER 8) within Parties and international stakeholders (e.g. multilateral funding agencies, non-governmental organizations and United Nations agencies).

The UNFCCC *"Guidelines for the Preparation of National Communications from Parties not included in Annex I to the Convention,"* contained in the annex to decision 17/CP.8, encourage (in PARAGRAPHS 32–36) non-Annex I Parties to include the following in their national communications with respect to V&A:

- Information on the scope of their V&A assessment, including identification of vulnerable areas that are most critical;
- A description of approaches, methodologies and tools used, including scenarios for the assessment of impacts of, and vulnerability and adaptation to, climate change, as well as any uncertainties inherent in these methodologies;
- Information on their vulnerability to the impacts of, and their adaptation to, climate change in key vulnerable areas. Information should include key findings and direct and indirect effects arising from climate change, allowing for an integrated analysis of the country's vulnerability to climate change;
- Information on and, to the extent possible, an evaluation of, strategies and measures for adapting to climate change, in key areas, including those which are of the highest priority;
- The use of policy frameworks, such as national adaptation programmes, plans and policies for developing and implementing adaptation strategies and measures.

Tip – Look for published national communications

In preparing to write a national communication, look at examples submitted in the past. A good place to start is the UNFCCC website, where national communications are available for download. See <http://unfccc.int/2979.php>.

A good way to assess if a national communication has successfully met these criteria and reporting requirements is to consider if it provides answers to the following questions:

- Does the national communication clearly communicate who and what is vulnerable to climate change?
- How does vulnerability vary across time and geographic region and across different sectors?
- Are limitations of the findings clearly outlined?
- Are the V&A frameworks, methods, tools and models used clearly described?
- Are any assumptions and context-specific interpretations outlined transparently?
- Who will need to adapt to climate change?
- Where and when are adaptation strategies planned?
- What needs to be done to ensure that implementation of adaptation strategies will be effective?

International experience has shown that national communications can also be used as strategic public awareness tools. This is possible both through the engagement processes used in developing the document and through outreach activities. This multi-stakeholder focus is demonstrated by experience in Uruguay, detailed in BOX VII-6.

Tip – focus

Focus on the audience! What kind of information do they need? How can it most effectively be presented to them? What has worked well in the past?

Box VII-6. **A strategic communication tool: national communications in Uruguay**

Uruguay has developed a programme called the '3 P's': Political, Public, Professor. The purpose of this programme has been to engage key stakeholders in climate change adaptation in the Government, community and academic sectors. Uruguay aims to collaboratively involve stakeholders in all of these three key sectors during the development of its third national communication.

VIII. MAINSTREAMING VULNERABILITY AND ADAPTATION

The term 'mainstreaming' is used to describe the process of bringing climate change adaptation actions, policies and plans into the centre of government decision-making programmes. Without undertaking conscious mainstreaming activities, it is possible that outcomes from all the V&A studies conducted may remain outside the main flow of decision-making.

The Asian Development Bank (ADB)[18] describes the benefits of mainstreaming as follows:

"Mainstreaming aims to increase the effectiveness, efficiency and longevity of initiatives directed at reducing climate-related risks while at the same time contributing to sustainable development and improved quality of life."

There are some key issues to consider when thinking about mainstreaming. Mainstreaming is a policy principal, which can be used to introduce complex environmental issues onto the political agenda.[19] The real challenge to mainstreaming adaptation is not planning but implementation and this is the most important strength and challenge of mainstreaming (see BOX VIII-7).

The UNDP Adaptation Policy Framework is an excellent tool for helping guide the process of adaptation mainstreaming. Two other useful documents that discuss challenges and issues with climate change mainstreaming are the Institute of Development Studies 2006 publication Overcoming the Barriers: Mainstreaming Climate Change Adaptation in Developing Countries[20] and the International Institute for Climate Development publication Mainstreaming Adaptation to Climate Change in Least Developed Countries.[21] There are also specific mainstreaming sector tools available, such as the Comprehensive Hazard and Risk Management (CHARM)[22] approach, which was developed to facilitate enhanced collaboration between disaster and risk reduction projects at all levels and across sectors to enhance sustainable development.

Box VIII-7. The challenge of implementation

In developing a strategy for successful implementation consider:

- Incorporating adaptation as a component of sustainable development to ensure a coordinated and comprehensive approach;
- Ensuring that the costs and benefits of adaptation are quantified when approaching key priority sectors and ministries;
- Adaptation measures that address multiple environmental factors. This would help overcome limitations in capacity, or assist countries that are particularly vulnerable;
- That the NAPA process can also be useful in facilitating implementation, particularly as collection of additional data or information outside of the process is not required.

Source: UNFCCC. 2007. *Synthesis of outcomes of the regional workshops and expert meeting on adaptation under decision 1/CP.10* (FCCC/SBI/2007/14). Available at <http://unfccc.int/resource/docs/2007/sbi/eng/14.pdf>.

