EuropeAid

ENVIRONMENT & CLIMATE CHANGE

EC Cooperation:

Responding to climate change

Sector Scripts: Introduction and Key Concepts

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The series of “sector scripts” on the response to climate change in the context of development and external cooperation programmes was developed by EuropeAid in cooperation with DG RELEX, DG DEV and DG ENV with the support of the "environmental integration advisory services” project. It was designed to provide practical guidance on the links between climate change and specific sectors, including the identification of potential impacts and vulnerability aspects, and possible adaptation and mitigation responses to climate-related challenges. The purpose of the sector scripts is to support political dialogue on climate change implications between the European Commission, partner governments and other national partners involved in EC development and external cooperation activities, as well as to facilitate strengthened climate change integration in ongoing and future cooperation programmes and projects, with a focus on developmental benefits for the partner countries.

This document provides an introduction to the series. It focuses on key concepts that are relevant for all sectors and types of development interventions. It is recommended preliminary reading for all users of the sector scripts.

The scripts address the following sectors/topics:

- Agriculture & Rural Development (incl. forestry, fisheries and food security)
- Ecosystems & Biodiversity Management
- Education
- Energy Supply
- Health
- Infrastructure (incl. transport)
- Solid Waste Management
- Trade & Investment (incl. technological development, employment and private sector development)
- Water Supply & Sanitation

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These documents can also be downloaded on the EuropeAid/E6 Intranet Pages.

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1.1. IDENTIFYING POTENTIAL CLIMATE CHANGE EFFECTS

The first step in addressing climate change in the context of a given sector or development project/programme involves reviewing its expected and possible effects (i.e. direct manifestations and resulting impacts) in the country or region concerned – focusing on those that are most likely and most significant to the sector or activities of concern. The identification of potentially significant effects is the starting point for the assessment of risks, constraints, vulnerability, opportunities and appropriate adaptive responses. Note that some of the "climate change effects" addressed below are not a consequence of climate change alone: they can have other causes, notably the pressures imposed by human activities on natural systems. Climate change sometimes just amplifies existing trends.

The potential biophysical effects of climate change, which of course may vary considerably across countries and regions, include the following:

- changes in average and/or extreme temperature and rainfall patterns;
- shifts in seasons;
- increased frequency and/or severity of extreme weather events and associated natural and semi-natural disasters (e.g. heat waves, droughts, floods, storms, hurricanes, cyclones, sea surges, landslides, wildfires, etc.);
- raised sea levels and increased coastal erosion;
- increased river bank erosion;
- acceleration in desertification and soil erosion processes;
- seasonal or permanent reduction in the availability of freshwater, e.g. as a result of seasonal or permanent changes in stream flows, reduced precipitation, increased variability in precipitation, the melting of glaciers, salinity intrusions due to sea-level rise, reduced groundwater recharge rate;
- decrease in water quality, e.g. increased salinity and increased concentration of pollutants as a result of lower flows and thus reduced effluent dilution; chemical and microbiological contamination as a result of floods; increase in pathogens[1] and disease vectors as a result of higher water temperature possibly combined with water stagnation;
- changes in the levels of groundwater, surface water drainage patterns and permafrost;
- loss of habitats and changes in ecosystems, possibly involving loss of biodiversity, accelerated extinction of species, shifts in the range of animal and plant species, changes in the balance/dominance patterns of species, and a reduction in the availability of ecosystem and life-supporting services (e.g. food and fibre provisioning, water purification, water flow regulation, nutrient recycling, local climate regulation, etc.);
- increased frequency and/or severity of disease and pest outbreaks, as pests and disease vectors modify their range or proliferate (e.g. due to more suitable breeding conditions, or the rarefaction of predators);
- changes in atmospheric pollution patterns, e.g. increased smoke and particulate matter pollution as a result of a surge in the frequency and severity of fire events; increased frequency and severity of dust storms as a result of droughts; increased ground-level ozone concentrations as a result of changes in temperature conditions and wildfires; reduced pollutant dispersion and thus slower dissipation of regional air pollution episodes, or on the contrary transport of air pollutants over longer ranges, as a result of changes in atmospheric circulation patterns.

The resulting potential socio-economic impacts include:

- damage to or destruction of infrastructure, resulting from the increased frequency and severity of extreme weather events, as well as more gradual changes in climatic patterns;
- seasonal or permanent reduction in the availability of energy, where energy supply depends on regular stream flows (hydropower);

[1] i.e. disease-producing agents.

