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Environmental Performance Indicators

A Second Edition Note

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Environmentally and Socially Sustainable Development

The World Bank

THE WORLD BANK ENVIRONMENT DEPARTMENT

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Acknowledgments

This note is an update and revision of an earlier note published in 1996 that was prepared by John Dixon, Arundhati Kunte, and Stefano Pagiola. This new edition was prepared by Lisa Segnestam. Please send comments and corrections by e-mail to lsegnestam@worldbank.org or by fax to (202) 522-1735.

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Executive Summary

The Performance Monitoring Indicators Handbook (1996) discusses how to structure indicators within a logical framework, how performance monitoring indicators are developed in general, how to link them to the objectives of different levels, and how they affect the World Bank's work. This Second Edition Note is part of a series of notes that are meant to assist World Bank task managers in the selection and design of performance indicators. Following the structure introduced in the Performance Monitoring Indicators Handbook, this note discusses the design and the use of *environmental performance indicators* (EPIs) to assess and evaluate the performance of World Bank projects in relation to environmental issues.

Performance monitoring vis-à-vis the environment is applicable to many types of projects. Projects with primary or secondary components that specifically address environmental issues, as well as projects whose activities may have a direct or indirect impact on the environment, need environmental performance indicators to evaluate their impact on the environment—that is, to ensure that they are having the desired positive impact, to monitor any possible adverse impacts, and to guard against unanticipated effects. Given the diversity of environmental problems, the variety of contexts in which they arise, and the numerous possible solutions to them, no "correct" set of indicators exists. This note is designed to help the reader select indicators by providing a framework and its application to the major categories of environmental problems normally encountered in the World Bank's work.

Indicator Framework. The framework used in this note is based on the *input-output-outcome-impact* model. While this approach distinguishes between project outcomes and project impacts, the format used in the guidelines for Project Concept Papers or Project Appraisal Documents bundles the two together.[1] For this reason the proposed framework speaks of "impact" indicators, to facilitate the use of this note and to allow for some of the ambiguities that arise in practical situations. Moreover, the note does not further present or discuss project *inputs* or indicators relating to project inputs, since the design of input indicators is already generally well developed. Hence, the note discusses two different levels of objectives and indicators: the project's overall objectives (e.g., reduction of water-borne diseases or increased access to safe drinking water) and the *impact* indicators that measure and monitor these overall objectives, and the project's components (e.g., installation of water monitoring stations) and the *output* indicators that measure and monitor the output of those components (e.g., the amount of water monitored).

Selecting EPIs. There is no universal set of indicators that is equally applicable in all cases. The note discusses the major selection criteria for choosing appropriate EPIs:

Direct relevance to project objectives. EPI selection must be closely linked to project objectives and the environmental problems being addressed. Vague or overly broad objectives such as "protecting biodiversity" are of little use in selecting EPIs (and may well indicate that the project or component itself is not very well thought out). Where the environmental impact is not the primary objective, the Environmental Assessment (EA) process can outline the potential impacts and hence help select EPIs.

Limitation in number. A small set of well-chosen indicators tends to be the most effective approach.

Clarity in design. It is important to define the indicators clearly in order to avoid confusion in their development or interpretation and maintain the distinction between output and impact indicators.

Realistic collection or development costs. EPIs must be practical and realistic, and their cost of collection and development therefore need to be considered. This may lead to trade-offs between the information content of various indicators and the cost of collecting them.

Clear identification of causal links. Causal links must be clearly identified in order to identify appropriate measures.

High quality and reliability. Indicators, and the information they provide, are only as good as the data from which they are derived. If the "ideal" indicator to measure a problem is based on unreliable data, it is common to depart from the "ideal" indicator and use proxies instead.

Appropriate spatial and temporal scale. Careful thought should be given to the appropriate spatial and temporal scale of EPIs. Since the environmental impact of project activities seldom coincides with administrative boundaries, EPIs often need to be measured on different scales. There might also be lags in time before project effects are felt.

