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Policy issues: state of the environment

**Synthesis of global environmental assessment: Environment for
development – policy lessons from global environmental
assessments**

Note by the Executive Director¹

Summary

The annex to the present note contains a synthesis report of global environmental assessments. It provides an overview of key messages of recent global environmental assessments and it examines their policy messages in terms of:

- (a) Trends in persistent environmental problems and costs and benefits of early action and cost of inaction;
- (b) Policy options to interlinked, persistent environmental problems;
- (c) Putting policies together.

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¹ The views expressed in the synthesis report are those of the authors and do not necessarily reflect the view of the secretariat of the United Nations Environment Programme.

Annex

Synthesis of global environmental assessment: Environment for development – policy lessons from global environmental assessments

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Summary

1. Never before have so many global assessments and outlooks been published in the field of the environment and sustainable development as in the past years (2007-2008). This report synthesises important and selected findings of the fourth Global Environment Outlook: environment for development (GEO-4) by the United Nations Environment Programme, the Environmental Outlook to 2030 by the Organization for Economic Co-operation and Development, the International Assessment of Agricultural Knowledge, Science and Technology for Development, the Fourth Assessment Report on Climate Change by the Intergovernmental Panel on Climate Change, the Human Development Report on Climate Change by the United Nations Development Programme, the Comprehensive Assessment on Water Management in Agriculture by the Consultative Group on International Agricultural Research and the World Water Development Report by the World Water Assessment Programme.
2. These assessments are complementary as each has a specific focus or entry point, and a different methodological approach. They resulted from processes that have been mandated by different international organisations, including UNEP. Some would not in the first place label themselves as environment-oriented. But taken together, these assessments provide a detailed picture of the current state of knowledge about various aspects of the environment and sustainable development. They also outline which future developments can be expected and the potential as well as advantages and disadvantages of the various policy options for solving these problems.
3. This report is written at the request of the UNEP secretariat, in support of the preparations of the twenty-fifth session of the UNEP Governing Council/Global Ministerial Environment Forum in February 2009. The overall goal of this synthesis report is to highlight to policy-makers key messages from recent global environmental assessments, and reaffirm key messages of GEO-4, which was presented to the Governing Council at its tenth special session. This report does not claim to produce a comprehensive and neutral overview of all assessments. More specifically, it looks across these assessments for key environmental problems foreseen for the next decades and to policy interventions to deal with these in an integrated manner.
4. 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, terrestrial as well as marine; land use and fresh water management and pollution. More than before, competition for land emerges as a global issue. The assessments conclude, each in their focal areas, that there are many technical solutions available and affordable to achieve national and international targets. However, the perspective on preferred policy options differs across the assessments.
5. The report concludes by presenting seven points derived from the assessments that could be considered for national and international policies to deal with persistent environmental problems. Apparently, assessment practice is beginning to move away from problem identification towards identification of policy responses. Since, in assessments the process is as important as the outcomes (i.e. the reports themselves), insight in to the processes that led to the assessments and the methodologies used, will help contextualise the outcomes of new assessments. Assessment processes are about building a collective policy relevant knowledge base, identifying scientific consensus and implications for policy making as well as identifying new research questions. Some important new questions that arise at the science-policy interface are included in this report.

1. Introduction

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

7. Nationally and internationally, there is a great need for an up-to-date knowledge base that policymakers can use to solve environmental issues. Never before have so many global environmental assessments been published as in the past years (2007-2008). As they are written for environmental and non-environmental policy domains, this in itself might 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’.

8. Forward-looking assessments are increasingly accepted by politicians and other stakeholders. The fact that large international organizations 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.

9. The assessments refereed to in this report seem to converge in their identification of the major environmental problems in this world, that is: the problems that 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 how to deal with these problems. This would include 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.

10. In fact, such a shift in the focus of worldwide assessments is starting to take place. The set-up of future assessments (including scenarios used) has to be chosen so as to facilitate this and to demonstrate more clearly options for action, by whom. 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.

11. The overall goal of this report is to highlight to policy-makers the key messages from the following assessments through the lens of ‘environment for development’:

(a) *The fourth Global Environment Outlook: environment for development (GEO-4)*, published by the United Nations Environment Programme (UNEP 2007a) and (UNEP 2007b)

(b) *Climate Change 2007. Fourth Assessment Report (IPCC AR4)*, published by the Intergovernmental Panel on Climate Change (IPCC 2007abcd).