- economic disruption (as a result of multiple impacts on infrastructure and productive sectors), loss of livelihoods and social disruption;
- increased malnutrition, resulting from decreases in crop yields, in forestry yields, in fish catches, in the productivity of livestock and fish farms, etc.
- increased mortality and morbidity[2], resulting from malnutrition as well as some of the biophysical effects listed above;
- increased probability and intensity of conflicts, in particular those related to access to natural resources;
- population displacement and human migrations.

Table 1 below identifies which of these potential effects and impacts are most likely to be relevant to the various sectors considered in the sector scripts.

Of course, not all effects described above are likely to occur everywhere: the most likely[3] and potentially most significant effects in a given context should be determined on a case-by-case basis, using available information such as scientific publications, other literature and studies, results of research programmes, dedicated websites, and various types of models and software programmes supporting the assessment of impacts and vulnerability. A few possible sources of information are mentioned at the end of this document.

1.2. How climate change might affect the achievement of sector, programme or project objectives and results

The identification of the potential impacts of climate change on a specific sector, programme or project should be used to determine the extent to which the achievement of its objectives and expected results may be jeopardised (or possibly promoted) by climate change. In this assessment, the following aspects should be considered:

- Will sector or programme activities be directly or indirectly exposed to the effects (direct manifestations and resulting impacts) of climate change?
- Does the achievement of sector or programme objectives and results depend significantly on the use of environmental resources, the availability, productivity or regeneration of which may be threatened (or possibly enhanced) by the effects of climate change?
- Are sector or programme activities and infrastructure vulnerable to natural or environmental disasters, the frequency and/or severity of which may increase as a result of climate change?

Most sectors and types of activities are expected to be impacted by the effects of climate change in one way or another, directly or indirectly. It is therefore recommended to undertake climate risk screening for all projects and programmes, whatever the sector. However, it is obvious that some sectors are more exposed than others. Box 1 below lists those traditional sectors of external cooperation that are most likely to be impacted directly and significantly.

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[2] i.e. the frequency of occurrence and the prevalence of diseases.

[3] Note that uncertainties regarding the occurrence, the magnitude and the timing of specific impacts are unavoidable, and should be kept in mind and discussed at the time of identifying and assessing possible impacts. To keep things manageable, it is recommended to focus on those impacts deemed to be most significant, in view of the combination of their possible magnitude, probability and the characteristics of the receiving natural and social environment. Where significant uncertainties prevail, the use of various scenarios of future change may support the assessment of risks and vulnerability.

Table 1: Main links between potential climate change effects and various sectors / topics

	Agr	E&B	Edu	Empl	Ene	Fish	For	FS	Hea	Inf	Inv	PSD	Rur	Tpt	Tra	Was	Wat
Biophysical effects																	
Changes in temperature and rainfall patterns	•	•			•	•	•	•	•	•			•	•	•	•	•
Shifts in seasons	•	•					•	•	•				•	•			•
Increase in extreme weather events / natural disasters	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Raised sea level and increased coastal erosion	•	•			•	•		•		•				•	•	•	•
Increased river bank erosion	•	•				•		•		•				•	•		
Desertification, soil erosion	•	•					•	•	•	•			•	•	•		•
Reduction in the availability of freshwater	•	•		•		•		•	•	•	•	•	•		•		•
Reduction in the quality of water	•	•				•		•	•				•				•
Changes in hydrological flows, in permafrost	•	•		•	•	•	•	•		•	•	•	•	•	•	•	•
Loss of habitats, changes in ecosystems and related services	•	•				•	•	•	•				•		•		•
Increase in disease and pest outbreaks	•	•				•	•	•	•				•		•	•	•
Changes in atmospheric pollution patterns									•	•							
Socio-economic impacts																	
Damage to infrastructure	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Reduced availability of energy (hydropower)	•		•	•	•		•	•	•	•	•	•	•	•	•	•	•
Economic and social disruption, loss of livelihoods	•	•	•	•	•			•	•	•	•	•	•		•		
Increased malnutrition		•	•					•	•				•				
Increased mortality and morbidity			•	•					•			•	•				
Increased probability and intensity of conflicts	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		
Population displacement and human migrations	•	•	•	•	•	•	•	•	•	•			•	•		•	•

