IEA Training Manual

A training manual on integrated environmental assessment and reporting

Training Module 5

Integrated analysis of environmental trends and policies

Authors:

László Pintér (IISD)

Darren Swanson (IISD)

Ibrahim Abdel-Jelil (AGU)

Kakuko Nagatani-Yoshida (UNEP-ROLAC)

Atiq Rahman (BCAS)

Marcel Kok (MNP)

UNEP

iisd International Institute for Sustainable Development / Institut international du développement durable

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List of Acronyms

AIM	Action-Impact Matrix
CAFC	Company Average Fuel Consumption
CAFÉ	Corporate Average Fuel Economy
DPSIR	Drivers-Pressures-State-Impacts-Responses
EEA	European Environment Agency
EIA	Environmental Impact Assessment
EVRI	Environmental Valuation Resource Inventory
GEO	Global Environment Outlook
GHG	Greenhouse Gas
IA	Integrated Assessment
IAASTD	International Assessment of Agricultural Science and Technology for Development
ICSU	International Council for Science
IEA	Integrated Environmental Assessment
MA	Millennium Ecosystem Assessment
NFU	National Farmer's Union
NGO	Non-Governmental Organization
NRCAN	Natural Resources Canada
R&D	Research and Development
SA	Sustainability Assessment
SEA	Strategic Environmental Assessment
SMART	Specific, Measurable, Aggressive but achievable targets, Relevant, Time-bound
SOLEC	State of the Great Lakes
SoE	State of the Environment
S&T	Science and Technology
TEV	Total Economic Value
TERI	The Energy and Resources Institute
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Overview

Integrated analysis of environmental trends and policies is one of the core elements of integrated environmental assessment (IEA). The integrated analysis described in this module helps answer the following three questions:

1. What is happening to the environment and why?
2. What are the consequences for the environment and humanity?
3. What is being done, and how effective is it?

In order to answer these questions, IEA analyses environment and human well-being trends and dynamics based on the drivers-pressures-state-impacts-responses (DPSIR) framework.

Using this framework, the assessment identifies the drivers of human development and associated pressures that, along with natural processes, affect the state and trends of the environment. Changes in the state of the environment have impacts on ecosystem services and aspects of human well-being. In order to assess how society is responding to these problems and effectiveness of these responses, IEA analyses policies directed at the mitigation and conservation of the environment, as well as adaptation by people to the environmental impacts.

Integrated assessment of the state of the environment identifies priority environmental and sustainability issues, specific indicators, and policy targets for a given issue. Such a process could also be used to identify linkages to human well-being. The current module reviews three types of analyses of impacts on human well-being: a qualitative analysis of impacts, an analysis based on the ecosystem and human well-being framework, and analysis of ecosystem—human well-being connections based on economic valuation.

The analysis of policy responses identifies existing policy measures, both in terms of their effects and their effectiveness. This involves considering both the policy landscape to identify potential gaps, and an in-depth analysis of particular policies or policy mixes to determine their effectiveness in light of targets. Analysing existing policy measures is based on the following steps:

A. *Understanding the issue* to determine what is happening to the environment, why and what the impacts are.
B. *Preparing a policy report card* to understand the array of high-level strategies affecting the environmental issue.
C. *Conducting a policy instrument scan* to identify the mix of policies influencing the environmental issue, and the effectiveness of such a mix.
D. *Performing a policy gap and coherence analysis* to determine if relevant policies are in place and are focused on the most important drivers and pressures.

Notes

Course Materials

1. Introduction and learning objectives

Integrated analysis of environmental trends and policies refers to a set of processes and methods to analyse the state of the environment as it is affected by natural forces, human activities and policies.

Traditional SoE reporting that tries to answer the question, "What is happening to the environment?" has been around for over three decades. Beginning in the late 1990s, several countries prepared SoE reports using the IEA approach, with increasing emphasis on root causes, policy drivers and impacts of environmental change. The IEA approach has a series of questions the assessment seeks to answer (Figure 1).

Module 1 of this Training Manual presents detailed information on the evolving concepts and methods used in the Global Environment Outlook (GEO) and related reports by UNEP. This module focuses on answering the first three questions in Figure 1. The fourth and fifth questions build on the first three, and are addressed in Module 6.

In **Step 1** (Figure 1), you will learn about compiling and analysing quantitative and qualitative information related to the status and trends of the environment, including spatial and temporal characteristics of change. We also will address how drivers—natural or anthropogenic—exert influence.

Step 2 will guide you through identifying and analysing ways environmental change affects the ability of the environment to provide specific services such as pollination of crops by insects, regulation of carbon in the atmosphere or the cultural or recreational value of landscapes. Here, you also will investigate direct versus indirect impacts on human vulnerability and well-being as well as the potential costs of those effects.

Step 3 involves identifying all policies that have significant influence on the environment and human well-being. It also helps identify policy gaps and opportunities for policy innovation, and determine the effectiveness of policies.

In order to illustrate the concepts and methodologies introduced in the three steps in this module, a feature case study focusing on the Red River basin in North America will be used. Different aspects of the case study will be presented as applicable to the methodology discussed in various sections.

Upon successful completion of this module, you will be prepared to:

- Identify priority issues influencing environmental change.
- Describe and interpret environmental change through time and space, by making use of qualitative and quantitative information, including indicators.
- Identify direct and indirect causes of environmental change.
- Identify and characterize impacts of environmental change on environment and society.
- Identify and analyse policy mechanisms and responses that directly or indirectly contribute—in positive or negative ways—to environmental change.

Keeping environmental state-and-trends assessment for all issues clustered helps analyze crosscutting issues within the environmental domain and then, separately, discuss policy matters in one section that may facilitate comparison. However, separating the analysis of policies from the description of underlying environmental status and trends might make for a more fragmented report.

BOX 1: What is an integrated environmental assessment?

The world is faced with major environmental challenges, which have complex causes and consequences. This requires a structured process of dealing with environmental issues and their interactions with society, including political processes and the economic system. It needs to use knowledge from a wide range of scientific disciplines and stakeholders, so that integrated insights are made available to decision-makers.

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

Integrated Environmental Assessment provides a participatory, structured approach to linking knowledge and action. Over time, GEO has developed an increasingly integrated approach to environmental assessment, the use of indicators and reporting in answering the questions shown on Figure 1.

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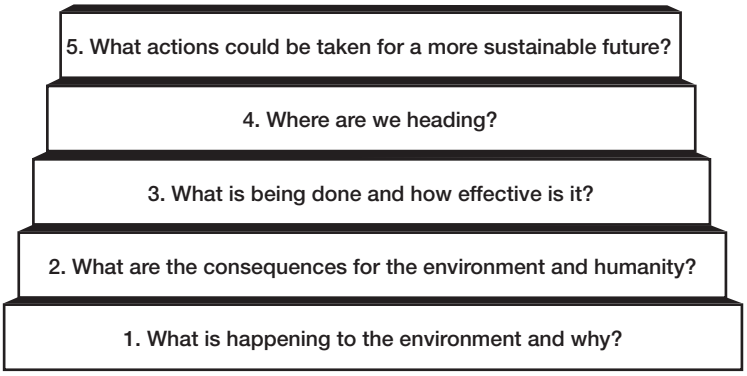
Figure 1: Key questions to be answered by State of the Environment (SoE) Assessment and Policy Analysis in the IEA Framework.



The "integrated approach" is an umbrella term for:

- linking the analysis of environmental state and trends with the policy analysis;
- incorporating global and sub-global perspectives;
- incorporating historical and future perspectives;
- covering a broad spectrum of issues and policies; and
- integrating the consideration of environmental change and human well-being.

DISCUSSION QUESTIONS

In groups of 3-4 persons, discuss the following questions for five minutes. Be prepared to share your key points in plenary.

Q: Do the questions proposed on Figure 1 reflect your understanding of what should be covered by IEA? If they do not, how would you rephrase them?

A: .....

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Q: In your opinion, given your experiences to date, is it more advantageous to treat state-and-trends separate from policy analysis or integrated? Why?

A: .....

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2. Spatial, temporal and thematic context

Environmental assessment and reporting has been around since the 1960s, and many countries have at least a few examples from previous reporting processes. Environmental state-and-trends analysis presents a "cutting the cake" dilemma since the environment is a complex subject. It has fuzzy spatial and thematic boundaries, and presents challenges to IEA practitioners in deciding on a geographic area within which to carry out assessment, themes and issues and/or resource sectors upon which to focus analyses.

Environmental themes for the purpose of this training module are defined as broad categories of environmental concern, sometimes related to environmental media such as air or water. Although terminology varies, it is common to find that those same themes cross a wide range of IEA analyses. A given environmental theme can include many environmental issues that are interconnected in a wide variety of ways. Issues are more specific concerns with which stakeholders can directly relate (e.g., land degradation, air and water pollution, smog, greenhouse gas emissions). Resource sectors include agriculture, forestry, fisheries, tourism and others.

2.1 Setting spatial boundaries

In principle, you can carry out an IEA analysis for any given issue, geographic area or level of decision making. In practice however, there usually are two choices: analysis based on jurisdictional (political) boundaries, or on non-political boundaries (e.g., ecoregion, watershed). Using either approach has advantages and disadvantages; only rarely do the two spatial boundaries coincide as they do, for example, in small island states. The geographic area is often specified by the mandate for the reporting programme. However, even in cases when the report is clearly focused on a country, there are needs to analyse specific issues on the level of ecological units (e.g., ecosystems, watershed, air-sheds), usually both in subnational and transboundary contexts.

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Table 2: Environmental assessment in ecosystems versus in political boundaries

Ecounit boundary	**Advantages** • More meaningful interpretation of environmental trends relevant to specific ecosystems. • Better understanding of ecosystems as functional units. • Direct connection to ecosystem-scale policies. • Focused research results and analysis.
	Disadvantages • Limited availability of some data expressed at the scale of ecounit (particularly socio-economic data). • Political complexity arising from analysis of resources under shared jurisdiction.
Jurisdictional (political) boundary	**Advantages** • More uniform regulatory environment. • More simple data collection. • Direct connection to jurisdiction-wide policies.
	Disadvantages • Resource-specific trends masked by data collected on the level of political jurisdiction. • Difficulty detecting differences in ecosystem impacts of specific policies.

(Modified after Pintér, Zahedi and Cressman 2000)

2.2 Temporal scale

In contrast with SoE reports that typically assess past and current trends and dynamics, IEAs combine retrospective integrated analyses with future outlook. Defining the temporal scale—how far do you look back and ahead—is important for conceptual clarity. There are also important methodological and technical implications.

Setting the retrospective boundary is relevant in Module 5, while the future outlook matters for the scenario analysis discussed in Module 6.

When considering the temporal scale, the key questions you may want to ask and answer include:

- Is the time scale on which you need to report explicitly defined in the mandate for the IEA? If this is the case, there is little room for flexibility.
- In which time scale do the environmental issues you want to assess show significant or detectable change?
- Do you need to use one time scale for all of your issues, or can you choose time scales as required by the dynamics of any given environmental issue?
- How far back do you expect to have reliable data?
- How far into the future do you need to or can you project environmental trends?

An additional question to consider is whether the time horizon chosen could or should be linked to a landmark event say, the publication of a key report, a political declaration or some other milestone that can serve as a point of comparison both from the policy and progress point of view. The key point is that besides technical feasibility and scientific rationale, a time should be chosen that also helps maximize the impact of the assessment.

2.3 Thematic vs. sectoral breakdown

Given the now widely recognized close coupling of the environment with economic and social development, IEA analysis must cover an ever growing circle of issues that used to be regarded as marginal to environmental reporting.

Broadening the focus brings with it questions concerning the way environmental themes and issues could be analysed. Ultimately, the environment is one unit, even if with many components and processes, and any thematic or sectoral division should serve only to simplify the analysis and communication.

In a more traditional approach, the analysis is organized around environmental themes (e.g., water, air). From the perspective of policy, however, environmental problems under different themes often intersect with the same set of socio-economic processes or policies. Development of the transportation infrastructure, for instance, has implications for land cover, water quality and biodiversity. Such impacts would appear fragmented if the analysis were structured around environmental themes. So, from one point of view, analysing environmental implications of the sector would be more practical/strategic.

However, using a sectoral approach, for example, transport, energy, agriculture, may result in fragmenting the environmental picture. Pressures on water quality, for example, may need to be addressed under agriculture, energy and municipal water supply.

Although we have presented sectoral and thematic approaches as two distinctly different alternatives in this module, there are ways to combine the two, depending on the environmental problems and information needs of your country or region. Before starting an actual IEA Analysis, your core group should have analysed its assessment needs, and agreed on a clear set of the objectives and goals for the process (see Module 3 for more detail). In developing a consensus on a context for the IEA, it is important to keep in mind that it is not possible to cover all aspects of the environment in one assessment or reporting process. Further, environmental assessment and monitoring should be conducted in a continuous cycle. There is a mix of both thematic and sectoral reporting with different frequencies (e.g., larger overall IEA reports every five years and shorter, sectoral or indicator-based reports annually).

With use of the Internet becoming more widespread, some aspects of IEA reporting also become ongoing rather than a cyclical, stop-go process. For instance, updates on specific indicators can be published on IEA websites and databases as new data become available, without waiting for the next IEA report cycle.

EXAMPLES

Examples of sectoral and thematic reporting programmes at the global level

Global Forest Resources Assessment – http://www.fao.org/forestry/fo/fra/main/index.jsp

World Water Assessment – http://www.unesco.org/water/wwap/index.shtml

State of the Great Lakes (SOLEC) – http://www.epa.gov/glnpo/solec/solec_2004/sogl_2005(full).pdf

World Energy Assessment (World Energy Council, UNDP) –
http://www.undp.org/seed/eap/activities/wea/

International Assessment of Agricultural Science and Technology for Development (IAASTD)–
http://www.agassessment.org/

DISCUSSION QUESTIONS

Q: What were the contexts of previous SoE reporting processes in your country?

A: .....

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Q: Having considered the contexts of previous reporting processes and the existing IEA and environmental information needs for decision making, what is the best context for a new assessment process in your country?

A: .....

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Q: How might the new IEA process be designed to minimize the "cutting the cake dilemma?" Discuss issues related to analysis of transboundary environmental problems.

A: .....

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3. Analytical framework for integrated environmental assessment

PRESENTATION AND DISCUSSION

Given that integrated environmental assessment deals with a system as complex as the environment and its interactions with society, a framework for analysis is essential for a successful IEA. A framework guides the analysis from general concepts towards details, and ensures that all participants involved explore different aspects of the environment from a common starting point, proceeding collectively and in an informed manner.

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Agreeing on an analytical framework:

- helps position the environment in relation to issues of sustainable development;
- helps establish cause-effect relationships qualitatively, and quantitatively supported by data and indicators;
- provides a communication tool for engaging a multi-sectoral and multidisciplinary group in an informed manner, by categorizing a set of complex issues and relations; and
- provides a roadmap and systematic checklist for the IEA authors.

Several common analytical frameworks for environmental analysis exist (Table 3). Some, such as the drivers-pressures-state-impacts-responses framework, have been developed and tested in national SoE reporting. Others, such as the orientor framework, are more recent, but hold promise because they are based on a systems view of ecosystems and economies (Bossel 1999).

Table 3: Alternative analytical frameworks and their advantages and limitations.

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Type	Components	Advantages and limitations
DPSIR	Drivers-Pressures-State-Impacts-Responses on environment and human well-being.	Advantage • Simple, intuitive analysis when focused on a single issue. • Considers human-environment interlinkages. • Integrated complex environment-socio-economic issues, analysing the impact of environmental change on human well-being. • Brings together multi-stakeholders with disparate expertise, e.g., social sciences, natural sciences, and policy and law. Disadvantages • Difficult to see horizontal linkages among environmental issues. • Provides little guidance on the type of impacts that can occur, or the types of policy responses that might be considered.
Vulnerability	1. Exposure to environmental change. 2. Capacity to adapt to change.	Advantage • Identifies areas where potential for unsustainability may be greatest. Disadvantage • Not directly suitable for whole system analysis.

Type	Components	Advantages and limitations
Ecosystem well-being	Ecosystem services: • provisioning • regulating • cultural. Human well-being: • the necessary material for a good life • health • good social relations to help others, and provide for children • security, human-made disasters • freedom and choice.	Advantage • Systematic linkages among many dimensions of the environment and human well-being interaction. • Research more focused and provides for new data. • Highlights emerging issues which require immediate policy response Disadvantages • Detailed and complicated terminology. • Relevance not immediate for policy-makers whose focus is on political jurisdictions. • Selective analysis of ecosystems. • Still in relative infancy.
Capital based	• Natural capital • Human-built capital • Social capital • Human capital.	Advantage • Solid basis in economic valuation and capital providing increased relevance for decision-makers. Disadvantage • Some resistance by practitioners to extending the concept of capital to environmental and social domains.
Sectoral	Land, forest, biodiversity, fresh water, marine and coastal areas, atmosphere, built-up areas.	Advantage • Relevant for those interested in sectoral discussion of issues. Disadvantage • No immediate relevance for those interested in regional discussion. • Weak linkages to other issues relevant to mainstreaming the environment
Issue based	Climate change, water pollution, urbanization, environmental education.	Advantage • Resonates with public and decision-makers' concepts and perceptions. • Provides for focused research and identifies emerging issues. Disadvantage • Can be ad hoc, depending on the contrast between public interest and what scientists deem important to address.
Sustainability	Environment, economy, society; some variations include governance or institutions as fourth components	Advantage • Based on systems perspective; takes environment/development interactions into account; intergenerational perspective; may require identification of safe thresholds or targets; increasingly accepted by public and private sector. Disadvantage • Potential for high level of complexity; uncertainty related to definition, interpretation and measurement

DISCUSSION QUESTION

Form groups of two and discuss what, if any, conceptual framework you have used in your work. Identify and explain the framework to your colleague; draw a diagram if applicable. What was your experience with the framework? When reconvening in plenary, prepare to comment on frameworks in your list.

This module is based on the **D**rivers-**P**ressures-**S**tate-**I**mpacts-**R**esponses framework. This framework is used in GEO reports, including the fourth *Global Environment Outlook: Environment for Development (GEO-4)* (see Figure 2 of Module 1). For training purposes, this training manual uses a graphically simplified version of the *GEO-4* framework, and this is presented in Figure 2.[1] This DPSIR framework guides you in telling an integrated story about an environmental issue. Arrows in the diagram indicate general cause-and-effect relationships among components of the framework. While some relationships are straightforward and easy to demonstrate, many linkages in environmental analyses are complex, and effects typically are attributable to multiple causes, related to different actors, operating on multiple spatial and temporal scales.