(c) *Environmental Outlook to 2030 (OECD EO)*, published by the OECD (OECD 2008).

(d) *International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD)*, which, among others, is supported by the UN Food and Agriculture Organisation (FAO), the UN Development Programme (UNDP), the UN Environment Programme (UNEP) and the World Bank (IAASTD 2008).

(e) *Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world (HDR)* (UNDP 2007).

(f) *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 press).

(g) *Climate Change and Water*, Technical paper VI published by IPCC (IPCC 2008).

(h) *Comprehensive Assessment of Water Management in Agriculture (CAWMA)*, published by the Consultative Group on International Agricultural Research (IWMI 2007).

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

13. This report is written at the request of the UNEP secretariat, in support of the preparations of the twenty-fifth session of the UNEP Governing Council/Global Ministerial Environment Forum (GC/GMEF) in February 2009. The findings of GEO-4 were presented to the Governing Council at its tenth special session (GC.SS.X). 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/DecisionSS.X/5).

14. This report highlights key messages from the assessments and any additional insights from these other assessments in view of the central theme of GEO-4, environment for development. It does not claim to produce a comprehensive and neutral overview over all assessments. Specifically, this report will look across the assessments for policy messages in terms of:

- (a) trends in persistent environmental problems and costs and benefits of early action and cost of inaction;
- (b) policy options to inter-linked, persistent environmental problems;
- (c) putting policies together.

15. The report is organised as follows. Chapter 2 provides an overview of the focus of the different assessments analysed in this report and the process and methods behind them. Chapter 3 subsequently presents a general overview of the main challenges identified in the assessments, as well as the challenges in the thematic areas of atmosphere, land, water and biodiversity especially looking at trends and cost and benefits of inaction. Chapter 4 identifies the main policy responses for three interrelated problems, looking at synergy and trade offs in ‘agriculture, water availability and biodiversity’; ‘energy, climate and air quality’ and ‘water and water quality, sanitation and health’. Chapter 5 puts these policies together and provides directions 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

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

2.1 What are the assessments about?

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

18. The *fourth Global Environment Outlook: environment for development* by UNEP 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).

19. The *Fourth Assessment Report* of the IPCC, *Climate Change 2007*, addresses the climate change problem, its causes, and 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).

20. 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 large developing countries such as Brazil, Russia, India and China (OECD 2008, MNP and OECD 2008).

21. The *International Assessment of Agricultural Knowledge, Science and Technology for Development* assesses agricultural knowledge, science and technology in agriculture 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.

22. The *Human Development Report 2007/2008. Fighting Climate Change: Human Solidarity in a Divided World* considers climate change as 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).

23. The *World Water Development Reports* provide every three years 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).

24. *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).

25. 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?

26. Since, in assessments the process is as important as the outcomes (i.e. the reports themselves), insight in to the processes that led to the assessments, as well as the methodologies used, will help contextualise their outcomes. Assessment processes are about building a collective policy relevant knowledge base, in which it becomes clear where the scientific consensus is, what this implies for policy making and where the new research questions are to deal with the relevant uncertainties.

27. 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 about causes, consequences and solutions – as far as that knowledge can be found in the literature. To a very large extent, these assessments are based on peer-reviewed literature, to ensure objectivity and, especially, to be regarded by policymakers as being objective. 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 that go beyond what is published in the literature and also include own research conducted to support the analysis. This means that, for the second group of assessments, it is less important to refer to all the relevant literature. And of course gradations exist. GEO-4, for example, has increasingly

been using methods from the scientifically-oriented assessments, whilst maintaining its network of collaborating centres.

28. Different ‘production’ processes and methods are used for 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. OECD EO, WWDR, CAWMA and HDR are merely governed by their ‘home organisations’, in line with their mandate. Showing 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: model-based analysis and long-term data series and peer-review of national environmental policies. The WWDR not only uses published science, but also case studies from specific regions and on specific water problems.

