Module 5:Integrated analysis of environmental trends and policies

Overview

Integrated analysis of environmental trends and policies is central to integrated environmental assessment (IEA). The integrated analysis described in this module helps to answer three questions:

1. How is the environment changing and why?
2. What are the consequences for people and the environment?
3. What is being done in response, and how effective is it?

To answer these questions, IEA analyses trends and changes in the environment and people's well-being using the drivers-pressures-state-impacts-responses (DPSIR) framework. This allows IEA to identify the drivers of human development and associated pressures that, along with natural processes, affect the state and trends of the environment. Environmental changes have impacts on ecosystem services and human well-being. To assess how society is responding to these impacts, and how effective its response is, IEA analyses policies aimed at improving and protecting the environment, as well as adaptation by people to environmental changes.

An integrated assessment of the state of the environment identifies priority issues of the environment and sustainability, specific indicators, and policy targets for a given issue. Such a process can also be used to assess impacts on human well-being. This module reviews two types of analyses of well-being: a qualitative analysis of impacts, and an analysis based on the ecosystem and human well-being framework.

The analysis of policy responses assesses existing policies in terms of both their ef-fects and their effectiveness. This approach includes both a consideration of the policy landscape to identify possible gaps, and an analysis of particular policies or policy mixes to determine their effectiveness in meeting targets. The policy analysis has four steps:

1. *Understanding the issue* to determine what is happening to the environment and why, and what the impacts are.
2. *Preparing a policy commitment review* to understand the array of high-level strate-gies affecting the environmental issue.
3. *Conducting a policy instrument scan* to identify the mix of policies influencing the environmental issue, and the effectiveness of this mix.
4. *Performing a policy gap and coherence analysis* to determine if relevant policies are in place and focused on the most important drivers and pressures.

1 Introduction and Learning Objectives

Integrated analysis of environmental trends and policies refers to a set of processes and methods for analysing the state of the environment (SoE), as affected by natural forces and human activities. Traditional SoE reporting that tries to answer the question "What is happening to the environment?" has existed for over three decades. Beginning in the 1990s, several countries adopted a broader, more integrated approach to SoE reporting that put greater emphasis on root causes, policy drivers and the impacts of environmental change. This approach, now known as integrated environmental assessment (IEA), was taken up and developed by UNEP in its Global Environmental Outlook (GEO) process.

At its core, the integrated approach to environmental assessment developed by GEO seeks to answer five key questions (Figure 1). In the first four modules of this training manual, you looked at issues related to setting up an IEA process and securing the mandate to build an impact strategy. In this module, you will work on the assessment itself, beginning with the first three key questions for IEA. You will address the fourth and fifth key questions for IEA in module 6 on scenarios.

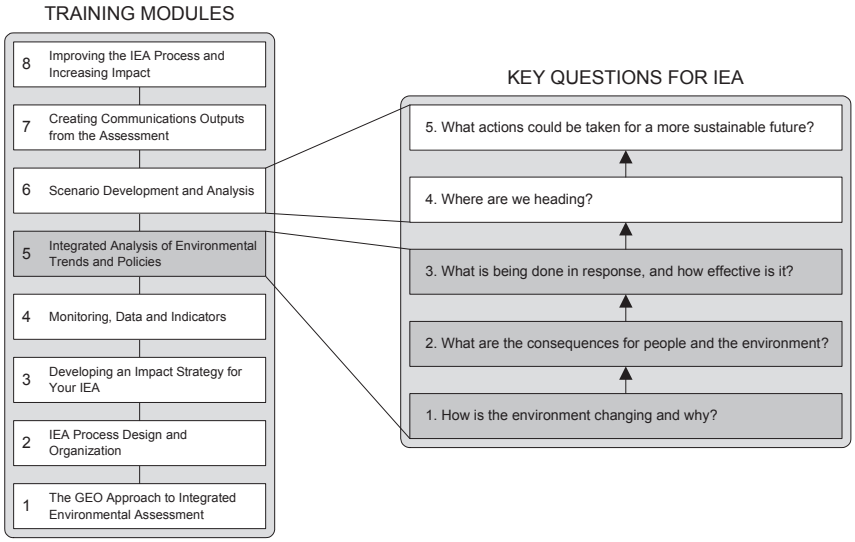


Figure 1. Key questions to be answered in the IEA framework.

This module is divided into three steps following the first three key questions for IEA in Figure 1. **Step 1** will introduce you to compiling and analysing quantitative and qualitative data on the status and trends of the environment. This will include data on the spatial and temporal aspects of change. You will also look at how various driving forces – natural and human – can influence environmental status and trends.

Step 2 will guide you through identifying environmental changes and analysing their effect on the environment's ability to provide specific services such as insect pol-lination of crops, regulation of atmospheric carbon, and the cultural and recreational values of landscapes. Here you will also investigate direct versus indirect impacts on human vulnerability and well-being, as well as the potential costs of these effects.

Step 3 involves identifying every policy that has an important influence on the environment and human well-being. This step also helps to determine the effectiveness of policies, and identify gaps and opportunities for improving policies.

After successfully completing this module, you will be ready to:

- Identify priority issues influencing environmental sustainability.
- Describe and interpret environmental change through time and space, by using qualitative and quantitative information, including indicators.
- Identify direct and indirect causes of environmental change.
- Identify and describe the impacts of environmental change on environment and society.
- Identify and analyse policy mechanisms and responses that directly or indirectly contribute – positively or negatively – to environmental change.

2 Defining the Boundaries of the Analysis

Analysing environmental status and trends presents a "cutting the cake" dilemma be-cause the environment is a complex subject. Its fuzzy spatial and thematic boundaries create a challenge for IEA practitioners in deciding which geographic areas to assess, and which themes, issues or resource sectors to focus on.

In this module, environmental themes are defined as broad categories of environ-mental concern, sometimes related to resources such as air or water. A given theme can include many interconnected environmental issues. Issues are specific and direct environ-mental concerns for stakeholders (e.g. land degradation, air and water pollution). Resource sectors include agriculture, forestry, fisheries, tourism and so on.

2.1 Setting spatial boundaries

In practice, the spatial boundaries of an IEA analysis usually follow political bounda-ries or ecosystem boundaries. In rare cases, such as a small island state or province, the two boundaries may coincide. Both types of boundaries have their advantages and disadvantages (Table 1).

Ecosystem 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 ecosystem scale (in particular s ocio-economic data). • Political complexity arising from analysis of resources in shared jurisdictions.
Political boundary	**Advantages** • More uniform regulatory environment • Simpler data collection • Direct connection to jurisdictional policies **Disadvantages** • Resource-specific trends masked by data collected at the jurisdictional level • Difficulty of detecting differences in ecosystem impacts of specific policies

Identifying political boundaries (e.g. states and provinces) should be straightforward. Identifying ecosystem boundaries, however, is a subjective process that depends closely on the questions you want to ask. A common and pragmatic approach to delimiting ecosystems is to use naturally occurring boundaries such as watersheds, floodplains, deltas and lakes. The case study of ecosystem-based assessment introduced in chapter 3, for example, focuses on a lagoon. Such “natural” ecosystems occur on many scales, and you should bear in mind that large ecosystems always include smaller ones. So defining an ecosystem boundary tends to be a matter of practical convenience, and is usually related to easily identifiable natural demar-cations.

2.2 Temporal scale

In contrast to SoE reports that typically assess past and current trends and changes, an IEA combines retrospective analysis with a future outlook. Defining the temporal scale – how far to look back and how far to look ahead – is important for conceptual clarity. It also has important methodological and technical implications.

Setting a retrospective limit, i.e. how far to look back, is relevant to this module. The question of a prospec-tive, or future, limit is relevant to the scenario analysis in mod-ule 6.

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

- On what timescale do the environmental issues you want to assess show appre-ciable or detectable change?
- Do you need to use one timescale for every issue, or can you choose a timescale appropriate to the dynamics of a given issue?
- How far back do you expect to have reliable data?
- How far into the future do you need or can you project environmental trends?

Besides technical feasibility and scientific rationale, you might also consider choosing a timescale that will maximize the IEA's impact. For example, the timescale could be linked to a landmark event, such as a key report, political declaration or other milestone, which serves as a point of comparison from the policy or progress point of view.

2.3 Thematic vs. sectoral breakdown

Since the environment is closely coupled with economic and social development, IEA analysis must cover an ever-growing circle of issues. Widening the scope of the analysis, however, raises questions about the way environmental themes and issues are analysed. Ultimately, the environment is a single integrated unit, and any division along thematic or sectoral lines should serve only to simplify analysis and communication.

Traditionally, the IEA analysis is organised around themes (e.g. air, water). From the perspective of policy, however, environmental issues under different themes often share the same set of socio-economic processes or policies. The development of transport infrastructure, for example, has implications for land cover, water quality and biodiversity. It would be difficult to reach a full understanding of such impacts if the analysis adopted a thematic approach.

Adopting a sectoral approach, however, may result in an incomplete picture of environmental change. 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 distinct alternatives, there are ways to combine the two, depending on the environmental problems and information needs of your country or region. Before starting an IEA analysis, your core group should have analysed its assessment needs and agreed on a clear set of goals and objectives (see module 3). In agreeing the context for an IEA, it is important to keep in mind that it will not be possible to cover all aspects of the environment in one assessment or reporting process. Further, assessment and monitoring should follow a continuous cycle, with a mix of both thematic and sectoral reporting at different frequencies (e.g. overall IEA reports every five years and shorter sectoral or indicator-based reports every year).

EXAMPLES

Some examples of sectoral and thematic reporting programmes at global and regional levels include:

- Global Forest Resources Assessment – http://www.fao.org/forestry/fra
- Global Biodiversity Outlook – http://www.cbd.int/gbo2/
- World Water Assessment Programme – http://www.unesco.org/water/wwap/
- World Energy Assessment – http://www.undp.org/energy/activities/wea/
- State of the Environment in Asia and the Pacific – http://www.unescap.org/esd/environment/soe/
- Asia-Pacific Environment Outlook – http://www.rrcap.unep.org/reports/apo2.cfm
- Greater Mekong Environment Outlook – http://www.roap.unep.org/pub/index.cfm

3 The DPSIR Analytical Framework

Because IEA deals with a system as complex as the environment and its interactions with society, a framework for analysis is essential to success. The framework guides the analysis from general concepts towards specific details, and ensures that all participants explore different aspects of the environment from a common starting point, proceeding collectively and in an informed manner.

Selecting an analytical framework:

- helps position the environment in relation to issues of sustainable development;
- helps establish qualitative cause-effect relationships supported by quantitative data and indicators;
- provides a communication tool for a multi-sectoral and multidisciplinary group to work 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 analytical frameworks exist for environmental analysis, including ecosystem well-being, capital-based, issue-based, sectoral and sustainability frameworks. Each has its advantages and disadvantages. The IEA assessment discussed in this module is based on the Drivers-Pressures-State-Impacts-Responses (DPSIR) framework. This is the framework used in the GEO process. For training purposes, this module uses a simplified version of the GEO framework (see Figure 2 and Box 1 below).

The DPSIR framework guides you in telling an integrated story about an environ-mental issue. Arrows in the diagram indicate general cause-effect relationships among components of the framework. Although some relationships are straightforward and easy to show, many are complex, with effects attributable to multiple causes, related to different actors, and operating on multiple temporal and spatial scales.

The DPSIR framework has several advantages. It allows a simple and intuitive analysis when focused on a single issue. It also integrates complex environmental and socio-economic issues, highlighting human-environment interlinkages and analysing the impact of environmental change on human well-being. This integrated approach also means that the framework brings together multiple stakeholders with different expertise and perspectives. However, the framework can make it difficult to see horizontal linkages among environmental issues, and it offers little guidance on the types of impacts that can occur, or the types of policy responses you might consider.