Analysing the **STATE and TRENDS** of the environment is central to IEA (Figure 2). This involves identifying priority environmental state issues, and analysing changes retrospectively through space and time. In the context of UNEP's Global Environment Outlook reports, typical environmental state variables are grouped according to categories such as air, land, water and biodiversity. To effectively answer the question *What is happening to the environment and why?* (Step 1, Figure 1), an analysis of state variables must be accompanied by an understanding and appreciation of the **DRIVERS** (driving forces or indirect drivers) and **PRESSURES** (direct drivers) that affect state variables individually and collectively. Drivers (including demographic changes, economic and societal processes) lead to more specific pressures on the environment (including for example, land use change, resource extraction, emissions of pollutants and waste, and modification and movement of organisms). These pressures lead to changes of the **STATE** of the environment (e.g., climate change, stratospheric ozone depletion, changes in biodiversity and pollution or degradation of air water and soils), which are in addition to those that result from natural processes.

These changes affect the ecological services that the environment provides to humankind, such as the provision of clean air and water, food and protection from ultraviolet radiation as well as impacts on other aspects of the environment itself, such as land degradation, habitat quality and quantity and biodiversity. As a result of changes in ecological services, and mediated by demographic, social and material factors, there are IMPACTS on the environment and human well-being (health, economic performance, material assets, good social relations and security).

Societal **RESPONSES** can influence the environmental state and their associated drivers and pressures (either intentionally or unintentionally). Societal responses essentially fall under two categories: (1) responses directed at *mitigating* exposure to environmental impacts (e.g., through environmental restoration and enhancement); and (2) responses which help society *adapt* directly to the impacts that occur and/or build the capacity to adapt to changes in the environment. Societal responses include formulating and implementing public policy, laws and establishing/strengthening institutions, as well as through advances in science and technology.

The *exposure* to changes in various environmental states, combined with the *ability of society to adapt* to these changes, determines the degree to which people are *vulnerable* or are *resilient* to environmental change.

1 The basic structure of the diagram has been developed by the European Environment Agency (Smeets and Weterings 1999).

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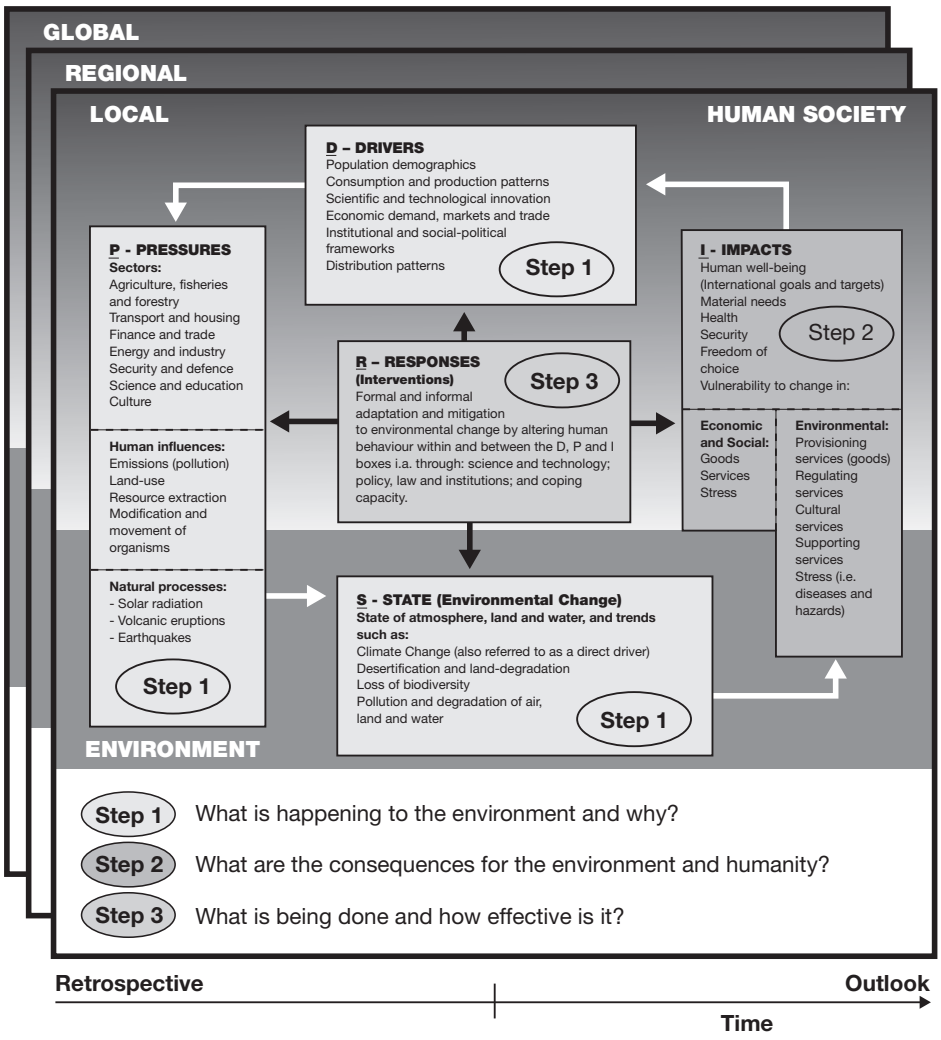
Figure 2: Analytical framework for integrated environmental assessment and reporting based on GEO-4.



It is clear that environmental issues are interlinked. An understanding and appreciation of these interlinkages is part of telling an integrated story of an environmental issue. For example, a driver (population growth in a forested watershed) can result in many environmental pressures such as increased logging and sewage discharge to rivers (Figure 3). Similarly, a pressure can have an effect on many environmental states (e.g., logging affecting the state of forest cover, soil quality and, in turn, water quality).

Figure 3: Interlinkages among environmental issues

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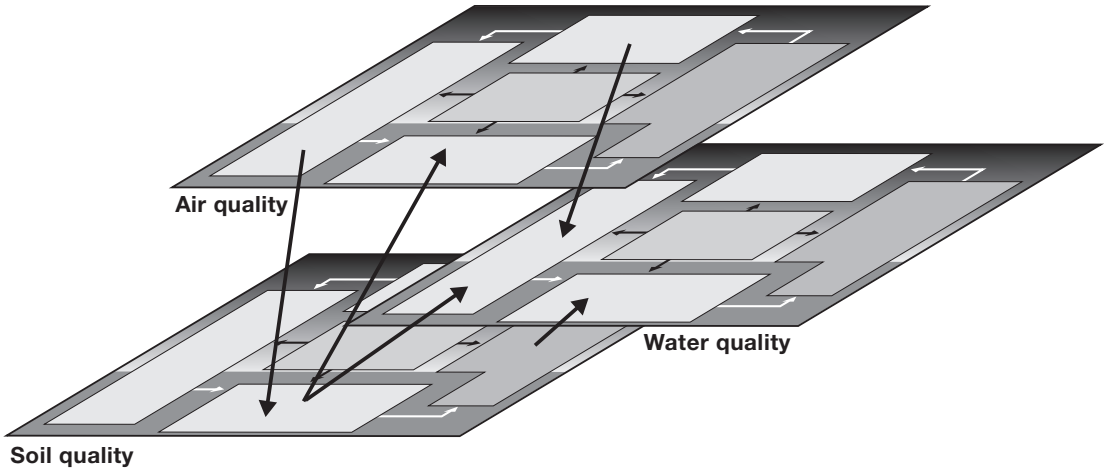

CASE EXAMPLE

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Telling an integrated story about water quality issues in Canada's Red River Basin and Lake Winnipeg

Figure 4: Lake Winnipeg and the Red River Basin

(Modified from Google Earth)

The Red River flows north from the United States into Canada where it empties into Lake Winnipeg, the world's 10th largest freshwater lake. The Red River Basin is about 846 000 square kilometres in extent.

State: Water quality in the Red River experienced increases in flow-adjusted, total nitrogen and phosphorous concentration between 1978 and 2000, particularly north of the city of Winnipeg and the confluence of the Assiniboine and Seine Rivers.

Among the key **Drivers** (i.e., indirect drivers) of these pressures are urban expansion due to population growth and increased agricultural production to meet growing agriculture export demands.

Pressures (i.e., direct drivers): Total nitrogen and phosphorous concentrations in the Red River arise primarily from non-point source nutrient loading from intensive agricultural production in the Red River Basin, and from urban runoff and sewage discharges from the city of Winnipeg in Canada, and Grand Forks and Fargo in the United States.

The decreasing water quality of the Red River is having a serious negative **Impact** on Lake Winnipeg due to massive and rapid eutrophication. This ecosystem impact affects human well-being. For example, there is a decrease in the quality of recreational use of the lake, while commercial fish catches are at least temporarily higher due to the increased availability of biomass fish can feed on.

Currently, a mix of **public policies** implemented by the Manitoba provincial government influences this environmental issue. For example, one policy is directed at the nutrient loading pressure. The Canada-Manitoba Agriculture Policy Framework calls for a 16 per cent reduction in average erosion rates on Manitoba farmland, and a 12 per cent reduction in residual nitrogen on Manitoba farmland by 2008. Specific policy instruments being implemented range from a single economic instrument (a riparian tax credit) to a host of direct programme expenditure instruments (e.g., expansion in number of conservation districts), regulatory instruments (finalization of water quality standards), and institutional instruments (e.g., provincial nutrient management strategy). Overall however, there is a general consensus that water quality in the Red River Basin in general, and in Lake Winnipeg in particular, is not being sufficiently addressed through the existing mix of local, provincial, federal and international policies.

Those policy efforts are directed at reducing the rate of change in the state of water quality (i.e., exposure to change). What are the societal responses directed at facilitating adaptation to impacts? One example of current adaptation is by recreational swimmers who forego use of the lake during algae blooms, aided by public warnings through news and media. Additionally, the Lake Winnipeg Stewardship Board (2005) has been formed to study the lake, and make recommendations for mitigating the pressures on the lake and for adapting to the impacts.

The issue of water quality degradation in the Red River Basin and Lake Winnipeg *is interlinked with other environmental issues* as well. Perhaps one of the most striking examples is the potential impact of greenhouse gas emissions on climate variability and change. An increase in occurrence of high-intensity rainfall events could affect water-borne soil erosion and subsequently, nutrient loading rates.

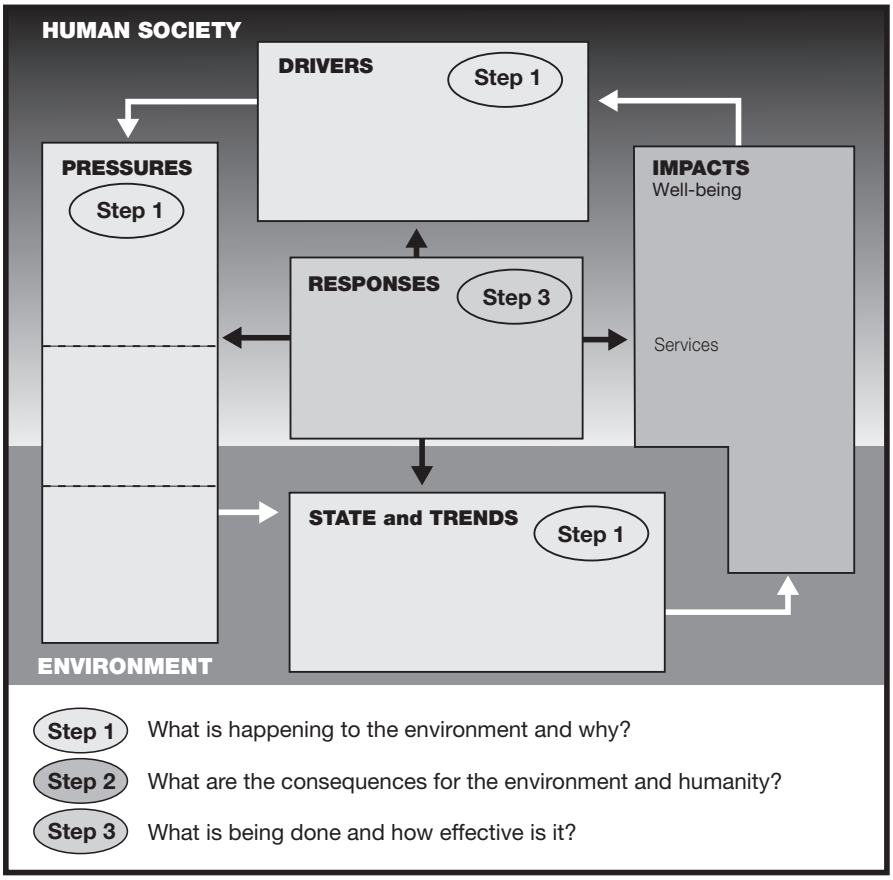
EXERCISE

As an option, the exercise can be completed, if conditions permit, before a training session.

Using the template provided, address the following questions:

- Select one specific issue, and identify the specific environmental STATE that the issue involves. How has this state changed over time?
- Identify a general societal DRIVER with broad influence on the pressure and environmental state.
- Identify a societal PRESSURE directly affecting that environmental state. What natural disturbances might be causing your environmental state to change?
- Given the change in your environmental state, what are examples of key IMPACTS on the services that ecosystems provide, and human well-being?
- What existing policies and policy instruments (including laws and institutions) contribute to restoring or enhancing the environment (e.g., have an influence on the drivers, pressures and environmental state)? What policies and policy instruments have helped (or hindered) the ability of communities and businesses to adapt to impacts of the change in the environmental state? What technologies have facilitated restoration and/or adaptation?

Figure 5: DPSIR framework exercise



4. Step 1: What is happening to the environment and why?

The first step in the GEO approach to an IEA is to address the question: *What is happening to the environment and why?* This question can be answered by considering more detailed questions of the DPSIR analytical framework. These questions include:

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- What are the priority environmental issues (e.g., water quality/quantity, air pollution, biodiversity)?
- What are the specific concerns related to the STATE of the environment for each issue and what are the key TRENDS?
- What DRIVERS and PRESSURES are causing environmental change?
- What INDICATORS are appropriate and necessary to characterize these drivers, pressures and states?

The following sections provide guidance for addressing these questions.

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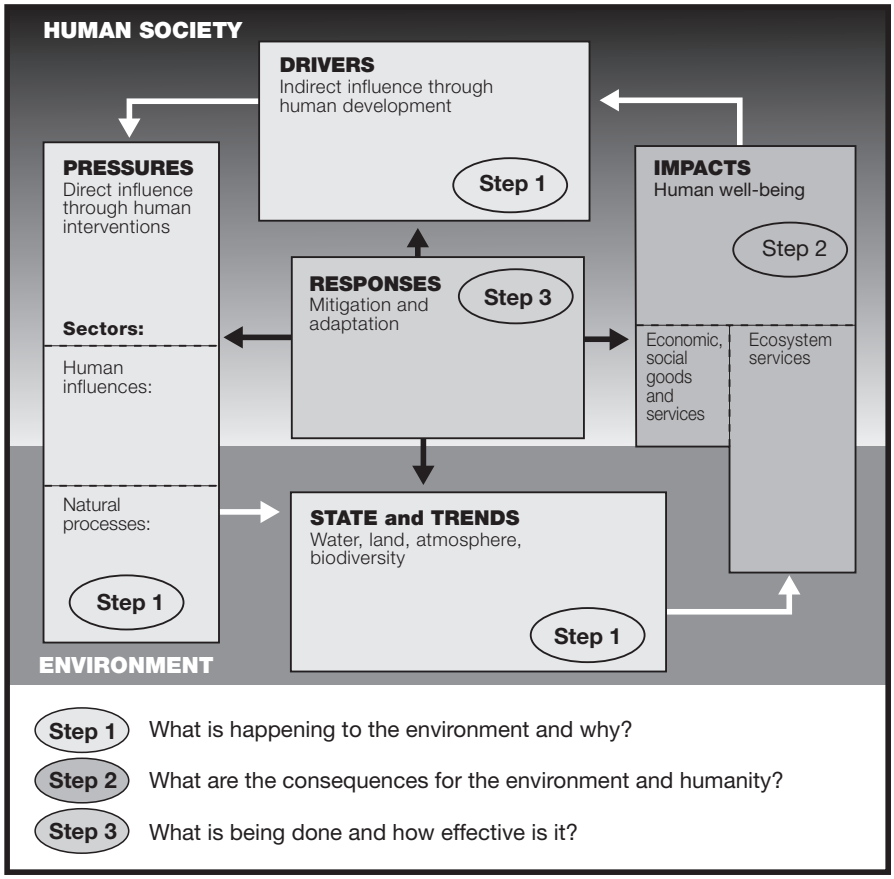
Figure 6: Analytical framework – What is happening to the environment and why?



4.1 What are the priority environmental issues?

IEA brings organizations and individuals representing a range of sectors and disciplines into a joint process, and generates a richness of viewpoints and interests while also building ownership of results. Such a multi-stakeholder process presents challenges in reaching consensus because assessing environmental conditions can raise a large number of intertwined issues, themes and interests, and stakeholders often have divergent views on these issues.

In order to carry out an IEA, it is essential to identify a list of major environmental issues, and then categorize them into a manageable number of themes. The desired result is a list that is comprehensive yet easy for the assessment participants to understand, and should be in a format in which contributions can be offered easily.

The issues important for any given state-and-trend environment analysis can be identified using a combination of methods. A good list often can be identified from a brainstorming session among IEA participants. The more diverse the group of participants, the more comprehensive the list of issues. Some of the methods for developing a list of important environmental issues include:

- Brainstorming in a multi-stakeholder group and breakout groups.
- Multiple expert and stakeholder consultations (smaller groups than above).
- Surveys of individual experts and stakeholders by e-mail, telephone or regular mail.
- Review of relevant literature.

Please note that these approaches are not mutually exclusive.

EXERCISE

Form groups of 4-5, and carry out the following tasks:

- Discuss and note key specific environmental issues related to the state-and-trends of the environment in your country (can be based on your homework assignment on DPSIR framework).
- Assign specific environmental issues to general categories (following the table below).
- How many distinctly different themes did your group identify? How many specific state-and-trends of the environment issues? Can some of the specific issues under a given theme be expressed as a single issue?

Priority environmental issue	General theme

In plenary, carry out the following tasks:

- Combine the work of all groups into one table (e.g., using flip charts or overheads).
- Determine the general themes for the overall group; organize all specific state-and-trends of the environment issues according to those themes.
- Combine related specific issues as appropriate.

Time: 20 minutes for group work, 30 minutes plenary.

For the most part, a limited number of general themes will emerge from any approach used to identify specific environmental issues. Because of this, global assessments often use a general themes-list as a starting point in the assessment.

The general themes of *GEO-4* and some other assessments are summarized in Table 4. These themes can be used to check the comprehensiveness of the list developed in your participatory approach.

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Table 4: State of the environment themes for selected environmental assessments

Report	State-and-trends of the environment themes and issues
GEO-4	• Atmosphere: climate change, ozone, air pollution • Land: land degradation, forests • Water: coastal and marine, freshwater • Biodiversity • Regional Perspectives
Millennium Ecosystem Assessment	• Forest/woodland: tropical/subtropical, temperate, boreal • Dryland: hyperarid, arid, semiarid, dry subhumid • Inland Water • Coastal: terrestrial, marine • Marine • Island • Mountain • Polar • Cultivated: pasture, cropland, mixed • Urban
GEO Brazil	• Soil and land • Water • Forests • Atmosphere • Marine and Coastal Areas • Fishery Resources
Pacific Environment Outlook	• Land and food • Forests • Natural disasters • Waste management and pollution • Freshwater • Biodiversity • Marine and coastal regions
Africa Environment Outlook – 2	• Atmosphere • Biodiversity • Coastal and Marine • Forests • Freshwater • Land • Urban Areas

Further selection is necessary even after a comprehensive set of state-and-trends of the environment themes and specific issues has been identified. This is because the list which emerges from this process is often longer that can be reasonably accommodated in a national IEA reporting process, given the constraints of time, and human and financial resources. It is, therefore, necessary to prioritize both themes and specific issues.

