IEA Training Manual
An integrated environmental assessment and reporting training manual

VIA Module
Vulnerability and Climate Change Impact Assessments for Adaptation

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Definition of Key Terms

Adaptation includes initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected stresses, including *climate change* effects. Various types of adaptation exist, for example, anticipatory and reactive, *private* and *public*, and *autonomous* and *planned*. Examples include: raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones, etc.

Adaptive capacity refers to the whole of capabilities, resources and institutions of a country or *region* to implement effective *adaptation* measures.

An assessment is the entire social process for undertaking a critical objective evaluation and analysis of data and information designed to meet user needs, and to support decision-making. It applies the judgment of experts to existing knowledge to provide scientifically credible answers to policy-relevant questions, quantifying, where possible, the level of confidence.

Climate change refers to a change in the state of the *climate* that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or *external forcings*, or to persistent *anthropogenic* changes in the composition of the *atmosphere* or in *land use*. Note that the *United Nations Framework Convention on Climate Change (UNFCCC)*, in Article 1, defines climate change as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the *climate* on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the *climate system* (*internal variability*), or to variations in natural or *anthropogenic external forcing* (*external variability*).

Development path or pathway is an evolution based on an array of technological, economic, social, institutional, cultural and biophysical characteristics that determine the interactions between natural and *human systems*, including production and consumption patterns in all countries, over time at a particular scale. *Alternative development paths* refer to different possible trajectories of development, the continuation of current trends being just one of the many paths.

Ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment, interacting as a functional unit.

Ecosystems-based adaptation refers to the management, conservation and restoration of ecosystems creating a valuable yet under-utilized approach for climate change adaptation, complementing other actions such as the development of infrastructure

Ecosystem services include the benefits people obtain from ecosystems (sometimes called ecosystem goods and services). These include provisioning services, such as food and water, regulating services, such as flood and disease control, cultural services, such as spiritual, recreational and cultural benefits, and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth.

The **Intergovernmental Panel on Climate Change** (**IPCC**) is a scientific intergovernmental body focused on evaluating the risk of climate change caused by human activity. The panel was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), two United Nations organizations. The IPCC shared the 2007 Nobel Peace Prize with former Vice President of the United States Al Gore.

Kyoto Protocol to the *United Nations Framework Convention on Climate Change (UNFCCC)* was adopted in 1997 in Kyoto, Japan, at the Third Session of the Conference of the Parties (COP) to the UNFCCC. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in *Annex B* of the Protocol (most Organization for Economic Cooperation and Development countries and countries with *economies in transition*) agreed to reduce their *anthropogenic greenhouse gas* emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride) by at least 5 per cent below 1990 levels in the 2008 to 2012 commitment period. The Kyoto Protocol entered into force on February 16, 2005.

Mainstreaming refers to the integration of adaptation objectives, strategies, policies, measures or operations such that they become part of the national and regional development policies, processes and budgets at all levels and stages.

Maladaptation refers to any changes in natural or *human systems* that inadvertently increase *vulnerability* to climatic *stimuli*; an *adaptation* that does not succeed in reducing vulnerability but increases it instead.

Mitigation refers to a technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to *climate change*, mitigation means implementing policies to reduce *greenhouse gas* emissions and enhance *sinks.*

Precautionary principle is a management concept stating that in cases where there are threats of serious or irreversible damage, lack of full scientific certainly shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Resilience refers to the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization and the capacity to adapt to stress and change. In the context of ecosystems, resilience refers to the level of disturbance that an ecosystem can undergo without crossing a threshold into a different structure or with different outputs. Resilience depends on ecological dynamics as well as human organizational and institutional capacity to understand, manage and respond to these dynamics.

Scenario is a description of how the future may unfold based on "if-then" propositions, typically consisting of a representation of an initial situation, a description of the key drivers and changes that lead to a particular future state. For example, "given that we are on holiday at the coast, if it is 30 degrees tomorrow, we will go to the beach".

Uncertainty implies anything from confidence just short of certainty to informed guesses or speculations; it is important to recognize that even good data and thoughtful analysis may be insufficient to dispel some aspects of uncertainty associated with the different standards of evidence and degrees of risk aversion/acceptance that individuals participating in this debate may hold. (WMO/TD No.1418, p.33)

United Nations Framework Convention on Climate Change (UNFCCC) was adopted on May 9, 1992 in New York and signed at the 1992 Earth Summit in Rio de Janeiro by more than 150 countries and the European Community. Its ultimate objective is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. It contains commitments for all Parties. Under the Convention, Parties included in *Annex I* (all OECD member countries in the year 1990 and countries with *economies in transition*) aim to return *greenhouse gas* emissions not controlled by the Montreal Protocol to 1990 levels by the year 2000. The Convention entered in force in March 1994. See *Kyoto Protocol*.

Vulnerability is the degree to which a *system* is susceptible to, and 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 change and variation to which a system is exposed, its *sensitivity*, and its *adaptive capacity*.

Sources: IEA Training Manual Module no 1, IPCC, 2007; Halle et al., 2009, UN/ISDR 2004, UNDP 2006, UNEP 2007.