Table 2.1 Overview of the assessments discussed in this report

	4 th Global Environment Outlook	IPCC 4 th Assessment Report	OECD Environmental Outlook to 2030	International Assessment of Agri. Knowledge, Science and Technology for Development	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 WWDR-3: Climate change, the MDGs, groundwater, biodiversity, water and migration, water and infrastructure, bio-fuels	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	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 adapt, 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 has the right to water and its benefits? Who is making water allocation decisions on who is 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	Causes of climate change, observed and projections for 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	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, urbanization, 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 changing world	Vulnerability of freshwater resources; strongly impacts 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 co-operation	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 simulation	Summary of formal and informal literature + new projections	Own analysis and review from literature	Summary of scientific literature; expert groups. Case studies from WWAP	Summary of scientific literature	Assessment of state of science and practice, background assessment research

	4 th Global Environment Outlook	IPCC 4 th Assessment Report	OECD Environmental Outlook to 2030	International Assessment of Agri. Knowledge, Science and Technology for Development	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
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 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 global groups of countries; 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 limits and options to cope with already committed climate change	24 UN-agencies; coordination by WWAP (UNESCO); input in writing teams by universities, individual experts, professional organizations, 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
Review process	Two rounds of external review by individual experts, organizations invited to review drafts; regional consultations with government representatives and stakeholders, Summary for Decision-makers considered and endorsed 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	Standing groups of government representatives. (Environment policy committee and other groups outside the environment 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 organizations invited to review drafts; universities, governmental and non-governmental	Writing teams; individual experts and organizations 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 umbrella organisations participated in reviews at discrete points in time. One review meeting with experts from non-OECD countries	Private and public sector on 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	http://www.unep.org/geo	http://www.ipcc.ch	http://www.oecd.org/environment/outlookto2030	http://www.agassessment.org	http://hdr.undp.org/en/	http://www.unesco.org/water/w/wap	http://www.ipcc.ch	http://www.iwmi.cgiar.org/Assessment/

29. 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 as intended users were also involved in designing many of the assessments: they formulated relevant questions, reviewed the results and approved one way or the other the summary for policymakers. Their direct involvement is intended to increase the policy relevance of the 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 to have governments accept the outcomes of the assessments. In IPCC this is done with a line-by-line approval of the summary for policy makers, in GEO-4 through consideration and endorsement of the summary of decision-makers, in the OECD EO this is done by government review at various stages and in the IAASTD through an approval procedure in which some countries took exception.

30. In all assessments forward looking is an important part of the assessment. Sustainable development implies critically examining potential solutions in the light of their consequences in 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. So, 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 this 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) and (IPCC 2007). The OECD EO and the IAASTD, by contrast, are each based on a single baseline scenario. Since the OECD focuses on policy analysis, a single baseline scenario against which specific 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 such as limit climate change below two degrees above pre-industrial levels and analyses what needs to be done to realise that 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 such as population growth and food demand (UNESCO 2006, p.251-255). In the CAWMA existing FAO and other projections have been enriched with assumptions on land use and agricultural technology (IWMI 2007, p.15).

3. Main environmental challenges

31. This chapter provides the main challenges with respect to 'Environment for Development' as put forward in the assessments. In summarizing the assessments, this chapter identifies some key findings across the assessments in section 3.1. Sections 3.2-3.5 summarize trends and cost and benefits of inaction by theme. In the following chapter possible policy responses are discussed in a more integrated manner looking at a number of inter-linked problems.

3.1 General findings

32. The 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 that are dependent on their immediate environment, sustainable managed ecosystems can provide valuable goods and services.

33. This message is confirmed by the other assessments; they are unanimous in identifying the main environmental problems, there is a better understanding of these problems and more insight in to 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.

34. The policy challenges are clear. With current policies extreme hunger and poverty will not be halved by 2015 in all countries as expected in the targets set of the UN Millennium Development Goals. The rate at which biodiversity is globally 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 proportion 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.

35. According to OECD EO (OECD 2007, pp.24-264 [chapter II]) 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, pp. 1-18) considers climate change the defining issue for human development of our time and pleads to establish an agreed threshold for dangerous climate change at 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 urbanization’ (IPCC 2008, p. 4). Emphasis in the water reports is mainly on climate variability changes.

36. 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.