There are many challenges associated with prioritization, including:

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- Criteria for an issue to be considered a priority (e.g., high cost, significant risk, public awareness, political attention, place in issue cycle [ref. Module 3])
- Relationship to the priorities listed in official policy statements
- Stakeholders who select priorities and legitimacy of representation
- Number of issues that can be included in a national IEA report?
- Process used to agree upon priority issues.

A range of techniques is available to help prioritize issues, including brainstorming sessions, expert consultations and surveys (Table 5). Whichever technique is used, it is important to identify key criteria to distinguish higher priority issues from lower priority ones. Additionally, it is important to have a sense of the number of specific issues that reasonably can be accommodated in the reporting process.

It is important to note that the priority list identified during an IEA might be refined after analysing its content in more detail. For example, there might be limited data for a certain issue, which might, in turn cause an issue lower on the priority list to be considered instead.

Table 5: Techniques that groups might use for setting priorities

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Prioritization Technique	Description and Reference
Traditional Voting	Given a list of important environmental issues, each participant is asked to vote, for example by: • Show of hands. • Secret ballot. • A dotocratic method, where each person is given a number of coloured stickers equalling the number of items that can be considered. With the entire issue list placed on a single board, each person places stickers beside their priority issues. People are allowed to distribute their dots as they wish (i.e., they can invest all their dots in a single issue if they feel that best represents their views). Issues are then ranked according to the number of stickers each received.
Nominal Group Methods	Participants are asked to choose a list of specific issues they feel are most important, and to rank them by relative importance. These rankings are collected from all participants, and aggregated. *Reference:* http://www.ryerson.ca/~mjoppe/ResearchProcess/841TheNominalGroupTechnique.htm
Consensus Decision Making	"A consensus represents a reasonable decision that all members of the group can accept. It is not necessarily the optimal decision for each member. When all the group members feel this way, you have reached consensus. This means that a single person can block consensus if he or she feels that it is necessary." *Reference:* http://www.npd-solutions.com/consensus.html

EXERCISE

Using the themes and issues identified in the previous exercise, rank the priority of each issue using a three-point scale (low, medium and high).

Compile the results in plenary, and establish a priority ranking of the issues (i.e., how many high, low and medium rankings each receive).

Complete the following worksheet below for your country.

What is the general theme?	What is the environment issue?	What is the geographical scale/coverage of the problem?	What priority should be given to the problem?		
			Low	Medium	High

Time: 10 minutes individually, 20 minutes plenary.

4.2 What is the specific STATE-and-TRENDS of the environment for each priority issue?

Priority environmental issues as identified above are often quite general (e.g., water quality, air quality, biodiversity). As we go forward, it is important to be more specific with regard to each priority environmental issue. This will make it much easier to identify what is happening to the environment and why.

Consider water quality for example. This issue is sometimes specified in an aggregate form (e.g., a country's national water quality index). To conduct an integrated analysis it is necessary to think of water quality in a more spatially defined context. For example, a certain river and lake system might be particularly problematic at the time you are developing your IEA. The following case illustrates this level of specificity, building on an earlier case study under Section 3. This example will be used in later sections to illustrate the telling of an integrated story using the DPSIR framework.

CASE EXAMPLE

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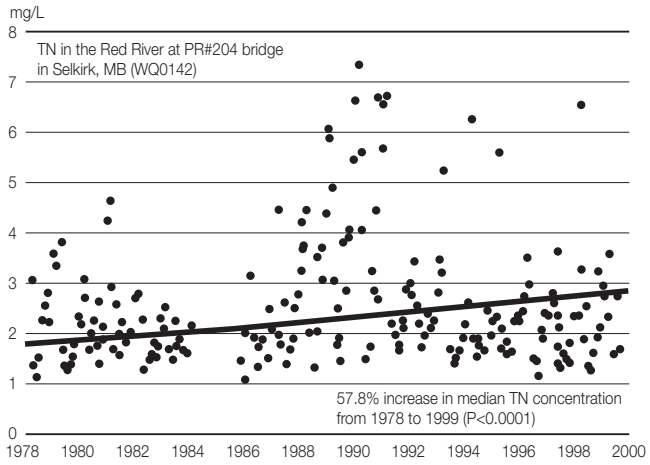
The state of water quality in the Red River, Province of Manitoba, Canada

For an example of an environmental state issue, consider water quality in Lake Winnipeg (introduced in section 4). From 1978 through 2000, there was an increase in nutrient concentration (in the Red River flowing into Lake Winnipeg, particularly north of the city of Winnipeg (approximately 600 000 inhabitants) and where two other rivers, the Assiniboine and Seine, merge with the Red River.

The figure below illustrates the increase in total nitrogen concentration between 1978 and 2000 at a monitoring station north of the city of Winnipeg, MB. The increase of nutrient concentration in a major river flowing into Lake Winnipeg is relevant for IEA analysis, as nutrients such as nitrogen and phosphorous in excessive quantities can be one of the common factors in causing algal blooms and other water quality problems. This piece of information is necessary, but insufficient to understand the nature of water quality problems in the lake, as there may also be other causal agents at work that would need to be monitored and understood.

Figure 7: Flow adjusted nitrogen concentration in the Red River north (downstream) of Winnipeg (Armstrong 2001).



4.3 What are the DRIVERS and PRESSURES causing environmental change?

Once we have come to understand the specifics of the environmental state, we can then start developing an integrated story of what is happening to the environment and why. We accomplish that by answering: "What are the Pressures and Drivers that have caused the change to occur?"

Examples of types of drivers and pressures identified in many global environmental assessment reports, such as UNEP's *GEO-4* report on the state of the global environment and the Millennium Ecosystem Assessment of 2005, are provided in Table 6.

Proposed table with changes

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	Types
DRIVERS	UNEP *GEO-4* • Consumption and production patterns • Demographics • Science and technological innovation • Economic demand, markets and trade • Institutional and socio-political frameworks • Distribution patterns.
PRESSURES	UNEP *GEO-4* • Sectors – agriculture, fisheries and forestry – transport and housing – finance and trade – energy and industry – security and defence – science and education – culture • Human influence – Pollution – land use – resource extraction – modification and movement of organisms

The purpose of identifying drivers and pressures is to establish an integrated story of likely causes of the observed changes in the state of the environment. The story starts with identifying a pressure, which is readily identifiable as a cause of the environmental change. For example, sewage discharge from upstream communities represents a pressure causing changes in water quality in a river or coastal bay. A driver behind this particular pressure could be rapid population growth in the upstream communities.

CASE EXAMPLE

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Drivers and pressures affecting the state of water quality in the Red River

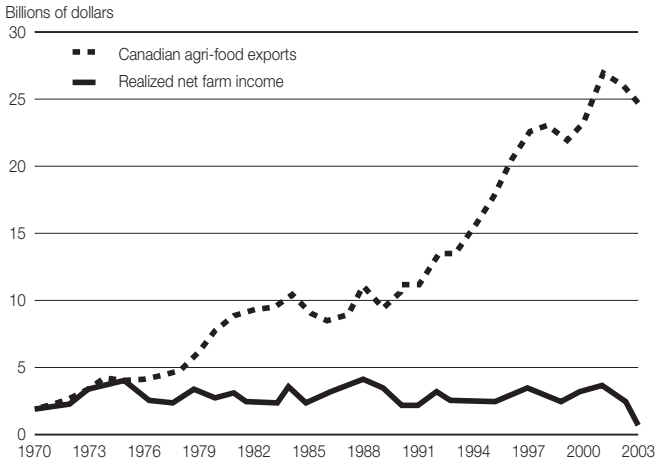
The increases in nutrient concentration in the Red River north of Winnipeg are affected by several direct pressures. The entire watershed of the Red River is intensively farmed on both sides of the border between Canada and the United States. Given this land use, there exists a high potential for non-point source nutrient loading via runoff during heavy rainfall and spring melt events.

There also is a major urban centre (the City of Winnipeg) just south of the mouth of Red River at Lake Winnipeg. Pressures on the river from storm water drainage, as well as treated and periodic discharges of untreated sewage add to the pressures resulting from agricultural activities. While Winnipeg is a major centre near the delta of the Red River, there are several towns and cities in the upstream reaches of the river in both Canada and the United States.

There also are natural events that directly pressure the river system, including slow biological metabolism during cold winter seasons when temperatures can remain below minus 15 degrees Celsius for weeks or months on end. Most notably, there are frequent floods in the Red River Basin, the most recent of which occurred in 1997, causing damage of close to CDN$1 billion in Canada alone (NRCAN 2006).

The drivers of these pressures also can be articulated. In terms of the pressure of nutrient loading from agricultural land, there has been a several-year trend of increasing agricultural exports from the Canadian prairies (Figure 8). Canada's National Farmer's Union (NFU) indicates that while Canadian agri-food exports have expanded fivefold since 1979, family farm incomes have declined over the same period (NFU 2005)

Figure 8: Growth of agriculture exports in Canada (NFU 2005)



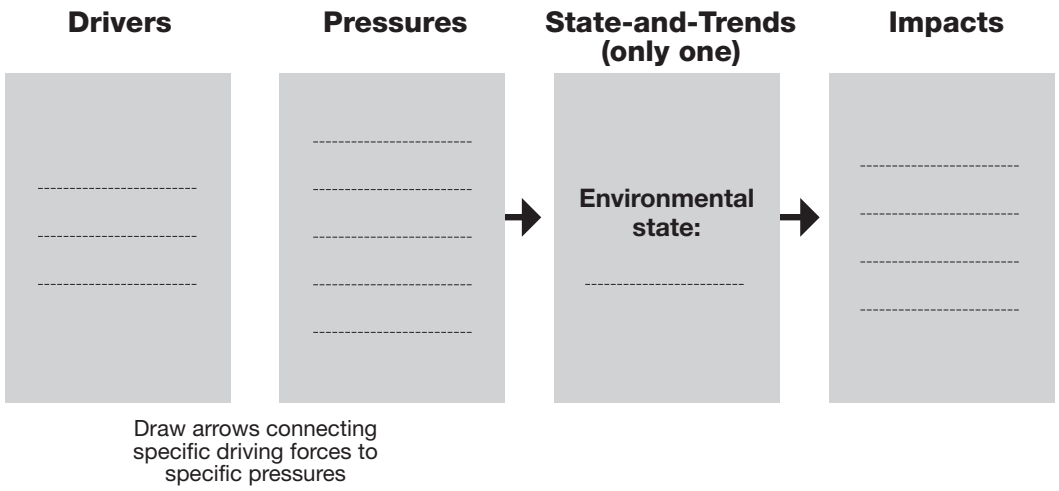
EXERCISE

- Form groups of 4-5, and select a specific environmental state for the exercise.
- Use the following DPSI Story Sheet to record the environmental STATE that is the focus of your issue.
- Identify DRIVERS and PRESSURES that influence the environmental state you have selected. Draw lines between the drivers and pressures that are linked.
- Complete the worksheet for discussion in plenary. Note that impacts will be identified in a subsequent exercise.

Q: Does your group have enough knowledge to identify all relevant relationships in a theme, issue or sector? If not, who else would need to be involved to complete the analysis?

Time: 25 minutes for group work, 15 minutes in plenary (pick two groups to present).

Figure 9: The DPSI Story Sheet.



An integrated story must not stop at understanding the causality chain for just one specific issue. Integrated environmental assessment looks for linkages among environmental issues. A driver or pressure identified for one issue could be having an effect on other environmental issues. This combination of interlinkages was described in Figure 3.

For example, you might have a concern about the state of water quality in a river, and might identify sewage discharge upstream as a direct pressure on this state. In that example, are there other environmental states for which this sewage discharge might be serving as a pressure? It is possible that the discharge affects the state of air quality (e.g., odour) in communities around the sewage discharge. Additionally, the driver of rapid population growth could cause increased agricultural activity, which in turn could cause an increase in deforestation.

EXERCISE

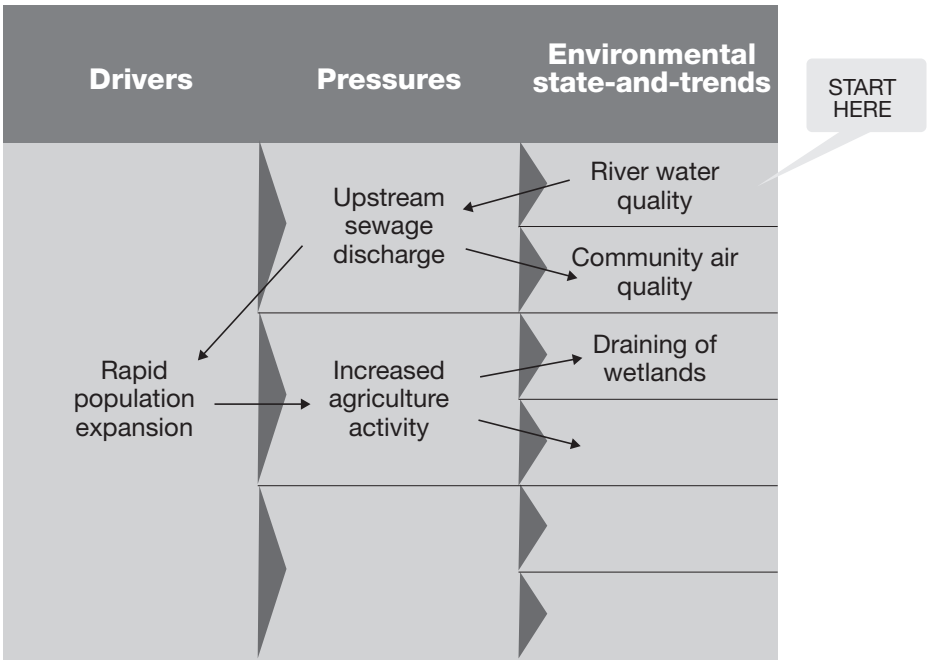
Identifying interlinkages among environmental issues

In your group of four or five (from the Integrated Story Sheet Exercise):

- From your DPSI Story Sheet, transfer the drivers, associated pressures and environmental state to the interlinkages table below.
- Starting from the driver, identify two other pressures and then other environmental states that could change as a result of each pressure. Note the multiple linkages among pressures and environmental states
- What impacts on the environment and human health are associated with changes in the various environmental states?
- Complete the diagram and discuss in plenary

Time: 20 minutes for group work, 15 minutes in plenary (assuming two groups volunteering to present).

Figure 10: Analysing drivers, pressures and states and trends



4.4 What are the appropriate INDICATORS of environmental states, drivers and pressures?

With drivers, pressures and environmental states identified for each issue, an additional layer of information is now required in order to tell the integrated story in a quantitative and qualitative manner.

Development of data and indicators is covered in detail in Module 4. The following section represents only the bare essentials necessary to continue with an integrated analysis of environmental trends and policies. Participants with no prior experience with data and indicators are urged to review Module 4 carefully before continuing.

4.4.1 Working with indicators

Indicators commonly are used to illustrate and substantiate statements made in assessments. The choice of indicators determines the kinds of data needed for an IEA, helping to structure and guide data collection. When choosing an indicator, it is important to select one that both demonstrates something important about the themes and issues, and one that can be clearly communicated. When selected and used properly, and where data are available, indicators can offer:

- Characterization of historic trends related to priority issues.
- Spatial patterns of change.
- Analysis of progress relative to targets/benchmarks/reference values.

Examples of indicators for a driver and environmental state are described in Figures 7 and 8, respectively.

To avoid selecting indicators haphazardly, we use selection criteria. For example, indicators should:

- Be developed within an accepted conceptual framework.
- Be clearly defined and easy to understand.
- Be subject to aggregation.
- Be objective.
- Have reasonable data requirements.
- Be relevant to users.
- Be limited in number.
- Reflect causes, processes or results (World Bank 1997).

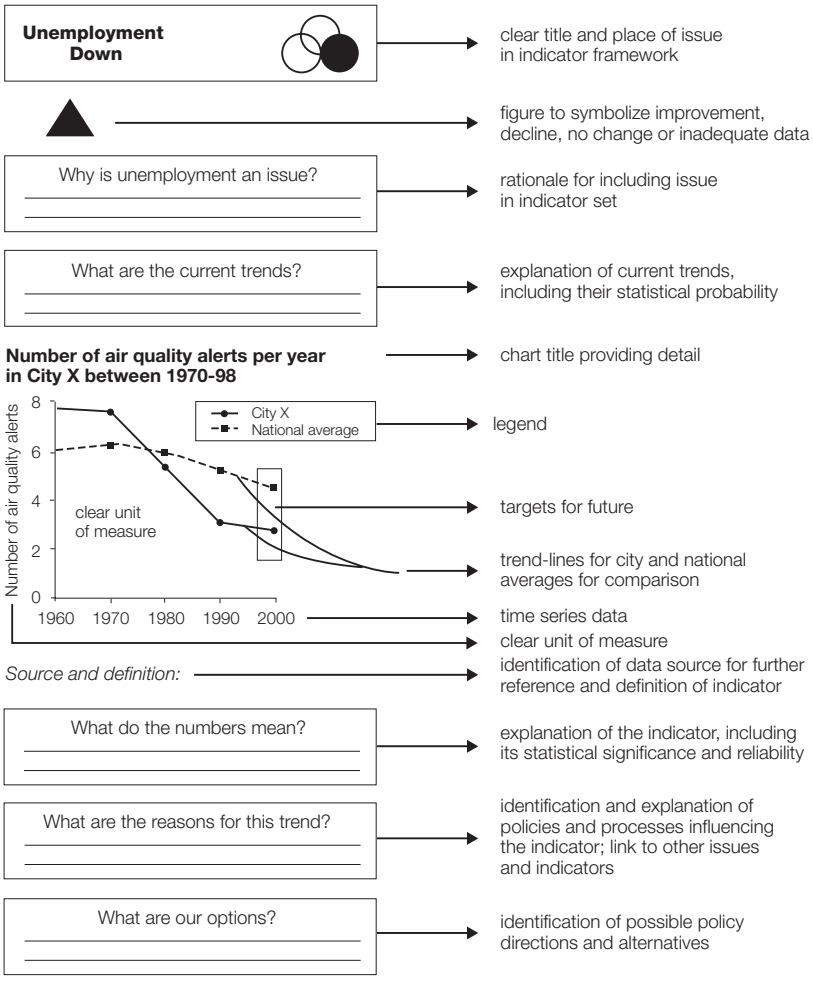
The management community has developed the SMART criteria for indicator selection. Under this system, indicators should be:

- **S**pecific
- **M**easurable
- **A**ggressive but achievable targets
- **R**elevant
- **T**ime-bound

Criteria like these are useful, but they are not a guarantee that the indicators selected will be the most meaningful to any given audience. Quality control needs to be built into the discussions with stakeholders not only for individual indicators but also for the entire set, to ensure that indicators are useful in subsequent analysis and to help substantiate trends within and connections among drivers, states and responses (See Module 4 to learn more about data and indicators).