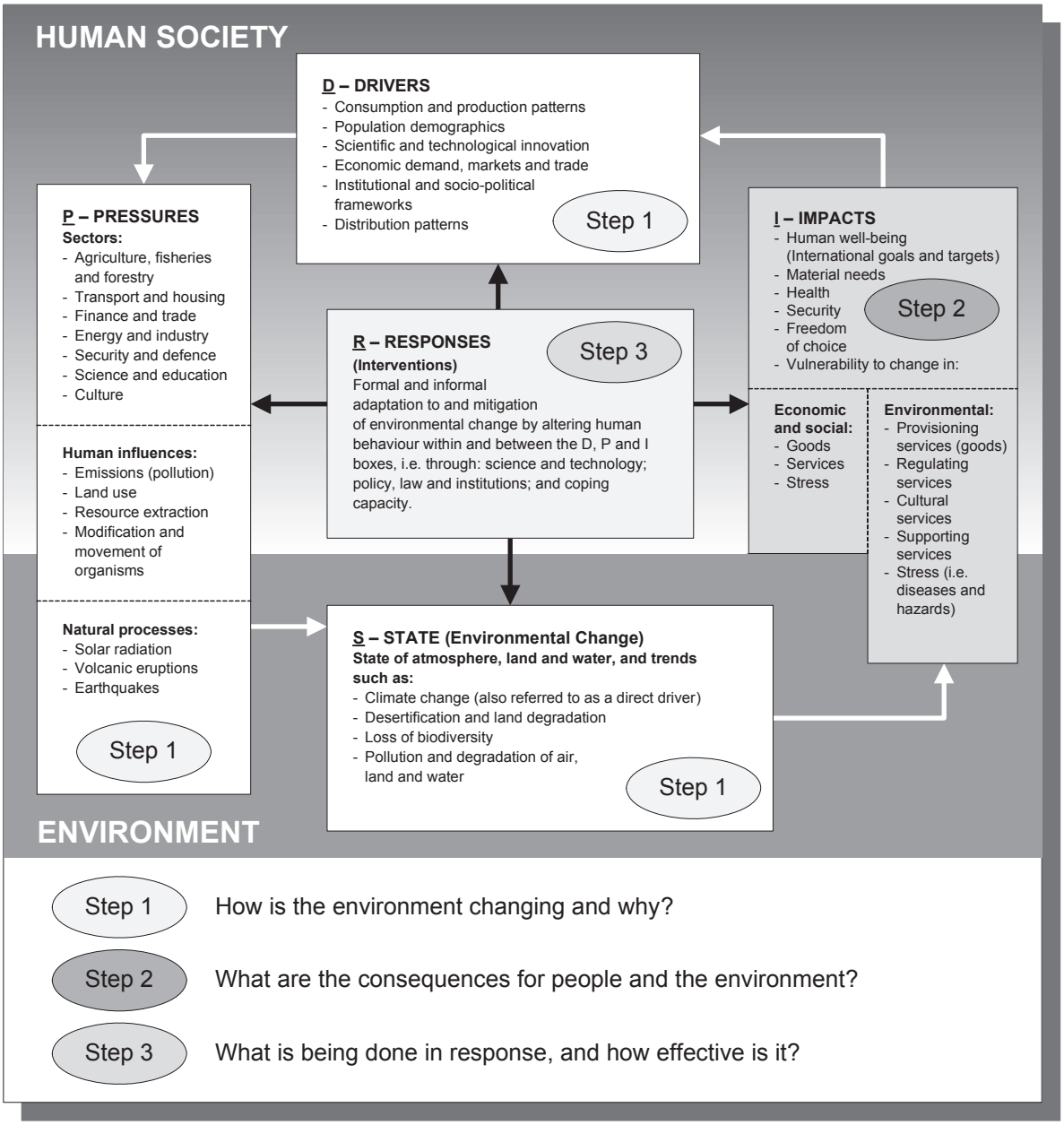


Figure 2. Simplified DPSIR analytical framework for IEA and reporting. For more information, see Box 1.

Box 1. The DPSIR framework: definitions and explanation

Analysing the **STATE** and **TRENDS** of the environment is central to IEA. This involves identifying priority environmental state issues, and analysing changes retrospectively through space and time. To effectively answer the question "How is the environment changing and why?" (Figure 1), the analysis of state variables must be accompanied by an understanding 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 modification and movement of organisms). These pressures lead to changes in the **STATE** of the environment (e.g. climate change, ozone depletion, changes in biodiversity and pollution), in addition to those resulting from natu-ral processes.

These changes affect the ecological services that the environment provides to humankind, such as 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, habi-tat quality and quantity, and biodiversity. As a result of changes in ecological services mediated by demographic, social and economic factors, there are IMPACTS on human well-being (health, economic performance, material assets, social relations and security).

Society's **RESPONSES** can influence these environmental states and their associated pressures and drivers (either intentionally or unintentionally). **Responses** fall under two broad categories: 1. responses which help society mitigate exposure to environmental im-pacts (e.g. through environmental restoration or enhancement); and 2. responses which help society adapt directly to the impacts that occur or build the capacity to adapt to envi-ronmental changes. Societal responses include formulating and implementing public pol-icy, laws and establishing or strengthening institutions, as well as making 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.

It is clear that environmental issues are interlinked. An understanding and appreciation of these interlink-ages is part of telling an integrated story of an environmental issue. For ex-ample, a driver such as popula-tion growth in a forested watershed can cause many envi-ronmental pressures, including increased logging and sewage discharge into rivers. Simi-larly, a pressure can have effects on many environmental states (e.g. logging affecting the state of forest cover, soil quality and, in turn, water quality).

CASE EXAMPLE

Using the DPSIR framework to tell an integrated story about water quality issues in Chilika Lagoon, Orissa, India (ecosystem-based assessment).

Chilika Lagoon is the largest lagoon on India's eastern coast, covering an average area of 760 km2. The Chilika drainage basin, including the lagoon itself, covers over 4,300 km2 (Figure 3). Freshwater runoff from the basin, combined with saltwater inflows from the ocean, results in a wide range of fresh, brackish and salt water environments in the lagoon. This diverse and productive ecosystem supports high levels of biodiversity and an impor-tant fishery for over 200,000 people. In recent years, natural and human-induced changes have degraded the lagoon, threatening many of its uses. A restoration initiative launched in the early 1990s has helped to reverse these changes, but serious challenges remain.

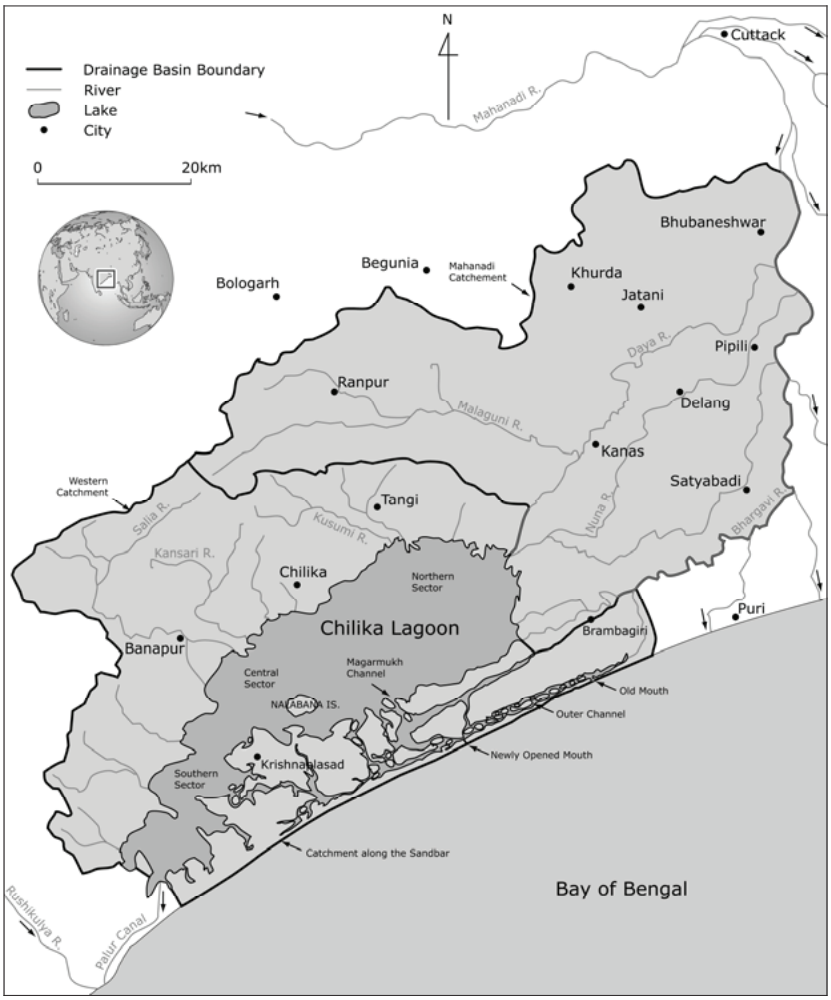


Figure 3. Chilika Lagoon and drainage basin, Orissa, India.

State: By the 1990s, gradual blockage of the lagoon's mouth by silt from upstream catch-ments, as well as oceanic longshore transport, had caused salinity levels to fall and reduced the area and depth of the lagoon. Siltation, declining salinity and an increase in nitrate lev-els allowed freshwater aquatic weeds such as Eichhornia crassipes and Potamogeton spp. to proliferate.

Among the direct **Pressures** on Chilika Lagoon are rapid drainage basin erosion, chemical runoff from surrounding agricultural land, and sewage intrusion from surrounding villages and the nearby state capital of Bhubaneshwar. The growth of commercial prawn farming in the lagoon since the 1980s, together with a steady expansion of fishing grounds, has also affected water quality and sediment transport.

The key **Drivers** behind these pressures include agricultural intensification and deforesta-tion in the drain-age basin of the lagoon. In the lagoon area itself, high population growth rates in the 1990s, together with rising prawn export prices that encouraged a shift of non-fishers into fishing, forced local fishers to opt for intensive prawn farming. People also started prawn farming in open areas and the lagoon periphery, and began catching large numbers of juvenile prawns for sale to prawn culture ponds.

Degradation of Chilika Lagoon had a serious **Impact** on the services it provides. Siltation, declining salinity, weed growth and overfishing reduced the recruitment and yields of sev-eral important fish and crustacean species. The decline in yields led many fishers to use a smaller mesh size, so putting even greater pressure on the fishery. Weed growth also con-tributed to a decline in bird populations, already threatened by hunting and habitat loss in the drainage basin. These declines in biodiversity not only affected local livelihoods, but also reduced the attractiveness of the lagoon as a tourist destination.

The **Response** of India's government and the state government of Orissa to these issues has comprised various policies and policy instruments. The lagoon island of Nalabana was declared a national bird sanctuary in 1973, and Chilika Lagoon itself was added to the Ramsar list of wetlands of international importance in 1981. In 1992, the state government of Orissa created the Chilika Development Authority (CDA) to coordinate a participatory restoration strategy for the lagoon. The main actions of this strategy have been the cutting of a new mouth to the ocean in 2000, and dredging of the lagoon's outer channel. These have restored the lagoon's flow regime, increasing salinity and reducing weed growth. Fishery yields have increased substantially, and several key fish and crustacean species have returned to the lagoon. Other measures include micro-watershed management, pro-tection of bird habitats, local socio-economic development and continuous monitoring (Figure 4).

Although these efforts have helped to restore Chilika Lagoon, several challenges remain. Siltation, sewage inflow and agricultural chemical runoff still pose a threat to water qual-ity. The lagoon's hydrological regime is also threatened by dam and barrage construction for irrigation projects in the drainage basin. Uncontrolled tourist activity is also a problem, as is illegal encroachment for prawn culture.

