Environment for Development – Policy Lessons from Global Environmental Assessments

Report for UNEP

Policy Studies

Netherlands Environmental Assessment Agency

UNEP

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Content

Summary

Never before have so many global assessments and outlooks been published in the field of environment and sustainable development as in the last two years (2007-2008). This report synthesises important and selected findings of the following publications:

- The fourth Global Environment Outlook: Environment for Development (GEO-4), published by the United Nations Environment Programme (UNEP 2007ab)
- Climate Change 2007. Fourth Assessment Report (IPCC AR4), published by the Intergovernmental Panel on Climate Change (IPCC 2007abcd).
- The OECD Environmental Outlook to 2030 (OECD EO), published by the OECD (OECD 2008).
- The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD), which is, among others, supported by the UN Food and Agriculture Organization (FAO), the UN Development Programme (UNDP), the UN Environment Programme (UNEP) and the World Bank (IAASTD 2008).
- The Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world (HDR) (UNDP 2007).
- The World Water Development Report 2 - Water, a Shared Responsibility and 3 - Water in a Changing World (WWDR), published by the World Water Assessment Programme (UNESCO 2006 and UNESCO (in prep.)).
- Climate Change and Water, Technical paper VI, published by IPCC (IPCC 2008).
- Water for Food: Water for Life. A Comprehensive Assessment of Water Management in Agriculture (CAWMA), published by the Consultative Group on International Agricultural Research (CGIAR) (IWMI 2007).

These assessments are complementary to each other, as each has a different, specific focus or entry point and a different methodological approach. They all resulted from processes that were mandated by different international organisations, including the UNEP. Some would not, first and foremost, label themselves to be environment-oriented. But taken together, these assessments provide an extensive picture of the current state of knowledge on various aspects of the environment and sustainable development. They also outline which future developments can be expected, the advantages and disadvantages, as well as the potential of the various policy options for addressing these problems arising from these developments.

This report is written at the request of UNEP, in support of the preparations for its *25th Session of the Governing Council/ Global Ministerial Environment Forum*, in February 2009. The overall goal of this synthesis report is to provide policy-makers with highlighted key messages from recent global environmental assessments, including the GEO-4, which was presented at the UNEP's 10th Special Session of the Governing Council in 2008. The current report does not claim to provide a comprehensive and neutral overview of all assessments. Rather, it analyses whether messages from these assessments strengthen the findings of the GEO-4 and what insights they add to the central theme of GEO-4: environment for development. More specifically, the report looks across these assessments for key environmental challenges foreseen for the next decades and to possible policy interventions for dealing with these in a comprehensive manner.

The assessments converge in identifying the main global environmental challenges in sustainable development. The assessments are consistent in their identification of the key issues in the management of the global environment: climate change; biodiversity loss, both terrestrial and aquatic (fresh water and marine); land use and freshwater management and pollution. More than ever, competition for land emerges as a global issue. The assessments conclude, each in its own focal area, that many technical solutions are available and affordable for achieving the domestic and international targets. However, they display different perspectives on preferred policy options.

Apparently, assessment practice is beginning to move away from problem identification towards analysis of possible policy responses. In some assessments, this shift is more distinct than in others. If a new round of assessments will proceed more strongly in this direction, assessments will need to adapt their methodologies accordingly. Because assessments of policy responses will likely create more controversies and result in assessment processes becoming more political, this will require that particular attention is paid to the rules and the process design of new assessments to deal with such controversies.

1 Introduction

Although there have been successes in many areas of environmental policy, all over the world, not all regions have made the same progress. Apart from that, the world as a whole still faces a number of persistent sustainable development problems, including poverty and hunger, the loss of biodiversity and climate change. The Global Environment Outlook 4: environment for development (GEO-4) has analysed how humankind depends on the environment (UNEP 2007ab). GEO-4 argues that 'natural resources are the foundation for the wealth of countries. Environmental degradation can negatively affect people's security, health, social relations and material needs. Environmental change thus affects human development options, with poor regions, poor people, the young and the elderly all over the world being the most vulnerable' (UNEP 2007b, p. 5-8).

Nationally and internationally, there is a great need for an up-to-date knowledge base, which policymakers can use to solve environmental issues. Never before have so many global environmental assessments been published as in the last two years (2007-2008). As they were partly written for users in non-environmental policy domains, the publication of these assessments might in itself be exemplary for a process of integration taking place in the generation of knowledge for decision-making beyond the environmental domain. UNEP has played various roles in many of these assessments to fulfil its mandate 'to keep the environment under review'.

The overall goal of this report is to highlight the key messages, for policymakers, from the following assessments through the lens of 'environment for development':

1. *The fourth Global Environment Outlook: Environment for Development (GEO-4)*, published by the United Nations Environment Programme (UNEP 2007ab)
2. *Climate Change 2007. Fourth Assessment Report (IPCC AR4)*, published by the Intergovernmental Panel on Climate Change (IPCC 2007abcd).
3. The *OECD Environmental Outlook to 2030 (OECD EO)*, published by the Organisation for Economic Co-operation and Development (OECD 2008).
4. The *International Assessment of Agricultural Knowledge, Science and Technology for Development* (IAASTD), which is, among others, supported by the UN Food and Agriculture Organization (FAO), the UN Development Programme (UNDP), the UN Environment Programme (UNEP) and the World Bank (IAASTD 2008).
5. The Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world (HDR) (UNDP 2007).
6. The World Water Development Report 2 - Water, a Shared Responsibility and 3 - Water in a Changing World (WWDR), published by the World Water Assessment Programme (UNESCO 2006 and UNESCO in prep.).
7. Climate Change and Water, Technical paper VI, published by IPCC (IPCC 2008).
8. Water for Food: Water for Life. A Comprehensive Assessment of Water Management in Agriculture (CAWMA), published by the Consultative Group on International Agricultural Research (CGIAR) (IWMI 2007).

These assessments were selected as they cover the main global environmental problems, worldwide. Furthermore, these assessments were published around the same time as the GEO-4 and, therefore, were not reflected in GEO-4. The findings of regional, national and local assessments are not included in this report.

This report is written at the request of the UNEP, in support of the preparations for their *25th Session of the Governing Council/Global Ministerial Environment Forum* (GC/GMEF), in February 2009. Parts of it are published in UNEP/GC.25/INF/11"Synthesis of global environmental assessments: Environment for development -- policy lessons from global environmental assessments" (http://www.unep.org/gc/gc25/info-docs.asp).

The findings of GEO-4 were presented at the UNEP's *10th Special Session of the Governing Council* (GC.SS.X) in 2008. The Governing Council acknowledged on that occasion '...that current environmental degradation represents a serious challenge for human well-being and sustainable development and in some cases peace and security, and that for many problems the benefits of early action outweigh the costs and represent opportunities for the private sector, consumers and local communities for strengthened cooperation at the national and international levels to achieve sustainable development' (UNEP/GCSS.X/10).

This report will identify how messages and results from these assessments either strengthen the findings of GEO-4 or provide diverging outcomes. It will also highlight any additional insights from these other assessments, in view of the central theme of GEO-4: environment for development.

It does not claim to provide a comprehensive and neutral overview of all assessments. Specifically, this report will look across the assessments for policy messages in terms of:

- trends in persistent environmental problems and costs and benefits of early action and the cost of inaction;
- policy options to interlinked, persistent environmental problems;
- putting policies together.

The report, that largely builds on earlier analysis by PBL (see Kok et al., 2008), is organised as follows. Chapter 2 briefly characterizes the assessments in terms of their focus, process and methods. Chapter 3 presents a general overview of the main challenges identified in the assessments, as well as (following the structure of GEO-4) the challenges in the thematic areas of atmosphere, land, water and biodiversity – especially looking at trends, costs and of inaction. Chapter 4 identifies the main policy responses for three interrelated problems, namely 'agriculture, water availability and biodiversity', 'energy, climate& air quality' and 'water and water quality, sanitation and health'. It also looks into synergy and trade offs. Chapter 5 is about putting these policies together. Looking across the assessments, it provides seven points of attention for policy-making on the domestic and international level. Chapter 6 concludes with insights for future assessments.

2

Focus, methods and process of the assessments

The recently published assessments provide an extensive picture of the current state of knowledge on various aspects of the environment and sustainable development. They also outline which future developments can be expected. Advantages and disadvantages of the various policy options are for addressing these issues are considered. Section 2.1 introduces the topics and the central questions in the assessments analysed in this report. Section 2.2 explains the processes, which resulted in the assessments. Table 2.1 provides a concise overview of focus, methods and processes of the assessments.

2.1 What are the assessments about?

All assessments focus on the relationship between environment and sustainable development, but each has its own central questions.

The fourth *UNEP Global Environment Outlook: Environment for Development* shows how both current and possible future deterioration of the environment can limit people's development options and reduce their quality of life. This assessment emphasises the importance of a healthy environment, both for development and for combating poverty (UNEP 2007ab).