Indicators should be presented with information that helps interpretation. A sample template is shown in Figure 11 (Source: Pintér, Zahedi and Cressman 2000).

Figure 11: General template for presenting indicators.



EXERCISE

In groups of five, identify indicators for each priority theme/issue from the previous exercise using the following matrix.

Thematic/issue category:

Problems	Framework element (D, P, S)	Indicators	Data source

Time: 10 minutes group work, 15 minutes plenary.

4.4.2 Identifying and explaining trends

Once you have developed potential indicators, and have collected relevant data, it is possible to begin to analyse those data to identify and demonstrate trends. Readers with little or no experience with indicator development and data collection are encouraged to take time now to review Module 4 on Data and Indicators.

The integrated story, illustrating causality among key drivers and environmental states is just the outer layer of the analysis. Beneath this high level integrated story are other stories more intimate in detail, which help us better understand what is happening to the environment and why. Getting to this next layer of information requires analysing the indicator to identify correlations, and to explain key temporal and spatial patterns.

A good place to start is the analysis of the state indicator to get to the core of the issue. The example below illustrates such an analysis for automobile fuel efficiency.

CASE EXAMPLE: Advanced

Identifying and explaining trends in on-road automobile fuel efficiency in Canada

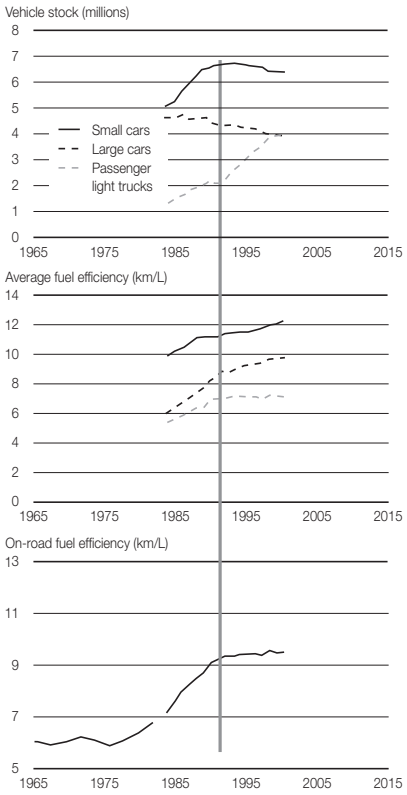
Travel by automobiles is one source of emissions in Canada. The fuel efficiency of the fleet of automobiles on the road in Canada is one good indicator of this pressure. Figure 12 presents on-road fuel efficiency data for the period 1970 through 1994, along with data for vehicle stock and average vehicle fuel efficiency.

Consider a historical analysis as a first step in identifying and explaining trends in a pressure indicator. The sudden improvement in fuel efficiency realized in the late 1970s as illustrated in Figure 12 below, can be explained by the Corporate Average Fuel Economy (CAFE) standard that was adopted in the United States in 1975, following the 1973 Middle East oil embargo. In Canada in the 1980s, voluntary industry fuel efficiency targets were put in place through the federal government's Company Average Fuel Consumption (CAFC) programme. Through the 1980s, a 55 percent improvement in on-road fuel efficiency was realized in Canada.

But, there was a sudden halt in fuel efficiency improvements in the 1990s. In looking at an indicator of the vehicle stock, we see a change from small and large cars to light trucks that were used as personal vehicles, and often called sport utility vehicles. In fact, it would also appear that the change in the vehicle stock during the 1980s (more small cars and fewer large cars) was a factor in the longevity of the on-road fuel efficiency increase experienced during the 1980s, aided by increases in the on-road fuel efficiency of both small and large cars during this time.

It would appear that the lack of improvement in on-road fuel efficiency in recent years late is due to society's preference for larger, less fuel-efficient light trucks and sport utility vehicles.

Figure 12: Historical analysis of on-road vehicle fuel efficiency in Canada.



Source: IISD and TERI 2002.

5. Step 2: What are the consequences for the environment and people?

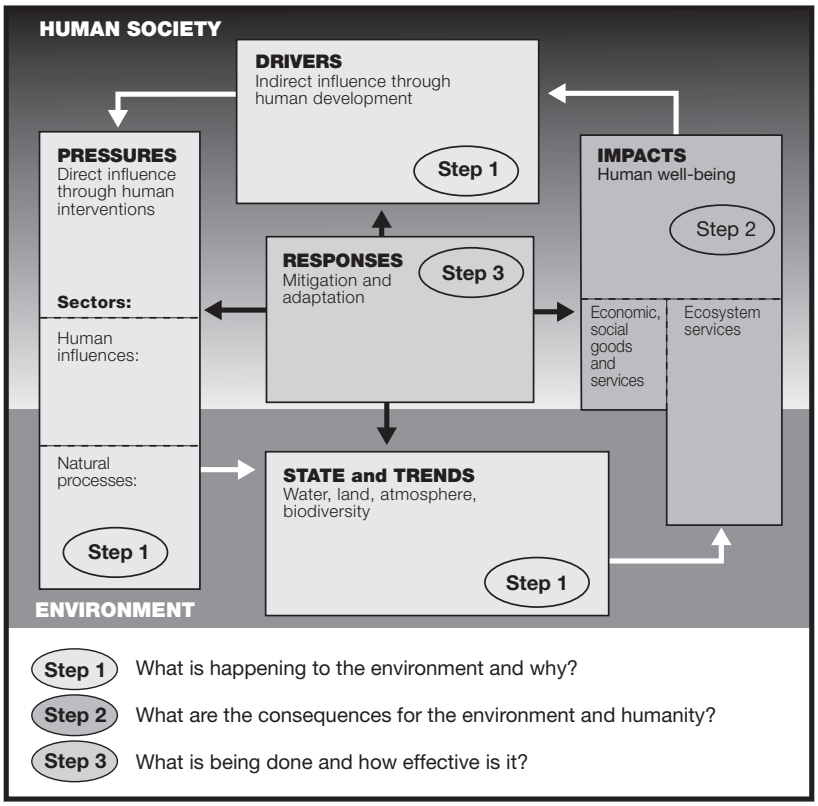
Presentation and discussion

With an understanding of what is happening to the environment and why, attained through Step 1, the second question to address in the IEA is: What are the consequences for the environment and humanity? or, more simply stated, what are the impacts?"

For purposes of this training module, this second step has been separated into three different levels of training:

- **Basic analysis (Section 6.1):** For groups or individuals conducting an IEA for the first time, specific impacts can be identified based on intuition and on data, which provide an understanding of what is happening to the environment and why. An understanding of environment/development linkages, as applied to a given context, may be sufficient to perform the analyisis.
- **Intermediate analysis (Section 6.2):** Those who have previous experience with IEA methods might identify impacts to changes in various states of the environment, using the concepts of ecosystem services and aspects of human well-being, which have been adopted in *GEO-4*.
- **Advanced analysis (Section 6.3):** Groups familiar with concepts of ecosystem services and having some experience with economic analysis may identify specific monetary costs and benefits resulting from changes in ecosystem services and human well-being. (Note that this training session offers only an introductory exposure to environmental valuation or full-cost accounting.)

Figure 13: Analytical framework for identifying consequences for the environment and humanity.



5.1 Basic analysis: Identifying impacts based on an understanding of sustainable development

Changes in a particular state variable have an impact on other aspects of the environment and on the well-being of people. Many of the important impacts can be identified through the experience and knowledge of participants in an IEA.

For example, a change in forest cover for a particular region can have an impact on biodiversity of that region. An impact on biodiversity could mean that a species particularly valuable as an eco-tourism resource no longer survives in the area. This could impact the ability of local residents to earn a livelihood based on ecotourism. The loss in biodiversity could also mean that a particular plant species upon which local residents relied for food or medicine resource can no longer thrive.

Sustainable development as a basic guideline for identifying potential impacts of a change in the state of the environment

The sustainable development concept as popularized by the World Commission on Environment and Development in 1987[2], tells us that economic, social and environmental conditions are inherently interrelated—that is, it is not possible to change the condition of one of the three dimensions without affecting the others.

In addition, the concept of sustainable development tells us that actions to meet our needs today should not compromise the ability of future generations to meet their needs.

Therefore, as a basic guideline for analysing impacts, sustainable development helps us think in four dimensions: economic, social, environmental and time. It also helps reflect on environment/development linkages.

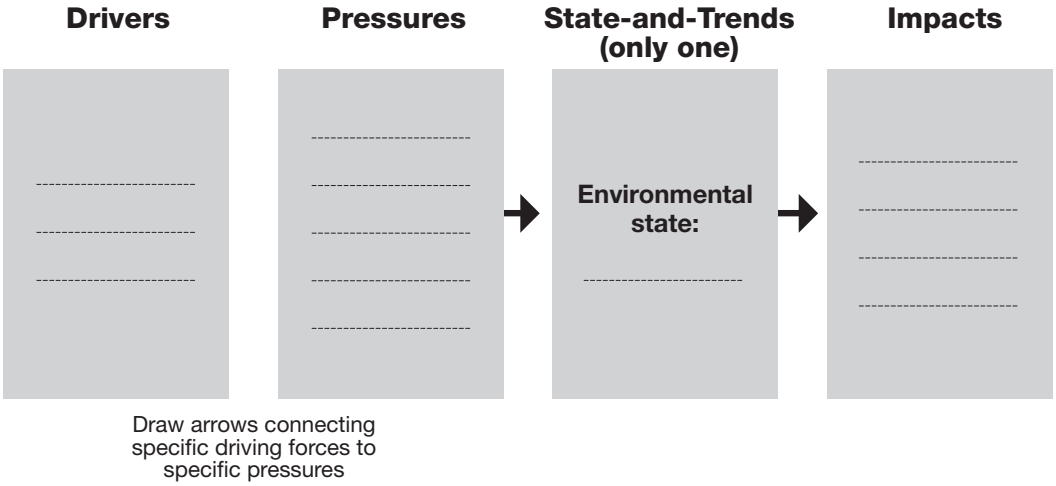
2 Also known as the Brundtland Commission.

EXERCISE: Basic

- Rejoin your group of five, and identify potential impacts for the changes in environmental states your group selected previously. Use the concept of sustainable development to help you identify impacts.
- Complete your DPSI Story Sheet using the template provided.

Time: 20 minutes for group work, 15 minutes in plenary.

Figure 14: DPSI Story Sheet



5.2 Intermediate analysis: Identifying impacts using the concept of ecosystem services and human well-being

The basic analysis demonstrates that it is possible to identify impacts based on limited experience, knowledge and a basic understanding of sustainable development. A more detailed analytical framework, such as the one adopted in *GEO-4* can facilitate identification of more specific impacts.

The *GEO-4* framework used in Figure 13 describes aspects of human well-being that are affected by demographic, institutional and material factors. These aspects are, in turn, influenced by environmental factors: ecosystem services, non-ecosystem natural resources such as hydrocarbons, minerals and renewable energy[3], and stresses such as disease, radiation, pests and hazards.

Ecosystem services are benefits that people obtain from ecosystems, in the form of provisioning services, cultural services, and regulating and supporting services (Table 7).

3 Non-ecosystem natural resources are assets with no directly vital ecosystem function but with significant value to human society. Availability of these resources has a significant impact on economic production and the ability of society to meet its material needs.

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Table 7: Examples of ecosystem services (from Millennium Ecosystem Assessment)

Category	Service	Description
Provisioning	Food and fibre	This includes the vast range of food products derived from plants, animals, and microbes.
	Fibre	Materials such as wood, jute, hemp, silk, and many other products derived from ecosystems.
	Fuel	Wood, dung and other biological materials serve as sources of energy.
	Genetic resources	This includes the genes and genetic information used for animal and plant breeding, and biotechnology.
	Biochemicals, natural chemicals and pharmaceuticals	Many medicines, biocides, food additives such as alginates, and biological materials are derived from ecosystems.
	Ornamental resources	Animal products, such as skins and shells, and flowers are used as ornaments, although the value of these resources is often culturally determined.
	Fresh water	Fresh water is another example of linkages between categories—in this case, between provisioning and regulating services.
Regulating	Air quality maintenance	Ecosystems both contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality.
	Climate regulation	Ecosystems influence climate both locally and globally. For example, at a local scale, changes in land cover can affect both temperature and precipitation. At the global scale, ecosystems play an important role in climate by either sequestering or emitting greenhouse gases.
	Water regulation	The timing and magnitude of runoff, flooding and aquifer recharge can be strongly influenced by changes in land cover, in particular alterations that change the water storage potential of the system, such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas.
	Erosion control	Vegetative cover plays an important role in soil retention and the prevention of landslides.
	Water purification and waste treatment	Ecosystems can be a source of impurities in fresh water, but also can help to filter out and decompose organic wastes introduced into inland waters and coastal and marine ecosystems.
	Regulation of human diseases	Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes.
	Biological control	Ecosystem changes affect the prevalence of crop and livestock pests and diseases.
	Pollination	Ecosystem changes affect the distribution, abundance and effectiveness of pollinators.
	Storm protection	The presence of coastal ecosystems, such as mangroves and coral reefs, can dramatically reduce the damage caused by hurricanes or large waves.

Category	Service	Description
Cultural	Cultural diversity	The diversity of ecosystems is one factor influencing the diversity of cultures.
	Spiritual and religious values	Many religions attach spiritual and religious values to ecosystems or their components.
	Knowledge systems	Ecosystems influence the types of knowledge systems developed by different cultures.
	Educational values	Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.
	Inspiration	Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture and advertising.
	Aesthetic values	Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, "scenic drives" and the selection of housing locations.
	Social relations	Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies.
	Sense of place	Many people value the "sense of place" that is associated with recognized features of their environment, including aspects of the ecosystem.
	Cultural heritage values	Many societies place high value on the maintenance of either historically important landscapes (cultural landscapes) or culturally significant species.
	Recreation and ecotourism	People often choose where to spend their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.
Supporting	Supporting services are those that are necessary for the production of all other ecosystem services.	These services differ from provisioning, regulating and cultural services in that their impacts on people are either indirect, or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people. Some examples of supporting services are primary production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling and provisioning of habitat.

To illustrate how impacts on various types of ecosystem services can be identified through an environmental state indicator, consider an example of water quality degradation in a lake. An indicator of water quality could be phosphorus concentration, Chlorophyll-A measurements, one of the parameters indicating trophic status of a lake, or aquatic plant counts.

For this hypothetical example, a change in an indicator could be linked to impacts to ecosystem services, as described in the figure below.

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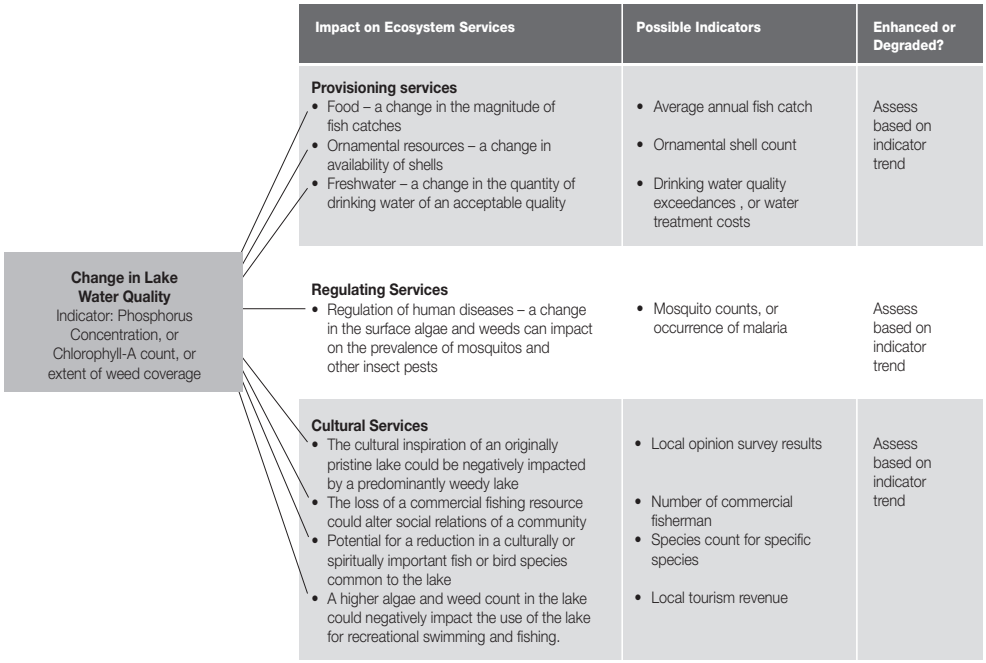
Figure 15: Example of impacts on ecosystem services due a change in lake water quality.



Impact on Ecosystem Services	Possible Indicators	Enhanced or Degraded?
Provisioning services • Food – a change in the magnitude of fish catches • Ornamental resources – a change in availability of shells • Freshwater – a change in the quantity of drinking water of an acceptable quality	• Average annual fish catch • Ornamental shell count • Drinking water quality exceedances , or water treatment costs	Assess based on indicator trend
Regulating Services • Regulation of human diseases – a change in the surface algae and weeds can impact on the prevalence of mosquitos and other insect pests	• Mosquito counts, or occurrence of malaria	Assess based on indicator trend
Cultural Services • The cultural inspiration of an originally pristine lake could be negatively impacted by a predominantly weedy lake • The loss of a commercial fishing resource could alter social relations of a community • Potential for a reduction in a culturally or spiritually important fish or bird species common to the lake • A higher algae and weed count in the lake could negatively impact the use of the lake for recreational swimming and fishing.	• Local opinion survey results • Number of commercial fisherman • Species count for specific species • Local tourism revenue	Assess based on indicator trend

When the environmental factors change, for whatever reason, the individuals, communities and even economic sectors that depend on these factors are also affected in myriad ways. Depending on the environmental stress involved, the relative importance of impacts through changes in ecosystem services, non-ecosystem environmental assets or risks and hazards may change. In our previous example of water quality, several impact pathways could have been identified using the ecosystem services and human well-being framework (Figure 16).

For example, natural gas is an asset with no direct ecosystem value in the sense that natural gas reserves without human intervention tend to be deep underground and not playing a role in ecological cycles. This role changes if and when gas reserves are exploited for human use. Once brought to the surface and utilized, natural gas creates both socio-economic dependencies and ecological imports. If availability of gas is reduced, human well-being is affected through functioning of socio-economic structures that rely on natural gas as an energy resource, and that have little immediate flexibility to shift to alternative energy sources. This is illustrated by the degree of political concerns related to the security of natural gas supply from Russia to other European countries during 2006-2007.