Source: Ghosh, A. K and Pattnaik, A. K. (2005) Chilika Lagoon: Experience and lessons learned brief. In: ILEC, *Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders*. International Lake Environment Committee Foundation, Kusatsu.

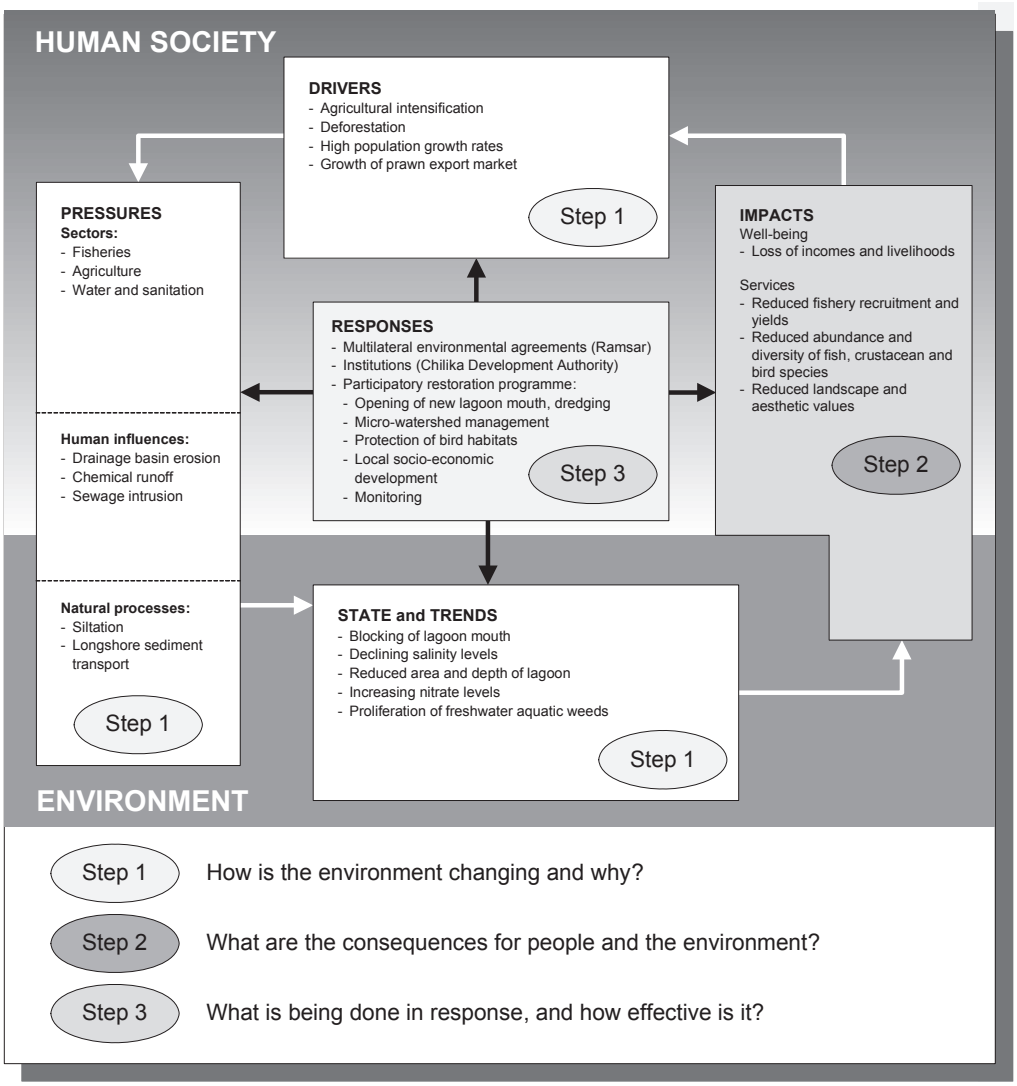


Figure 4. DPSIR analysis for Chilika lagoon, India

EXERCISE

Using the template in Figure 5 below, 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 environ-mental 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, laws and institutions contribute to restoring or enhancing the environment (i.e. have an influence on the environmental state, pressures and drivers)?
- What policies, laws and institutions have helped (or hindered) the ability of communi-ties and businesses to adapt to the impacts of changing environmental state?
- What technologies have facilitated mitigation or adaptation, or both?

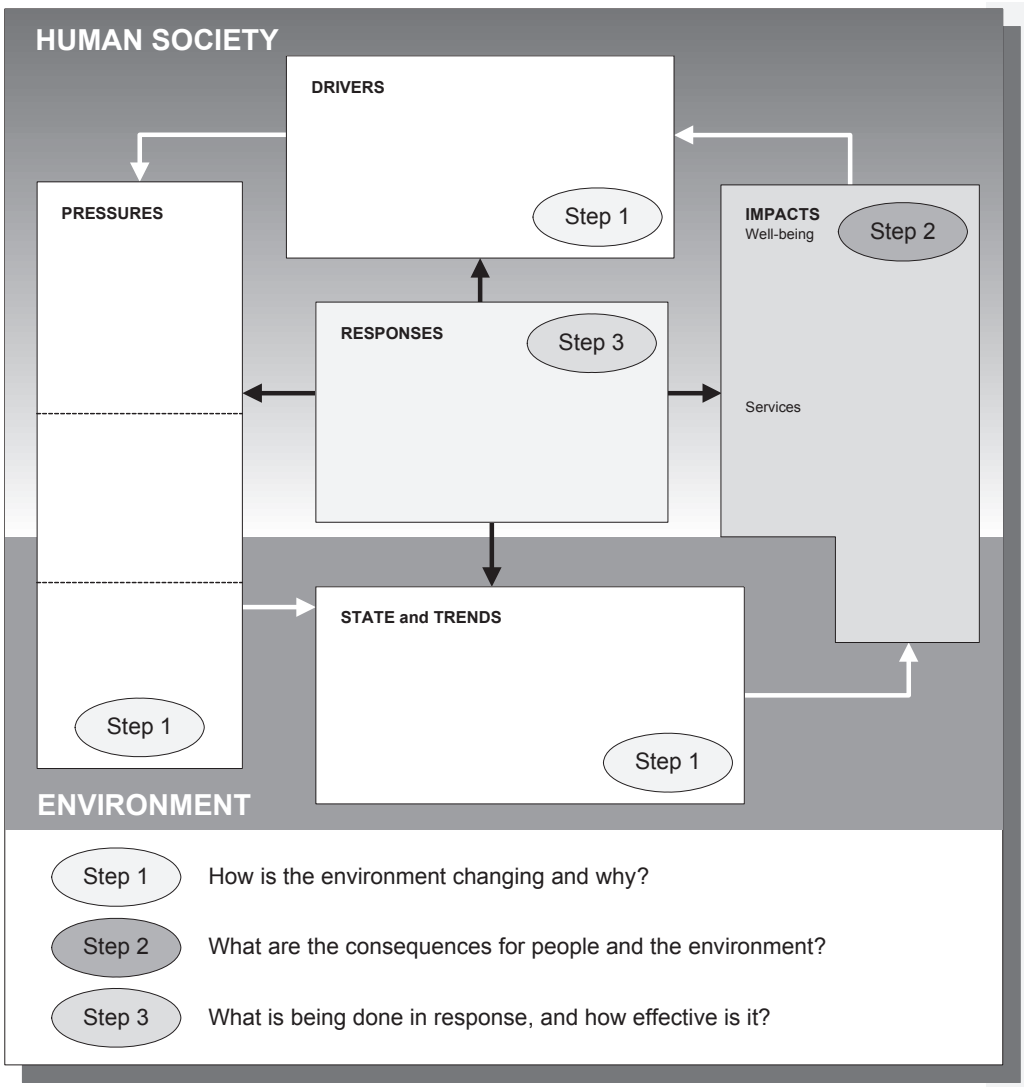


Figure 5. DPSIR framework exercise

4 Step 1: How is the Environment Changing and Why?

The first step in the GEO approach to an IEA is to address the question: *How is the envi-ronment changing and why? (refer to Figure 1).* This question can be answered by using the DPSIR analytical framework to investigate more specific questions, such as:

- What are the priority environmental issues (e.g. water quality, air pollution, biodiver-sity)?
- 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 describe these states, pressures and drivers?

The following questions provide guidance for addressing these questions.

4.1 Identifying the priority environmental issues

To carry out an IEA, it is essential to prepare a list of the 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 participants to understand. The list should be in a format that allows participants to make contributions eas-ily.

Various methods can be used to identify the important issues for a state-and-trend envi-ronmental analysis. One method is brainstorming in multi-stakeholder groups or breakout groups of IEA participants. Other methods for developing a list of issues include:

- Multiple expert and stakeholder consultations (smaller groups than brainstorming).
- Surveys of individual experts and stakeholders by e-mail, telephone or regular mail.
- Review of the relevant literature.

Note that these approaches are not mutually exclusive.

In most cases, 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 list of themes as a starting point. Table 2 below summarises the general themes of GEO-4 and some other environmental assess-ments.

Table 2. 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, fresh water ▪ Biodiversity ▪ Regional perspectives

Report	State-and-trends of the environment themes and issues
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 ▪ Fresh water ▪ Biodiversity ▪ Marine and coastal regions
Africa Environment Outlook – 2	▪ Atmosphere ▪ Biodiversity ▪ Coastal and marine ▪ Forests ▪ Fresh water ▪ Land ▪ Urban areas

EXERCISE

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

- Discuss and record key environmental issues related to the state and trends of the envi-ronment in your country.
- Categorize your issues according to general environmental theme.
- How many different themes did your group identify? How many specific issues under a given theme can be expressed as a single issue?

In plenary, carry out the following tasks:

- Combine the work of all groups into one table.
- Determine the general themes for the overall group. Organize all specific environ-mental issues according to those themes.
- Combine related specific issues as appropriate.

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

The list that emerges from the process of identifying issues and themes is often longer than can be accommodated in a national IEA reporting process, given the constraints of time and resources. So it is necessary to prioritize both specific issues and themes.

Prioritization presents many challenges, including the choice of criteria for assigning pri-orities, stakeholder legitimacy and preferences, and the relationship to priorities in official policy statements. A range of techniques is available to help prioritize issues, including brainstorming issues, expert consultations and surveys. Whichever technique you choose, it is important to identify key criteria to distinguish higher priority issues from lower prior-ity ones. It is also important to have an idea of the number of specific issues that can be accommodated in the reporting process.

It is important to note that the list of priorities identified during an IEA may be refined or rearranged later in the process, perhaps because of a lack of data.

EXERCISE

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

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

Complete the worksheet below for your country.

What is the general theme?	What is the environmental 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 Specifying STATE-and-TRENDS of the environment for each issue

The priority environmental issues you identified above are often quite general. As we go forward, it is important to be more specific about each issue. This will make it easier to identify how the environment is changing and why.

Take water quality for example. This issue is sometimes described in an aggregate form, for example as a national water quality index. To conduct an integrated analysis, it is nec-essary to think of water quality in a more specific and targeted context. For example, a certain river and lake system may be particularly problematic at the time you are develop-ing your IEA. The following case illustrates this level of specificity, building on the earlier case study of Chilika Lagoon in chapter 3. This example will be used in later sections to illustrate the telling of an integrated story using the DPSIR framework.

CASE EXAMPLE

The state of water quality in Chilika Lagoon, Orissa, India.

For an example of an environmental state issue, consider the level of salinity in Chilika Lagoon. This is dictated by river discharges during different seasons, wind action, and the extent of tidal inflow carrying sea water from the Bay of Bengal. By the mid-1990s, the reduced inflow of saline water caused by narrowing of the lagoon mouth had caused aver-age salinity to fall by a third.