[18] Asian Development Bank. 2005. *Climate Proofing: A Risk-based Approach to Adaptation.* Available at <www.adb.org/Documents/Reports/Climate-Proofing/default.asp>.
[19] UNDP. 2004. Adaptation Policy Framework. Available at <http://www.energyandenvironment.undp.org/>.
[20] Institute of Development Studies. 2006. *Overcoming the barriers – Mainstreaming climate change adaptation in developing countries.* Available at <http://www.tearfund.org/webdocs/website/Campaigning/Policy and research/Overcoming the barriers briefing paper.pdf>.
[21] International Institute for Climate Development. 2003. *Mainstreaming Adaptation to Climate Change in Least Developed Countries.* Available at <http://www.iied.org/pubs/display.php?o=9219IIED&n=4&l=4&c=climate&k=mainstream>.
[22] Pacific Islands Applied Geoscience Commission. 2001. *Comprehensive Hazard Risk Management Regional Guidelines for Pacific Island Countries.* Suva: South Pacific Applied Geosciences Commission. Available at <http://www.sopac.org/tiki-index.php?page=Community+Risk+Programme+Risk+Management>.

Tip – theory and practice

There is a recognized gap between the theory and practice of adaptation mainstreaming. The UNDP in its Adaptation Policy Framework (APF) describes mainstreaming as an "elusive goal." Fortunately, the APF (and other documents cited in this chapter) provide useful guidance on making this important goal less elusive.

IX. TEST YOUR KNOWLEDGE

After reading this module, readers may find it useful to review what they have learned. This review will also allow the reader to identify what subject areas may still be unclear or where further reading is required. A summary of some of the key concepts important for preparing the V&A section of national communications is presented in TABLE IX-8.

Table IX-8. Some key concepts for reporting vulnerability and adaptation in national communications

Chapter/section	Concepts	
1. Introduction	• Key sources of information on vulnerability and adaptation	
2. What is vulnerability and adaptation to climate change?	• Vulnerability • Adaptation • IPCC glossary • Vulnerable systems	• Exposure • Sensitivity • Adaptive capacity
3. Frameworks for vulnerability and adaptation assessment	• Major vulnerability and adaptation assessment frameworks • Stakeholder-led thinking • Key questions to ask when initiating a vulnerability and adaptation assessment	• Bottom-up and top-down thinking • Framework selection considerations • National adaptation programmes of action (NAPAs)
4. Baseline scenarios	• Purpose of baseline scenarios • Socio-economic scenarios • Four steps for development • Key indicators • Special Report on Emission Scenarios approach • Data sources • Climate change scenarios • Atmosphere–ocean general circulation models	• Regional climate models • General circulation models • Downscaling • Criteria for selection • Past climate analogues • Spatial analogues • Incremental arbitrary changes

Table IX-8. **Some key concepts for reporting vulnerability and adaptation in national communications** (continued)

Chapter/section	Concepts	
5. Selected methods and tools	• Data uncertainties and limitations • Calibration and validation	• Support material for method and tool selection • Data requirements for modeling
5.1. Coastal resources	• Drivers of coastal change • Coastal sensitivity • Confidence levels	• Adaptation and shoreline management • Levels of assessment
5.2. Freshwater resources	• Connection between human activities and freshwater resources • Water supply and demand data • Simulation models	• Integrated water resource management models • Hydrologic implications of climate change
5.3. Agriculture	• Drivers of agricultural response • Food security • Agroclimatic indices • Crop models • Social analysis tools	• Integrated assessments Farm-based adaptation • Policy-based adaptation • Limits to agricultural adaptation
5.4. Human health	• Climate sensitive diseases • Health outcomes	• Health adaptation baseline • Risk factors
6. Integration	• Multi-sector integration • Cross-sector integration • Macro–economic models	• Ranking adaptations • Qualitative and quantitative methods
7. Communication	• Requirements for presentation, structure and content • Focus for national communications	• Useful guidelines • Stakeholder engagement
8. Mainstreaming vulnerability and adaptation	• Steps to facilitate mainstreaming • Broader context of mainstreaming • NAPA guidelines • Multi-sector approach	• Comprehensive hazard and risk management approach • Issues and barriers

For further information contact

Climate Change Secretariat (UNFCCC)
Martin-Luther-King-Strasse 8
53175 Bonn, Germany

Telephone +49. 228. 815 10 00
Telefax +49. 228. 815 19 99

Email secretariat@unfccc.int
www.unfccc.int

Produced by the Financial and Technical Support Programme of the UNFCCC

Art direction and design: Heller & C

Printing: Color Gruppe, Munich

Paper: Classen-Papier Z-Script*

* Recycled paper

Produced by the Financial and Technical Support Programme of the UNFCCC.

United Nations Framework Convention on Climate Change