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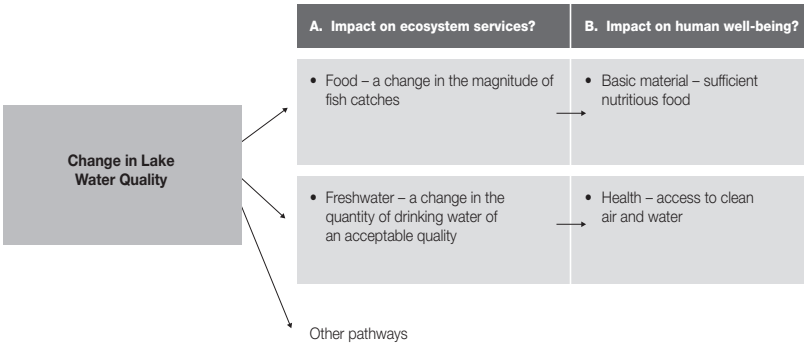
Figure 16: Possible impact pathway diagram for a change in lake water quality.



CASE EXAMPLE

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Potential impacts due to increasing nutrient concentration in the Red River.

Increases in total nitrogen and phosphorus in the Red River, as previously described, can affect ecosystem services and human well-being in the Lake Winnipeg region. There is the fear that massive and rapid eutrophication of Lake Winnipeg will occur due to those changes in nutrient loads.

The ability of Lake Winnipeg to provide human food through fresh fish could be negatively affected because the numbers and composition of fish species will change under the high nutrient levels.

The impact on human well-being can be through changes to the livelihood of local fishers, degraded recreational opportunities and tourism revenue, as well as human health impacts through ingestion of water while swimming.

Figure 17: 2001 Algal blooms in Lake Winnipeg's North Basin, Red River Basin Case Study.

Source: McCullough 2001, in Stainton and others 2003

EXERCISE: Intermediate

Developing an Impact Pathways Diagram

Working in groups of five, choose a specific environmental state to analyse. Conduct the following tasks in your group:

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- Identify which ecosystem services (from column 2 of Table 7) potentially could be affected by an adverse change in the environmental STATE.
- For each affected ecosystem service, identify which aspects of human well-being would likely be affected
- Describe possible indicators for each of the ecosystem services and human well-being impacts that you identified.

Designate one spokesperson from each group to report results in plenary

Time: 40 minutes group, 30 minutes plenary.

5.3 Advanced analysis: An introduction to identifying economic costs and benefits of impacts on ecosystem services and human well-being[4]

It is possible to assess costs associated with changes in ecosystem services, some more readily than others. This is typically referred to as environmental valuation. Costs and benefits in such an analysis are commonly referred to as environmental externalities (i.e., costs or benefits that are not reflected in the prices of goods and services in our regular markets).

4 Based on Barg, S. and D. Swanson (2004). Full Cost Accounting for Agriculture. Prepared for Agriculture and Agri-food Canada. Available at http://www.iisd.org/publications/pub.aspx?pno=788 (Accessed July 2006).

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The most commonly analyzed externalities tend to be negative (e.g., if a factory or a farm pollutes a river which negatively impacts users of the water downstream, but does not pay to clean up the pollution, there is a negative externality). The polluter gains an economic advantage because it can sell its product at a price that does not include the cost of dealing with the pollution; that cost is borne by downstream (or offsite) users. An example of a positive externality is the possible value of pollination by honeybees for fruit production in a region.

Some externalities can be quantified directly from market prices. For example, a change in water quality of a river could impact the magnitude of fish catches; the decline in fish catches could be quantified economically by considering the loss of income from commercial fishing, or by estimating the cost of a food substitute (Figure 18). Similarly, if drinking water quality is affected, economic costs might be equated to increased health costs for treating water-related sicknesses, or also to the costs of improved water treatment.

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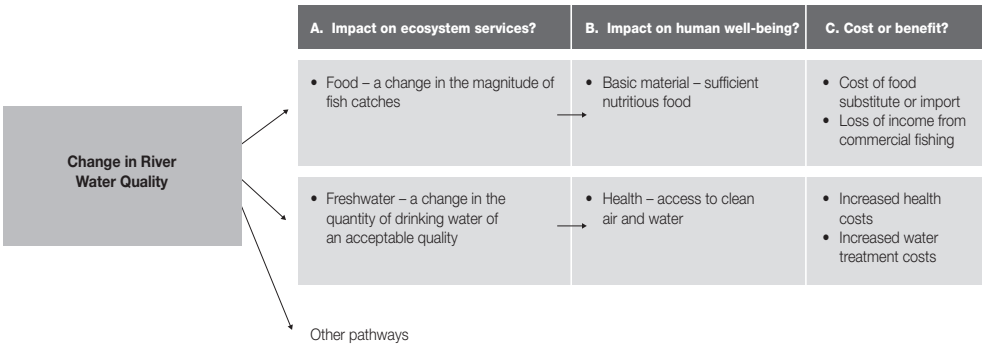
Figure 18: Examples of impact pathways for a change in river water quality, including potential economic costs.



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5.3.1 Frameworks for Environmental Valuation

Many externalities cannot be directly quantified, because they are based on willingness to pay among those who benefit from a particular ecosystem service. This is best presented in the context of a broader conceptual framework, which include environmental externalities. The broader framework can be called "total value," or Total Economic Value" (TEV) (Pearce 1993; Bateman and others 2003). Pearce breaks TEV down into use and non-use values, in the following categories:

Use value:

- *Direct use value:* The value of the use of the resource, for whatever purpose. Agricultural land can produce crops, but it also can provide biomass for energy generation, perhaps forage for animals, and so on. Some of these values will be difficult to quantify.
- *Indirect use value:* These correspond to "ecological functions" (e.g., protecting watersheds from siltation, maintaining biodiversity). Carbon sequestration was an indirect use value, until there developed a market for it—at which point sequestration became a direct value.
- *Option values:* These also are direct values, even though they do not require that there be specific use at the time of valuation. Option values are those for which individuals are willing to pay to maintain availability of something for future use, even though the individual has not and may never see or use it. Old growth forests in British Columbia as valued by a New York taxi driver might be an example.

Non-use values:

- *Existence value:* This is an indirect value, in contrast to the categories listed above. It is the result of people's willingness to pay for something with no expectation that they themselves will benefit from it. People contribute to organizations to save the Amazonian rain forest or gorillas in Africa, because they feel that these natural wonders should not be destroyed.

The sum of these categories equals the TEV. However, these are the "economic" values, necessarily an anthropocentric calculation. There is a category of non-economic values as well, often called intrinsic values. These values do not depend on human willingness to pay for them, but are intrinsic to the animal, ecosystem or other part of nature.

A slightly more detailed breakdown of total economic value is given by Bateman and others (2003). They add the concept of bequest value, which modifies the value of an environmental good to include the value to those alive now of leaving the good for future generations. This then shows up as both a use value, and as a non-use value, on the basis that future generations will get both kinds of use from the asset. The diagram below shows the various components of environmental value (Figure 19).

Figure 19 : Environmental value (Bateman and others 2003)

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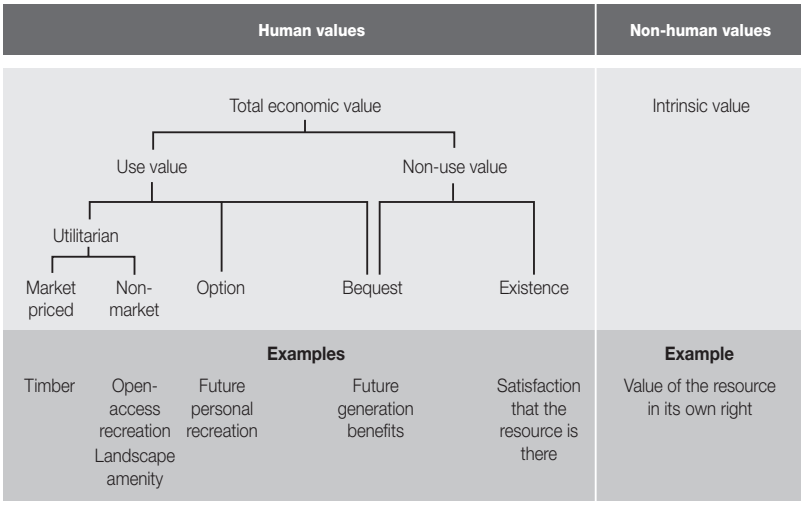

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The Millennium Ecosystem Assessment (MA) considered valuation a "tool that enhances the ability of decision-makers to evaluate trade-offs between alternative ecosystem management regimes and courses of social action that alter the use of ecosystems and the multiple services they provide (MA 2005)."

The MA's conceptual valuation methodology was based on the TEV framework described earlier, but also placed significant emphasis and research on intrinsic aspects of ecosystem value, particularly in relation to socio-cultural values. Their methodology, involves "estimating the change in the physical flow of benefits (quantifying biophysical relations) and tracing through and quantifying a chain of causality between changes in ecosystem condition and human welfare" (Figure 20). The MA authors recognize that a common problem in this methodology is that "data is only available on some of the links of the chain and in incompatible units."

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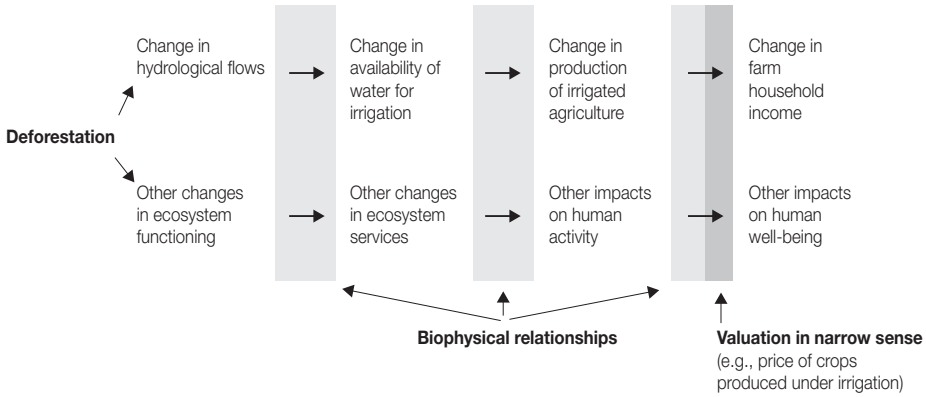
Figure 20: Methodology for valuing the impact of ecosystem change used in the Millennium Ecosystem Assessment – the example of deforestation (MA 2005)



EXERCISE: Advanced

Identifying economic costs and benefits associated with changes in ecosystem services and human well-being

Return to your group of five, and select one of the impact pathways from this exercise:

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- Identify the costs and/or benefits associated with the change in ecosystem service or human well-being (market or non-market).
- What types of values do these represent (e.g., market, non-market, bequest, existence, intrinsic)?

Designate one spokesperson from each group to report results in plenary.

Time: 40 minutes group, 30 minutes plenary.

6. Step 3: What is being done, and how effective is it?

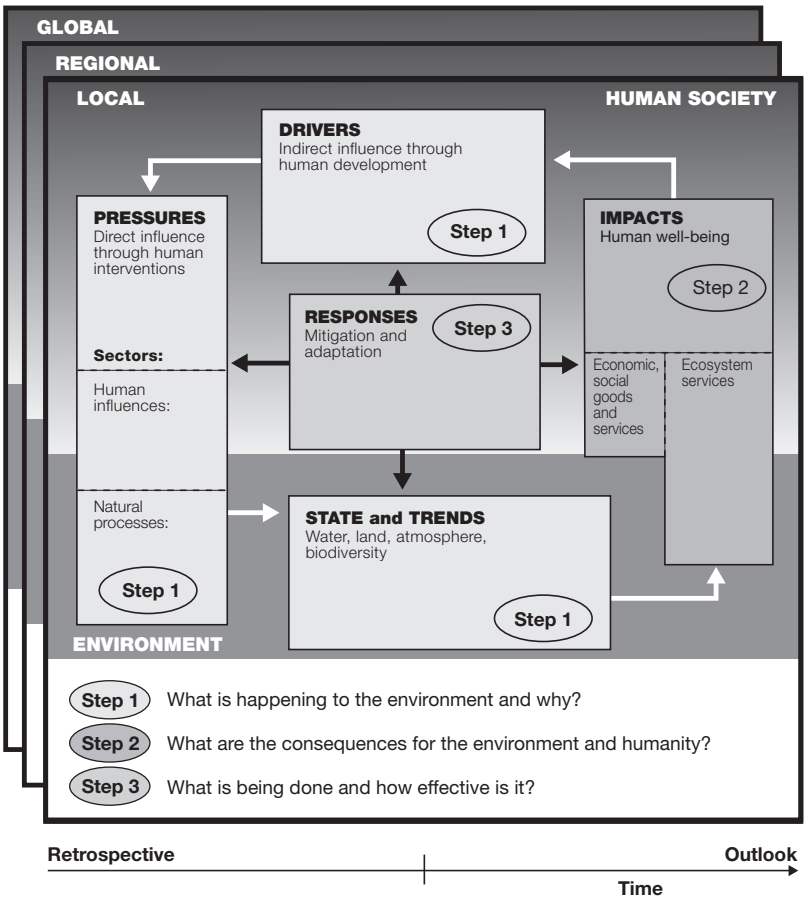
After analysing what is happening to the environment and why, and what the impacts are, the third step in the IEA is to address the question: *What is being done and how effective is it?*

This is a retrospective analysis of what has been and is being done to maintain and enhance the environment and human well-being. This information paves the way for forward-looking policy analysis, which is further considered in Module 6, *Scenario Development and Analysis*.

From an analytic perspective, this third step in the GEO approach to IEA deals with societal responses (Figure 21). These actions include government policies, plans and programmes, as well as actions of civil society and business through such interventions as science and technology.

Responses can have an effect on many facets of an environmental issue, including the state of the environmental issue (e.g., afforestation actions affect the state of forests), pressures (e.g., housing construction), drivers (e.g., community population growth) and even the impacts of changes in an environmental state (e.g., actions which help communities adapt to lack of forest cover, such as alternative fuel or building material sources [Figure 21]).

Figure 21: Analytical framework – societal responses and the third step in the GEO IEA approach



As a general categorization, those actions that influence drivers, pressures and environmental states are helping to reduce society's *exposure* to a change in the environment. In contrast, societal

responses which alleviate the impact of a change in the environment help build society's *capacity to adapt*. Together, responses that influence both our exposure to change and our ability to adapt to impacts help reduce our vulnerability to environmental change.

This section focuses on societal responses in the form of government policy. To help you better understand what is meant by policies, section 6.1 presents background information on policies and policy analysis. Sections 6.2–6.7 introduce you to five simple steps for analysing the mix of existing policies that may be having an influence on environmental issues in your area.

6.1 Policy analysis background

Environmental states can change over space and time for many reasons, driven by many processes, and influenced in many ways by multiple actors. Traditional state of the environment (SoE) reports document these trends, their interactions and their potential implications for human well-being. Although traditional SoE information alone may help influence the way people view the environment and their relationship with it, a SoE typically stops short of systematically pointing out causes or levers of change.

IEA goes beyond traditional SoE analysis, and can help answer *what is being done and how effective is it?* In this policy background section we build an understanding of policies and the policy process (the *what*), along with an understanding of policy actors (the *who*).

6.1.1 Understanding policies and the policy process

Although scholars have proposed many definitions for policy, the term remains a vague concept. The following definition of policy expresses the broad meaning used in this training manual:

> A set of interrelated decisions taken by a political actor or group of actors concerning the selection of goals and the means of achieving them within a specified situation where these decisions should, in principle, be within the power of these actors to achieve. – Jenkins, 1978

Policy comes in the form of rules, principles, norms and negotiated decision making procedures (Najam 2005). For purposes of this module, we consider aspects of policy that constitute decisions taken by those with responsibility for a given decision making area; these decisions usually take the form of statements or formal positions on an issue. Policy needs to be seen as an inherently political process, rather than simply the instrumental execution of rational decisions.

Once declared or tacitly accepted, a policy becomes a set of rules or principles to guide individual and organizational behaviour. Policy not only helps achieve specific goals, but also can serve as a basis for judging performance.

Policies come in many different varieties, including:

- General or specific
- Explicit or implicit
- Reactive or proactive
- Evolutionary or revolutionary
- Independent or integrated within other policies (nested)
- Prescribed or voluntary
- Punitive or incentive
- Preventive or curative
- Strategic and opportunistic

Of course, individual policies can be anywhere within these extremes. *Explicit* policies are articulated and announced clearly. Examples include: press releases, green papers, white papers, ministerial speeches, legislative statements, regulations and laws.

In contrast, *implicit* policies are not as clearly stated or explained, but can be equally powerful. For example, some countries have laws requiring that decisions about forestry be made in consultation with local communities (usually representatives from the village). In reality, decisions in such cases often are reached by the forest officer and, at best, rubber stamped by the village committee without any real consultation. This practice of rubber stamping is an implicit policy that is not written down (in fact, it would be against the official and stated policy), but is the one that tends to be in force. Often, policies result simply from the incremental accumulation of decisions made over time. Although each of these individual decisions may be of little environmental consequence, together they can produce far-reaching effects.

"Policy making" is a long-term, interactive and multi-stakeholder process to develop a framework to implement a certain policy, and to evaluate and modify its implementation on a regular basis.

Environmental policy is developed in a socio-economic and political context, usually in response to a problem. Addressing specific problems in democratic societies often takes a predictable course, called the policy life cycle. The typical policy life cycle has four stages: recognition, formulation, implementation and control (Figure 22). Each of these stages carries a certain amount of political weight, which varies over time. It should be noted that the following four stage cycle is a simplified view of a highly complex and often contentious political process[7].

- **Recognition:** Early perception of an environmental problem, often coming as a result of scientific research or observation, followed by dissemination and popularization of information by the media.
- **Formulation:** This is a stage of rapidly increasing political weight. The public and the media are now aroused, and debate about different policy options to address the problem occurs in numerous political circles.
- **Implementation:** At this stage, the policy has been determined, and the focus moves to implementation. Public concern and political weight decline. Over time, greater attention may be given to policy evaluation to assess whether the policy achieves its objectives and solves the environmental problem.
- **Control:** By this stage, years have passed since the early recognition of the problem, the problem has been partially solved and it is under control. Public awareness and support have improved, and the public often forgets that there ever was a problem as new problems are recognized and new cycles begun.

One class of policy instruments with special relevance for some environmental issues is multilateral environmental agreements (MEAs). MEAs typically cover environmental issues that affect more than one country or in some cases the entire global community. MEAs have been in force since the 1930s and they cover a wide range of issues some with direct, other indirect but important environmental implications (UNEP 2007).

Some MEAs such as the United Nations Framework Convention on Climate Change (UNFCCC) have more general applicability, others are more specific and therefore one could not expect to be signed by all countries. Also, being a signatory to an MEA alone does not necessarily lead to enforcement, so more detailed analysis of specific policy measures would be required.