Legend:
Agr = agriculture
E&B = ecosystems & biodiversity management
Edu = education
Empl = employment
Ene = energy supply
Fish = fisheries (marine and freshwater fisheries
For = forestry
FS = food security
Hea = health
Inf = infrastructure
Inv = investment
PSD = private sector development
Rur = rural development (in general)
Tpt = transport
Tra = trade
Was = waste management
Wat = water supply & sanitation

Box 1: Sectors most at risk from the effects of climate change

The sectors most likely to be impacted directly and significantly include:

- agriculture, fisheries and forestry – and therefore rural development and food security;
- ecosystems and biodiversity management;
- energy supply;
- health;
- infrastructure (including transport);
- trade and investment – and generally economic development, as a result of impacts on productive sectors, infrastructure and energy;
- and water supply.

1.3. Assessing vulnerability

The identification of potential impacts also supports the assessment of vulnerability to climate change. Generally speaking, the vulnerability of human populations, systems and activities depends on a combination of:

- exposure to the biophysical and socio-economic consequences of climate change, which differ across geographical areas;
- sensitivity to these effects: sensitivity may vary across and within populations and is strongly related to ability to adapt – which depends on factors such as wealth, age, gender, education and skills, access to information and technology, "built" infrastructure, "green" infrastructure[4], institutions and social organisation, cultural norms, equity and in general on the "development level".

[4] "Green infrastructure" refers to the life-supporting and regulation services (e.g. regulation of hydrological flows) provided by the natural environment and ecosystems. More information on this concept is provided in the script on Ecosystems & Biodiversity Management.

V ADAPTING TO CLIMATE CHANGE

2.1. OBJECTIVES OF ADAPTATION

Adaptation to climate change aims to reduce the vulnerability of human populations to the impacts of climate change both in the short and in the long term. Most adaptation measures aim to offset negative impacts, but some measures may also be designed to take advantage of positive ones, where they exist.

2.2. MEANS OF ADAPTATION

Adaptation involves adjustments in practices, processes and infrastructure but also changes in social and institutional structures and decision-making processes. The systemic nature of climate change impacts makes the development of adaptation policies rather complex; systemic, multi-sectoral answers will often be required. Development interventions should aim to increase adaptive capacity which is the ability to anticipate, respond to and learn from disturbance and change. In most cases, measures aimed at reducing poverty, protecting or restoring ecosystems (to ensure the continued provision of ecosystem services), diversifying livelihood strategies and improving access to essential services and resources can be expected to enhance the population's resilience and adaptive capacity – nevertheless this should not be taken for granted: applying a "climate change lens" to specific policies and planned interventions is needed to avoid "maladaptation", i.e. the adoption of measures or the implementation of policies that end up increasing, rather than reducing, overall vulnerability to climate change.

Across sectors, adaptation to climate change involves:

- strengthening systems for data collection and monitoring, knowledge management and sharing;
- using tools such as integrated models, GIS and scenarios to predict impacts and support adaptation assessments and interventions;
- raising awareness (in the general population and in specific groups) and improving access to information;
- building capacities (in the public and the private sector, at the national, regional and local levels), through the education system, the provision of training and advisory services, etc.;
- financing research, pilot projects and demonstration activities, as well as the dissemination of research results and the scaling-up of successful initiatives;
- strengthening the (public and private, national, regional and local) institutions involved in governance, and fostering cross-sectoral planning, cooperation and response mechanisms.

More sector-specific measures are presented in the various sector scripts.

2.3. SPECIFICITY OF ADAPTATION MEASURES

It should be noted that not all adaptation measures identified in the scripts will be relevant, feasible or appropriate everywhere. Adaptation measures should match:

- the identified (country- or location-specific) risks and opportunities;
- the magnitude and rapidity of expected changes: some proposed measures may work for relatively mild or gradual climatic and environmental changes but become ineffective beyond certain thresholds or in the presence of very sudden changes;
- physical limits, economic constraints, available resources and capacities: some options may be affordable and/or technically feasible in some specific contexts but not in others;
- other local characteristics, such as political and social limitations, culture and traditions: some proposed measures may be acceptable in some places but not others.

The application of Strategic Environmental Assessments to policy making in the context of climate change could provide an appropriate framework to identify and respond to the identified issues and constraints. At the project level, financial and economic analysis (if possible including elements of risk analysis) is one of the tools that can be used to determine which adaptation options are the most suitable in a

given situation or for a given set of possible scenarios.