The *Fourth Assessment Report* of the IPCC, *Climate Change 2007*, addresses the climate change problem, its causes, projections of future change, consequences and possible directions for solutions. Both learning to deal with the consequences of climate change and finding solutions to prevent further climate change are important components of sustainable development (IPCC 2007abcd).

The *OECD Environmental Outlook to 2030* explores possible ways in which the global environment may develop, analyses the costs of inaction to emphasise the economic rationality of ambitious environmental policy and shows why it is desirable for the OECD countries to work with newly emerging world players, such as Brazil, Russia, India and China (OECD 2008, MNP and OECD 2008).

The *International Assessment of Agricultural Knowledge, Science and Technology for Development* (short title: the *Agriculture Assessment*) assesses agricultural knowledge, science and technology, in relation to development and sustainability goals, such as reducing hunger and poverty, improving rural livelihoods and environment sustainability. This assessment focuses strongly on the multi-functionality of agriculture: social, economic and environmental.

The *Human Development Report 2007/2008, Fighting climate change: Human solidarity in a divided world,* considers climate change to be the defining human development issue of our time. It demands urgent action now to address a threat to two constituencies with a weak political voice: the world's poor and future generations. This assessment focuses on social justice, equity and human rights, across countries and generations (UNDP 2007).

Every three years, the *World Water Development Reports* provide substantive input for the agenda of the International Decade for Action, 'Water for Life' (2005-2015). They assist in monitoring progress towards achieving the targets set at the Millennium Summit and the World Summit for Sustainable Development, many of which have timelines culminating in 2015 (UNESCO 2006 and in prep).

Climate Change and Water, Technical Paper VI from IPCC, pulls together information related to the impacts of climate change on hydrological processes and regimes, and on freshwater resources – their availability, quality, uses and management, from IPCC assessment and special reports. The Technical Paper takes into account current and projected regional key vulnerabilities and prospects for adaptation (IPCC 2008).

The *Comprehensive Assessment of Water Management in Agriculture* is a critical evaluation of the benefits, costs, and impacts of the past 50 years of water development, the water management challenges communities face today, and the solutions people have developed around the world. The findings will enable better investment and management decisions

in water and agriculture, in the near future, by considering their impact over the next 50 years (IWMI 2007).

2.2 How did the assessments come about?

Since, in assessments, the process is as important as the outcomes (i.e. the reports themselves), insight in the processes and in the methodologies used will help contextualise an assessment's outcome. Assessment processes are about building a shared knowledge base, in which it becomes clear where the scientific consensus lays, what this implies for policy-making and what the new research questions are for dealing with the relevant uncertainties.

Assessments adopt a wide range of approaches on the science–policy interface, in accordance with their goals and intended uses. At one end of the continuum there are the comprehensive IPCC and IAASTD reports. These assessments mainly evaluate the current state of knowledge on causes, consequences and solutions – as far as that knowledge can be found in the literature. To a large extent, these assessments are based on peer-reviewed literature, to ensure objectivity. The Millennium Ecosystem Assessment (MA 2005), which is not discussed here, is another example of this approach. At the other end of the continuum are assessments, such as the OECD EO, the WWDR and the HDR, which go beyond what is published in the literature and also include own research to support the analyses. This means that, for the second group of assessments, it is less important to refer to all the relevant literature. And, of course, variations exist; GEO-4, for example, has increasingly used methods from the scientifically-oriented assessments, while also maintaining UNEP's network of collaborating centres.

Different 'production' processes and methods are used in the assessments; see Table 2.1 for an overview. The IPCC assessment reports and the IAASTD, for example, are governed by strict process rules regarding the production process, mandated by a number of international organisations. Conversely, OECD EO, WWDR, CAWMA and HDR are merely governed by their 'home organisations', in line with their mandates. Showing the progress made in achieving policy goals in countries and regions is one of the main characteristics of GEO. The OECD EO combines information from two important sources. One main source is quantitative historical and model-based analysis – with economic and environmental models working in tandem. The other main source is the programme of peer review of national environmental policies in OECD member countries, as well as in other participating countries, such as China and Russia. The WWDR uses not only published science, but also case studies from specific regions and on specific water problems.

In order to provide a solid, shared an unbiased knowledge base, it is crucial that scientists, policymakers and other stakeholders from different regions and disciplines are involved in the establishment of assessments. Most global assessments involved hundreds of scientists as authors or reviewers. Policymakers and stakeholders were also involved, as intended users, in designing many of the assessments: they formulated relevant questions, reviewed the results and, in some way approved the summary for policymakers of the assessments. Their direct involvement is intended to increase the policy relevance of assessments. GEO-4 redesigned its process to increase stakeholder involvement. Direct involvement of stakeholders as authors of the assessment did, for example, occur in the IAASTD and the World Water Development Reports.

In some cases, special procedures are applied so that governments will accept the outcome of the assessment. In IPCC, this is done with a line-by-line approval of the summary for policymakers, in GEO-4 through an endorsement of the summary for decision-makers, in the OECD EO this is done by government review at various stages, and in the IAASTD through an approval procedure, to which some countries took exception.

In all assessments, forward looking is important. Sustainable development implies critical examination of potential solutions, in the light of their consequences for the future. Decisions have to be placed in a long-term perspective, so that short-term considerations do not become the sole determinants of policy. How do the assessments approach the future? The assessments use different scenario methods to achieve this goal. The GEO-4 is an example of an assessment in which four contrasting scenarios are used to develop a vision and a strategic orientation. The IPCC has previously used contrasting scenarios in its Special Report on Emission Scenarios (IPCC 2000). This is less evident in IPCC AR4, because it mainly reviews existing literature. The Technical Paper on Climate Change and Water (IPCC 2008) relies on the materials assessed in other IPCC assessment reports (IPCC 2000, 2007). By contrast, the OECD EO and the IAASTD are based on a single baseline scenario. Since the OECD focuses on policy analysis, a single policy scenario against which specific policy scenarios can be compared is a logical choice. In the case of the IAASTD, this choice is less self-evident, since it examines long-term developments and controversial topics. The HDR takes a desired long-term target (limit climate change below two degrees above pre-industrial levels) and analyses what needs to be done to realise this target and how to cope with the consequences of it. The WWDR does not use formal scenario techniques, but makes use of projections from each of the areas of interest (population growth, food demand etc.) (UNESCO 2006, p.251-255). In the CAWMA, existing FAO and other projections have been enriched by assumptions on land use and agricultural technology (IWMI 2007, p.15).

Table 2.1 Overview of the assessments discussed in this report

	Global Environment Outlook 4	IPCC 4th Assessment Report	OECD Environmental Outlook to 2030	IAASTD (Agriculture Assessment)	Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world	World Water Development Report	IPCC Special report on water	Comprehensive Assessment on Water Use and Agriculture
Focus	Environment for development	Climate change	International environmental policy	Agricultural knowledge, hunger, rural development and sustainable agriculture	Human development and climate change	WWDR2: Governance and stakeholder involvement WWDR3: Climate change, the MDGs, groundwater, biodiversity, water and migration, water and infrastructure, biofuels	Impacts of climate change on freshwater; regional vulnerabilities and prospects for adaptation.	Water management in agriculture in a social, ecological, and political context; assessment of the dominant drivers of change
Initiated by	UNEP	IPCC	OECD	IAASTD (Secretariat provided by the World Bank)	UNDP	World Water Assessment Programme (WWAP)	IPCC	CGIAR via the Challenge Program on Water and Food
Most important questions	How do changes in the environment influence human well-being? What are the opportunities the environment provides for human well-being?	How are people influencing the climate, what are the consequences of climate change, how can people and nature adopt, which options are there for mitigating climate change?	Which environmental policy is needed? Which instruments are effective? How can OECD countries and others, such as Brazil, Russia, India and China, best work together?	How can agricultural knowledge and technology (formal and informal) be used to meet the challenges of poverty and malnutrition in a way that is sustainable from an environmental, social and economic point of view?	What is the climate change challenge from a development perspective? Who are vulnerable in an unequal world? How can dangerous climate change be avoided? What are the options for adaptation through national action and International collaboration?	WWDR2: Who have a right to water and its benefits? Who are making water allocation decisions on who will be supplied with water, from where, when and how? WWDR3: How far have we come towards meeting the targets of SD? What actions can we take to move faster?	What are the impacts of climate change on hydrological processes and regimes, and on freshwater resources?	How can water in agriculture be developed and managed to help end poverty and hunger, ensure environmentally sustainable practices, and find the right balance between food and environmental security?
Most important issues	All international environmental issues, regional analyses, the design of environmental policy	Observed causes of climate change and projections of future change, energy, land use, food, water, ecosystems, settlements, consequences for people and nature; solutions	Land use, energy and climate change, air pollution, biodiversity, fisheries, nitrogen loading on surface waters, health effects of pollution, policy instruments, costs of policy and policy inaction	Agriculture, land use, combating hunger and poverty, equity, environmental sustainability	Consequences of climate change for human development. Social justice, equity and human rights across countries and generations in national and international policies for avoiding dangerous climate change and reducing vulnerability.	WWDR2: Governance, urbanisation, resources, water ecosystems, health, food, industry, energy, risk management, sharing water, valuing water, knowledge and capacity building WWDR3: drivers of change, use of resources, state of resources, options to respond to a changing world	Vulnerability of freshwater resources; strongly impacted by climate change; wide-ranging consequences for human societies and ecosystems	Water use in agriculture compared to available resources
Policy processes in focus	Environmental policies of national governments + UNEP	UNFCCC + climate policies of national governments	Agenda-setting for national policies affecting the environment and possible international cooperation	National and international agricultural policy	Development and climate policy – international and national	WWDR2: Strong emphasis on national policy (governance); also UN agencies WWDR3: all levels including non-governmental bodies	Water managers at all levels	Decision makers in water management for agriculture
Own research?	Summary of scientific literature + scenario development	Summary of scientific literature	New projections and analysis of policy simulations	Summary of formal and informal literature + new projections	Own analyses and review from literature	Summary of scientific literature; expert groups. Case studies from WWAP.	Summary of scientific literature	Assessment of the state of science and practice, background assessment research
Approach	Separate analysis of status and trends to 2015, contrasting scenarios for 2050, extensive global and regional analyses	Assessment and synthesis of 'peer-reviewed' literature of the climate system, the consequences of climate change, the potential for adaptation and the vulnerability of people and nature, combating climate change; overview of a broad range of scenarios but no new scenarios	Baseline scenario and analysis of costs and impacts of various policy packages with different degrees of cooperation between groups of countries, globally; policy horizon is to 2030, horizon for environmental consequences is 2050.	One global and five sub-global reports; review and synthesis of peer-reviewed literature. 50 years in retrospect, and 50 years forwards; a baseline scenario with policy variants is quantified, plus a review of other relevant scenarios	Analysis of necessary action to keep human induced climate change within two degrees above pre-industrial levels and options to cope with already committed climate change	24 UN agencies; coordination by WWAP (UNESCO); input in writing teams from universities, individual experts, professional organisations, NGOs.	Assessment and synthesis of 'peer-reviewed' literature of water-related issues in the climate system, the consequences of climate change, the potential for adaptation and vulnerability of people and nature	Critical evaluation of the benefits, costs, and impacts of the past 50 years of water development, the water management challenges today, and the solutions people have developed around the world.