7 Richard T. Wright, "Environmental Science," Pearson, 2005

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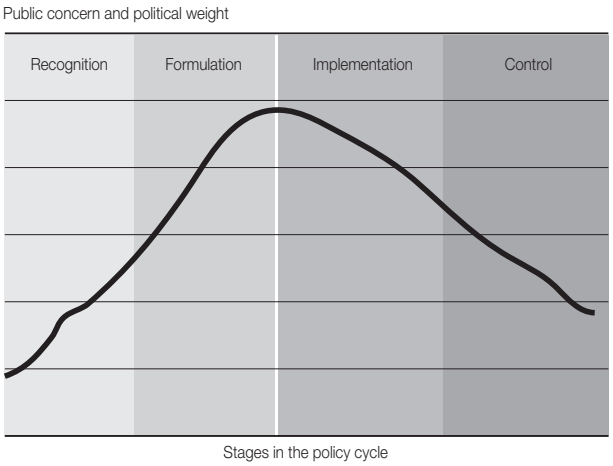
Figure 22: Stages in the policy life cycle (from Pearson 2005)



While a policy can be described as an *interrelated set of decisions and goals*, a policy instrument is a tool or a mechanism used as a means to accomplish a policy goal(s). There are myriad ways to categorize policy instruments. Table 8 presents one such categorization according to economic, regulatory, expenditure and institutional policy instruments (IISD and TERI 2003).

DISCUSSION QUESTIONS

Table 8 illustrates just one way to categorize types of policy instruments.

Q: What other types of policy instruments are familiar to you?

A: .....

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Q: What categories do your policy instruments fall under; are they represented in Table 8, or a new category completely?

A: .....

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Policy analysis is meant to help understand why ineffective policy happens. Ineffective policy can be a result of many things, such as relevant actors being ignored, a misunderstanding of the policy context, policy goals not being supported, and/or a misreading of the politics of the issue (Najam 1995; Najam 2000).

Table 8: An example categorization of policy instruments (from IISD and TERI 2003)

Instrument Category	Instrument	Description
Economic:	Economic instruments – also referred to as market-based instruments or financial incentives – are measures that directly influence the price that a producer or consumer pays for a product, behaviour or activity.	
	Tradable Permits	**Market Creation Instruments:** A system of direct regulations can be used to create a tradable good or service and a market in which it can be traded. Previous to the establishment of the market, the use of this good may have been implicitly appropriated by polluters. Examples include emission permits (i.e., CO_2); development quotas (i.e., for tourism construction); water shares (where the resource is indivisible in space, but divisible in use [Panayotou 1998]).
	Deposit Refund	**Revenue Generating Instruments:** Examples such as taxes, charges, user fees and deposit-refund schemes require that money be paid to government in return for engaging in some behaviour. These economic instruments discourage undesired behaviours by raising their prices. To induce a significant degree of behavioural change, a tax or fee may have to be imposed at a level that raises the price of an undesired behaviour above that of an alternative behaviour, in order to achieve the correct relative pricing between the two options. The general principle to follow in applying revenue generating instruments is to tax activities or behaviours that are to be discouraged or reduced (Barg *et al*. 2000).
	Performance Bonds	
	Taxes	
	Earmark Taxes and Funds	
	User Fees	
	Subsidies	**Subsidies:** Instruments such as cash subsidies, tax breaks and grants induce behavioural change by making the more desired behavioural option cheaper, thereby increasing its attractiveness to the producer or consumer (Barg and others 2000).
	Tax - breaks	
	Administered Prices	Price control by governments via a regulated market.
Direct Expenditure:	Governments influence producer and consumer behaviour by channeling expenditures directly at the behaviour they want to encourage. Direct expenditures differ from subsidies in that they are typically broad programmes of expenditures targeted at a macro level to foster activities like technological innovation, whereas subsidies reward incremental changes in individuals' behaviour (Barg and others 2000).	
	Programme/Project Operation	Governments may direct their budget toward programmes that work directly on the environment to carry out ecosystem protection and/or restoration.
	Green Procurement	Governments can opt to spend its routine procurement budget on goods and services that support environmental improvement goals.
	Research and Development	Governments can allocate budget expenditures to R&D directed at specific economic, social and environmental goals.
	Moral Suasion	Governments can encourage behavioural changes consistent with ecological goals by funding programmes designed to provide information and education to raise awareness. These moral suasion and education programmes are based on the premise that people behave in environmentally harmful ways because they lack information and knowledge, and that if they have good information they will do the "right" thing (Barg and others 2000).

Instrument Category	Instrument	Description
Regulatory:	Creating change via legal avenues	
	Legislative Instruments	Acts and regulations passed to carry out legal mandate for change.
	Enforcement Activity	The enforcement of legislative instruments.
	Liability	Aims to induce socially responsible behaviour by establishing legal liability for certain activities, such as natural resource damage, environmental damage, property damage, damage to human health, non-compliance with environmental laws and regulations, and non-payment of taxes, fees or charges (Panayotou 1998).
	Competition and Deregulation Policy	Government policy initiatives directed at orienting markets such that "prices are established and investments are made in competitive and freely functioning competitive markets" (NRCAN).
Institutional:	Affect the workings of the government itself in an effort to promote change.	
	Internal Education	Internal efforts to educate technical officers and policy-makers on sustainable development topics (i.e., a national round table on the environment and economy).
	Internal Policies and Procedures	Governmental institutional changes (i.e., Canada's Commissioner of the Environment and Sustainable Development) or procedural changes (requiring drafting of a sectoral sustainable development strategy).

6.1.2 Understanding policy actors

Policy requires shaping and managing people's behaviour, so understandably those groups of persons affected by policy, either positively or negatively, are important actors to be consulted in the policy formulation process. Policy actors can be categorized broadly into three sectors of society: *State, Market and Citizen* (Najam 1996, Najam 1999).

DISCUSSION QUESTIONS

Q. What is an environmental issue of concern in your region?

A: .....

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Q. Who are the government actors involved in addressing the issue?

A: .....

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Q. How do you get multiple stakeholders involved in the policy analysis to ensure that policy choices are more robust?

A: .....

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Who are the policy-makers? Policies are made (i.e., they are formulated) by a wide range of players called policy-makers. In most countries, public policy-makers are usually elected officials or their appointees.

In the private sector, policy-makers are CEOs, Boards of Directors and other top-ranking corporate officials. Policy-makers usually are influenced by special interest groups (i.e., entities that do not have the power to make or enforce policy themselves, but who influence development of a particular policy for their own interests or for the interests of third parties). Special interest groups include lobbyists, political groups, individuals, corporations, donors, NGOs and many others (Najam 2000). A second group important in setting policy consists of technical advisors or policy analysts; they advise and inform policy-makers on alternative options, and likely on the effects of those alternatives. In democratic societies, a third group that influences decisions is the general public, who elect policy-makers.

DISCUSSION QUESTIONS

Q. For the environmental issue you previously identified, name the one policy or policy instrument, which is currently the most influential, or the most talked about?

A: .....

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Q. Which actors are aligned with the goals of the policy, and which are not?

A: .....

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6.1.3 What is policy analysis?

With a basic understanding of policies and policy instruments, *what is policy analysis?* It can be considered any systematic analysis of any and all components of the policy process as illustrated (Figure 24) (Najam 2005). The policy process includes the formal activities of policy formulation and implementation of the policy life cycle. Najam describes the policy process as consisting of three primary components: policy choice, policy implementation and policy assessment (Najam 1995). With policy choice, government and society are formulating the goal that should be achieved and the types of policy instruments that could best achieve the goal. Following implementation of these instruments, assessment links policy choice to implementation and asks if the original goal is being achieved, and if not, why not. All three gears of the policy process need to move in order for policy to work (Figure 23).

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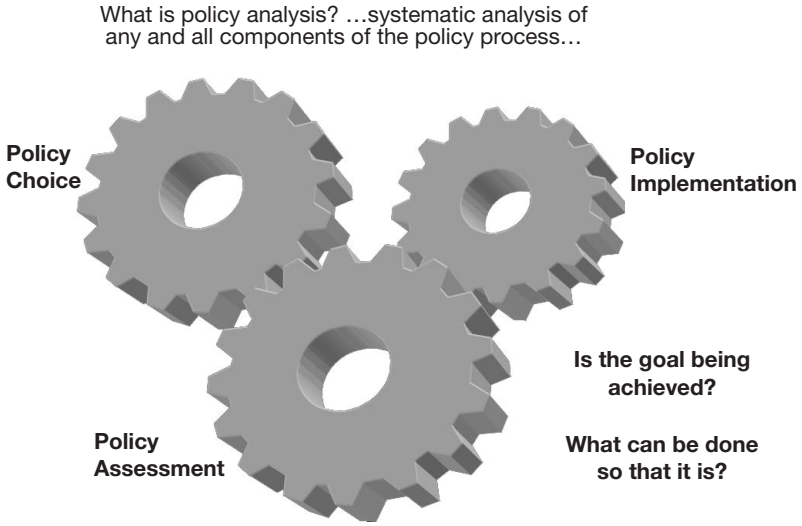
Figure 23: Gears of the policy process (from Najam 2005)



Analysis of government policies is an inexact process wrought with uncertainties. It is, however, an essential segment of social learning and adaptation that brings attention to the complex relationship between decision making and environmental outcomes. Policy analysis is rarely exhaustive and in most cases, cannot be prescriptive. It provides baseline information, points out major linkages between decisions and environmental outcomes, and provides a starting point for consideration of more sustainable policy options.

In order to slow, stop and ultimately reverse environmental degradation, we need to understand not only what is directly causing that degradation, but also how human society is contributing through its policies and decisions. Policies, formal or informal create the "rules of the game," and they represent leverage points influential in system direction. But because policies are deeply ingrained, they often are difficult to change unless their relationship to the interests of social groups is well understood.

Analysing the linkages between observed environmental change and society's policies is one of the most important yet most challenging aspects of IEA. It is one thing to recognize a linkage (e.g., between groundwater depletion and water withdrawal for irrigation). In order to go to the root of the problem, one must look not only at potential physical causes, but also understand public policy decisions and the web of related interests that lay in the background (e.g., economic incentives for water pumping, strategic food self-sufficiency policies). Even deeper, one needs to develop a clear picture of how political and economic interests motivate various actors from government to agribusinesses to farmers, getting them involved in formulating and accepting a particular policy in contrast to perpetuating unsustainable forms of behaviour.

It also is important to understand that societal responses may mitigate an environmental problem leading to improving the state of the environment, or could be in themselves drivers for worsening the same problem or creating new ones. For example, subsidizing energy prices could be increase energy accessibility for the poor. However, low energy prices could send market signals that result in a growing energy demand, that results in an increase in harmful air emissions.

CASE STUDY

Saudi Arabia's food self sufficiency policy and impact on water resources

Source: http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/W4356E/w4356e0q.htm

Environmental issue of concern

Water withdrawal

In 1992, total water withdrawal was estimated at 17 km^3, of which 90 per cent was for agricultural purposes. That was up nearly five per cent over the 16.3 km^3 recorded in 1990. Desalinated water is used for municipal not agricultural purposes because it is too saline for irrigation even after treatment. Treated wastewater is used to irrigate non-edible crops, for landscape irrigation and for industrial cooling. However, most of the water used (> 13.5 km^3) comes from non-renewable, deep aquifers. At the 1990 rate of abstraction, it is estimated that the usable reserves will last for no more than 25–30 years. The quality of the abstracted water is likely to deteriorate with time because of the flow of low quality water in a given aquifer towards the core of the depression at the point of use. In 1988, there were 4 667 multi-purpose government wells, and 44 080 multipurpose private wells.

Irrigation and drainage development

The most recent soil surveys (1989) and classifications put the area of land suitable for irrigated agriculture at about 10 million ha. However, the limiting factor is water. Depletion of non-renewable "fossil" water already is taking place at a very high rate.

All agriculture is irrigated, and in 1992 the area under water managment was estimated at about 1.6 million ha, all equipped for full/partial control irrigation. Surface irrigation is practiced on the old agricultural lands, cultivated since before 1975, which represent about 34 per cent of the irrigated area. Sprinkler irrigation is practiced on about 64 per cent of the irrigated areas. The central pivot sprinkler system covers practically all the lands cropped with cereals. Normally, pumped groundwater from one deep well supplies one or two central pivots. The irrigation application efficiency of this method is estimated at between 70 and 85 per cent. Vegetables and fruit trees in general are irrigated by drip and bubbler methods respectively. Groundwater is used on almost 96 per cent of the irrigated area, treated wastewater on one per cent.

In 1992, 428 000 ha were estimated to be cultivated by 1 070 large farms, with an area of more than 200 ha each. The total area of medium farms (5–200 ha) was 730 000 ha, comprising 7 300 farms. Small farms (< 5 ha) covered 450 000 ha, comprising 180 000 farms.

The average cost for irrigation development is about US$251/ha for microirrigation, sprinkler irrigation and surface irrigation systems respectively. Water is free of charge.

The cropped area more than tripled between 1977 and 1992. In general, there is only one cropping season. The major irrigated crop is wheat. In 1988, it consumed almost 40 per cent of irrigation water, and covered almost 62 per cent of the irrigated area. Other major crops are fodder, other cereals (particularly sorghum and barley), fruit trees and vegetables. Since 1988, self sufficiency in wheat has been reached, and part of the production is being exported. In 1992, wheat production was almost 4.1 million tonnes, while national demand was only about 1.2 million tonnes. Vegetables, fruits and dates and fodder are also exported.

Water resources management policies

In 1981, there began a change in agricultural cropping patterns based on the adoption of new technologies, exercising extensive and effective agricultural extension, using improved seed varieties with high productivity and providing advanced plant protection services in line with modern agricultural methods.

The government's involvement in the agricultural sector has been extensive. During the 1980s, food self-sufficiency, particularly in wheat and dairy products, became a major priority. With the support of heavy subsidies, the added value in agriculture increased by more than 70 per cent from 1985–91. Wheat production was even sufficient to enable Saudi Arabia to become the world's sixth largest wheat exporter. Despite its success, this policy is a threat to the country's water reserves. On economic grounds, the 1991–92 harvest was estimated to have cost the government around US$480 per tonne compared with world prices for wheat of US$100 per tonne. At present, the national goal is diversification of agricultural production in order to meet the growing demand for other types of crops, and to adjust the wheat production to the level of annual national consumption.

Because of the development of agriculture, which is by far the largest water user, the depletion of fossil groundwater takes place at very high rates. It is expected that at the present rates of abstraction, all reserves will be used within the next 25–30 years. The Ministry of Planning had proposed a target to reduce annual irrigation water use from the current 15.3 km^3 to 14.7 km^3 by the year 2000. Measures to be taken were:

- implementation of effective irrigation schedules at farm level to deliver irrigation water according to actual crop need, which is expected to result in a saving of water of at least 30 per cent;
- replacement of surface irrigation systems by sprinkler irrigation and micro-irrigation systems;
- shifting some fodder and cereals areas from high to lower water consumption zones, and cultivation of crops with lower water requirements; and
- introduction of water meters at farm level to control pumping of water.

Extensive pumping of groundwater has resulted in a significant drop in the groundwater level (100 metres in the northwest in the last decade), requiring deeper and larger holes to be drilled and a higher head for pumping, which results in a higher production cost. Groundwater quality has deteriorated to the point where it can no longer be used for municipal supply without expensive treatment. Furthermore, only half the groundwater reserves are located near the areas of highest demand. Coastal areas suffer increasingly from sea water intrusion into groundwater.

While Saudi Arabia is already by far the largest producer of desalinated water, future development will have to depend even more on development of this source and on reuse of treated wastewater. However, desalinated water is still too saline for agricultural use, the problem of the rapid depletion of fossil water is still a long way from being solved.

DISCUSSION QUESTIONS

Q: Can you think of examples in your country of policies that had impact on a specific state of the environment? Was this impact good or bad?

A: .....

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Q: Is it possible that other policies also had an impact on this environmental state?

A: .....

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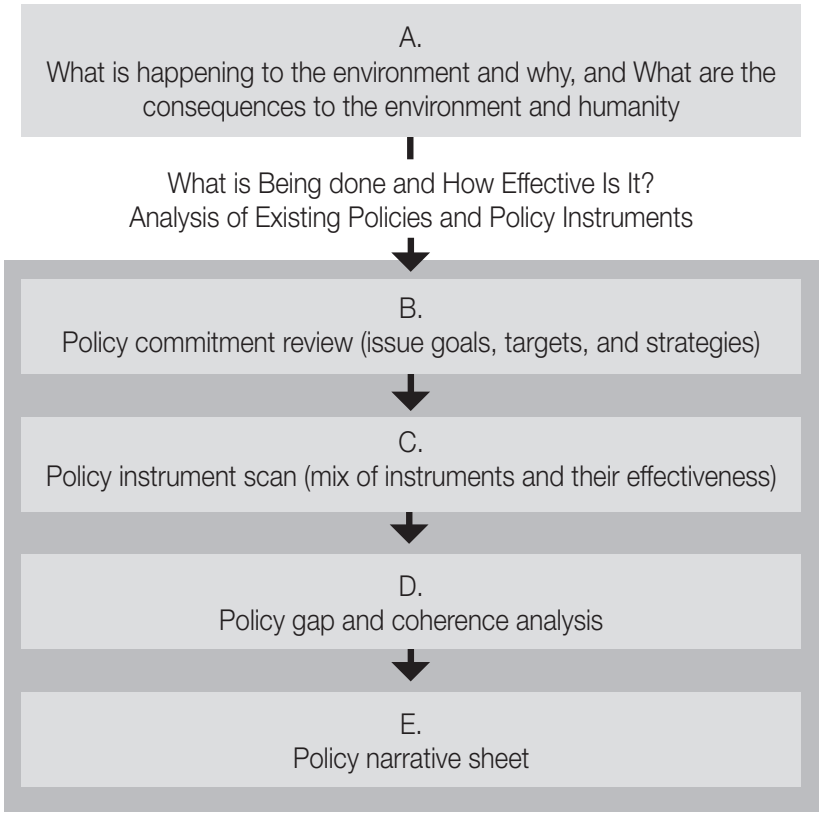
6.2 Steps in the analysis of existing policies

The policy analysis steps introduced in this section emphasize the need to link actual policy performance with criteria for policy performance. Policy performance criteria are expressions of expected outcomes related to the implementation of the policy, preferably in quantitative terms and with a time limit (for example, achieve a 20% reduction in the number of smog days within ten years). One of the common challenges with this approach is that performance criteria are implicit and assumed or simply unknown.

Most or perhaps all environmental change, however, is a result of not one but multiple influences and policies. There are many potential constellations of influencing factors that can lead to a given environmental change, though some of these are more common than others. For instance, agricultural land use, water quality and biodiversity are often interlinked through common impact pathways. However, while there is a high degree of certainty that choices related to the type and intensity of cultivation will have biodiversity and water quality implications, these interlnkages may shift over time and new, strong forces (e.g., climate change) may emerge.

Considering the challenges but also the critical importance of policies and policy instruments in an IEA, this module introduces a five-step policy analysis process as outlined in Figure 24.

Figure 24: Steps in the analysis of existing policies



A. **Understanding the Issue** – understanding what is happening to a specific aspect of the environment and why it is happening, and also what are the specific impacts on the environment and humanity are precursors to policy analysis. A methodology for understanding the issue was outlined in sections 4 and 5 of this module.