2.4. Added value and robustness of adaptation measures

Adaptation involves costs, but should also produce social and economic benefits, especially if a medium- to long-term perspective is adopted: in the long term, the costs of "no action" may indeed well exceed the cost of action.

Adaptation should thus not be seen just as a constraint and an additional financial and economic burden. In almost every sector, climate change intensifies already existing problems. Climate-related concerns may provide the impetus needed to implement many of the environmental and developmental "best practices" previously neglected and in this way make a sector's programmes and projects both more effective and more sustainable. There are many instances in which measures labelled as "climate change adaptation measures" may alleviate factors that contribute to chronic vulnerability today, enhance equity, reduce poverty, improve management, and generally make a positive contribution to development objectives – regardless of the extent to which the potential effects of climate change ultimately materialise. In the presence of significant uncertainties, "adaptive management" based on the adoption of "no regrets" or "robust" measures[5] is a good starting point.

2.5. Taking account of the timing of impacts

Among the potential effects of climate change identified above, some are already occurring; others are expected to occur in future, gradually or more abruptly. The rise in sea level, for instance, is already being observed and seems to take place at an accelerating pace, but very significant rises are not expected to occur overnight.

In these circumstances, it may be tempting to consider only those impacts that are already being observed or are anticipated in the short term. In most cases however, this attitude may be inadequate: many development strategies, programmes and projects are expected to deliver benefits far beyond the period of initial implementation and/or construction (and far beyond the period in which they receive external financing). Where infrastructure building is planned, in particular, it is very important to consider that the external environment may undergo considerable modifications within the next two, three or four decades – when the infrastructure to be developed over the next five years is still expected to be in use. Even in the case of "softer" projects, it may be appropriate to start planning now for effects that are unlikely to materialise within the lifetime of the programme or project, taking into account the long "lead times" required to raise awareness, build capacities and develop monitoring and response systems

[5] "No regrets" measures are those that are expected to produce net benefits for society even if climate change effects fail to materialise, or are less severe than predicted: no resources are wasted by implementing them. "Robust" measures are those that produce net benefits across various possible climate change scenarios; they are particularly valuable in the presence of uncertainty about future climate evolution.

W CONTRIBUTING TO CLIMATE CHANGE MITIGATION

3.1. OBJECTIVES OF MITIGATION

Climate change mitigation, i.e. efforts to reduce greenhouse gas (GHG) emissions in order to ultimately stabilise their atmospheric concentration, aims to limit the magnitude of climate change.

3.2. SHARING THE MITIGATION BURDEN

Most developed countries, which have the largest GHG emissions per capita and are responsible for the bulk of historic anthropogenic emissions, accept that they should make the largest contribution to the mitigation effort. However, the stabilisation of GHG levels in the atmosphere is indispensable to prevent climate change impacts of an unmanageable magnitude, and scientists agree that this stabilisation should occur as soon as possible and at the lowest possible level. This cannot be achieved unless all countries and sectors collaborate to what must become a global effort.

At the moment of drafting this paper, developing and emerging countries are not concerned by mandatory emission reduction targets, but as part of the international climate change negotiations, they are increasingly being called upon to start curbing the growth of their emissions. In preparation for the Copenhagen agreement (which is to succeed the Kyoto Protocol when it expires in 2012), the EU calls for developing countries as a group to curb the growth of their emissions by 15-30% by 2020 compared to "business-as-usual" scenarios – and for all developing countries except the poorest to commit to adopting low-carbon development strategies by the end of 2011.

It is therefore important that development and other external cooperation interventions, as well as other initiatives under the United Nations Framework Convention on Climate Change (UNFCCC) such as the Kyoto Protocol's Clean Development Mechanism and its successor, help partner countries opt for "climate-friendly" or "climate-neutral" development paths – and provide access to the technical and financial resources required for this purpose.