Trends in global scenarios

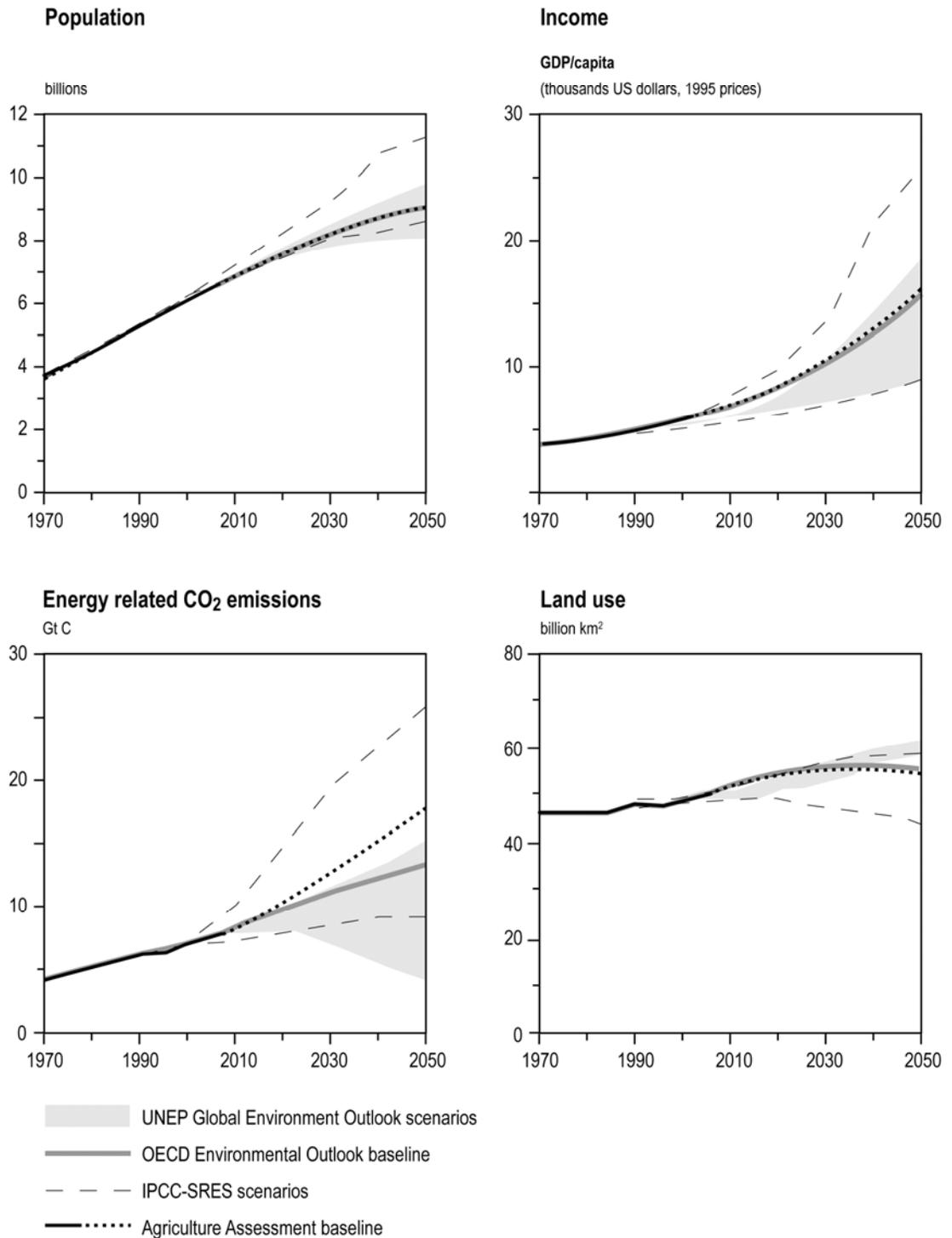


Figure 3.1 Historic trends and forecasts in population, income, land use and energy-related carbon dioxide emissions in the scenarios that are used in the four assessments. Water-scenarios are not included because of differences in scenario approaches.

37. Figure 3.1 provides an overview of these trends 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.

38. Almost all scenarios in the assessments show that action now however, is in many cases cheaper than waiting for better solutions. The consequences and costs of environmental policy inaction could be high and are already affecting economies. Delayed action not only results in higher costs, but unfairly shifts the burden of paying for such costs to developing countries and future generations. These issues need to be given greater weight in the decision making processes and in the estimates of the costs of taking action.