B. **Policy Report Card** – identifying the landscape of high level strategies, policies and policy goals, whether in multilateral environmental agreements (MEAs), regional treaties or national programs establishes the big picture and the extent of attention that is currently being given to the environmental issues. This step would also involve identifying policy perforance indicators in the context of which targets can be identified and interpreted and that also help track progress.

C. **Policy Instrument Scan** – identifying the mix of specific policy instruments that are currently influencing your environmental issue and how effective this mix has been (comparing actual versus intended effects) provides the foundation for further policy analysis. This analysis should also consider that most environmental issues are strongly linked to others, such as land use and water quality for instance. Therefore, the scan could also cover those policies that are targeting a strongly linked environmental issues and their impact is mediated due to issue interlinkages.

D. **Policy Gap and Coherence Analysis** – identifying if a relevant policy is not implemented, if a policy type is under-represented, and if policies are not focused on the relevant drivers or pressure, are all part of understanding the *gaps* in government policy. Additionally, policy influence is complex, given the dynamic and highly adaptive interrelationships among people, the economy and the environment. Policies can therefore have impacts that were not intended or anticipated. Assessing the positive and negative influence of policies on other policies is an important aspect of understanding policy *coherence*.

E. **Policy Narrative Sheet** – This step develops a summary of the key insights from the analyses carried out in Steps A through D. It is in this narrative where policy failures and successes, along with key policy gaps and opportunities for innovation and improvement are highlighted.

The steps are described below in detail in sections 6.3 through 6.8.

6.3 Step A. Understanding the issue: What is happening to the environment and why, and what are the impacts?

The starting point for any type of policy analysis is a thorough understanding the issue. This was the topic of sections 4 and 5 of this module which addressed the questions: what is happening to the environment and why? and what are the impacts on the environment and humanity?

An adequate understanding of the issue would require the following information:

- Identification of the causal chain of drivers, pressures, state and impact for a given environmental issue.
- Development of specific, measurable, achievable, relevant and time-bound (SMART) indicators for the key drivers, pressures, state and impacts.
- Identification of key points in time where policy(ies) had impact. Time-bound information is important for this, particularly for the state indicator.

EXERCISE

Understanding the Issue

In groups of 4-5, carry out the following tasks:

- Select the drivers – pressures – state – impact chain from your exercises in sections 5 and 6 and put this into the first row of the table provided.
- In the second row, identify an indicator and approximate trend line that, in your best judgment, describes reality, or use actual data if available.
- Note major changes in the indicator trend over time.

	Drivers	Pressures	State	Impact
Description				
Indicator and trend				

Time: 20 minutes.

Identifying and explaining key trends in environmental state indicators is a central part of creating a baseline understanding for policy analysis. Environmental state may be influenced by anthropogenic drivers and pressures and these typically have some underlying policies. For instance, over-fishing may be driven by the availability of easy credit for fishing fleet development and no restrictions on potentially damaging fishing practices. However, state variables are also affected by natural causes, and phenomena such as El Niño events can contribute to fish population dynamics in positive and negative ways.

Such an analysis can also be conducted to better understand pressures and drivers. The case example presented in section 4.4.2, relating to automobile fuel efficiency, illustrates this.

6.4 Step B: Policy commitment review

This step in the integrated policy analysis involves taking a high level look at environmental commitment in effect in the jurisdiction of the IEA. Environmental commitments can take different forms. Some are tied to MEAs, regional or bilateral agreements, or expressed through national legislation, strategies or political declarations. Not all commitments have the same force, and the review should focus on those where commitments require action and inaction has potential consequences. There is also a difference in the specificity of the commitments: some are at the level of general political statements, others can be more specific and precise with quantitative, time-bound targets and responsibilities.

Consider the issue of climate change as an example. If your country is an Annex 1 country under the Kyoto protocol, and your country has ratified the agreement, then your national-level government will have a target to reduce greenhouse gas emissions to a certain percentage below 1990 levels by the period 2008–2012. Given such a target, is it quite likely that your country has a national strategy or action plan to reduce GHG emissions, and such a plan would set forth a mix of policy instruments to achieve the target. It is important to note for this climate change example, the target is directed at a direct driver (GHG emissions) and not the state of atmospheric CO_2 concentrations. In fact, while the overall goal of the Kyoto protocol is to stabilize atmospheric concentrations of CO_2, it only sets out targets addressing the pressure from GHG emissions.

Table 9 summarizes Canada's climate change commitments based on the above description. The exercise below involves the analysis of high level commitments related to an issue selected by participants in their own country.

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Table 9: Analysis of Canada's commitments under the Kyoto Protocol

Issue	Goal and target	Strategy or action plan	Status of implementation
Climate change Environmental state: Atmospheric CO_2 concentration	6% reduction in GHG emissions by the period 2008–2012 (Kyoto Protocol)	Climate Change Plan for Canada – 2002 Moving Forward on Climate Change – 2005	Some policy instruments being implemented, but overall GHG emissions are still rising

EXERCISE

This exercise requires completing an analysis of commitments for selected priority environmental issues.

In groups of 4-5, carry out the following tasks:

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- Select two priority environmental issues from those listed by members of your group.
- Complete the analysis of commitments for each issue, making sure to cover the following:
  - Name of the issue and the specific environmental state that the issue focuses on.
  - Any goals or targets that have been established for the issue
  - The name of a strategy or action plan for achieving the goal and target.
  - The status of implementation in terms of progress in implementing policy instruments and progress in achieving the goal and target set for the issue.

Time: 20 minutes group, 10 minutes plenary.

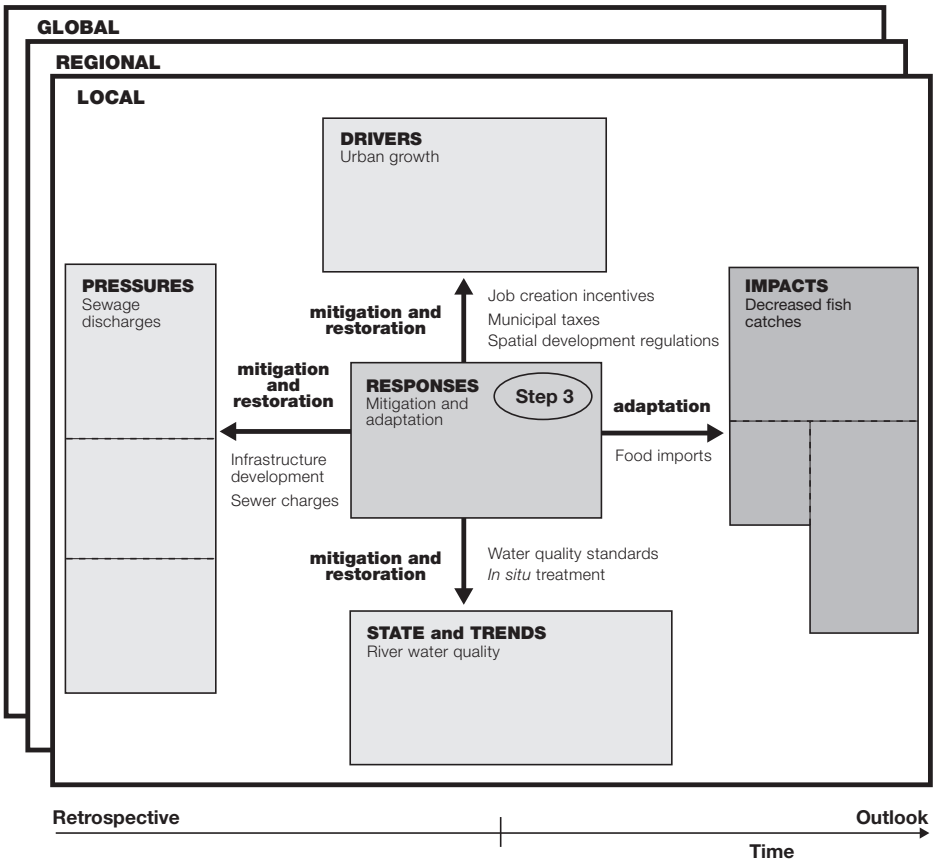
6.5 Step C: The policy instrument scan

While the analysis of commitments provides a *big picture* of the policy landscape for an environmental issue, a policy instrument scan can provide *details*. This more detailed picture includes the mix of policies having an effect on your environmental issue, and an assessment of effectiveness of these policies in achieving positive change.

The *policy instrument scan* is designed to help you identify the mix of specific policy instruments that are having an influence on your environmental issues. For any given issue, policy instruments will be having an affect (positive or negative) on the entire causal chain, including drivers, pressures, the environmental state itself and the impacts of changes in the environmental state.

For example, consider river water quality. A number of policy instruments, such as *in situ* treatment and water quality standards, could have positive or negative impacts on the state of the water quality. Other impacts can come from the effects of municipal taxes driving as urban growth, infrastructure development reducing sewage discharges and food import programmes to compensate for a reduction in fish as a food source.

Figure 25: Example policy instrument scan for water quality of rivers



It is important to remember that there are a variety of diffent policy instruments available to governments. These different policy instruments can be categorized into general categories. Recall that Table 8 presented one way to categorize policy instruments, namely:

- Economic instruments (e.g., taxes, subsidies, tradable permits, etc.).
- Regulatory (e.g., laws and regulations).
- Direct expenditure (research and development, education and awareness, infrastructure projects, etc.).
- Institutional instruments (sector and cross-sector strategies, green procurement).

Such a categorization provides a checklist to help in the brainstorming process for the policy instrument scan. Besides national governments, lower levels of governments have policy-making power, as do corporations. The policies of these actors are equally important and would also need to be included in the analysis.

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CASE EXAMPLE

Policy instruments directed at water quality improvements in the Red River Basin of Canada

For the example involving the Red River in central Canada, STATE of water quality data reveals a trend toward increasing nutrient concentrations in the river, which flows into Lake Winnipeg. One of the drivers is nutrient loading into the river from agricultural fields, and from sewage and storm water discharges from towns and cities along the Red River.

There are two strategy level documents which cite relevant targets for the nutrient loading pressure. The Canada-Manitoba Agriculture Policy Framework Implementation Agreement cites a 12 per cent reduction target for residual nitrogen on Manitoba farmland by 2008 and a 16 per cent reduction in average water erosion rates on Manitoba farmland (in Oborne 2005). Additionally, the provincial Department of Water Stewardship cites a target of a 10 per cent reduction in Manitoba-based nutrient loads to Lake Winnipeg by 2010 (in Oborne 2005).

A sampling of some specific policy instruments directed at the pressure of agriculture discharges and the state of nutrient concentrations in Lake Winnipeg include (Oborne 2005):

- Water export/interbasin transfers banned (regulatory instrument).
- Seventeen conservation districts established since 1970 (expenditure instrument).
- Riparian Tax Credit established (economic instrument).
- Land and Water diploma programme at Assiniboine Community College (expenditure instrument).
- Several watershed plans in development (institutional instrument).
- Nutrient Management Strategy completed (institutional instrument).

6.5.1 Understanding policy effects and policy effectiveness

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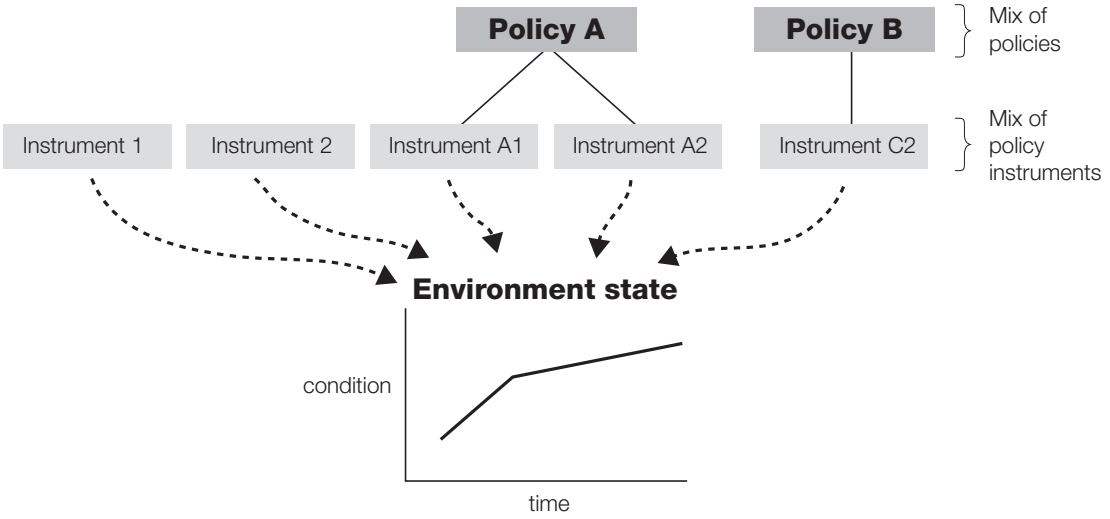
Included in the policy instrument scan as described in this module is an analysis of policy effectiveness. Before talking about *policy effectiveness*, we define what is meant by *policy effects*.

The European Environment Agency (EEA) notes that the *effects* of policy responses imply causality between policy and driver, pressure, state or impact. The intended and unintended effects can be determined based on scientific and social observation and analysis. Such an analysis as described by the EEA should be judgment free.

Determining the effect of an individual policy on a driver, pressure or an environmental state can be challenging because of the complexity of the causal chain of drivers and pressures for a range of environmental, social and economic issues. It is often easier and more accurate to attribute the change in a driver, pressure or an environmental state to a mix of policies, given that attribution is so difficult to establish for a single policy (refer to Figure 26).

That being said, analysing the effect of an individual policy or a small set of policies on a specific issue is not impossible. It often is just a matter of time and computational effort. Section 6.9 of this module presents an example of an advanced policy analysis related to SO_2 emissions in the Netherlands.

Figure 26: Effects of a mix of policies and policy instruments on an environmental state



Different from policy effect, the EEA describes *policy effectiveness* as going beyond analysing effects, and judges how the actual effect measures up to the policy objective. This is a performance assessment of the policy.

In order to carry out an analysis of *policy effectiveness* it is necessary to identify performance criteria. In an ideal case, performance criteria and the requirement for a performance assessment are built into policies, and the criteria are easily associated with routinely monitored indicators and cited targets. If this is the case, assessment is relatively straightforward, assuming that both the indicators and criteria appropriately represent the effects of the particular policy.

Often, policies are designed either without clearly defined and specific performance criteria, or with criteria that are not necessarily related to environmental performance. This is often so for economic policies related to taxation, trade or investment. Although these may have very significant links to environmental issues—in fact they may be the key drivers of environmental change—their built-in evaluation criteria are usually limited to economic performance. This makes their evaluation particularly challenging from an environmental and sustainable development perspective.

Performance criteria can range from general and descriptive (for example, whether a policy is in compliance with broadly defined principles), to specific and quantitative (for example, a target value associated with a specific indicator on a specific time scale). In essence, they provide a basis for comparison between planned or desirable performance and actual performance. Table 10 provides examples for some main types of performance criteria.

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Table 10: Main types of performance criteria for policies (based on Pintér, Zahedi and Cressman. 2000)

Type of criteria	Example
Benchmark	Comparison with a documented best-case performance related to the same variable within another entity or jurisdiction. The policy is evaluated based on its impact in a given jurisdiction compared with conditions in the benchmark or reference jurisdiction. *Example:* highest percentage of households connected to sewage system in a comparable jurisdiction.
Thresholds	The value of a key variable that will elicit a fundamental and irreversible change in the behaviour of the system. The policy is evaluated based on its role in making the system move toward or away from the threshold in any given period. *Example:* maximum sustainable yield of a fishery.
Principle	A broadly defined and often formally accepted rule. If the definition of the principle does not include a relevant performance measure, the evaluator should seek a mandate to identify one as part of the evaluation. *Example:* the policy should contribute to the increase of environmental literacy.
Standards	Nationally and/or internationally accepted properties for procedures or environmental qualities. The policy is successful if it helps keep performance within specified limits. *Example:* water quality standards for a variety of uses.
Policy-specific targets	Determined in a political and/or technical process taking past performance and desirable outcomes into account. *Example:* official development assistance shall be 0.4 percent of national GNP.

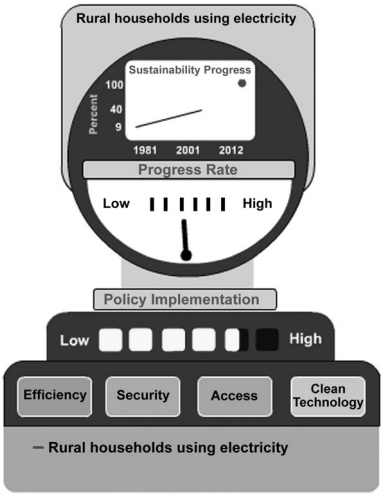
CASE STUDY

State of energy access for rural households in India

The energy sustainability gauge

Source: The Energy and Resources Institute 2002
http://www.teriin.org/ee/gbr/fesa/fesa_report.htm (see Section 3)

Figure 27: Energy sustainability gauge for India showing energy access.



Sustainability progress

Indicator: Percentage of rural households with access to electricity (Census of India)

Reference level: 100% by 2012 Government of India target.

Progress rate: Actual annual rate of growth since 1991 is only 46% of that required to meet the objective by 2012.

Policy implementation

There is ahigh level of policy implementation, relying mostly on subsidized tariffs and government sponsored electrification schemes. The ineffective targeting of subsidies has been, however, a cause of concern both from the point of view of equitable access as well as financial implications for the government. Ongoing structural reforms and the setting up of regulatory commissions are seeking to address the issue.

Supplemental information

Indicator: Percentage of rural households using electricity for fuel and lighting purposes as estimated by the Census of India.

Figure 28: Per cent of rural households using electricity for fuel and lighting.

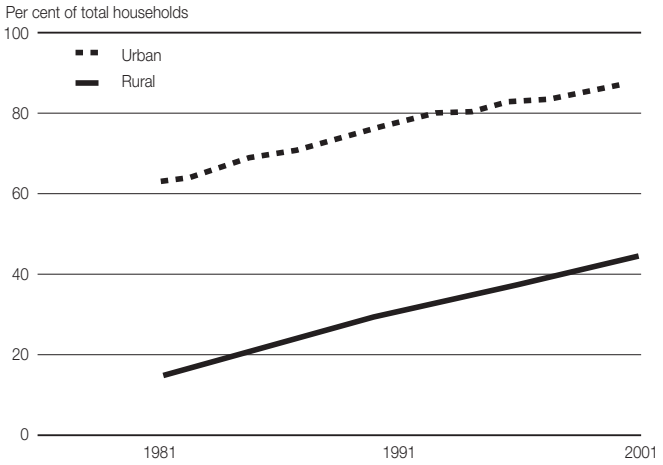


Table 11: Policy mix directed at the issue (2002)

Category	Policies
Economic	Subsidized rural electricity tarifs Subsidized loans under the Accelerated Rural Electrification Programme, REC, etc.
Expenditure	Various central government schemes, e.g., The Minimum Needs Programme, the Kutir Jyoti Programme, the Prime Minister's Gramodaya Yojana
Regulatory	Tariff Orders of State Electricity Regulatory Commissions
Institutional	The Rural Electrification Corporation

Performance Criteria: The Government of India target is 100 per cent electrification by 2012. Of the balance, the Tenth Plan proposes to cover all 62 000 villages that can be electrified through grid extension. The remaining 18 000 remote villages are to be electrified by 2011–12 through the use of non-conventional technologies (MoF 2002-03).