Tablel 2 .1 continued

	Global Environment Outlook 4	IPCC 4th Assessment Report	OECD Environmental Outlook to 2030	IAASTD (Agriculture Assessment)	Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world	World Water Development Report	IPCC Special report on water	Comprehensive Assessment on Water Use and Agriculture
Review process	Two rounds of external review by individual experts, organisations invited to review drafts; regional consultations with government representatives and stakeholders, endorsement of Summary for Decision-makers by governments	Extensive two-stage review process, first review by experts, second by governments and experts; final review and approval of the Summary for Policymakers by governments.	Existing groups of government representatives. Environment policy committee and other groups outside environment policy domain for selected chapters. Overall review by govt-designated experts. Website mechanisms.	Extensive two-stage review process, first review by experts, second by governments and experts; final review and approval of the Summary for Policymakers by governments.	Writing teams; individual experts and organisations invited to review drafts; universities, governmental and non-governmental	Writing teams; individual experts and organisations invited to review drafts; universities, governmental and non-governmental	Shorter review process than IPCC Assessment reports, as it is based on other IPCC reports that have undergone extensive review.	Multi-institute process with review: 2 rounds with 10 reviewers per chapter, per round, from civil society groups, researchers, and policymakers, among others; review editor
Stakeholder involvement	Governments and relevant international organisations and conventions (mainly from the UN system)	Meetings with NGOs and business	Major groups of umbrella organisations participated in reviews at certain points in time. One review meeting with experts from non-OECD countries.	Private and public sector participation in writing teams	Wide consultation process with stakeholders and experts	All possible stakeholders invited to participate; regional cases.	Only experts	Stakeholders (on scientific basis) involved at all stages of writing
Websites	www.unep.org/geo	www.ipcc.ch	www.oecd.org/environment/outlookto2030	www.agasessment.org	http://hdr.undp.org/en/	www.unesco.org/water/wwap	www.ipcc.ch	http://www.iwmi.cgiar.org/Assessment/

3 Main environmental challenges

This chapter provides the main challenges with respect to 'Environment for Development', as put forward in the assessments. In summarising the assessments, it identifies some key findings from across the assessments in Section 3.1. Next, the Sections 3.2 and 3.5 summarise trends and the costs of inaction, by theme. In chapter 4 possible policy responses will be discussed in a more integrated manner, looking at a number of interlinked problems.

3.1 General findings

TThe main message from GEO-4 is that the environment is undergoing unprecedented global and regional changes (UNEP 2007a, p. xviii). This will have major consequences for human development options, in the absence of appropriate mitigation measures. The report also shows that the protection and sustainable management of the environment and nature provide important opportunities for combating poverty and improving human well-being. Especially for the poor who are dependent on their immediate environment, sustainable managed ecosystems can provide them with valuable goods and services.

This message is confirmed by the other assessments; these are unanimous in identifying the main environmental problems, there is improved understanding of these problems and more insight into possible solutions in the context of sustainable development. The main challenges are in finding the governance mechanisms and policy approaches that will effectively deal with these problems.

The policy challenges are clear, at least in physical terms. With current policies, extreme hunger and poverty will not be halved in all countries, by 2015 (UN Millennium Development Goals). The rate at which biodiversity, globally, is being lost, will not be reduced by 2010 (a goal set in the Convention on Biological Diversity, the CBD) and the impacts of climate change will not remain within safe limits (the goal of the United Nations Framework Convention on Climate Change, the UNFCCC). The targets for water supply (halve the number of people without access, by 2015) and, especially, sanitation (significant improvement for more than 100 million slum dwellers, by 2020) will be extremely difficult to reach.

According to OECD EO (OECD 2008, p. 24-26), the most important environmental issues are climate change, loss of biodiversity, water shortages and health impacts due to environmental pollution (urban air pollution and chemicals). Other assessments elaborate on specific issues. The HDR (UNDP 2007, p.1-18) considers climate change the defining issue of our time for human development and pleads for the establishment of an agreed threshold for dangerous climate change of 2 degrees above pre-industrial levels. In the water related assessment, the *relative* importance of climate change is stressed; 'the adverse effects of climate change on freshwater systems aggravate the impacts of other stresses, such as population growth, changing economic activity, land-use change and urbanisation' (IPCC 2008, p. 4). The emphasis in the water reports is mainly on climate variability and the related changes.

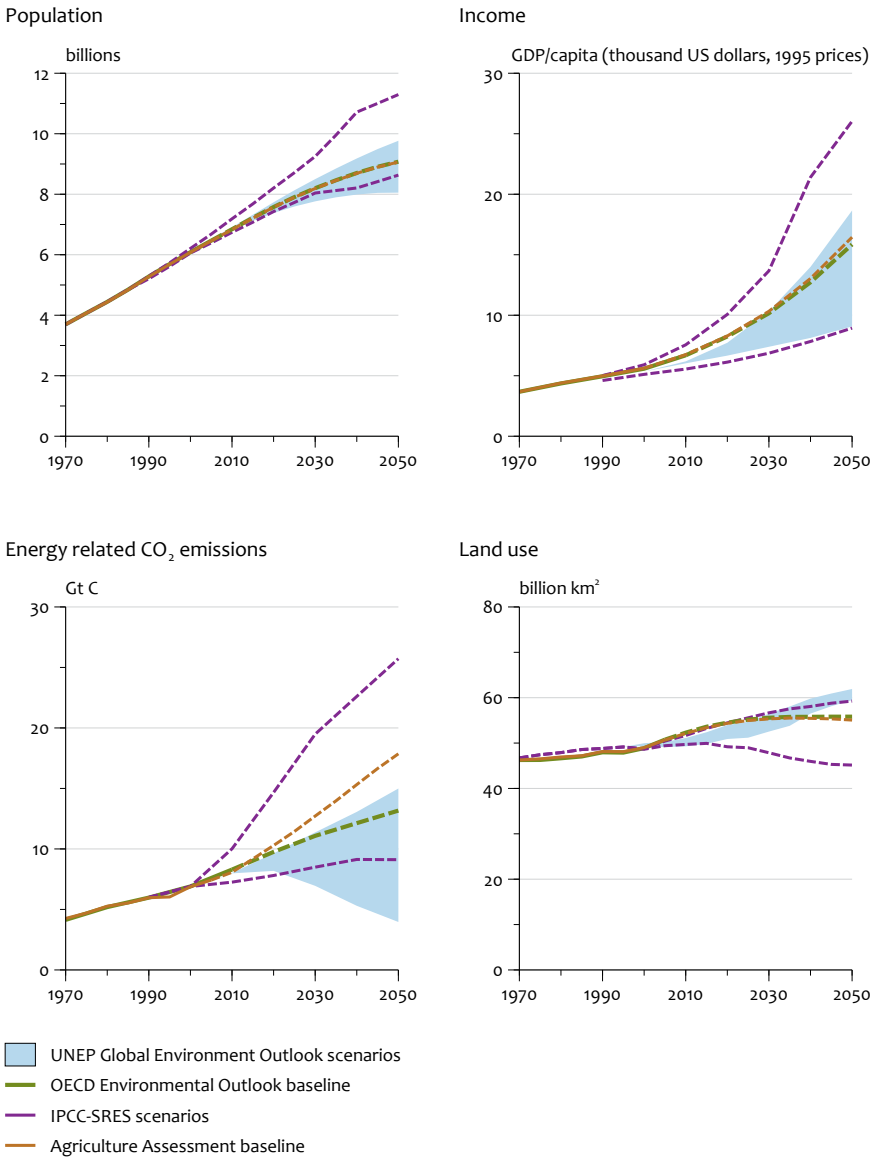
Taken together, the assessments cover the most widespread expectations regarding future trends. All the scenarios assume that the world population and world economy will continue to grow, over the next few decades, with major consequences for land use and energy consumption.