39. The assessments conclude that many (technical) solutions are already known (although perhaps less so for biodiversity) and that the measures that could be taken are theoretically affordable. Options to combat ongoing climate change look more concrete and are still 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 of the OECD Environmental Outlook. GEO-4 points at the need to develop policy approaches to deal with the persistent environmental problems (UNEP 2007a, chapter 10). Also the other assessments seem to confirm this message. Knowledge and technology needs to be urgently diversified to take differences in local ecological, social and cultural circumstances into account.

40. The assessments emphasise 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 the assessments emphasize the importance of broadening environmental policies into other policy domains and economic sectors (policy coherence and mainstreaming).

41. Effective policy requires a balance between the costs and benefits of policy. That is not easy, especially in relation to the distribution of 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 to achieve the required global cooperation, while paying special attention to distributional issues. The fair distribution of costs and benefits will be crucial. Currently the industrialised world is shifting part of the burden of its own environmental problems onto developing countries, with direct consequences for vulnerable groups in developing countries (UNEP 2007a, chapter 7).

3.2 Atmosphere

42. The message of IPCC AR4 is that climate change is 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.

43. 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 2007, p. 270).

44. The long term goal of the UNFCCC is to stabilize greenhouse gas concentrations at a level that would prevent dangerous human induced interference with the climate system. This goal is not yet quantified, not to mention there is no global agreement on fighting climate change. The HDR is going the farthest and recommends a stabilization target for atmospheric concentrations of 450 CO₂-eq limiting global warming to 2 degrees (UNDP 2007, pp. 17-18). This target implies global emission reductions of about 50% by 2050 compared to 1990 levels. All social 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

45. There is an increasing competition for land for agriculture due to rising population and changes in diets with rising income, urbanization and infrastructure and the bio-based economy that results in more

intense land use as well as increasing pressure on natural areas. The Millennium Development Goals (MDGs) aim at reducing extreme hunger, the assessments that pay attention to this goal do not expect it to be achieved by 2015. 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).

46. Despite increasing productivity in agriculture, people still suffer from malnutrition and poverty in many regions of the world. Lack of ownership and problems of the distribution of land also play a role in this. Agricultural development in the past strongly focused on productivity and the exploitation of natural resources. Although 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 increasing difficulties in producing food. This is partly due to lack of good land, but also partly because of water problems and climate change. More attention needs to be given to the complex interactions between agriculture, local ecosystems and the local community, to make the sustainable use of natural resources possible.

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

3.4 Water

48. Human well-being and ecosystem health in many places are seriously affected in many places 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, pp. 221-229). Both 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 using an integrated approach, drinking water supply without proper sanitation is counter-productive in view of health impacts.

49. A continuing challenge for the management of water resources is to balance 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 it will be possible to meet the acute freshwater challenge facing humankind in 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 user and social institutions; this is often ignored in agricultural reforms.

50. 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 demand-side as well as supply-side strategies. Water resources management clearly impacts on many other policy areas, e.g., energy, health, food security and nature conservation. 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, pp. 262-265).

3.5 Biodiversity

51. 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 feed-back 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 changes are happening more rapidly than at any time in human history, and have led to substantial loss of many of the world's ecosystem services. Freshwater and marine species are declining

more rapidly than those of other ecosystems (OECD 2007, p. 136). Biodiversity is forecast to decrease further, and in some areas at an accelerating rate.

52. 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 rising demand from countries such as China, agricultural production in the tropics and sub-tropics will increase, for example in countries like Brazil. The net effect of that agricultural production shift on biodiversity will depend very much on the existence of countervailing policies to prevent 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.

53. The main question is that of trade-offs between biodiversity on the one hand and intensification versus integral management on the other. Intensification concentrates production on the most suitable and efficient areas, and leaves room for valuable natural areas that should be excluded from human impacts, while integral sustainable management tries to include biodiversity aspects (agro-biodiversity). Finding the balance between these approaches is the main challenge.

54. Dependence on and growing requirements for energy result in significant changes in biodiversity as a result of current energy use patterns and the search for alternative energy sources like bio-fuels. 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, p. 159).

55. Getting a precise total figure for the cost of policy inaction is not possible yet, but there is good reason to suspect that it is large (OECD 2007, p. 215). Therefore, promoting the awareness of the societal costs of degradation and value of ecosystems services is one of the key priorities (IAASTD 2008).

4. Policy responses

56. 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 from the assessments on how to deal with these harder to solve, global environmental problems.