Figure 6 illustrates the decline in average salinity between 1957–58 and 1995 for Chilika Lagoon. This decline is relevant for IEA analysis, as salinity is the dominant factor deter-mining the lagoon's ecology. Any change in salinity will affect the abundance and diver-sity of its fish and crustacean populations. The data on salinity alone, however, are insuffi-cient to understand the nature of water quality problems in the lagoon. Other causal agents may also be at work, and these will need to be monitored and understood.

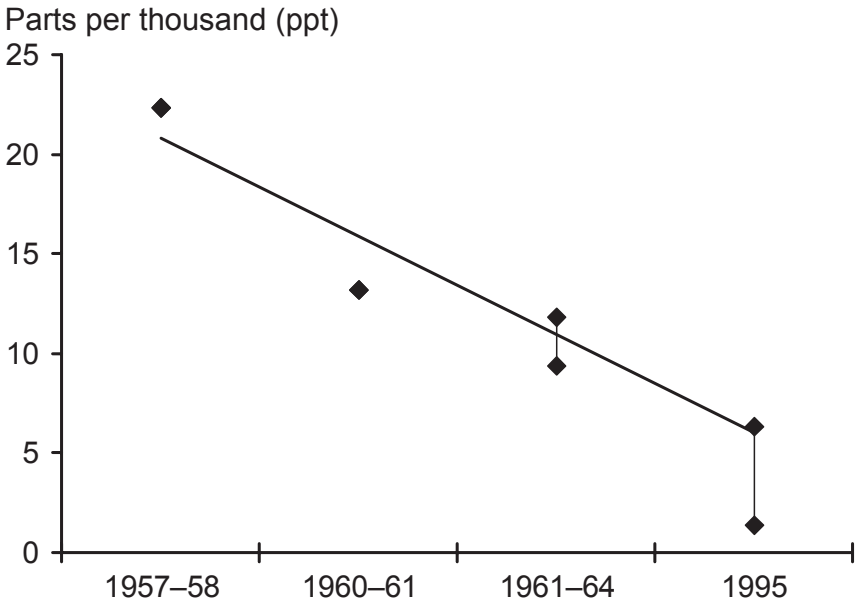


Figure 6. Average salinity for Chilika Lagoon. The data points for 1961–64 and 1995 represent maximum and minimum values. *Source*: **Ghosh and Pattnaik (2005).**

4.3 Identifying the DRIVERS and PRESSURES causing environmental change

Once you have come to understand the environmental state, you can start to develop an integrated story of what is happening to the environment and why. This is accomplished by answering the question: Which pressures and drivers have caused the change?

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 by identi-fying a pressure, which is readily identifiable as a cause of the environmental change. For example, sewage discharge from upstream communities represents a pressure leading to 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

Drivers and pressures affecting the state of water quality in Chilika Lagoon

The decline in salinity and other changes in water quality in Chilika Lagoon result from several direct pressures, both natural and human. Longshore sediment transport along the coast of the Bay of Bengal tends to shift the lagoon's mouth every year, restricting tidal exchange. Upstream erosion and sedimentation also contribute to choking of the lagoon and loss of lagoon bed depth. Further, the introduction of prawn culture in the 1980s con-tributed to substantial changes in hydrology and sediment transport, largely because the split bamboo and fine mesh nets used to encircle culture areas prevented free sediment flow.

The high nitrate concentrations observed in Chilika Lagoon result from land drainage car-rying agricultural fertilizers. The use of fertilizer in the drainage basin nearly doubled be-tween 1986–87 and 1997–98. Agricultural runoff has been exacerbated by the lack of soil conservation measures. Untreated domestic wastewater from the state capital of Bhu-baneshwar and the 114 surrounding villages also finds its way into the lagoon.

The drivers of these pressures include agricultural intensification and deforestation in the drainage basin of the lagoon. High population growth rates, coupled with the rapid growth of prawn culture, have also contributed to the pressures on water quality. The major push for exploiting wetland resources such as Chilika began when India started a national proc-ess of structural adjustment and market liberalisation in 1991. These policies created a price gap between traditional species and those demanded by export markets, such as tiger prawn (Figure 7). The price of export-quality tiger prawn rose sharply from Rs 280/kg in 1992 to Rs 420/kg in 1996–97. This made exporting commercially attractive and attracted numerous non-fishers to the trade. By 1996 the number of active fishers in the lagoon had grown to over 27,000, compared with 8,079 in 1957.

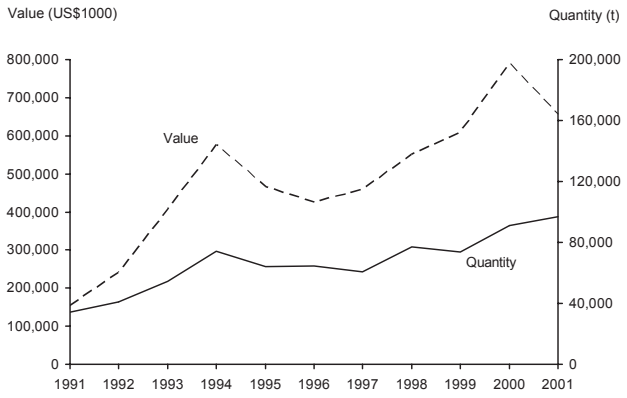


Figure 7. Growth in production and value of giant tiger prawn (Penaeus monodon), India, 1991–2001. Data are for prawn cultured in brackish water. *Source*: FAO Fishery Statistics (http://www.fao.org/fishery/statistics).

EXERCISE

- Form groups of 4–5, and select a specific environmental state for the exercise.
- Use the DPSI Story Sheet (Figure 8) to record the environmental STATE that is the focus of your issue.
- Identify PRESSURES and DRIVERS that influence the environmental state you have selected. Draw lines between pressures and drivers that are linked.
- Complete the worksheet for discussion in plenary. Impacts will be identified in a sub-sequent exercise.

Q: Do you have enough knowledge to identify all relevant relationships in a theme or is-sue? If not, who else should be involved to complete the analysis?

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

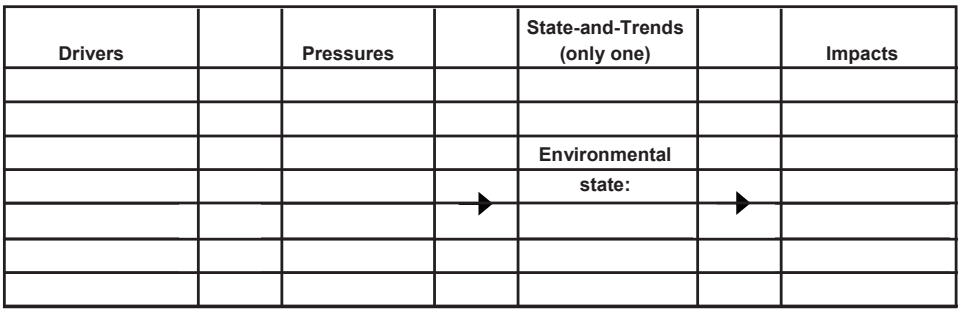


Figure 8. The DPSI Story Sheet.

An integrated story should not stop at understanding the chain of causality for one specific issue. IEA also looks for linkages among environmental issues. A direct or indirect driver identified for one issue could be having an effect on other environmental issues. For ex-ample, you might be concerned about the state of water quality in a river, and might iden-tify sewage discharge upstream as a direct pressure on this state. Could this sewage dis-charge be acting as a pressure on other environmental states? It is possible that the dis-charge affects the state of air quality (e.g. odour) in surrounding communities. The driver of population growth could also cause increased agricultural activity, which in turn could cause an increase in deforestation.

EXERCISE

Identify interlinkages among environmental issues.

In your group from the previous exercise:

- Transfer the environmental state, key pressure and associated drivers from your DPSI Story Sheet to an interlinkages table like the one in Figure 9.
- Starting from the driver, identify two other pressures. Go on to identify other environ-mental states that could change as a result of each pressure. Note the multiple linkages between 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 (pick two groups to present).

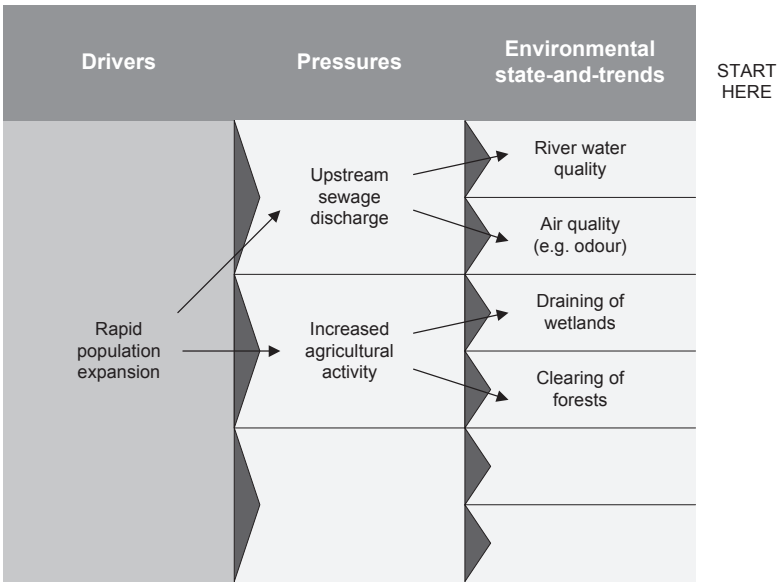


Figure 9. Analysing drivers, pressures, and states and trends.

4.4 Selecting appropriate INDICATORS to describe environmental states, pressures and drivers

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

The development of data and indicators is covered in detail in module 4. Participants with no previous experience of indicators are urged to review module 4 carefully before con-tinuing with this section.

4.4.1 Working with indicators

The choice of indicators determines the kinds of data needed for an IEA, helping to struc-ture 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 can be clearly communicated. Where data are available, suitable indicators can offer:

- Description of historical trends in priority issues.
- Spatial patterns of change.
- Analysis of progress relative to targets, benchmarks or reference values.

To avoid selecting indicators haphazardly, we use selection criteria. Various selection cri-teria have been developed. The management community, for example, has developed the SMART criteria. These require indicators to be:

- Specific
- Measurable
- Achievable (and linked to policy targets)
- Relevant
- Time-bound (i.e. sensitive to changes within policy time frames)

Indicators should be presented with information that helps interpretation. A sample presen-tation template is shown in Figure 10.

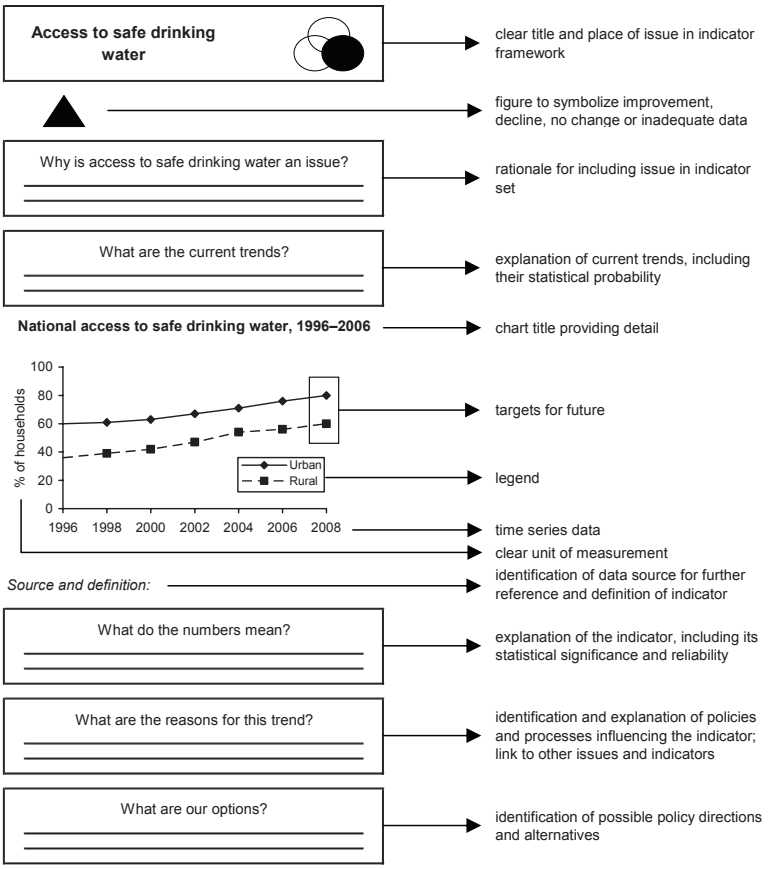


Figure 10. General template for presenting indicators.
Source: Modified after Pintér, Zahedi and Cressman (2000).