Figure 3.1 provides an overview of the trends and forecasts in the assessments. These figures refer to the world as a whole, so the graphs do not show regional differences. In all scenarios without climate policy, carbon dioxide emissions increase. Land use can develop in a number of different directions: there are scenarios with an increase in global human land use and scenarios with a reduction. The amount of land required is influenced by underlying competition from agriculture, nature, urban development and bio-energy.

Rapid action is needed to realise these goals, including agreements on new targets where they are not yet in place. Almost all scenarios used in these studies assume that future environmental conditions will not significantly constrain economic development, in the next decades. With that assumption, environmental policy will always be portrayed as an extra burden. However, action taken now, in many cases, is cheaper than waiting for better solutions. The consequences and costs of environmental policy inaction could be large and are already affecting economies. Delayed action not only result in higher costs, but also shifts this financial burden to

Trends in global scenarios

Figure 3.1



Historic trends and forecasts in population, income, land use and energy-related carbon dioxide emissions in the scenarios that are used in the four assessments. Water scenarios are not included because of different scenario set ups that make comparison difficult.

developing countries and future generations. Distributional issues need to be given greater weight in the decision-making processes and in the estimation of the costs of taking action.

The assessments conclude that many technical solutions are already known (although perhaps less so for biodiversity) and that the possible measures are affordable under ideal conditions. Options to combat ongoing climate change look relatively concrete and could be affordable to the world as a whole. This is the main subject of the Working Group III report of the IPCC AR4 (IPCC 2007c) and an important issue in the OECD Environmental Outlook (OECD 2008, Chapters 7 and 17). GEO-4 points at the need to develop policy approaches for dealing with the persistent environmental problems, like biodiversity loss and climate change (UNEP 2007a, Chapter 10). Here, progress in developing policy approaches is less advanced, a message that the other assessments seem to confirm. Knowledge and technology need to be urgently diversified to take differences in local ecological, social and cultural circumstances into account.

The assessments emphasise the interaction between environment and development and the necessity to better balance the various aspects of sustainable development. To deal with the root causes of environmental problems, action is required, not only in environmental policies, but especially in other policy domains. Hence, it is necessary to look at inter-linkages between different problems and into trade-offs and possible synergies between different policy domains. All assessments emphasise the importance of broadening

environmental policies to include other policy domains and economic sectors (policy coherence and mainstreaming).

Effective policy requires a balance between the costs and benefits of policy. That is not easy, especially in relation to the distribution of those costs and benefits. Less poverty, maintaining biodiversity, clean water and a safe climate are in everyone's interest. The biggest challenge, therefore, is to find effective political and economic mechanisms for achieving the required global cooperation, while paying special attention to distributional issues. A fair distribution of costs and benefits will be crucial. Currently, the industrialised world is shifting part of the burden of its own environmental problems towards developing countries, with direct consequences for vulnerable groups in those countries (UNEP 2007a, Chapter 7).

3.2 Atmosphere

A key message of IPCC AR4 is that, compared to previous IPCC assessments, climate change has become more certain and more serious. Most of the observed increase in global average temperatures is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. A certain degree of warming is now unavoidable and the world will have to cope with impacts of climate change.

The consequences of climate change for nature and for people are becoming ever clearer. Food production and the availability of water will be under pressure. Various ecosystems might disappear; coasts and low-lying areas are in danger. The poorest countries and the poorest people are the most vulnerable. The estimated costs of inaction associated with climate change vary widely. Estimated costs range from less than 1% of global output, to more than 10% (OECD 2008, p.270).

The long-term goal of the UNFCCC is to stabilise greenhouse gas concentrations at a level that would prevent dangerous human-induced interference in the climate system. This goal is not yet quantified, not to mention that there is no global agreement on fighting climate change. The HDR is going the farthest and recommends a stabilisation target for atmospheric concentrations of 450 CO2eq, limiting global warming to 2 degrees (UNDP 2007, p.17-18). This target implies global emission reductions of about 50%, by 2050, compared to 1990 levels. All economic sectors and all regions of the world will have to contribute. The worldwide burden-sharing of the costs is the thorniest issue.

3.3 Land

There is an increasing competition over land due to rising populations and changes in diets with increasing incomes, urbanisation and infrastructure and the bio-based economy that results in more intense land use, as well as in increasing pressure on natural areas. Two billion people will be suffering the consequences of unsustainable land use and land degradation: pollution, soil erosion, water scarcity and salinisation. Land degradation and poverty are mutually reinforcing problems. Recovery will take a long time and will be difficult in most part of the world (UNEP 2007a, Chapter 3).

Despite increasing productivity in agriculture, people still suffer from malnutrition and poverty in many regions of the world. Lack of ownership and problems of distribution of land, also play a role in this. Agricultural development in the past strongly focused on productivity and the exploitation of natural resources. Hunger and malnutrition are not caused by global food shortages. The IAASTD (2008) assumes that food prices will rise as a consequence of increasing demand and the increasing difficulties in producing food. This is partly due to lack of good agricultural land, but also due to water problems and climate change. More attention needs to be given to the complex interactions between agriculture, local ecosystems and the local community, to enable the sustainable use of natural resources.

The food supply can be improved by strengthening local markets, by reducing transaction costs for small-scale producers, and by protecting markets from sudden price fluctuations and the effects of extreme weather conditions. Small farmers and rural communities, often, have not benefited from integration into global markets and suffer most from weather variability. These advantages can be realised, for example, by improving technology transfer, education and training, by providing buffers (in food, water or money) to local farmers and by giving local actors more say in the management of natural resources (IAASTD 2008). The costs of inaction in this domain have not been covered in the assessments.

3.4 Water

Human well-being and ecosystem health, in many places, are being seriously affected by changes in the global water cycle (IPCC 2008, p.3). A combination of unsafe water and poor sanitation is the world's second biggest threat to children's health. In 2002, more than 1.1 billion people lacked access to clean water and 2.6 billion lacked access to improved sanitation (UNESCO 2006, p.221-229). Both these numbers are expected to increase with population growth and increasing urbanisation. This means that many countries are still not on track to reach the water-related targets of the MDGs. It is widely accepted that sustainable and equitable water management must be undertaken by using an integrated approach and that drinking-water supply without proper sanitation is counterproductive in view of health impacts. In addition, the OECD EO flags that without changes to policies, the capacity of sewage treatment plants will be outstripped – leading to very strong increases in nitrogen loading on fresh water and marine coastal ecosystems in India, China and the Middle East (OECD 2008, p. 225; MNP and OECD 98-108).

A continuing challenge to the management of water resources is the balancing of environmental and development needs. Thinking differently about water is essential for the triple goal: ensuring food security, reducing poverty, conserving ecosystems. Only if action is taken to improve water use in agriculture, will it be possible to meet the acute freshwater

challenge facing humankind, over the coming 50 years (IWMI 2007, p.4). A wider set of policy options and investments to realise this, becomes available if the distinctions between rain-fed and irrigated agriculture are broken down. Water use in agriculture is also influenced by policies in other sectors, and by user and social institutions; this is often ignored in agricultural reforms.

Aquatic ecosystems continue to be heavily degraded, putting many ecosystem services at risk. Climate change will also result in changes in water quantity and quality (UNESCO 2006, p.160). This will, in turn, affect food security, the function and operation of existing water infrastructure. Adaptation options designed to ensure water supply require integrated strategies, from the demand-side, as well as the supply-side. Water resource management clearly impacts on many other policy areas, for example, energy, health, food security and nature conservation. The costs of inaction on water pollution are especially high in developing countries, where the health impacts of inadequate water supply and sanitation are particularly high (OECD 2008, p.262-265).