Analysis: Only 44 per cent of rural households have access to electricity, compared to 88 per cent of urban households. Out of the 597 258 inhabited villages in the country, about 80 000 are yet to be electrified, going by the current definition of village electrification. 32 Ten states have declared 100 per cent electrification of their villages (Tenth Five-Year Plan).

As indicated in the gauge, there is a high level of implementation of policies directed at the provision of electricity access in rural areas. Policies have mostly relied on subsidized tariffs and government-sponsored electrification schemes. Progress is, however, not as encouraging as indicated by the low level of access. Though statistics show that 86 per cent villages are "electrified," available data indicates that only 44 per cent of the rural households have access to electricity. There are thus inadequacies in the current definition of village electrification itself, which needs to be changed so that a village is considered electrified only if a minimum number of households in that village are provided with electricity connections (Tenth Five-Year Plan).

EXERCISE

In groups of 4-5, carry out the following tasks:

- Transfer the description and indicator trends from the earlier "Understanding the Issue" exercise to a table similar to the one provided below.
- Identify policy instruments that are having a significant impact on:
  - Reducing the extent of environmental change via drivers, pressures and state(s).
  - Helping society adapt to the impacts of environmental change.
  - Make sure you do not limit your attention only to certain types of policy instruments (e.g., market based) while ignoring others (e.g., regulatory, expenditure and institutional instruments). Try to define policy instrument in specific terms
  - Identify performance criteria for the indicator that describe the indicators for key drivers, pressures, environmental state as well as impacts. Be as specific as possible.
  - How does the indicator trend compare to the performance critiera? How do actual trends and performance criteria compare?

Present your results in plenary.

Time: 45 minutes group, 15 minutes plenary.

Environmental Issue:_____

	Driver	Pressure	State	Impact
Description				
Indicator and Trend				
Policy Instruments • Economic • Regulatory • Expenditure • Institutional • Etc.				
Performance Criteria • Targets • Benchmarks • Thresholds • Principles • Standards • Etc.				
Comparison of observed trends and expected performance				

6.6 Step D: Policy gap and coherence analysis

With a mix of policy instruments identified for a particular environmental state, and the related drivers, pressures and impacts, and the effectiveness of these policies assessed, based on some form of performance criteria, the policy analysis can be taken to a more informative and pragmatic level.

If the *policy effectiveness* assessment reveals that the mix of policies has not resulted in adequate improvement in the state of the environment or has not facilitated adaptation, then one must begin to explore why this is the case. Or alternately, if progress has been made on these two fronts, it is important to better understand why successful performance was achieved. This module presents two methods to gain this better understanding, including:

- Identifying gaps in the policy mix.
- Assessing policy coherence.

6.6.1 Identifying gaps in the policy mix/interlinkages

Policy gaps can take many forms, such as:

- Relevant policy not in place.
- A policy type with significant potential for positive impact is under-represented.
- Policies not focused on relevant drivers or pressures.

The identification of these types of gaps can be facilitated by using a *policy mix matrix* such as the one illustrated in Table 12. One of the challenges facing sustainable development is that a proactive policy strategy requires that policy-makers take account of an optimal mix of policy instruments that can be brought to bear on the key issues, considering the type of issue and policy implementation context.[8] A policy mix matrix can reveal which policy types (e.g., economic instruments, regulatory, direct expenditure, institutional) might be under-represented.

Table 12: Example policy mix matrix

	Driver	Pressure	State	Impact
Description of DPSI				
Economic instruments				
Regulatory instruments				
Expenditure instruments				
Institutional instruments				

8 Gale R., S. Barg and A. Gilles. (1995). *Making budgets green: Leading practices in taxation and subsidy reform*. International Institute for Sustainable Development, p. 1.

EXERCISE

In groups of five, carry out the following tasks in relation to one driver-pressure-state-impact chain used in the previous exercises:

Characterizing the policy mix

- Copy the descriptions of your drivers-pressures-state-impacts chain from the previous exercise to the first row of the policy mix matrix.
- Using shorthand or code, transfer policies influencing the driver, pressure, state and impact from previous table to the appropriate cell in the policy mix matrix. Can you think of any additional policies to add to the table that you did not identify previously?
- Use the examples of policy types described previously in Table 8 as possible categories, but you may also create new categories, if necessary.

Estimating the policy effect

- Working with the results of the table just completed, indicate your *perceived effect of the policy on the given environmental issue*, based on existing information, by placing the appropriate symbol in the cell representing the policy. You could use a scale similar to the following:
  - Highly positive effect: +++
  - Moderately positive: ++
  - Slightly positive: +
  - Neutral: 0
  - Slightly negative effect: -
  - Moderately negative: - -
  - Highly negative: - - -
  - Policy effect unclear: ?

In plenary, carry out the following analysis of policy gaps:

- Identify policy types that appear to be over- or under-represented.
- Note if there are policies directed at each part of the issue chain (driver, pressure, state and impact).
- Identify policy types and/or specific policies that are currently absent, but might have significant potential for positive effect.
- Discuss opportunities and barriers for optimizing the policy mix, either by adding new or discontinuing existing policies or policy types.

Time: 45 minutes group, 30 minutes plenary.

There are certainly policy gaps other than those identified above. For example:

- Policy developed, but not implemented or enforced.
- Policy not functioning properly (e.g., relevant actors ignored, policy theory not accurate, etc.).
- Policy effect reduced or negated because of the effects of another policy.

The first two of these gaps require additional analysis, which is not within the scope of this module and training manual. The last one, policy effect negated because of the effects of another policy, is the focus of the next section.

6.6.2 Assessing policy coherence

Analysis of *policy effectiveness* focuses on comparing the *actual* and expected performance of a given policy, based on relevant performance criteria. As neither environmental issues nor policies can exist in isolation, any given environmental trend will be a combined result of interacting policies and natural factors, some of which are outside the control of human decision making.

For example, energy subsidies and increased energy consumption may have implications for air quality, overall material use and waste production, but also for global climate change. It may well be that a given policy deals well with one particular type of environmental impact, but fares poorly with another.

One tool for assessing these types of combined effects is an action-impact matrix (AIM). An example of an AIM is illustrated in Table 13. The AIM lists specific policy instruments in the first column, then assesses the effect of the policy, intended and unintended, on a range of environmental issues. Through such a thought process it is possible to identify interlinkages among policy effects, many of which will not be intuitive. In some instances, the positive effect of one policy might be completely neutralized by the negative effect of another policy.

The *policy instrument scan* may produce a lengthy list of policy instruments, which would be too difficult to work with given time and human resource constraints. Prioritizing the instruments in such a case would be necessary. Some criteria for selecting policies to include in a current environmental policy analysis include the following (not in order of importance):

- Relevance to the environment.
- Relevance for the public and decision-makers.
- Link with key environmental priorities identified in the state of the environment and trends section.
- Affecting the health, income and well-being of a large number of people.
- Importance of policy response to an environmental situation that is:
  - physically severe
  - changing rapidly
  - irreversible
- Related to the country's international obligations.
- Potential for policy to cause disruption or conflict.
- Potential for easy and feasible solutions.
- Uniqueness of current policy initiative for region.

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Table 13: Simple example of an action impact matrix (AIM) (Source: Munasinghe 1993, as quoted in Atkinson et al. 1997)

		Impacts on key sustainable development issues			
Action/Policy	**Main objective**	**Land degradation**	**Air pollution**	**Resettlement**	**Others**
Macroeconomic and sectoral policies	Macroeconomic and sectoral improvements	Positive effects because of removing distortions, Negative effects mainly because of remaining constraints			
• Exchange rate	• Improve trade balance and economic growth	(-H) (deforest open-access areas)			
• Energy pricing	• Improve economic and energy use efficiency		(+M) (energy efficiency)		
• Others					
Investment projects investments	Improve efficiency of	Investment decisions made more consistent with broader policy and institutional framework			
• Project 1 (Hydro dam)	• Use of project evaluation (cost-benefit analysis, environmental assessment, multi-criteria analysis, etc.)	(-H) (inundate forests)	(+M) (displace fossil fuel use)	(-M) (displace people)	
• Project 2 (Re-forest and relocate		(+H) (replant forests)		(+M) (relocate people)	
• Project N					

GROUP DISCUSSION

In plenary, choose five key policies from among those identified in your *policy instrument scan*.

Additionally, select four other environmental issues in your country. Develop an action impact matrix (AIM) similar to the example in Table 13.

Time: 30 minutes.

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6.7 Advanced policy analysis – analysing the relative impacts of multiple policies on the evaluation of an environmental issue

To evaluate government policy in more detail we need to be able to determine the relative effects of different trends, technological changes or policy measures. This type of analysis can help to show the impacts of different policy instruments, and can be performed in retrospective and in forward-looking modes. Such an analysis of individual policies is data and labour intensive, so it is considered here as an advanced part of policy analysis.

Consider the environmental state issue of the atmospheric concentration of CO_2 in the context of the European Union. One of the key pressures on this environmental state is the emission of greenhouse gases. Figure 29 presents an example in which the effects of different policies on greenhouse gas emissions are analysed for the EU-15 in the period 1990–2001 along with an estimate of the level of greenhouse gas emissions in the absence of different type of policies (Harmelink and Joosen 2004).

Greenhouse gas emissions in the EU-15 were more or less constant on the same level during the period 1990–2001 (EEA, 2003). It is estimated that in the absence of policies in the period 1990–2001, greenhouse gas emissions would have risen by 4.7 per cent.

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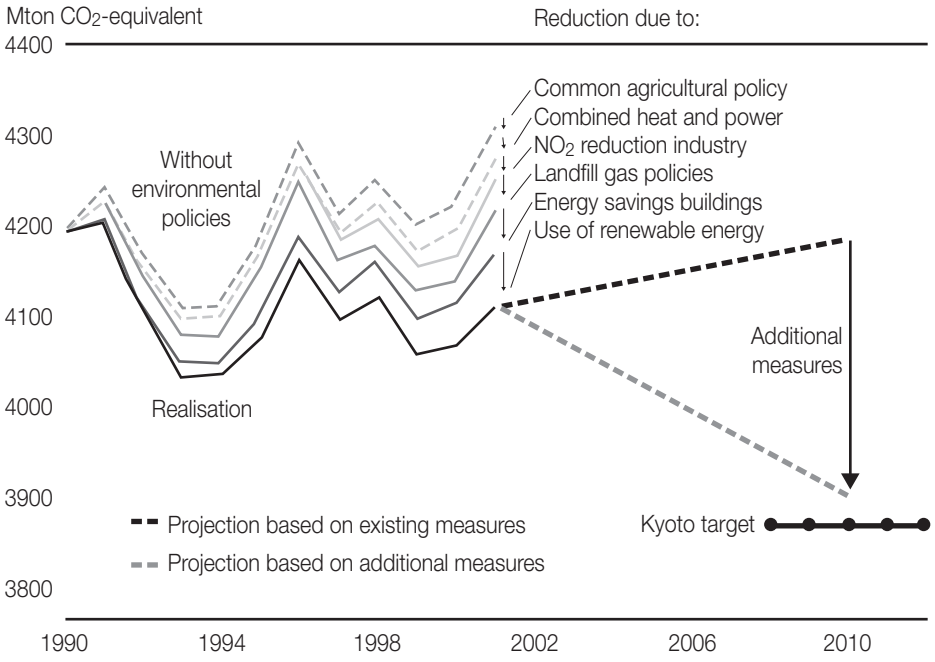
Figure 29: Breakdown of the effects of environmental policies on greenhouse gas emissions in the EU-15 (MNP/RIVM, 2004)



The following policies are analysed in this example:

- Renewable energy policies.
- Landfill gas policies.
- Best available technologies for adipic acid production.
- Cogeneration (combined heat-power) policies.
- Efficiency improvements in the built environment.
- Common Agricultural Policies.

The effects, in terms of CO_2-equivalent attributed, are sensitive to assumptions with respect to the reference case. The choice of the reference is arbitrary, and therefore always must be described, because other references may result in other outcomes (and other conclusions) (to be further detailed).

Figure 29 also illustrates the "distance to future policy targets" by including baseline projections and comparing them with the EU policy target under the Kyoto Protocol. It indicates how much emission reduction needs to be achieved with additional measures to realise this emission target.

The most simple and therefore most commonly used method to compare the effects on the level of emissions of different changes is to compare all of these changes with the same baseline. The baseline is defined as "what would have happened if the changes had not occurred." Or, in other words, "what will happen if these changes don't occur." Because the answer to this question is always hypothetical, often the easiest answer is chosen: nothing will happen in the production-structure.

For example, when one wants to evaluate the effect of the increase of nuclear energy, the average emission factor of the production of electricity of the base year is multiplied by the electricity production of nuclear plants for a specific year. This comparison can also be made for other changes and measures, for example the increase in renewable energy or the increase in cogeneration.

This method is easy to use, and it gives a good insight into the scale of the effect of changes and how the measures relate to one another. However, it's not really reflecting all complexities. A nuclear power plant is a source of base load electricity (producing a steady, constant power source), as opposed to other power sources, such as wind generators, which only operate when the wind blows. When such differences are taken into account, one can get a better sense of the real impacts of different approaches. This type of analysis will be more realistic, but it takes considerably more time and data to do.

The fact that a variety of changes and measures occur simultaneously is a complicating factor when analysing the effectiveness of policy because it makes it more difficult to distinguish between the effects of individual measures. Because results will depend on the method chosen, measures have to be interpreted with caution. We can present some alternative methods for analysis and illustrate which methods can be used under which conditions.

The emission of CO_2 by the electricity generation sector in the Netherlands (Figure 31) is an example that illustrates such an analysis.

CASE EXAMPLE

Emission of CO_2 by the electricity generation sector in the Netherlands

Since 1990, electricity production has risen at a faster rate than the amount of CO_2 emitted during the generation of this electricity. The question is, how this can be explained and what role has policy played in this change?

Since the end of the 1980s, Dutch policy has been to encourage energy savings and reduce CO_2 emissions. In 2000, total electricity production in the Netherlands was 377 PJ, having risen from 282 PJ in 1990. For the purpose of this analysis, the electricity production is divided into:

- central generation by companies primarily engaged in electricity generation;
- decentralized generation by companies for whom electricity generation is a secondary task, mainly CHP;
- remaining decentralized generation by companies for whom electricity generation is a secondary task, all non-CHP units;
- renewable generation (wind, solar, etc); and
- net imports (balance of imported and exported electricity).

Figure 30: Electricity production by source 1990-2000 (in PJ electricity)

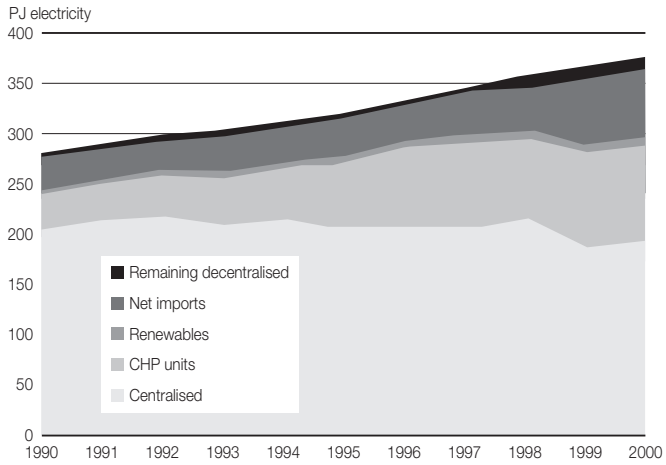
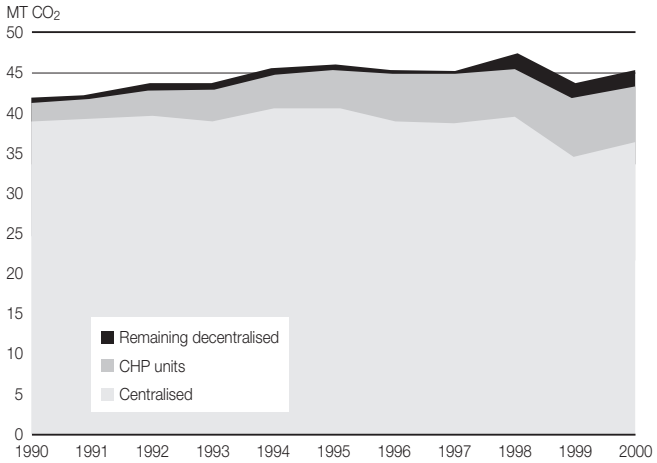


Figure 31: CO_2 emissions by energy source



Comparing Figures 30 and 31 we can see that electricity production is rising much faster than the CO_2 emissions. The possible causes of this decoupling are:

- import of electricity;
- increased production of electricity by decentralized CHP plants;
- more efficient generation by central power stations;
- shift in fuel mix by the central power stations; and
- increase in renewable electricity generation.

There are various methods to determine the effects on CO_2 emissions of the above trends. The method of the individual trend is already described in the previous section. However, if a number of trends occur simultaneously they will influence each other. Composition/decomposition methods assume the simultaneous occurrence of various trends, the outcome being sensitive to the sequence chosen. A number of conclusions can be drawn about the applicability and utility of these methods. Several methods to evaluate changes and measures exist. All give different results and one is not better than the other, so it is very important that when presenting the results the method chosen is also explained.

6.8 The policy narrative sheet – summarizing policy failures and successes

The final step in the policy analysis approach is to develop a policy narrative that summarizes the results of the policy analysis (steps A-D and the analysis of relative policy impacts, if known). The purpose is to develop credible statements regarding the adequacy of past and current policy responses for restoring and maintaining the state of the environment, and facilitating adaptation to impacts.

The policy narrative sheet should have components similar to those illustrated in Table 14.

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Table 14: Example of a policy narrative sheet.

Policy Narrative Sheet
Describe the Environmental Issue in terms of indicator trends for the State and key Drivers, Pressures and Impacts.
…
How effective is the policy mix that currently influences the environmental State and the key Drivers, Pressures and Impacts (compare indicator data to targets or benchmarks)?
…
What are the key policy gaps? • Is a policy type under-represented (economic, regulatory, expenditure, institutional policy instruments)? • Are policies not focusing on key Drivers, Pressures, the State or the Impacts? • Are relevant policies missing?
…
What are the key policy interlinkages, and are they positive or negative?
…
What are some of the key policy success stories?
…
What improvements are necessary for the current mix of policy instruments influencing this environmental issue to improve their overall effectiveness?
…

EXERCISE

Using the policy analysis information from Steps A through D, prepare (individually) a policy narrative sheet similar to the one shown in Table 14

Share your results with your workgroup. Select one policy narrative sheet from among your group to share in plenary.

Time: 30 minutes group, 15 minutes plenary.

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