3.3. ADDED VALUE AND ROBUSTNESS OF MITIGATION MEASURES

Climate change mitigation should not be seen only as a constraint but also as a source of opportunity. While some trade-offs between mitigation and developmental goals are likely to be unavoidable, especially in the short term, in many instances the adoption of mitigation measures may actually make a positive contribution to development objectives. They may for instance improve financial and economic returns, reduce dependence on imported energy, put partner countries on a more sustainable development path (which is in their short- and long-term interest) – and, in some instances, give them access to additional financial resources (through carbon-finance mechanisms).[6] Here too, techniques such as sensitivity analysis (applied in the context of financial and economic analysis) may be used to test the robustness of mitigation measures in view of uncertainties regarding the future international climate change regime and future carbon prices.

3.4. PRIORITISING THE MITIGATION EFFORT

Not all sectors contribute equally to global warming. Based on recent (2005) emission statistics, Chart 1 below, developed by the World Resources Institute[7], provides a useful

[6] For generic information on financing opportunities linked to GHG emission reductions and the so-called 'carbon markets', see notably:

- World Bank (2008) – *State and Trends of the Carbon Market 2008*, downloadable from: http://carbonfinance.org/docs/State_Trends_FINAL.pdf;
- Clean Development Mechanism of the Kyoto Protocol: http://cdm.unfccc.int/index.html;
- website of the World Bank's Carbon Finance Unit, which has entered partnerships with other international organisations as well as several EU governments to promote the financing of 'emission reductions cum sustainable development/poverty alleviation' projects in developing countries: http://carbonfinance.org.

[7] See http://www.wri.org/chart/world-greenhouse-gas-emissions-2005.

approximation of the current contribution of various human activities and sectors to the GHG emissions and the global warming effect, taking account of the fact that different gases have a different "global warming potential" (measured in CO_2-equivalent units over 100 years).

Unsurprisingly, it appears that the largest contributor to global warming is the energy sector, which is disaggregated into various components. 'Electricity and heat generation' comes first, followed by industry and transportation; however, it should be noted that the shares of agriculture and land use change (primarily deforestation) are nearly as large as the shares of industry and transportation. The chart represents global emissions and of course, the relative contributions of sectors vary across countries. Country priorities regarding climate change mitigation should thus be established on the basis of country-level analysis of emission patterns. It is clear, however, that in general the largest potential for curbing GHG emissions lies in:

- improving energy efficiency, across all uses and sectors;
- relying more significantly on low-carbon technologies to convert energy and in particular to generate heat and power;
- opting for more sustainable modes of transport;
- curbing deforestation (and stopping desertification);
- and modifying agricultural practices, notably by making more efficient use of nitrogen-based fertilisers and improving the management of manure

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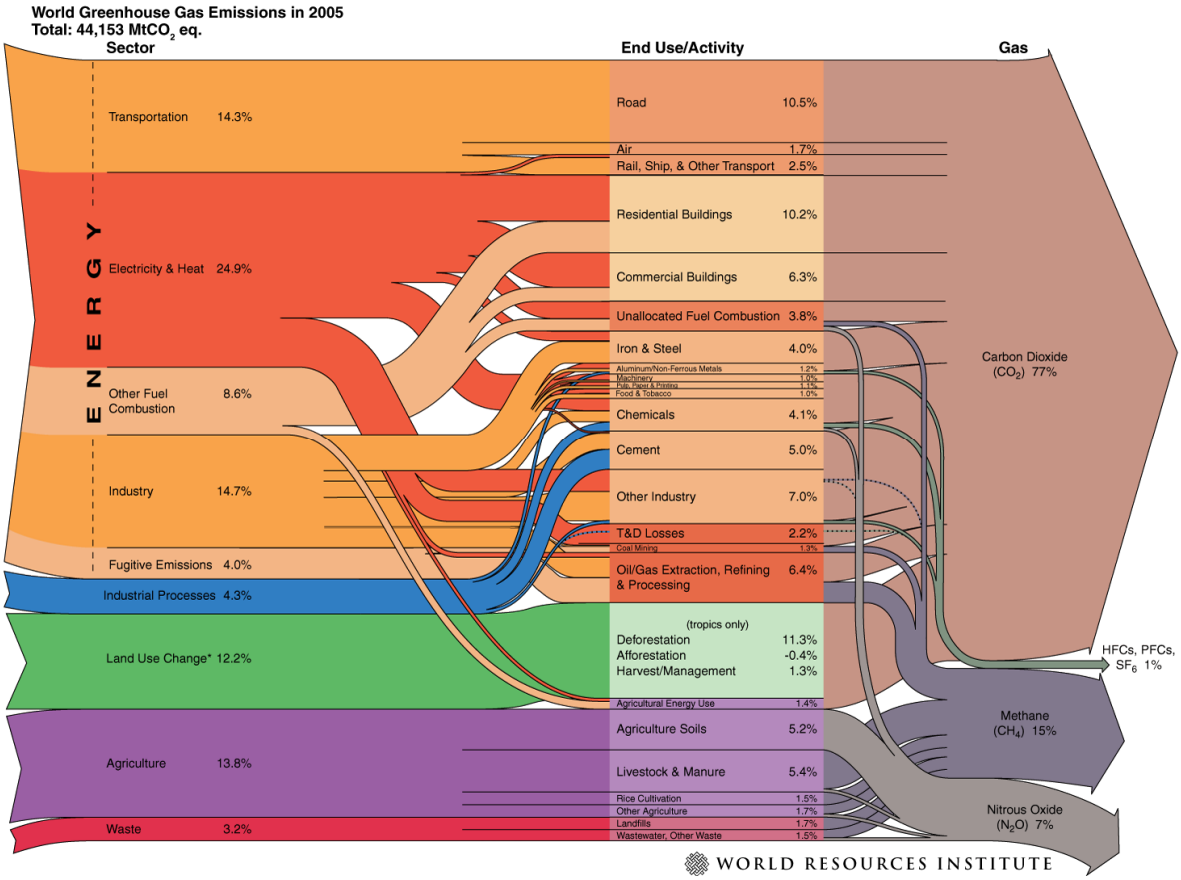
Chart 1: World Greenhouse Gas Emissions Flow Chart