3.5 Biodiversity

Biodiversity plays a critical role in providing livelihood security for people through the ecosystem goods and services it provides. It is particularly important for the livelihoods of the rural poor (UNEP 2007a, p. 158). This feedback from biodiversity to the social and economic domains needs to be better understood and valued, to give biodiversity-oriented policies more impact. It is well established that biodiversity, currently, changes more rapidly than at any time in human history. This has led to substantial loss of many of the world's ecosystem goods and services. Freshwater and marine species are declining more rapidly than those in other ecosystems (UNEP 2007a, p.136). Biodiversity is forecasted to decrease further, and in some areas at an accelerating rate.

Agriculture is the largest driver of biodiversity loss. Meeting increasing global food needs may dramatically and negatively affect biodiversity. As a result of free trade, the reduction of subsidies and growing demand from countries such as China, agricultural production in the tropics and sub-tropics will increase, for example in Brazil. The net effect on biodiversity of that agricultural production shift will depend very much on the existence of countervailing policies to limit negative effects. The loss of diversity in agricultural ecosystems may undermine the ecosystem services necessary to sustain agriculture, such as pollination, renewable water supply and soil nutrient cycling.

The main question emerging from the assessments is that of trade-offs between biodiversity on the one hand and agriculture on the other. Within agriculture the question is between intensification versus integrated, multi-functional approaches. Intensification will lead to concentration of agricultural production in the most suitable and efficient areas, and leaves space for valuable natural areas that should be excluded from human impacts, while integrated, multi-functional management approaches try to include biodiversity aspects (agro-biodiversity). Optimising and finding the balance between these approaches is a major challenge.

Dependence on, and growing requirements for energy result in significant changes in biodiversity through the search for alternative energy sources like biofuels. Climate change driven by fossil-fuel use, is likely to have very significant consequences for livelihoods, including changing patterns of human infectious disease distribution, crop productivity and increased opportunities for invasive alien species (UNEP 2007a, p159).

Getting a precise total figure for the cost of policy inaction on biodiversity is not possible yet, but there is good reason to suspect that it is large (OECD 2008, p.215). Therefore, promoting the awareness of the societal costs of degradation and the value of ecosystems services is one of the key priorities (IAASTD 2008).

Policy responses

4

Analysis in GEO-4 shows that especially for many of the persistent, large-scale problems, time-bound, quantified policy targets are 'less common' (i.e. missing). For the easier to solve problems, scaling up and wider application of already proven policy approaches is necessary, worldwide. This report focuses on the lessons taken from the assessments on how to deal with these harder to solve, global environmental problems (Figure 10.2 in UNEP, 2007a).

Policy responses very much depend on the type of problem at hand. Regarding the global concerns for environment and development, clear solutions and governance and institutional mechanisms remain poorly defined. Climate change, biodiversity loss and water stress have characteristics in common, including complex interactions across global, regional and local scales, long-term dynamics and multiple stressors. These problems are, therefore, hard to manage (Chapter 10, UNEP, 2007a).

Issues, such as poverty and global environmental change, require collective agreements on concerted action and governance, across scales that go beyond an appeal to individual benefit. At the global, regional, national and local levels, decision-makers have to be conscious of the fact that there are diverse challenges, multiple theoretical frameworks and development models and a wide range of options for meeting development and sustainability goals.

GEO-4 calls for a two-track approach: expanding and adapting proven policy approaches to the more conventional environmental problems, especially in lagging countries and regions; and urgently finding workable solutions for the persistent environmental problems, before they reach 'tipping points'. Implementation of good practices needs to be extended to countries that have been unable to keep pace, due to lack of capacity, inadequate finances, neglect or socio-political circumstances. For the persistent problems, development of innovative solutions is needed (UNEP 2007a, Chapter 10).

Traditionally, policy options include regulations and standards, market-based instruments, voluntary agreements, research and development and information instruments. Market instrument are becoming increasingly popular. Economic policies send important signals to producers and consumers. International use of such economic instruments is growing. OECD EO demonstrates that widespread use of market-based instruments can considerably lower the cost of action for achieving ambitious environmental goals, but at the same time they always have to be combined with other types of policies such as regulation (OECD 2008, p. 433-443). Notably, policy options include ending subsidies that encourage unsustainable practices.

Many technologies and more sustainable production options are mature and commercially available, but there is a great need for global cooperation regarding technology transfer, to make them more widely available. Important notions from the assessments, for policies to become more effective, are:

- Political commitments to specific goals and targets are essential to effectively address environmental issues. For example, the lack of quantifiable targets for Millennium Development Goal (MDG) 7 on environmental sustainability has been one factor in its relatively low profile on the global agenda.
- It is important to recognise the trade-offs, synergies and opportunities that exist in addressing the challenges of achieving goals for environment, development and human well-being.
- The economic valuation of ecosystem services can provide a powerful tool for mainstreaming environmental development planning and decision-making. Environmental problems and mismanagement of natural resources result from not paying the full price for the use of ecosystem goods and services.
- Not one option or policy instrument, by itself, will do. A mix of complementary policies is needed, to tackle the most challenging and complex environmental problems.
- Partnerships between industrialised and developing countries need to be improved, to address global environmental challenges. Further environmental co-operation between countries can help spread knowledge and best technological practices.
- Mainstreaming environmental policies in development co-operation programmes and promoting more coherent policies.
- Globalisation could lead to more efficient use of resources and to the development and dissemination of eco-innovation. By providing clear and consistent long-term policy frameworks, governments can encourage eco-innovation and safeguard environmental and social goals.

The next sections address, in more detail, possible responses to three interlinked problems, as suggested in GEO-4 (UNEP 2007a, Chapter 8). These include synergies and trade-offs

between these problems and possible responses within and outside the environmental policy domain.

4.1 Agriculture, water availability and biodiversity

A number of policy goals have been set for agriculture, food and biodiversity, in the context of sustainable development: eradication of extreme hunger; affordable food prices and a certain degree of self-sufficiency; food security and maintaining biodiversity. The availability of water for agriculture and nature and the impacts of agriculture on water systems are not always sufficiently taken into account.

In the cases of agricultural, water and biodiversity policies, it is difficult to reap the benefits of synergy. Agricultural expansion and biodiversity are clearly at odds. Often, the agriculture, water and biodiversity theme features both winners and losers (from trade liberalisation, for example). Moreover, it is difficult to quantify the exact benefits in the different policy areas (for example, poverty reduction and biodiversity). Nevertheless, awareness of the importance of balancing claims on land and water, in an integral way, in spatial and water-resource planning, would make synergy more likely. This could, for example, include climate policy that focuses on increasing the volume of carbon stored in soils and biomass, which could be combined with protecting the natural condition of ecosystems. National sovereignty plays a prominent role in land-use related policies, too. Compared to climate change, agricultural and biodiversity issues are less dependent on an overall global solution. However, in international policies, limited decision-making mechanisms for land use are in place, that balances different demands, while competition for land will increase.

The IAASTD (2008) is most explicit with regard to agricultural policy. It advocates giving renewed attention to agricultural policy and, in particular, to institutional changes and the involvement of civil society in many developing countries. The IAASTD also argues for a focus on the multi-functional use of land, although it does not explore this concept in detail. Furthermore, it recommends much more intensive contact between farmers from different parts of the world. At the same time, uniform ('one size fits all') solutions are rejected. The IAASTD calls for much larger investments in agricultural research, especially publicly-funded research. The CAWMA urges to change the way we think about water and agriculture; to fight poverty by improving access to agricultural water and improving its use.

According to the IAASTD, one goal of agricultural research should be to increase agricultural production while preventing negative effects. The CAWMA urges to manage agriculture to enhance ecosystem services (to recognise diversity in agricultural ecosystems). The role of organic and ecologically responsible agriculture is much debated, because lower yields per unit of land imply that more land will be needed for agriculture. In GEO-4 scenarios, sustainable land use leads to expansion of the agricultural area under production.

Especially IAASTD, but also the OECD EO and GEO-4 all look, in detail, on boosting agricultural productivity as an important way for increasing food production, without a corresponding increase in the amount of land or water required. According to the OECD Environmental Outlook, by using modern technology, it will be possible to feed the expanded world population, in 2030 and 2050 (OECD 2008, p.308). To realise this food production increase, existing water-supply technology, could already help a lot (CAWMA, 2007). The OECD EO states that, mainly, the large-scale farms will benefit from modern technology, but suggests that cooperation and leasing could enable smaller farms to benefit, also. In the CAWMA a plea is made for targeting small-scale farming, instead of large irrigated systems. Ultimately, a reform in agriculture is highly important for increasing crop yields, according to the OECD EO. The IAASTD takes a different view. While recognising the important role of technology, this assessment at the same time observes that the biggest challenges lie in the field of 'governance'. In addition, the IAASTD states that the less well-off benefit more from public than from private investments. Private investments, due to the profit motive, are said not to take into account the needs of the poorest. Therefore, the IAASTD takes a critical look at the increasing private investments and the – mainly in the developed countries – stagnating public investments.