57. Policy responses depend very much on the type of problem at stake. For the global concerns over environment and development clear solutions and governance and institutional mechanisms remain poorly defined. Climate change, biodiversity loss and water stress share common characteristics, including complex interactions across global, regional and local scales, long term dynamics and multiple stressors and stakeholders. These problems are therefore hard to manage.

58. Issues such as poverty and global environmental change require collective agreements on concerted action and governance across scales. 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 to meet development and sustainability goals.

59. 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 irreversible turning 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 further development of innovative solutions is needed (UNEP 2007a, chapter 10).

60. Policy options traditionally 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 to achieve ambitious environmental goals (OECD 2007, pp. 269-289). Notably, policy options include ending subsidies that encourage unsustainable practices.

61. Many technologies and more sustainable production options are mature and commercially available, but there is 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 MDG 7 on environmental sustainability has been one factor in its relatively low profile on the global agenda.
- It is important to recognize the trade-offs, synergies and opportunities that exist in addressing the challenges of achieving environmental, development and human well-being goals.
- The economic valuation of ecosystem services can provide a powerful tool for mainstreaming environment 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.
- No one option or policy instrument will do. A mix of complementary policies is needed to tackle the most challenging and complex environmental problems.
- Improving partnerships between industrialized and developing countries 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 programs and promoting more coherent policies.
- Globalization can lead to more efficient use of resources and the development and dissemination of eco-innovation. Governments by providing clear and consistent long-term policy frameworks can encourage eco-innovation and to safeguard environmental and social goals.

62. 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

63. 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. Not always are the availability of water for agriculture and nature and the impacts of agriculture on water systems sufficiently taken into account.

64. 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. Much is still unknown, for example, about the value of biodiversity. Also, the costs of possible policies are less understood. Often, the agriculture, water and biodiversity theme features both winners and losers, for example, from trade liberalisation. Moreover, it is difficult to quantify the exact benefits in the different policy areas such as poverty reduction and biodiversity. Nevertheless, awareness of the importance of balancing claims on land and water in an integral way in spatial and water resources 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. In international policies there are, however limited integrated decision-making mechanisms for land use in place, while competition for land will increase.

65. The IAASTD (2008) is most explicit with regard to agricultural policy. It advocates giving renewed attention to agricultural policy and in particular 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. It furthermore 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.

66. 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 (recognize 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.

67. The OECD EO, GEO-4, and the IAASTD all look, in detail, into boosting agricultural productivity as an important way to increase food production without a corresponding increase in the amount of land or water required. According to the OECD EO, with modern technology it will be possible to feed the expanded world population in 2030 and 2050 (OECD 2007, p.308). For this increase, known technology for water supply can already gain a lot (CAWMA 2007). The OECD EO states that it is mainly large scale farms that 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 to target small scale farming instead of large irrigated systems. Ultimately, a reform of agriculture is highly important to increase crop yields, according to the OECD EO. The IAASTD takes a different view. On the one hand, the role of technology is recognised in this assessment, but at the same time it 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.

68. 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 will then be connected to world markets. The IAASTD is more critical about the impact that trade liberalisation will have. On balance, it says, the poorest developing 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 slightly differing world views on the impacts of agricultural trade liberalisation on biodiversity. In GEO-4, these differing world views are incorporated in separate scenarios.

69. CAWMA (2007) recognizes that difficult choices have to be made in many cases. It says that countries have to deal with tradeoffs and *make* those difficult choices, for example between agriculture and nature; between equity and efficiency; between this generation and next ones (IWMI 2007, pp. 36-37).

70. 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.

71. Some 'win-win' opportunities have already 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 underutilized or degraded lands and rangelands;
- land use options such as carbon sequestration in agricultural soils;
- reduction and more efficient use of nitrogenous inputs; and
- effective manure management and use of feed that increases livestock digestive efficiency.

72. Effective biodiversity policy requires clear choices. As the different assessments show, it is not possible to preserve all current biodiversity and, at the same time, meet the needs of a growing global human population. Similar to addressing the climate problem, a combination of measures and associated

instruments is required, designed to stimulate development. 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 different goals, but also because of the many dimensions of biodiversity.

73. 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).

74. 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 and rain-fed agriculture instead of large irrigated systems.