EXERCISE

In groups of five, identify indicators for each priority theme/issue from the previous exer-cise 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 identified potential indicators and collected relevant data, you can start to analyse those data for trends. The integrated story, describing causality between environ-mental states and their key drivers, is only the outer layer of analysis. Beneath it are more detailed stories, each of which helps us better understand how the environment is changing and why. Exposing this lower layer means analysing indicators to identify correlations and explain key temporal and spatial patterns. A good place to start is the analysis of the pres-sure indicator to get to the core of the issue, as in the example below.

CASE EXAMPLE: **Advanced**

Identifying and explaining trends in energy intensity in China

Energy is essential for economic and social development, but consumption of fossil fuels is a major cause of air pollution and climate change. Energy intensity – the ratio of energy use to economic output – is one indicator of this pressure. Figure 11 charts China's energy intensity for the period 1980 through 2004.

Consider a historical analysis as the first step in identifying and explaining trends in a pressure indicator. Between 1980 and 2002, China's energy intensity declined by three-quarters. Industry accounts for about 70% of total energy consumption in China, and this decline can be attributed to a structural shift from energy-intensive industries to the ser-vices sector and less energy-intensive industries (UN 2006).

After 2002, however, China's energy intensity started to rise. According to Liao et al. (2007), it rose by 10.7% between 2003 and 2005, only to decline again by 1.2% in 2006. What induced China's energy intensity to fluctuate so drastically?

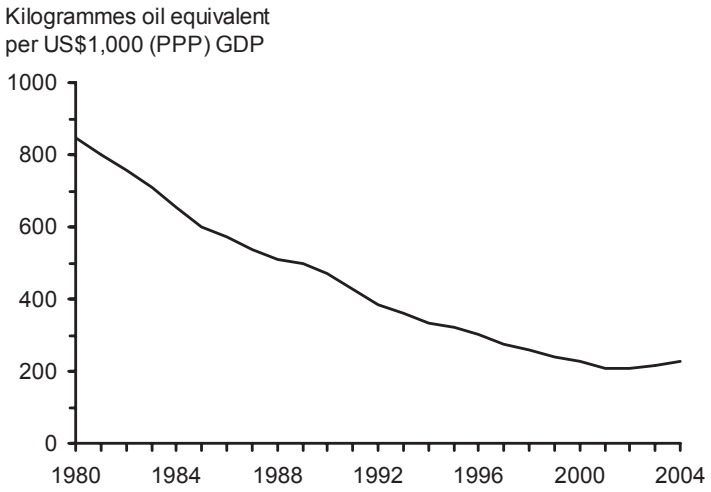


Figure 11. Energy intensity in China, 1980–2004. *Source*: United Nations Statistics Division(http://mdgs.un.org/unsd/mdg/Data.aspx).

In looking at the output of energy-intensive heavy industries, such as iron and steel, we see rapid growth in the first years of the new millennium (Figure 12). Between 2000 and 2005, the output value of China's iron and steel industry more than quadrupled, and its share of gross industrial output value rose by more than a half. It would appear that this expansion in iron and steel, and other heavy industries such as cement and petrochemicals, over-whelmed the benefits of any efficiency gains or structural shift among sub-sectors, leading to an increase in overall energy intensity. The subsequent decline in intensity can be at-tributed to government efforts to discourage energy-intensive processing and promote effi-ciency improvements.

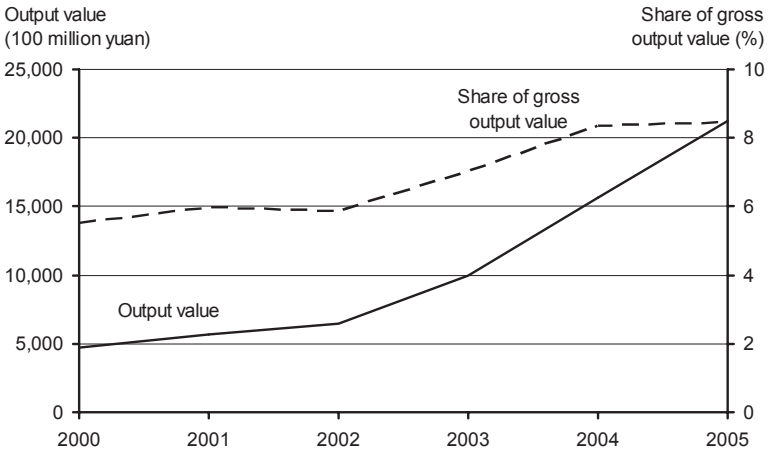


Figure 12. Increasing output value and share of China's iron and steel industry, 2000–05. *Source*: China Statistical Yearbook (various years).

5 Step 2: What are the Consequences for People and the Environment?

With the understanding you gained in Step 1 of how the environment is changing and why, the second question to address is: What are the consequences for people and the environ-ment? or, put simply, What are the impacts?

For the purposes of this training module, this second step has been separated into two dif-ferent levels of formal training, namely for the beginners and those who had some past experience in IEA Methodology:

- Basic analysis (Section 5.1): For groups or individuals conducting an IEA for the first time, specific impacts can be identified based on past experience and data, which pro-vide an understanding of what is happening to the environment and why. An under-standing of environment-development linkages, as applied to a given context, may be sufficient to perform the analysis.
- Intermediate analysis (Section 5.2): Those who have previous experience with IEA methods might identify impacts of changes in various states of the environment using the concepts of ecosystem services and aspects of human well-being adopted in GEO-4.

Please note that a third, advanced level of training covered in Module 5 of the global GEO Resource Book has been omitted from this module. Groups familiar with concepts of eco-system services and with some experience with economic analysis may refer to the global GEO Resource Book for guidance on this level.

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

The concept of sustainable development tells us that economic, social and environmental conditions are closely interrelated – that is, it is not possible to change the condition of one dimension without affecting the other two dimensions. It also tells us that actions to meet our needs today should not compromise the ability of future generations to meet their needs.

As a basic guideline for analysing impacts, sustainable development helps us think in four dimensions: economic, social, environmental, and temporal. It also helps us reflect on en-vironment-development linkages. Hence changes in a particular state variable will almost certainly have an impact on other aspects of the environment and on people's well-being. Many of the important impacts can be identified through the experience and knowledge of IEA participants.

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

EXERCISE

- Rejoin your group of five, and identify potential impacts of the changes in environ-mental states your group selected previously. Use the concept of sustainable develop-ment to help you identify impacts.
- Complete your DPSI Story Sheet using the template provided (Figure 13).

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

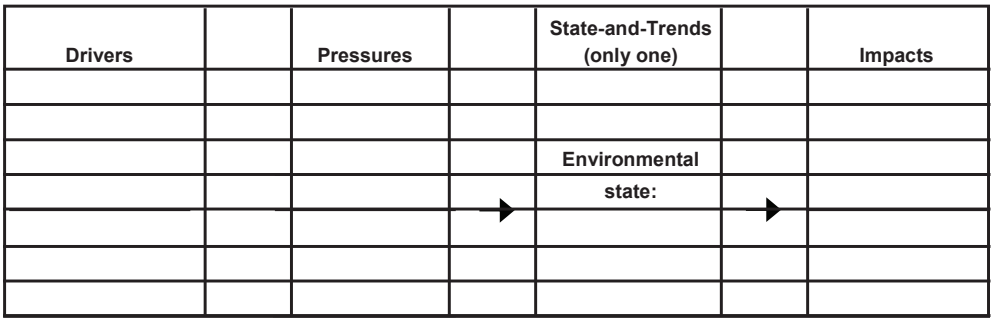


Figure 13. DPSI Story Sheet

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

The basic analysis discussed above shows that it is possible to identify impacts based on prior experience, knowledge, and a basic understanding of sustainable development. A more detailed analytic framework, such as the one adopted in GEO-4, can help identify more specific impacts.

The DPSIR framework illustrated in Figure 2 above describes aspects of human well-being affected by demographic, institutional and material factors. These aspects in turn are influ-enced by environmental factors: ecosystem services, non-ecosystem natural resources such as hydrocarbons, minerals and re-newable energy, and stresses such as disease, radiation, pests and hazards.

Ecosystem services are benefits that people obtain from ecosystems, in the form of provi-sioning services, cultural services, and regulating and supporting services (Table 3).

Table 3. Examples of ecosystem services (from the 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 chemicals and biological materials are derived from ecosystems.
	Ornamental resources	Animal products, such as skins and shells, and flowers are used as ornaments, though the value of these resources is often culturally determined.

Category	Service	Description
	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 water treatment	Ecosystems can be a source of impurities in fresh water, but also waste treatment 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 diseases 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.
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 values 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.

Category	Service	Description
	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” associated with recognized features of their environment, including aspects of the ecosystem.
	Cultural heritage values	Many societies place a 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 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 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 the example of water quality degradation in a lake. An indicator of water quality could be phosphorus concentration, Chlorophyll-A measurements, one of the parameters of trophic status, or aquatic plant counts. For this example, a change in an indicator could be linked to impacts on ecosystem services, as illustrated in Figure 14.