Trade is another aspect of agricultural policy that receives a lot of attention in the assessments. The OECD EO is reasonably positive about the continued liberalisation of world trade, and that this will help to stimulate the more efficient use of natural resources. Moreover, many regions get connected to world markets. The IAASTD is more critical about the impact that trade liberalisation will have. On balance, it says that the least developed countries will be the losers. As for the short term, both the OECD EO and the IAASTD show that trade liberalisation will initially lead to more land use. The OECD EO and the IAASTD represent contrasting world views on the impacts of agricultural trade liberalisation on biodiversity. In GEO-4, these differing world views are incorporated in separate scenarios.

CAWMA (2007) recognises that difficult choices have to be made, in many cases. It says that countries have to deal with trade-offs and make those difficult choices, for example, between agriculture and nature; between equity and efficiency; between this generation and following ones (IWMI 2007, p.36-37).

The instruments available for making land-use policy are still very limited. At the local level, property rights are an important instrument, but at the international level countries are not yet prepared to accept any great degree of interference in the decisions they make about land use.

Some 'win-win' opportunities have been identified (IAASTD, 2007). These include:

- land-use approaches, such as lower rates of agricultural expansion into natural habitats;
- afforestation, reforestation, increased efforts to avoid deforestation, agro-forestry, agro-ecological systems;

- restoration of underutilised or degraded lands and rangelands;
- land-use options, such as carbon sequestration in agricultural soils;
- reduction and more efficient use of nitrogenous inputs;
- effective manure management and use of feed that increases livestock digestive efficiency.

Effective biodiversity policy requires clear choices. As the different assessments show, it is not possible to preserve all current biodiversity taking into account all other claims on land. Similar to addressing the climate problem, a combination of measures and associated instruments is required. Separate measures could only make a small contribution. However, the total potential of all these measures is unclear, in part because of the aforementioned trade-off between the goals, but also because of the many dimensions of biodiversity.

The assessments say little, or speak only in broad terms, about the effectiveness of biodiversity policies. They project positive effects for biodiversity mainly resulting from the pursuit of other goals, such as intensifying land use and measures to prevent climate change. However, the assessments do list various forms of policy instruments and measures intended to protect biodiversity, such as eco-labelling, setting sustainability criteria and charging for ecosystem goods and services, but without showing the resulting effects in their scenarios. Only GEO-4 explicitly includes biodiversity policies, by using expansion scenarios for protected areas. In addition, policy coherence could be improved by integrating an awareness of, and concern for, biodiversity into other sectors (trade, agriculture, water management and fisheries).

Policy instruments can be used to protect, maintain and develop biodiversity, in combination with the removal of the direct and indirect causes of the loss of biodiversity. One important element is integrating preservation and the sustainable use of biodiversity in sectoral development (in agriculture, water management, energy and trade). The IAASTD regards 'sustainable intensification' of agriculture as an important strategy for solving problems. The last option mentioned involves changing the pattern of consumption in prosperous countries, so that people eat less meat, which would also yield health benefits. This needs to be done through public information campaigns, raising consumer awareness. The CAWMA however gives much more attention to smallholder farming instead of large irrigated systems; to rain-fed agriculture next to large irrigated systems.

Proper valuation of biodiversity seems a silver bullet, as it provides a feedback from biodiversity to the market economy. The view is that further loss of biodiversity can be prevented if market and policy failures are corrected, including perverse production subsidies, undervaluation of biological resources, failure to internalise environmental costs into prices and failure to recognise global values at the local level. Appropriately recognising the multiple values of biodiversity in national policies, is likely to require new regulatory and market mechanisms. The WWDR (2006) points to the necessity for planning and carrying out programmes together with the relevant stakeholders. A top down approach is believed to be insufficient for solving the large problems with biodiversity in water systems (including coastal zones).

Various available policy options, when applied separately, can deliver only a limited contribution to slowing the loss of biodiversity. If ambitious measures are taken, there will also be undesirable side-effects, so that, worldwide, little net improvement will be achieved. For example, suppose that nature is given a chance to recover in Europe by reducing the area of agricultural land. In that case, agricultural production would partially shift to other regions, causing the biodiversity in those regions to decline faster than the biodiversity in Europe could recover (unless production growth goes hand in hand with an increase in efficiency in the use of land and water).

Protecting biodiversity-rich areas deserves high priority (Chapter 5, UNEP, 2007a). The assessments present a picture of continuing loss of biodiversity that is virtually impossible to slow down, given global economic development. This makes it crucial to identify and protect natural areas. However, the preparation of 'hot spot' maps for biodiversity is a subjective and controversial topic. How a global network of protected areas can best be designed, is a question for further research.

Measures to prevent climate change may create synergy with biodiversity protection. If the expected climate effects after 2050 can be avoided by taking effective measures now, biodiversity will benefit. Biodiversity may be expected to benefit most from options, such as energy efficiency and sustainable forms of energy generation. But that synergy will not be achieved if, as a result of climate policy, more land is brought into production, as would happen if biomass were to be used on a large scale, as part of mitigation efforts.

4.2 Energy, climate and air quality

A number of policy goals have been set for energy, climate and air quality, in the context of sustainable development: improving access to modern energy services, increasing energy security, limiting climate change and air pollution.

Climate concerns dominate the assessments. Air quality is still a major concern, but seems manageable, in principle. 'Command and control' measures have been very successful, here, in the past. Despite the success of regulation, economic instruments, such as taxation and emission trading, have become increasingly popular. They can be more cost-effective than regulation because they provide an incentive to the market (industry, transport sector) for taking those measures which cost the least. The global assessments devote relatively little attention to the goal of improving universal access to modern energy services and energy security. Responses include providing households with improved stoves, cleaner fuels, such as electricity, gas and kerosene, and information and education to make people aware of the impacts of smoke on the health of those exposed – especially women and young children.

There may be both synergy and trade-offs between energy and environmental policies. Decreasing the volume of an activity (energy use, transport) or limiting its increase, will almost surely decrease all the ensuing environmental pressures: greenhouse gas emissions, air pollution, noise and so on. Mass transport is an important alternative to private vehicles, and has been successfully implemented in many cities. Clean energy can reduce air pollution and bring other environmental benefits, too. But the balance can be negative; end-of-pipe measures and similar technical changes to improve air quality, can conflict with climate goals. Policies which address the driving forces more directly tend to have a better chance of enhancing synergies.

There is much evidence of substantial potential for the mitigation of global greenhouse gas (GHG) emissions over the coming decades. Several technologically feasible options are available for addressing climate change in all countries. Many of these options are economically competitive, especially when considering the co-benefits of increased energy security, reduced energy costs and lower impacts on the environment and human health.

A wide variety of policies and instruments is available to governments for creating the incentives for mitigation action. An effective carbon-price signal could realise significant mitigation potential in all sectors. A large number of market-based instruments is used by countries for mitigating GHG emissions. These include emission charges and taxes, product charges, tax differentiation and subsidies. GHG emission trading is another prominent market-based instrument for climate change mitigation. While R&D programmes play an essential role, they will need to be supplemented with other policies, for example with economic instruments and other incentives, such as feed-in tariffs to promote deployment and diffusion of low-carbon technologies, to ensure reductions in GHG emissions.

Successful mitigation of climate change will require an international effort to limit global greenhouse gas emissions that are significantly below current levels, in the long term. Broad participation by all the large emitting countries, in the coming decades, will be required to achieve these outcomes in any future international collaboration the burden-sharing mechanism to reduce global emissions will be crucial. The burden could be shared through a variety of ways, but one that is often discussed is the use of permit allocation under an emission trading system. Another approach would involve allowing each country/region to set its own local price for abating CO_2 emissions.

Since most GHG emissions are from energy, transport and agricultural land use, it is crucial to integrate climate concerns in these sectors, both at policy and operational levels. In this way it can be possible to achieve maximum co-benefits, such as improvements in air quality, generation of employment and economic gains. Recently concern has been expressed about GHG emissions from hydropower generation. This might, at least partly, offset the gains from using this energy source. The focus needs to be broader than energy options for mitigating GHG emissions. Changes in lifestyle, behaviour patterns and management practices, can contribute to climate change mitigation. A future climate regime has to be more inclusive of all agricultural activities, such as reduced emission from deforestation and soil degradation to take full advantage of the opportunities offered by the agriculture and forestry sectors.

The assessments are cautious about the use of bioenergy. The diversion of agricultural crops to fuel can raise food prices and reduce our ability to alleviate hunger, throughout the world. From an environmental perspective, there is considerable variation, uncertainty and debate over the net energy balance and level of GHG emissions. In the long term, effects on food prices may be reduced, but environmental effects caused by land and water requirements due to large-scale increases in first generation biofuels production, are likely to persist and will need to be addressed. Proper assessment of what the implications of producing bioenergy crops are for the water system is almost never done.

The costs of even the most stringent mitigation cases are in the range of only a few percent of global GDP, in 2050. Thus, they are manageable, especially, if policies are designed to start early, to be cost-effective and to share the burden of costs across all regions. Even the costs of the most aggressive mitigation case – stabilising concentrations at 450 ppm CO_2eq – are manageable. The total loss in GDP (relative to the baseline) is projected to be roughly 0.5% by 2030, increasing to approximately 2.5% by 2050.