75. Proper valuation of biodiversity seems a silver bullet, as it provides a feed-back from biodiversity to the 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 internalize environmental costs into prices, and failure to recognize global values at the local level. Appropriately recognizing the multiple values of biodiversity in national policies is likely to require new regulatory and market mechanisms. The WWDR (2006) points to the necessity to plan and carry out programmes together with the relevant stakeholders. A top down approach is believed to be insufficient to solve the large problems with biodiversity in water systems (including coastal zones).

76. 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 productivity growth goes hand in hand with an increase in efficiency in the use of land and water).

77. Protecting biodiversity rich areas deserves a high priority. The assessments present a picture of continuing loss of biodiversity, which is virtually impossible to slow down given global economic development. This makes it crucial to identify and protect natural areas. The preparation of 'hot spot' maps for biodiversity is, however, a subjective and therefore controversial topic. How a global network of protected areas can best be designed is a question for further research.

78. Measures to prevent climate change may create synergy. 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

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

80. Climate concerns dominate the assessments. Air quality is a major concern still, 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 emissions trading have become increasingly popular. They can be more cost-effective than regulation because they give an incentive to the market (industry, transport sector) to take 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.
81. There may be both synergy and trade-offs. Decreasing the volume of an activity such as energy use 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.
82. There is high agreement and much evidence of substantial economic potential for the mitigation of global greenhouse gas (GHG) emissions over the coming decades. Several technologically feasible options are available to address climate change in all countries, and many of them are economically competitive, especially when the co-benefits of increased energy security, reduced energy costs and lower impacts on the environment and of air pollution on health are considered.
83. A wide variety of policies and instruments are available to governments to create the incentives for mitigation action. An effective carbon-price signal could realize significant mitigation potential in all sectors. A large number of market-based instruments are used in a variety of ways by countries to mitigate GHG emissions. These include emission charges and taxes, product charges, tax differentiation and subsidies. GHG emission trading is another prominent form of market-based instrument for climate change mitigation. While research and development programs play an essential role, they will need to be supplemented with other policies, for example economic instruments and other incentives such as feed-in tariffs to promote deployment and diffusion of low carbon technologies and to ensure reductions in GHG emissions.
84. Successful mitigation of climate change will require an international effort to limit global greenhouse gas emissions significantly below current levels over the long-term. Broad participation by all the big emitting countries in the coming decades will be required to achieve these outcomes. The need for a burden-sharing mechanism in any future international collaboration is crucial to reduce global emissions. 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 CO₂ emissions. While this may be workable, it may also be vulnerable to the free-rider problem in allocating emission reductions.
85. 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, 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 offset at least partly the gain from using this energy source. Focus needs to be broader than energy options to mitigate GHGs. 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 agriculture and forestry sectors.
86. The assessments are cautious about the use of bio-energy. 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 of large-scale increases of first generation bio-fuels production are likely to persist and will need to be addressed. Proper assessment of the implications on the water system of raising bio-energy crops is almost never done.

87. 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 – stabilizing concentrations at 450 ppm CO₂ eq – are manageable. Total loss of GDP (relative to the baseline) is projected to be roughly 0.5% by 2030, rising to about 2.5% by 2050.

88. Adaptation is necessary. Some impacts of climate change are inevitable in the coming decades due to the inertia of the climate system (IPCC 2008, pp.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 through urbanization 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) and (IPCC 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.

89. The ultimate success of global efforts for climate adaptation can be realized only by mainstreaming climate concerns in all relevant development programmes ('climate proofing'). There has been progress in many countries to develop 'whole-of-government' efforts to integrate climate change into pre-existing sector policy frameworks emergence of multilevel 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 still seldom seen.

90. 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 international partnerships for poverty reduction. This requires strengthening of 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 poverty reduction and sustainable development strategies. These strategies can also be used to conduct estimates of the costs of scaling up adaptation. Finance mechanisms to provide the necessary funds (estimated in the order of US\$ 86 Billion (HDR 2007) in new and additional funds for adaptation to protect progress towards the MDGs and prevent reversals in human development.

4.3 Water, sanitation and health

91. A number of policy goals have been set for water quality, sanitation and health in the context of sustainable development: MDG 7 aims at the provision of 1.5 billion people with access to 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 resources management in general are only set for specific regions such as the European Union or USA and some major river basin areas elsewhere.