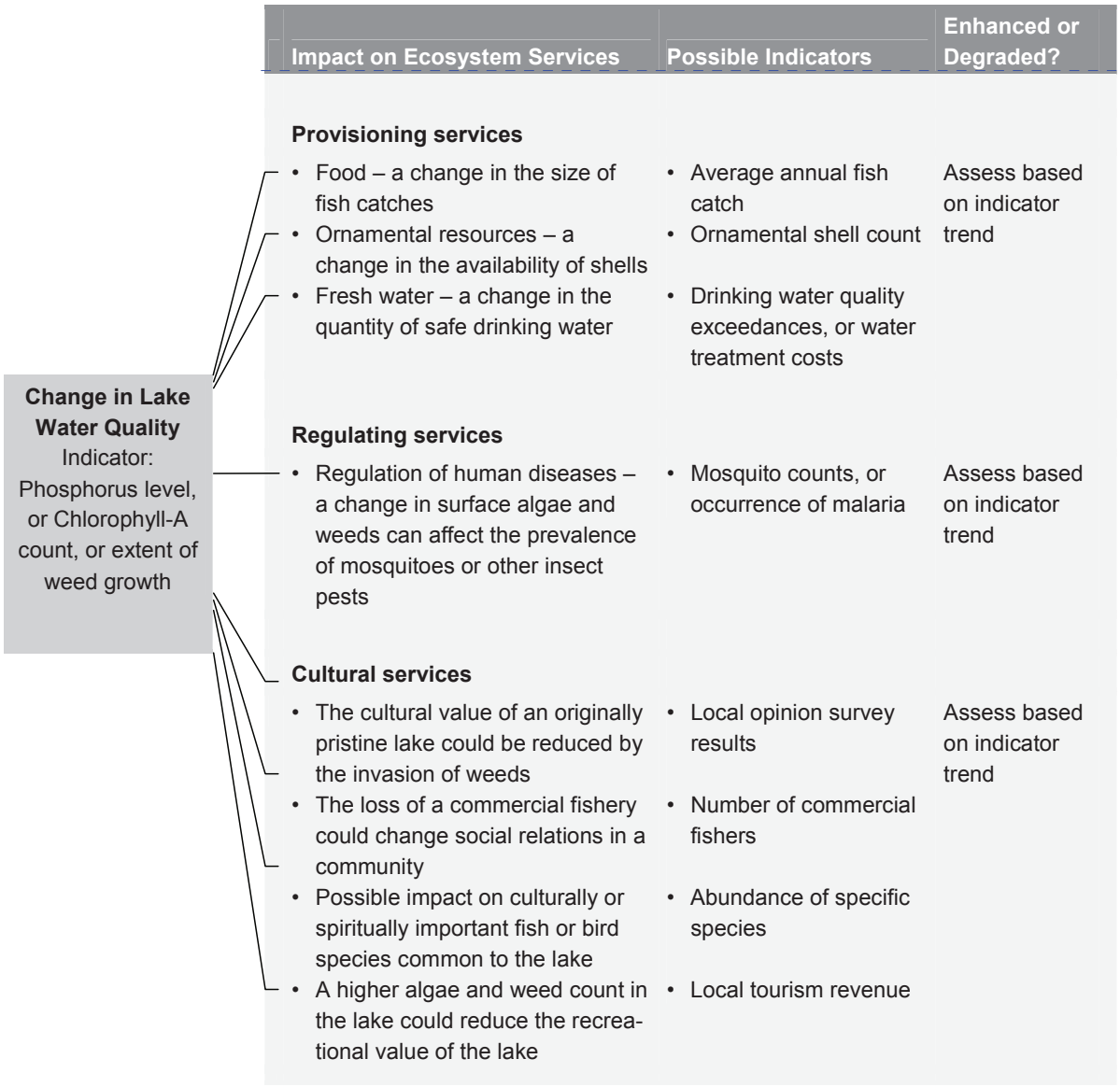


Figure 14. Example of impacts on ecosystem services from a change in lake water quality.

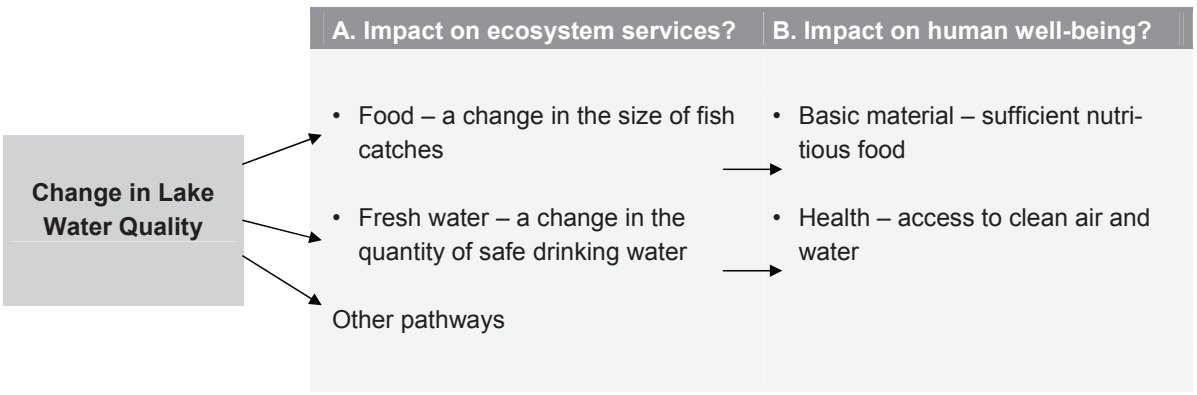


Figure 15. Diagram of possible impact pathway for a change in lake water quality.

CASE EXAMPLE

Impacts from decreasing salinity and increasing nitrate concentrations in Chilika Lagoon.

As previously described, siltation, decreasing salinity and increasing nitrate levels affected ecosystem services and human well-being in Chilika Lagoon. These changes resulted in rapid growth of freshwater aquatic weeds (Figure 16), and restricted the free movement of juvenile fish and crustacean species from the sea into the lagoon. They also affected the breeding and spawning grounds of many important fish, mollusc and crustacean species.

As a result of these changes, fish and prawn catches declined rapidly, from over 8,000 ton-nes in 1986 to just 1,600 tonnes in 1997–1998. Family incomes fell, and the resulting pressure to maintain livelihoods led to overfishing, poaching of migratory birds and log-ging in the lagoon's drainage basin.

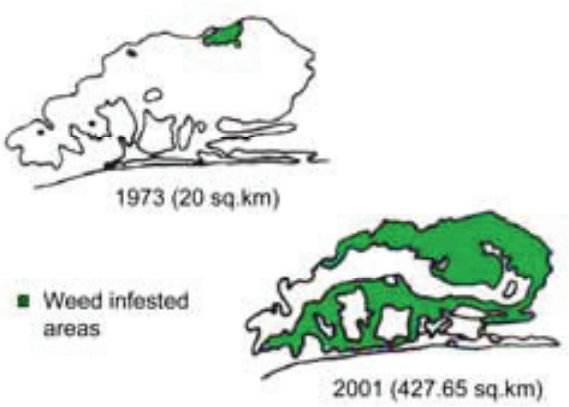


Figure 16. Growth in area covered by weeds between 1973 and 2001, Chilika Lagoon.

EXERCISE

Developing an Impact Pathways Diagram

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

- Identify which ecosystem services (from column two of Table 3) might 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 have identified.

Designate one person from each group to present your results in plenary.

Time: 40 minutes group, 30 minutes plenary.

6 Step 3: What is Being Done in Response, and How Effective is It?

After analysing how the environment is changing and why, and what the impacts are, the third step in the IEA is to address the question: *What is being done in response, and how effective is it?* This involves a retrospective analysis of what has been done, and is being done, to maintain and enhance the environment and human well-being. This information paves the way for the forward-looking policy analysis discussed in module 6.

This third step in the IEA analysis deals with societal responses. These include govern-ment policies, plans and programmes, as well as the actions of civil society and businesses through such interventions as science and technology.

Responses can affect many aspects of an environmental issue, including its state (e.g. af-forestation affects the state of forests), pressures (e.g. housing construction), drivers (e.g. population policies), and even the impacts of changes in environmental state (e.g. actions which help communities adapt to a lack of forest cover, such as alternative fuels or build-ing materials).

Generally speaking, actions which influence drivers, pressures and environmental states help to reduce society's exposure to a change in the environment. In contrast, actions which alleviate the impact of a change 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 chapter focuses on government policy as the principal societal response. To help you better understand what policy means, section 6.1 gives an overview of policy and policy analysis. Sections 6.2–6.7 introduce you to five simple steps for analysing the existing policies that may be influencing environmental issues in your country.

You should note that separating the analysis of policies from the description of underlying environmental status and trends might lead to a more fragmented report. However, cluster-ing the environmental assessment for all issues helps analyse cross-cutting issues within the environmental domain, and discussing policy matters in a separate section may facili-tate comparison.

6.1 Background to policy analysis

For the purposes of this module, policy may be defined as:

> 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

(Jenkins, I. 1978. *Policy Analysis: A Political and Organisational Perspective*)

Policies come in different forms. Explicit policies are articulated and announced clearly. Examples include press releases, government policy papers, ministerial speeches, regula-tions and laws. Implicit policies are not as clearly stated or explained, but can be equally powerful. Often, these result simply from the gradual accumulation of decisions made over time. Although each of these decisions may have little impact on the environment, together they can have far-reaching effects.

Policies are usually developed in response to a problem. Addressing specific problems in democratic societies often takes a predictable course, called the policy life cycle. In simpli-fied form, the typical cycle has four stages: recognition, formulation, implementation and control.

While a policy can be described as an interrelated set of decisions and goals, a policy in-strument is a tool or mechanism used as a means to accomplish particular policy goals. Many ways exist to categorize policy instruments, including grouping them into economic, regulatory, expenditure and institutional categories (Table 4). One class of policy instru-ments with special relevance to some environmental issues is the multilateral environ-mental agreements (MEAs). These typically cover environmental issues that affect more than one country or in some cases the entire global community.

Policy requires shaping and managing people's behaviour. Those groups of people af-fected by policy, either positively or negatively, are important actors in the policy life cy-cle. Policy actors can be broadly categorized into three sectors of society: state, market and citizen.

Policies are made by a wide range of players called policy-makers. In democracies, public policy-makers are usually elected officials or their appointees. In the private sector, policy-makers are chief executive officers, boards of directors and other top-ranking corporate officials.

Policy makers usually are influenced by special interest groups, such as lobbyists, political groups, individuals, corporations, donors, NGOs and others. A second group important in influencing policy consists of technical advisors or policy analysts who advise and inform policy-makers on different options and their likely effects. In democratic societies, a third group that influences decisions is the general public, which elects policy-makers.

Policy analysis can be considered the systematic analysis of any and all components of the policy process. The policy process includes the formal activities of policy formulation and implementation of the policy life cycle. Policy analysis is an inexact process with many uncertainties. It is, however, an essential part of social learning and adaptation which calls attention to the complex relationship between decision making and environmental out-comes. It provides baseline information, points out major linkages between decisions and environmental outcomes, and provides a starting point for consideration of more sustain-able policy options.

Table 4. An example of categorisation of policy instruments (from IISD and TERI 2003).

Category	Instrument	Description
Economic	*Economic instruments – also referred to as market-based instruments or financial incentives – are measures that directly influence the price a producer or consumer pays for a product, behaviour or activity.*	
	Tradable Permits	**Market Creation Instruments**: A system of direct regulation can be used to create a tradable good or service, and a market in which it can be traded. Before the creation of the market, polluters may have implicitly appropriate the use of this good. Examples include emission permits (e.g. for CO2); development quotas (e.g. for tourism construction); and water shares (where the resource is indivisible in space but divisible in use (Panayotou 1998)).

Category	Instrument	Description
	Deposit Refund	**Revenue Generating Instruments**: Taxes, charges, user fees and deposit-refund schemes all 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 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 *et al*. 2000).
	Tax Breaks	
	Administered Prices	Price control by governments via a regulated market.
Direct expenditure	*Governments influence producer and consumer behaviour by targeting expenditures directly at the behaviour they want to encourage. Direct expenditures differ from subsidies in that they are typically broad programmes of expenditure targeted at a macro level to foster activities such as technological innovation, whereas subsidies reward incremental changes in individuals' behaviour (Barg et al. 2000).*	
	Programme/Project Operation	Governments may direct their budget towards programmes that work directly on the environment to carry out ecosystem protection and/or restoration.
	Green Procurement	Governments can opt to spend their 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 financing 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 *et al*. 2000).
Regulatory	*Creating change via legal avenues*	
	Legislative Instruments	Acts and regulations passed to establish and fulfil a legal mandate for change.
	Enforcement	The enforcement of legislative instruments.

Category	Instrument	Description
	Liability	Inducing 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 markets.
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 (e.g. a national roundtable on the environment and economy).
	Internal Policies and Procedures	Governmental institutional changes or procedural changes, e.g. requiring drafting of a sectoral sustainable development strategy.

Analysing the linkages between observed environmental changes and policy is one of the most important yet challenging aspects of IEA. It is one thing to recognise a linkage. It is quite another to understand not only the potential physical causes, but also the policy deci-sions and web of related interests that lie in the background. Even deeper, you need to de-velop a clear understanding of how political and economic interests motive different actors into formulating and accepting policy and modifying behaviour.

It is also important to understand that although societal responses can mitigate an envi-ronmental problem, they can equally exacerbate the problem or create new ones. For ex-ample, subsidizing energy prices could enhance energy accessibility for the poor. Lower energy prices, however, could send market signals that increase energy demand, resulting in increased harmful emissions.

CASE STUDY

Turkmenistan's food production policies and their impacts on water resources.