Adaptation to climate change is necessary. Some impacts of climate change are inevitable in the coming decades, due to the inertia of the climate system (IPCC 2008, p.24-31). More extensive adaptation than is currently occurring is required to reduce impacts of climate change, or to benefit from the opportunities climate change sometimes provides. Flood protection requires additional attention. People and assets are concentrated, more and more (urbanisation), in areas with a high frequency of flooding: coastal plains or along rivers. Climate change leads to sea level rise and an increase in variability and extreme events, including floods (IPCC 2007b, 2008). Technology is not always a solution, due to a lack of investment funds. Reducing the vulnerability of people can also be achieved by emergency planning and other risk-reduction strategies. Direct public involvement is a prerequisite.

The ultimate success of global efforts for climate adaptation can only be realised by mainstreaming climate concerns in all relevant development programmes ('climate proofing'). There has been progress in many countries, in developing 'whole-of-government' efforts to integrate climate change into already existing sector policy frameworks and the emergence of multi-level governance on climate change issues, both vertically (from local to national) and horizontally (across both governmental and non-governmental actors). Inclusion of stakeholders and public participation in these frameworks, however, is yet seldom seen.

Planning at international, national and local levels is needed. The HDR (2007) recommends putting climate change adaptation central in new climate agreements, as well as in inter-

national partnerships for poverty reduction. This requires strengthening of the capacity of developing countries, to assess risks and integrate adaptation into all aspects of local and national planning, empowering and enabling vulnerable people to adapt by building resilience through investments in social protection, health care, education and other measures. Adaptation can be integrated in strategies for poverty reduction and sustainable development. These strategies can also be used to scale up adaptation efforts. Finance mechanisms to provide the necessary funds (estimated in the order of 86 billion US$ (HDR 2007)) and new and additional funds for adaptation are needed to protect progress towards the MDGs and prevent reversals in human development.

4.3 Water, sanitation and health

A number of policy goals has been set for water quality, sanitation and health, in the context of sustainable development: MDG 7 aims at providing 1.5 billion people with access to an improved water supply. For sanitation, the goal is to achieve significant improvement in the lives of at least 100 million slum dwellers, by 2020. Overall quantitative policy goals for water resource management, in general, are only set for specific regions (like the EU, USA and some major river basins elsewhere).

There is a need for improving governance, as it relates to water resource management. There is a need, not only to develop new approaches, but also to facilitate the practical, timely and cost effective implementation of existing international and other agreements, policies and targets.

A global consensus has emerged on the need for implementing ecosystem-based management approaches to address needs for sustainable water resources. Through responses, such as Integrated Water Resources Management (IWRM), social and economic development goals can be achieved in a manner that gives the world sustainable aquatic ecosystems, which meet the water needs of future generations. Decision-makers are increasingly adopting integrated, adaptive management approaches, such as IWRM, rather than single issue, command-and-control regulatory approaches that previously dominated water resource management efforts. These necessitate education, capacity building and public involvement.

Regional water framework agreements are needed for strengthening national and local laws, policies and institutional structures, such as in cooperation among states. Collaboration among institutions with complementary environmental and economic development functions, is equally important. According to UNEP's GEO-4 (UNEP 2007a, p.141), this calls for:

- clearly-established roles and responsibilities;
- availability and accessibility of basic data and information for informed decision-making;
- an enabling environment for all stakeholders to participate in collective decision making.

Market-based instruments can operate by valuing public demand for goods or services, then paying suppliers directly for changes in management practices or land use. Tradable quota systems and permits have emerged as effective tools for encouraging users to develop and use more efficient technologies and techniques for reducing water demand and pollutant emissions, and for achieving the sustainable use of common resources and ecosystems. Quota systems may be particularly useful in managing water demand in arid and semi-arid areas with limited supplies, but they can be problematic where resources are undervalued, leading to overuse and degradation. Quota mechanisms are best suited to countries with high levels of institutional development.

Technological responses to water scarcity include reducing water consumption through more efficient irrigation and water distribution techniques, wastewater recycling and reuse. Choosing different crops that demand less water, is used more and more, but still has large potential for expansion. Technology has long been an important tool in preventing and remedying water quality degradation, particularly to facilitate industrial and agricultural development. Adequate spatial planning can be used to protect specific (valuable and vulnerable) systems.

The OECD EO underlines that a large part of the burden of disease due to unsafe water, sanitation and hygiene, can be prevented through cost-efficient environmental policies (OECD 2008, p.262). Hygiene interventions (e.g. awareness campaigns on hand-washing) can be cost-efficient in developing countries, because these are generally cheaper than water-supply and sanitation interventions. The option with the highest benefits-to-cost ratio, in terms of health and total benefits, is minimal water disinfection at the point of use, on top of improved water supply combined with sanitation facilities. Countries could, therefore:

- continue to support environmental policies as a key vector for reducing health damages and healthcare costs, caused by environmental degradation;
- commit significant financial resources, in the coming decades, to upgrading water supply and sanitation infrastructure;
- improve the effectiveness of surveillance systems for waterborne disease outbreaks;
- increase international development aid and encourage internal investment towards helping developing countries achieve MDG Target 10.

Additional efforts will be needed for low-income OECD countries to reach the levels of drinking water quality and sewage treatment, currently observed in OECD countries on average. Failure to recognise the essential role of water in the provision of food, energy, water supplies and sanitation, has led to a lack of investment in the appropriate infrastructure, the capacity to build and maintain it, and its renewal. This failure also applies to the management of responses to droughts, floods and other disasters and environmental sustainability. More and immediate investment in appropriate water management, capacity and infrastructure, is the only solution (WWDR3, in prep).

Putting policies together

5

Which overall directions for effective policy-making can be derived from the assessments? The previous chapter discussed the outcomes of the assessments, with respect to policy responses to several inter-linked problems. On the basis of all assessments, this chapter identifies seven points that could be considered for domestic and international policies, to deal with the persistent environmental problems, like climate change, biodiversity los and land degradation. These are the highly inter-related, global problems, with inherent, long, time lags and social time lags in addressing them, which require globalised solutions to solve them (UNEP 2007a, Chapter 10).

- *Intensification of policies.* The urgency that is clearly evident from the assessments (see Chapter 3), requires translation into more intensive policies at all levels of decision-making if the agreed policy goals are to be reached. Long-term policies are needed that include concrete ambitious goals (see the proposals for climate change and development in the HDR). This also includes those areas of policy in which there are no such goals as yet, such as global access to modern energy services that is not a formally agreed policy goal, or areas in which only short-term goals have been set (as is the case with biodiversity). Moreover the persistent character of these problems requires consistent long-term policies, too. This will provide markets with more certainty, so that the private sector can prepare to make the required investments (OECD 2008).
- *Efficient and equitable solutions.* It is important to find solutions that are economically efficient as well as equitable. A global climate coalition can make use of the cheapest mitigation options, worldwide. This requires a well-functioning market, in the true sense. One in which currently externalised environmental and developmental factors are incorporated in prices and which provide a level playing field. This still does not address the issues of equity, like impacts on the most vulnerable and how to distribute costs. Agreeing on the distribution of costs and benefits is crucial. Global coalitions can only be established if the costs and benefits are shared fairly. Furthermore, choosing the most efficient solution for achieving a particular objective is not the only thing that counts. The costs of doing nothing also have to be taken into account. The assessments all signal the benefits that payments for ecosystem goods and services may have for both ecosystem conservation and development.
- *Realising the promise of technology.* While many technological solutions to current problems may already be known, a lot is needed to realise their full potential. According to the assessments, over the next two to three decades, there may be no need for technological breakthroughs to solve the problems they outline. However, the further development and large-scale introduction of technologies that are already available require considerable efforts and investments. From the local level perspective, it is especially important that technological improvements – tried and tested in certain parts of the world – also will be applied elsewhere. This requires the development of new approaches which are attuned to local, social and cultural circumstances and which draw on local knowledge (IAASTD 2007). The rate of technology transfer can be increased by governments, by giving financial support and covering the risks of exporting new technologies (IPCC 2007c).
- *International cooperation*. Global coalitions, as well as regional cooperation are needed to develop joint approaches for dealing with the persistent environmental problems. It is essential to agree on common goals, how best to share burdens and benefits, and on the policy instruments to be used. The distribution of the responsibilities for action amongst countries is likely to become increasingly problematic and, if unresolved, may prevent major advances in environmental cooperation (OECD 2008, p.462). An essential issue is the mobilisation of financial resources, by using economic instruments, greening of financial flows, such as trade revenues, investments and development assistance, as well as the phasing out of some subsidies. With a contribution by new players, emerging on the world stage, such as Brazil, Russia, India and China (BRICs), international environmental policy can become much more effective. OECD EO, hence, flags the need to develop new coalitions and new mechanisms for cooperation on the global level.
- *Improved governance mechanisms and structures*. The assessments note an institutional 'gap' that hinders the achievement of national and, particularly, international goals. They emphasise that new, innovative forms of policy and institutional arrangements have to be developed to deal with persistent environmental problems, but make relatively few concrete proposals in this direction. The assessments indicate that it is not enough to set goals. Sufficient financial and human capacity is required within countries to implement policy, and to monitor and enforce compliance. Governance structures need to pay sufficient attention to local situations and local people, including, for example, strengthening local rights and securing

access to and maintaining natural resources for reducing the vulnerability of people (UNEP 2007a, chapter 7). On the international level, governance could be improved by simplifying the large number of environmental treaties, by strengthening international organisations and by developing more coherent international governance mechanisms (UNEP 2007a, Chapter 8).