List of Acronyms

CCE – Climate Change Explorer
CIAT – International Center for Tropical Agriculture
DPSIR – Drivers Pressures State Impact Responses
ECCO – Environment and Climate Change Outlook
EEA – The European Environmental Agency
EIA – Environmental Impact Assessment
GEO – Global Environmental Outlook
GCM – Global Circulation Model
GPS – Global Positioning System
GHG – Greenhouse Gas
IEA – Integrated Environmental Assessment
IED – The Institute of Economic Development
IIED – International Institute for Environment and Development
IISD – International Institute for Sustainable Development
IPCC – The Intergovernmental Panel on Climate Change
LDC – Least Developed Country
NAPA – National Adaptation Programs of Action
PRSP – Poverty Reduction Strategy
RCM – Regional Climate Models
SRES – Special Report on Emission Scenarios
UN/ISDR – United Nations International Strategy for Disaster Reduction
UNDP – United Nations Development Programme
UNEP – United Nations Environment Programme
UNITAR – United Nations Institute For Training and Research
UNFCCC – United Nations Framework Convention on Climate Change

Overview

Impacts of climate change pose very serious risks for countries, vital ecosystems, and sectors including agriculture, forestry, health, local economic activities and biodiversity. In conjunction with other pressures, they could also exacerbate other serious local and regional challenges, such as poverty, poor healthcare, inequitable distribution of resources, diminishing ecological resiliency and energy insecurity. This module will help you identify impacts of changing climate and developing adaptive responses. It aims to help carry out a vulnerability and impact assessment based on an ecosystem analysis and suggest sectoral adaptation options that are relevant to the decision-makers. The adaptation options could be developed into practical implementation plans at the sub-ministerial level. The module builds on the IEA conceptual framework and analytic methods by providing guidance for their application to the case of climate change while preserving the integrated approach.

Supported by examples and exercises, the module describes the process for addressing climate change in the context of other development priorities and ecosystems to help decision-makers' move towards more sustainable development pathways and ecosystem resilience. In this module, we emphasize that, when developing responses to climate change, the following key principles need to be taken into account (Bizikova, *et al.*, in press):

- **First**, since maintaining healthy and resilient ecosystems, achieving development priorities and improving the quality of life are as important as adaptation to climate change; it is the combination of promoting conservation and restoration of ecosystems, development choices, adaptation actions and capacities that will allow us to effectively address the climate change.
- **Second,** understanding the linkages between the impacts of a changing climate and their implications at the local level is more complex than is captured in spatial, regional and global climate models. Participation of local partners is necessary to facilitate integration of climate impact information with local development knowledge to create pathways that promote resilience and adaptation to climate change.
- **Third**, understanding adaptation as part of ecosystem management and development requires balancing the focus of the biophysical risks associated with climate change with specific risks and opportunities in order to address issues such as ecosystem and human well-being, capacity and long-term development.

This module outlines key approaches to help in assessing vulnerability to climate change in the context of other non-climatic issues and stresses such as environmental change and consumption levels, and their integration with other drivers and pressures. In this way, they make use of the general DPSIR framework. The DPSIR framework also helps in mainstreaming responses to climate change with other development measures.

This module is structured according to the following logic:
Overview of the course materials
Introduction and Learning Objectives
Relevance
Characteristics of vulnerability and scope of the assessment
Defining vulnerability
Specifying vulnerability to climate change
Vulnerability assessment and the DPSIR framework
Monitoring vulnerability
Impacts of climate change and their assessment
Creating responses - determining the adaptation options
Mainstreaming climate change into development decisions
Developing Adaptation responses
Prioritizing the adaptation options

Developing a basic implementation plan and a communication strategy
Implementing adaptation responses
Communicating climate change and adaptation

Course Materials

Introduction and Learning Objectives

Climate change impacts will affect social and ecological systems in complex and broad-ranging ways as technological, economic, social and ecological changes take place across regions, groups and sectors. Many of these impacts, such as impacts on ecological systems, have cascading effects on social, economic and health outcomes. In order to respond to climate change, more vigorous actions are required to mitigate emissions of greenhouse gases (GHGs) and to adapt to unavoidable consequences that are increasing vulnerability around the world.

This module has been specifically developed to include adaptation issues into the Integrated Environment Assessment (IEA) process. The IEA process is part of a mandate requiring that countries regularly monitor their State of the Environment. Traditionally, these have been developed in national, sub-regional and Global Environment Outlooks (please refer to Module 1 of the IEA training manual for more background). This module provides training on how to include vulnerability, climate change and adaptation in the IEA process.[1] When focusing on impacts of climate change and developing adaptation responses, we can either be broad or focus on target-specific themes such as agriculture, water resource management and coastal development. During the process of developing responses to climate change, there are several IEA modules that are not discussed in detail here, but have obvious relevance for this module, including the IEA process (Module 2), impact strategy (Module 3), data and indicators (Module 4), assessing environmental trends, policies and impacts (Module 5), scenarios (Module 6) and evaluation (Module 8).

The DPSIR framework underlines the IEA process. It is explained in detail in Module 5 and refers to Drivers (D), Pressures (P), State and trends (S), Impacts (I) and Responses (R). For this module, a "current" DPSIR will be developed in which the responses (R) will focus only on capacities to cope or to adapt (vulnerability assessment). A future DPSI will be developed (Impact assessment) in which the R will focus only on needed capacities. These will then be analyzed along side proposed Responses in the form of adaptation options. It is suggested that the assessments are ecosystem-based and the adaptation options are sectoral-based in an attempt to make science policy relevant.

This module places local sustainability, its development challenges and local vulnerabilities in the context of climate changes at regional and global levels in order to understand their linkages. It is well recognized that a response strategy to climate change is an additional and new area of sustainable community development, that in