Source: http://www.fao.org/docrep/W6240E/w6240e18.htm

Water withdrawal

In 1994, the total annual water withdrawal was estimated at 23.8 km3, of which 97% was for agricultural purposes. In recent years total water withdrawal has fallen slightly, mainly because of the adoption of water saving methods in agriculture. The main source of water is surface water. Drainage water from irrigated land is also re-used and constitutes another source of water for irrigation. In 1994, 214 million m3 of ground-water was used for do-mestic purposes, 151 million m3 for agriculture, and 36 million m3 for industry.

Irrigation and drainage development

Irrigation is the lifeblood of Turkmenistan's economy. In 1975 the total irrigated area was estimated at about 857,000 ha. In 1994 it was 1,744,100 ha, or 99.4% of the total culti-vated area. The major irrigated crops are cereals (mainly wheat), cotton and fodder. Cotton and vegetables are the most important export crops.

Irrigation in Turkmenistan is mainly concentrated in oases. Here water is diverted from the Murghab, Atrek and Tedzhen rivers, and from the Kara Kum canal, for the irrigated areas in the south, or from a system

of canals which have been built along the Amu Darya River in the north. The total potential for irrigation development is estimated at 2,353,000 ha.

Surface irrigation was the only technique used in Turkmenistan up to 1992. In 1994, there were 400 ha under micro-irrigation. About 43,600 ha were irrigated with groundwater, while the remainder was irrigated with surface water, including a small part with collector-drainage water (a mixture of agricultural drainage water and wastewater). In 1994, the to-tal length of the irrigation network was about 39,131 km, and overall irrigation efficiency, considering losses between the source and the irrigated field, was estimated at 59%.

No private irrigation schemes exist in Turkmenistan. All the schemes are managed by a state agency. Most of the schemes are larger than 10 000 ha. Water is allocated to each farm on the basis of standard crop water requirements. When a farm exceeds its allocation, a fine is applied, based on the extra volume of water. In 1995, the rate was US$0.20/1000 m3. This measure has been introduced to encourage farmers to reduce water consumption.

The average cost of irrigation development is estimated at US$4,000–10,000/ha for large-scale surface irrigation schemes using modern technologies, including agricultural infra-structure. If micro-irrigation were to be developed on existing irrigated areas, its estimated implementation cost would be US$3,500–5,000/ha. It is estimated that about 653,000 ha of irrigation schemes need rehabilitation.

Water resources management policies

Increasing food production is one of the major goals of the national agricultural policy in Turkmenistan. Irrigation development and agricultural intensification have to be achieved in a general context of limited water resources. Increased re-use of wastewater and of agri-cultural drainage water is seen as one of the solutions to increasing water availability for further irrigation expansion. At the same time, research is being carried out on water sav-ing techniques, and new measures are expected to be adopted on a large scale to increase irrigation efficiency. Rehabilitation of drainage and irrigation networks is also envisaged to reduce water losses and limit the spread of salinisation.

All these measures have been proposed in the national water strategy, part of the regional water strategy. They should make it possible to contain the irrigation water withdrawal at around 25 km3/year between 2000 and 2010, compared with 23.2 km3/year in 1994. The irrigated area is expected to increase from 1,744,100 ha in 1994 to 2,353,000 ha in 2010.

Environmental issues are particularly acute in Turkmenistan. Water in the rivers and in the drainage networks is of poor quality, containing high concentrations of salts and pesticides from upstream countries. This also affects the Aral Sea where some of the main collector-drainage canals discharge. A trans-desert collector running for about 800 km from the northeast to the Caspian Sea in the far west is under construction. It is intended to collect the agricultural drainage waters from the Murghab, the Tedzhen oases, and from the other irrigated areas located along the Kara Kum canal.

6.2 Steps in analysing existing policies

The policy analysis steps introduced in this section emphasize the need to link the per-formance of a policy with criteria for measuring this performance. Such criteria are the expected outcomes or targets of policy implementation, preferably expressed in quantita-tive terms and with a time limit. One common challenge of this approach is that perform-ance criteria are often implicit, assumed or simply unknown.

Attributing environmental change to a specific policy is difficult, given that environmental outcomes are typically the result of several policies reinforcing or mitigating each other's effects. Approaching policy analysis

from the perspective of the policy mix is therefore necessary. Further, it is only through the analysis of the policy mix that opportunities for new types of policies can be identified.

Given these challenges, and the critical importance of policies and policy instruments to an IEA, this module introduces a five-step policy analysis process (Figure 17).

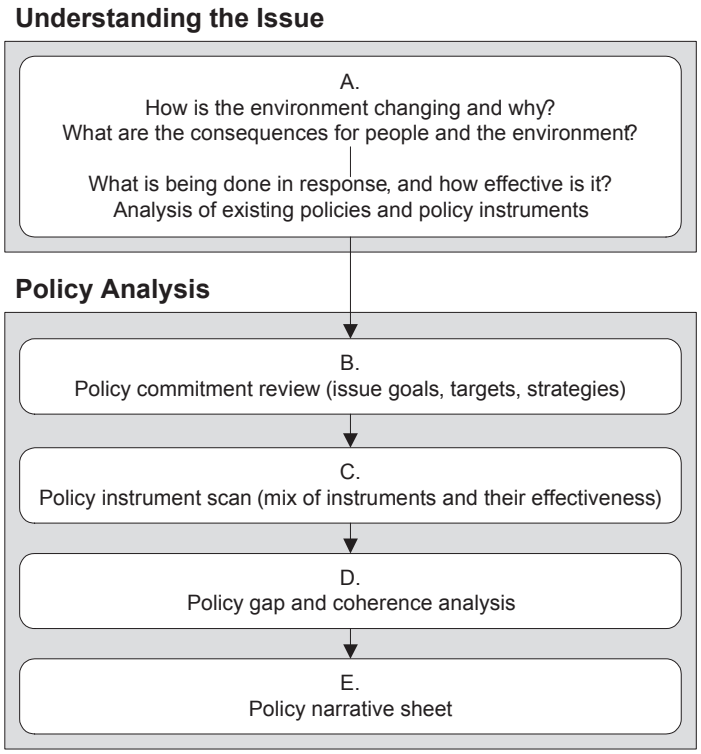


Figure 17. Steps in the analysis of existing policies.

These steps are described in detail in the remaining sections of this chapter.

6.3 Step A: Understanding the issue

The starting point for any policy analysis is a thorough understanding of the issue. This was the topic of chapters 4 and 5 of this module, which addressed the questions: How is the environment changing and why? and What are the consequences for people and the environment?

An adequate understanding of the issue requires the following information:

- Identification of the chain of causality of direct pressures, indirect drivers, state and impact for a given environmental issue.
- Development of SMART indicators for the key drivers, pressures, state and impacts.
- Identification of key points in time where policies have had an impact. Time-bound information is important for this, particularly for the state indicators.

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 chapters 4 and 5, and put this into the first row of the table below.
- In the second row, identify an indicator and approximate trend line that, in your best judgement, describes reality, or use actual data if they are 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 influ-enced by human drivers and pressures, and these typically have underlying policies. Over-fishing, for example, may be driven by the availability of easy credit for fishing fleet de-velopment 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 affect fish population dynamics in positive and negative ways.

6.4 Step B: Policy commitment review

This step in the integrated policy analysis takes a high-level look at environmental com-mitments within the political boundary 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 declara-tions. Not all commitments have the same force, and the review should focus on those where commitments require action, and where the consequences of inaction are potentially serious. There is also a difference in the specificity of commitments: some are at the level of general political statements, whereas others may be more specific and precise with quantitative, time-bound targets.

The policy report card can be used to take stock of high-level commitments to priority en-vironmental issues and proposed targets. Table 5 summarises Thailand's biodiversity commitment in the form of a policy report card. The exercise below involves the analysis of high-level commitments related to an issue selected by participants in their own coun-try.

Table 5. Policy report card for biodiversity in Thailand

Issue	Goal and Target	Strategy/action plan	Status of implementa-tion
Biodiversity; Protected areas	National targets to meet 2010 global targets: ▪ 40% of land area under forest (30% conservation forest; 10% economic forest) ▪ 300 km2 of marine ecosystems gazetted as marine protected areas ▪ 35% of national wetland areas targeted for conservation and restoration	Second National Biodiversity Strategy and Action Plan (2003)	Biodiversity still declining, but some policies are being implemented, e.g.: ▪ Outreach materials for Convention on Biological Diversity ▪ Raising awareness of fire prevention ▪ Improving accessibility to information

EXERCISE

This exercise requires completing a policy report card for selected priority environmental issues.

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

- Select two priority environmental issues from those listed by group members.
- Complete the policy report card for each issue, making sure to include:
  - Name of the issue and the specific environmental state 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 instru-ments 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 pic-ture includes the mix of policies affecting 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 in-struments having an influence on your environmental issues (refer back to Table 4 for a categorisation of different policy instruments). For any given issue, a range of policy in-struments will affecting (positively or negatively) the entire causal chain, including indi-rect drivers, direct pressures, the environmental state itself and the impacts of changes in that state.

For example, consider river water quality (Figure 18). A number of policy instruments, such as in situ treatment and water quality standards, could have positive or negative im-pacts on the state of water quality. Other impacts can come from the effects of municipal taxes driving urban growth, infrastructure development reducing sewage discharges and food import programmes to compensate for a reduction in fish as a food source.

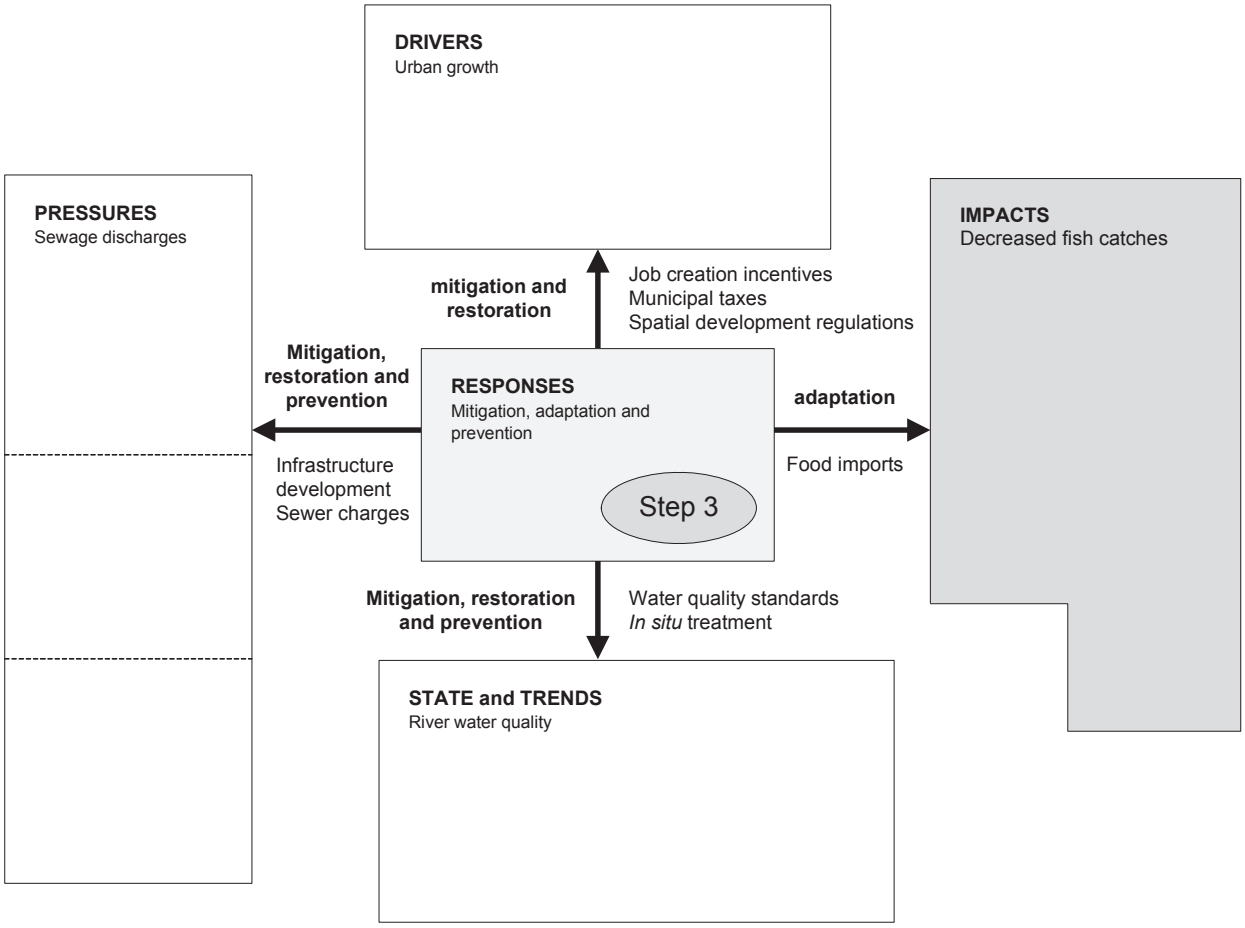


Figure 18. Example policy instrument scan for water quality of rivers.