- *Making international production and consumption chains more sustainable.* Companies can play an important role in this, by making their own business operations environmentally responsible, as well as by influencing the whole supply and delivery chain that relates to their activities. Producers would take social, economic and environmental considerations into account. As a consequence consumers would have to pay more for sustainable products. In this way, costs and benefits would be shared more equitably. Governments can introduce sustainability criteria and organise monitoring and compliance mechanisms. A relevant new development is the emergence of stewardship councils for resources or commodities, such as fish or palm oil. These developments present opportunities but, for governments, also raise the question of how they intend to relate to these developments. One important issue is how to change consumer behaviour, but the assessments devote little attention to behavioural change in relation to consumption.
- *Policy coherence*. Improved policy coherence is crucial to seize possible synergies between policy goals and to explicitly address the trade-offs. Policy coherence relates to integration in governance, across time, scales, sectors and places (UNEP 2007a). Improved policy coherence can help to bring solutions closer and make implementation easier. At the same time, integration clearly makes policy-making more complex, while the political and economic mechanisms for establishing cooperation are weak and require strengthening. An important area for improved policy coherence is that between trade, environment and development. For example small farmers, rural populations and many poor countries often do not benefit from current agricultural trade rules. According to the assessments, freer trade can have both positive and negative effects, in the fight against poverty and for the environment. Additional policy measures are necessary to limit the negative consequences of freer trade rules, while making the most of the possible advantages of making trade more fair (IAASTD 2007).

6

Epilogue: insights for future assessments

Outlooks into the future are increasingly accepted by politicians and other stakeholders. The fact that large international organisations have mandated the major assessments, reviewed in this report, is a sign that more attention is being paid to long-term considerations by those who make national and international policies. Global assessments and future scenarios seem to have become a normal part of the interface between science and policy. The significance of worldwide assessments has been described as 'reducing the political risk of doing the right thing' (Van Bers and others (eds) 2007). In essence, this means that while the assessments contain perhaps not that many new facts, they importantly contribute to societal consensus – or at least to structuring and, thereby, facilitating public debate on difficult issues. One aspect of this is that the extent to which decision-makers can practically use the scientific insights that are contained in the assessments, depends on the translation of the insights into the terminology and reference frame of key actors and their constituencies. This can, for example, be done by connecting global issues to regional issues, or by analysing long-term environmental issues from a point of view of short-term economic risks and liabilities.

The various assessments seem to converge in their identification of the major environmental problems in this world, that is, the problems which play out on a global scale and require global scale solutions. At this point in time, a policy demand can be expected to shift the focus in new assessments from 'what are the priority problems' to 'what are the priority actions'. In other words, future assessments would have to look into the governance question of how to deal with these problems. This would include the analysis of policy instruments, implementation and enforcement; the economics of environmental policy; new alliances for international collaboration and policy integration; stakeholder involvement; and capacity building and education.

In fact, such a shift in the focus of worldwide assessments is starting to take place. This is where other assessments (particularly OECD EO and WWDR) bring added value, relative to GEO-4. The set-up of future assessments (including scenarios used) could respond to this. For example, economic sectors would come to mind as a primary structure, instead of a breakdown along the traditional environmental thematic lines (atmosphere, land, water, biodiversity) that GEO-4 adhered to. A regional breakdown of global issues has been the hallmark of GEO. However, during the past decade, this has become almost a universal – and useful – practice and, thus, is not that special anymore. In fact, some worldwide assessments have regional involvement that is as elaborate as that of GEO. But, assuming that the attention in future global assessments will be more on governance issues, the GEO global-regional framework will be precisely right once more, namely to assess if and how general policy recipes are translated and played out in the context of the various world regions.

A shift in future assessments towards exploring policy options and governance issues, would mean putting the spotlight on questions that, up to now, have remained only vaguely illuminated because they are controversial. For example, in relation to globalisation and food production, is it better to pursue food sovereignty or a global food market? Another example of a laden issue, that would have to come into focus, is the role of technology as part of solutions – biotech in land-related issues, nuclear technology and carbon capture and storage in the climate change debate. As a final example of a debate waiting to be helped forward by future, action-oriented assessments, is the issue of global versus bilateral strategies. That is: does it remain useful to pursue all global goals through global processes, in view of, for example, the rate of progress under the global climate treaty? The assessments of the 1990s and 2000s often go around such ideologically laden questions – for example, by placing the possible answers in contrasting scenarios – or by not touching them altogether.

If future assessments become more action-oriented, which seems likely, they would also, and more strongly, have to handle large differences in perspective on preferred solutions. This might result in a situation in which the process of preparing assessments becomes more political. Whether the results of the assessments will nevertheless be perceived as 'salient, legitimate and credible' will be largely determined by the processes in which the assessments will be produced (Farell and Jäger (eds) 2005). This may require re-examining the ground rules for conducting environment-related assessments. Hence, this necessity may lead agencies, such as

UNEP, to pay due attention to the careful and efficient design of new assessments.

In the changing assessment landscape, a number of coordination roles would need to be fulfilled, among lead agencies and sponsors. First and foremost, the overlapping audiences of the various assessments need to be informed, in advance, of upcoming studies – not only of what has been mandated by the 'own' organisation but also of adjacent studies. Second, a lightweight coordination mechanism between the assessment leaders for identifying, for example, possible contradictory messages and understanding the reasons for such contradictions can be helpful. The assessments covered in this report benefited from such a process that was initiated by OECD, but purely ad hoc. Third, because this report is a synthesis of the outputs of the assessments, it hardly mentions the necessary information infrastructure at the input side – data, data standards, models, collaboration networks and peer review mechanisms. These structures are costly, take a long time to develop and still have glaring insufficiencies. For example, if future assessments have to address action and governance mostly at the regional and sub-regional level, the current spatial and sectoral resolution of many data sets and indicators will be too coarse to be helpful.

New questions

One of the functions of assessments is to help guide research from the perspective of what is needed at the science-policy interface. Some important new topics include:

- *Insight into the importance of biodiversity for delivering ecosystem services, the valuation of ecosystems and ecosystem services and the options for reducing biodiversity loss, including payments for ecosystem goods and services. Currently, biodiversity and ecosystem services are ignored in policy analyses.*
- *Coherent assessments of the vulnerability of people, social structures and ecosystems to global changes and the resilience of such systems to recover from shocks, are still in their infancy. Many assessments ignore variability and risks of extreme events.*
- *The costs of inaction ('business as usual') have, so far, been studied in detail for only a few topics and these are still surrounded by many uncertainties. More in-depth analyses for specific areas of policy will make a useful contribution to the policy debate.*
- *Water use and availability for agriculture needs to be truly integrated in the modelling of land-related issues for future assessments. Without this, long-term projections of agricultural productivity remain questionable.*
- *The risks of irreversible changes (tipping points), extreme events and other surprises have received too little attention in research for these crucial factors to play a major role in the assessments. However, this can have far-reaching implications, incurring huge costs for society.*
- *What changes should be made in production and consumption and how can such changes be brought about? Many assessments mainly examine technological solutions and largely ignore measures and policy options related to behavioural changes in consumption patterns.*
- *What new governance and institutional arrangements are needed to address global problems, including issues of policy instruments, implementation and enforcement; the economics of environmental policy; new alliances for international collaboration and policy integration?*

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Global Assessments have painted a concurrent picture of the world's major challenges of environmentally sustainable development

This report is written at the request of UNEP, in support of the preparations for its 25th Session of the Governing Council/Global Ministerial Environment Forum, in February 2009. The overall goal of this synthesis report is to provide policymakers with highlighted key messages from recent global environmental assessments, including the fourth Global Environment Outlook: Environment for Development (GEO-4), published in 2008. The current report does not claim to provide a comprehensive and neutral overview of all assessments. Rather, it analyses whether messages from these assessments strengthen the findings of the GEO-4 and what insights they add to the central theme of GEO-4: environment for development. More specifically, the report looks across these assessments for key environmental challenges for the next decades and to possible policy interventions for dealing with these in a comprehensive manner.

The assessments converge in identifying the main global environmental challenges in sustainable development. More than ever, competition for land emerges as a global issue. The assessments conclude, each in its own focal area, that many technical solutions are available and affordable for achieving the domestic and international targets. However, they display different perspectives on preferred policy options.

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