92. There is a need to improve governance as it relates to water resources management. Not only is there a need to develop new approaches, but also to facilitate the practical, timely and cost effective implementation of existing international and other agreements, policies and targets.

93. A global consensus has emerged on the need to implement ecosystem-based management approaches to address sustainable water resources needs. 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 to 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 resources management efforts. These necessitate education and public involvement.

94. Regional water-framework agreements are needed in strengthening national and local laws and policies and institutional structures, such as cooperation among states. Collaboration among institutions with complementary environmental and economic development functions is equally important. According to UNEP 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; and
- an enabling environment for all stakeholders to participate in collective decision making.

95. Market-based instruments can operate by valuing public demand for a good or service, 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 to reduce water demand and pollutant emissions, and 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.

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

97. 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. 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; and
- increase international development aid and encourage internal investment towards helping developing countries achieve MDG Target 10 with clearly-established roles and responsibilities;

98. 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 as a whole.

99. Failure to recognize the essential role of water in the provision of food, energy, water supplies and sanitation, the management of responses to droughts, floods and other disasters and environmental sustainability has led to a lack of investment in the appropriate infrastructure, the capacity to build and maintain it, and its renewal. More and immediate investment in appropriate water management, capacity and infrastructure is the only solution (WWDR3 in press).

5. Putting policies together

100. What 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 national and international policies to deal with the persistent environmental problems. These are the highly inter-related, globalized problems with inherent long time lags and social time lags in addressing them and require globalized solutions to solve them (UNEP 2007a, chapter 10):

- *Intensification of policies.* The urgency that is clearly evident in the assessments (see chapter 3) requires translation into more intensive policies at all levels of decision making quite soon if the agreed policy goals are to be reached. The persistent character of these

problems requires consistent long-term policies. This will provide markets with more certainty, so that the private sector can prepare to make the required investments (OECD 2007). Moreover, such long-term policy needs to 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 energy supply (global access to modern energy services is not yet a formally agreed policy goal), or areas in which only short-term goals have been set (as is the case with biodiversity).

- *Efficient and equitable solutions.* It is important to find efficient and equitable solutions. 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 provide a level playing field. This still does not address the issue of equity, 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 are shared fairly. Furthermore, choosing the most efficient solution to achieve 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 be already known, a lot is needed to realise their full potential. The further development and large-scale introduction of technologies that are already available require considerable effort 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 (IPCC 2007c).
- *International cooperation.* Global coalitions as well as regional cooperation are needed to develop joint approaches to deal with the persistent environmental problems. It is essential to agree on common goals, how best to share burdens and benefits and policy instruments that can be used. The distribution of the responsibilities for action amongst countries is likely increasingly problematic and, if unresolved, may prevent major advances in environmental cooperation (OECD 2007, p.462). An essential issue is the mobilization of financial resources, by using economic instruments, greening of financial flows such as trade, investments and development assistance, as well as phasing out of some subsidies. With a contribution of new players emerging on the world stage, such as Brazil, Russia, India and China (BRICs) international environmental policy can become much more effective.
- *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 simply to set goals. Sufficient financial and human capacity is required within countries to implement policy, and to monitor and enforce compliance. There needs to be sufficient attention to local situations and local people, including for example strengthening local rights and securing access to and maintaining natural resources to reduce vulnerability of people (UNEP 2007a, chapter 7). On the international level the improved conditions for this can for example be created 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. Consumers would then pay more for sustainable

products. One important issue is how to change consumer behaviour, but the assessments devote little attention to behavioural change in relation to consumption. Producers would take social, economic and environmental considerations into account and will be paid for doing so. 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 also raise the question for governments as to how they intend to relate to these developments.

- *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, scale, sectors and place (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 between trade, environment and development. According to the assessments, freer trade can have both positive and negative effects in the fight against poverty and for the environment. For example small farmers, rural populations and many poor countries often do not benefit from current agricultural trade rules. Additional policy measures are necessary to limit the negative consequences of these trade rules while making the most of its advantages, to make trade fairer (IAASTD 2007).

101. Some important new questions that arise at the science-policy interface are listed in the box below.

New questions

- Insight into the importance of biodiversity for delivering ecosystem services, the valuation of ecosystems and ecosystem services and the options for reducing biodiversity loss. Currently, biodiversity and ecosystem services are almost entirely 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.
- 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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