CASE EXAMPLE

Policy instruments directed at water quality and environmental improvements in Chilika Lagoon, India.

Until 1992, management of Chilika Lagoon was mainly the responsibility of Orissa's fish-eries and tourism departments. The bird sanctuary of Nalabana Island, the only protected area of the lagoon, was managed by the state forest (wildlife) division. In response to the degradation of the lagoon ecosystem, the state government of Orissa created the Chilika Development Authority (CDA) in 1992. The Authority comes under the state govern-ment's oversight and is governed by a multi-stakeholder body comprising legislators, offi-cials, scientists and community representatives.

Action plans for restoring Chilika Lagoon were developed in 1996–2000 and 2001–04 with funding from central government. The World Bank-supported Orissa Water Resource Consolidation Project also recognised Chilika as a project component, allocating funds for hydrobiological monitoring. This Project also financed preparation of an Integrated Man-agement Action Plan for Chilika Lagoon, though only certain elements of this have been adopted.

The restoration strategy implemented by CDA includes various policy instruments, most of which may be classed primarily as expenditure instruments:

- Opening of new lagoon mouth and dredging of outer channel (expenditure)
- Environmental impact assessment (institutional)
- Construction of salinity embankment, jetties, fish-landing centres, etc. (expenditure)
- Participatory micro-watershed management (expenditure)
- Removal of illegal prawn enclosures (regulatory)
- Restoration and protection of Nalabana bird sanctuary (expenditure, regulatory)
- Construction of Wetland Research and Training Centre (expenditure)
- Public awareness raising and education (expenditure)

Source: Ghosh and Pattnaik (2005)

Included in the policy instrument scan as described in this module is an analysis of policy effectiveness. Before talking about policy effectiveness, we should define what we mean by policy effect. The European Environment Agency notes that the effects of policy re-sponses imply a cause-effect relationship between policy and driving force, pressure, state or impact. Both intended and unintended effects can be determined by scientific and social observation and analysis.

Determining the effect of an individual policy on an environmental state, pressure or driv-ing force 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 to a mix of policies. That being said, analysing the effect of an individual policy or a small set of policies on a specific issue is not impossible. Often it is just a matter of time and analytical effort.

Policy effectiveness differs from policy effect because it goes beyond analysing effects and assesses how the actual effect measures up to the policy objective. This is a perform-ance assessment of the policy.

To analyse policy effectiveness it is necessary to identify performance criteria. If such cri-teria are built into the policy, and are easily associated with regularly monitored indicators and targets, the analysis is relatively straightforward. Often, however, policies lack clearly defined and specific criteria, or include criteria that are not necessarily related to environ-mental performance. This often happens with economic policies related to taxes, trade or investment. Their built-in evaluation criteria are usually restricted to economic perform-ance, even though they may have close links to environmental issues.

Performance criteria can range from general and descriptive to specific and quantitative. In essence, they provide a basis for comparing actual performance with planned or desirable performance. Table 6 provides examples of some main types of performance criteria.

Table 6. Main types of performance criteria for policies.

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 towards 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% of gross national product.

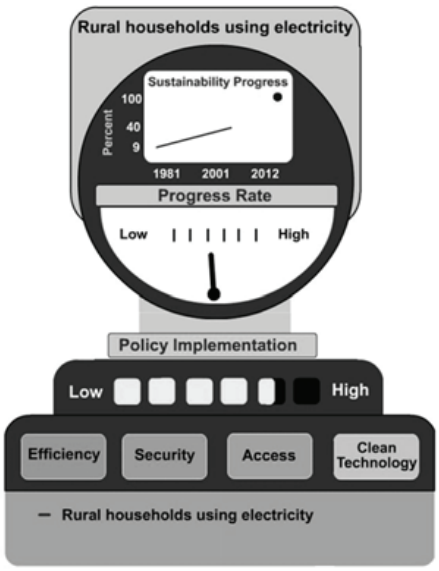
(Based on Pintér, Zahedi and Cressman 2000)

CASE STUDY

State of energy access for rural households in India

The energy sustainability gauge

Source: The Energy and Resources Institute (http://www.teriin.org/ee/gbr/fesa/esg.htm)



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 a high level of policy implementation, relying mostly on subsidized tariffs and government-sponsored electrification schemes. The ineffective targeting of subsi¬dies, however, has caused concern from the point of view of both equitable access and the financial implications for the government. Electricity Regulatory Commis-sions are seeking to address the issue as part of the ongoing struc¬tural reforms in the electricity sector.

Figure 19. Energy sustainability gauge for India showing energy access

Supplemental information

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

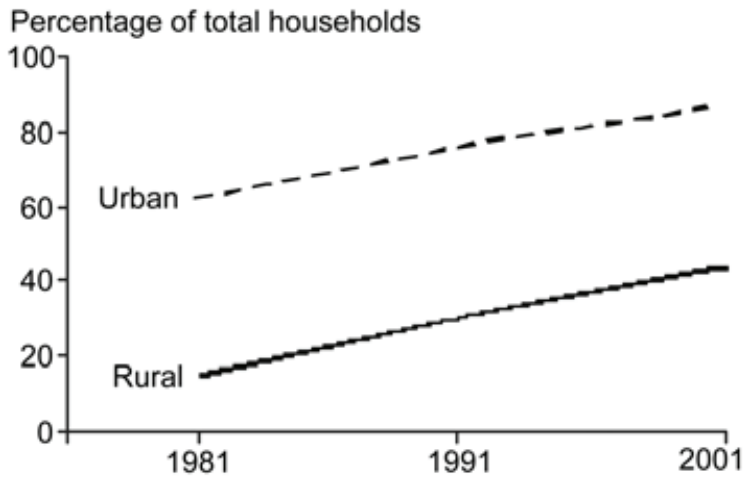


Figure 20. Percentage of rural households in India using electricity for fuel and lighting

Table 7. Policy mix directed at the issue (2002)

Category	Policies
Economic	Subsidized rural electricity tariffs 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's target is 100% electrification by 2012. Of the balance, the Tenth Plan proposed 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.

Analysis: Only 44% of rural households have access to electricity, compared with 88% 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. Full (100%) electrification of villages has been declared by 32 (??) states.

As the gauge indicates, there is a high level of implementation of policies aimed at provid-ing access to electricity in rural areas. Policies have relied mostly on subsidized tariffs and government-sponsored electrification schemes. Progress, however, is not as encouraging as indicated by the low level of access. Though statistics show that 86% of villages are "electrified", the available data indicate that only 44% of rural households have access to electricity. So there are inadequacies in the current definition of village electrification it-self, which should be revised to consider a village electrified only if a minimum number of households in that village have electricity connections.

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 institu-tional instruments).
  - Identify performance criteria for the indicator that describe the environmental state indicator and the indicators for the key drivers, pressures and impacts. Be as specific as possible.
  - How does the indicator trend compare to the performance criteria? How do actual trends and performance criteria compare?

Present your results in plenary.

Time: 45 minutes group, 15 minutes plenary.

	Drivers	Pressures	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

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

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

Policy gaps may take many forms, for example:

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

Identification of these gaps can be facilitated by using a policy mix matrix such as the one in Table 8. Such a matrix can reveal which policy types (e.g. economic instruments, regu-latory, direct expenditure, institutional) might be under-represented.

Table 8. Example policy mix matrix.

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

EXERCISE

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

Characterising 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 driving force, pressure, state and impact from the previous table to the appropriate cell in the matrix. Can you think of any additional policies to add to the table that you did not previously identify?
- Use the examples of policy types described previously 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 such as 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 (driving force, pres-sure, 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.

The analysis of policy effectiveness focuses on comparing actual and expected perform-ance 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.

One tool for assessing these types of combined effects is an Action Impact Matrix (AIM). An example is illustrated in Table 9. The AIM lists specific policy instruments in the first column, then assesses the effect of the policy, intended or unintended, on a range of envi-ronmental issues. Through this process it is possible to identify interlinkages among poli-cies, many of which will not be intuitive.

Table 9. Simplified example of an Action Impact Matrix (AIM)

		Impacts on key sustainable development issues		
Activity/Policy	Main objective	Land degradation	Air pollution	Resettlement
Macroeconomic and sectoral policies	Macroeconomic and sectoral improvements	Positive effects from removal of distortions Negative effects mainly from 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)		

Complementary measures	Specific/local social and environmental gains	Enhance positive impacts and mitigate negative impacts (above) of broader macroeconomic and sectoral policies		
• Market based	• Reverse negative impacts of market failures, policy distortions and institutional constraints		(+M) (pollution tax)	
• Non-market based		(+H) (property rights)	(+M) (public sector accountability)	
Investment projects	Improve efficiency of investments	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 (Reforest and relocate		(+H) **(replant forests)**		**(+M) (relocate people)**

Notes:

- A few examples of typical policies and projects as well as key environmental and social issues are shown. Some illustrative but qualitative impact assessments are also indicated: thus + and - signify beneficial and harmful impacts, whereas H and M indicate high and moderate intensity. The AIM process helps to focus on the highest priority environmental issues and related social concerns (Munasinghe and Cruz 1994).

The *policy instrument scan* may produce a long list of policy instruments which would be too difficult to in-corporate into the AIM given time and resource constraints. In such cases prioritizing the instruments would be necessary. Some criteria for selecting policies to in-clude in an analysis of current environmental policies include (not in order of importance):

- Relevance to the environment.
- Relevance to the public and decision-makers.
- Link with key environmental properties identified in the state of the environment and trends section.
- Impact of health, income and well-being.
- Severity of environmental situation.
- Relation to the country's international obligations.
- Potential for causing disruption or conflict.
- Potential for easy or feasible solutions.
- Uniqueness of policy initiative within country or region.

GROUP DISCUSSION

In plenary, choose five key policies identified in your policy instrument scan. Also select four other environmental issues in your country. Develop an AIM similar to the one above.

Time: 30 minutes.

6.7 The policy narrative sheet: summarizing policy successes and failures

The final step in the policy analysis is to develop a policy narrative summarizing the re-sults of the analysis. The purpose is to develop credible statements regarding the adequacy of past and current policy responses for restoring and maintaining the state of the environ-ment, and facilitating adaptation to impacts. The policy narrative sheet should have a structure similar to that illustrated in Table 10.

Table 10. 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 to enhance the overall effectiveness of the current mix of policy instruments influencing this environmental issue?
…

EXERCISE

Using the policy analysis results from Steps A through D, prepare (individually) a policy narrative sheet similar to the one shown above.

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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