Source/Copyright: World Resources Institute, Washington, DC

3.5. SPECIFICITY OF MITIGATION MEASURES

As in the case of adaptation measures, it should be noted that not all mitigation measures identified in the scripts will be relevant, feasible or appropriate everywhere. The application of Strategic Environmental Assessments to policy making in the context

of climate change could provide an appropriate framework to identify and respond to the identified opportunities and constraints. At the project level, financial and economic analysis is one of the tools that can be used to determine which mitigation options are the most suitable in a given situation.

It should also be noted that mitigation measures should not result in increased vulnerability to climate change nor rely on environmentally unsustainable practices (from other points of view than the emission of GHGs). The various sector scripts draw attention to specific cases of incompatibility between adaptation and mitigation measures, or caution against the possible adverse environmental impacts of some mitigation measures

x SELECTED GENERAL REFERENCES

(1) IPCC (2007) – Climate Change 2007: Synthesis Report, Fourth Assessment Report, Intergovernmental Panel on Climate Change. Available on: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

(2) IPCC (2007) – Climate Change 2007 – Impacts, Adaptation and Vulnerability, contribution of Working Group II to the Fourth Assessment Report, Intergovernmental Panel on Climate Change/Cambridge University Press. Available on: http://www.ipcc.ch/ipccreports/assessments-reports.htm. This report includes regional chapters (Ch. 9: Africa, Ch. 10: Asia, Ch. 12: Europe, Ch. 13: Latin America, Ch. 15: polar regions, Ch. 16: small islands) on impacts, adaptation and vulnerability.

(3) IPCC (2007) – Climate Change 2007 – Mitigation of Climate Change, contribution of Working Group III to the Fourth Assessment Report, Intergovernmental Panel on Climate Change/Cambridge University Press. Available on: http://www.ipcc.ch/ipccreports/assessments-reports.htm

(4) Stern N. (2007) – The Economics of Climate Change: Stern Review, Cambridge University Press. Available online at: http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

y SELECTED WEBSITES

(1) Adaptation Learning Mechanism (UNDP, UNEP, World Bank, GEF): http://www.adaptationlearning.net

(2) Commission on Climate Change and Development: http://www.ccdcommission.org/home.html

(3) Development and Climate Project (UNEP Risoe Centre, MNP, IIED): http://developmentfirst.org/

(4) United Nations Framework Convention on Climate Change – National Communications for non-Annex I countries: http://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/653.php

(5) United Nations Framework Convention on Climate Change – National Adaptation Programmes of Action (NAPAs) for Least Developed Countries: http://unfccc.int/cooperation_support/least_developed_countries_portal/items/4751.php

(6) World Bank's Climate Change Data Portal for Development Practitioners and Policy Makers: http://sdwebx.worldbank.org/climateportal/