Targets and baselines. The goal of EPIs is to monitor and evaluate the long-term environmental effects arising from Bank-supported activities. This implies a need to measure the environmental problem at three points in time: before the project begins (to obtain baseline values), during project implementation, and after the project has ended (to compare baseline values to targets).

Interpreting EPIs. The interpretation of EPIs varies across problems and indicators. Where benchmarks exist (e.g., WHO safe drinking water standards), indicators can be compared to them. In many cases, the emphasis is on variations in the indicator over time. The appropriate comparison, however, is generally to the counterfactual situation of what would have happened in the absence of the project. Interpretation can be hampered if appropriate baseline information is not collected. Because many EPIs vary substantially over time, measurements over prolonged periods are often necessary before trends can be ascertained. In some cases, control groups can be used to measure conditions in areas not affected by the project; in others, statistical techniques need to be used to predict what would have happened without the project.

Representative environmental problems. Based on this general discussion of selecting EPIs, the note provides examples of EPIs in various broad categories of environmental problems (forestry, biodiversity, land quality, air pollution, water pollution, global environmental problems, and institutional issues) and discusses their strengths and limitations and the conditions under which they may be appropriate. In some cases, such as air and water pollution, appropriate indicators are well established and already in widespread use. In other cases—notably in the case of biodiversity and institutional capacity—there is much less experience to draw upon. Examples are presented in boxes, and, where possible, reference is made to more comprehensive documents which provide additional detail. A matrix summarizes selected EPIs for each sector.

Note

1. The Project Concept Document (PCD) defines the rationale for a proposed investment operation and the framework for its preparation, and flags issues or areas of special concern to the Bank. It serves as the basis for a Bank decision to assist a borrower with project preparation in the early stages of the project cycle. The PCD later evolves into the Project Appraisal Document (PAD).

1 Introduction

In recent years, the World Bank has substantially increased its lending portfolio for environmental projects. Various safeguard policies[2] and other instruments have also been developed to ensure that adverse environmental impacts arising from Bank-supported activities are minimized. Monitoring and evaluating both positive and negative environmental impacts of Bank-supported activities play an important role in this process, and that is where environmental performance indicators are needed.

The Performance Monitoring Indicators Handbook (1996) discusses how to structure indicators within the logical framework, how performance monitoring indicators are developed in general, how to link them to the objectives of different levels, and how they affect the World Bank's work. This Second Edition Note is part of a series of notes meant to assist World Bank task managers in the selection and design of performance indicators. Following the structure introduced in the Performance Monitoring Indicators Handbook, this note discusses the use of *environmental performance indicators* (EPIs) to assess and evaluate the performance of World Bank projects in relation to environmental issues.

Given the diversity of environmental problems and of the projects causing them or designed to address them, arriving at a set of 'universal' indicators applicable to all situations is not feasible. Nor is it practical to develop an exhaustive list of all possible indicators. This note provides a framework and selection criteria to assist World Bank task managers in selecting appropriate indicators for their projects and discusses issues that may arise in doing so. In the second half of the note, examples of EPIs in various broad categories of environmental problems (forestry, biodiversity, land quality, air and water pollution, global environmental problems, and institutional issues) are provided, along with a discussion of their strengths and limitations and the conditions under which they may be appropriate.

Note

2. For example, World Bank Operational Policies 4.01, Environmental Assessment; and 4.04, Natural Habitats.

2 Environmental Performance Indicators

Performance monitoring vis-à-vis the environment is appropriate in projects of many types and in many sectors. Some projects address an environmental problem as their primary emphasis (e.g., industrial pollution management projects). Other projects may have the environment as a secondary component (e.g., a biodiversity conservation component in a forestry project). Projects that do not include any environmental components at all (e.g., infrastructure construction projects) may still warrant monitoring of possible adverse effects on the environment. For some projects that fit into the latter category, such as education projects, EPIs will not be relevant. In each relevant case, EPIs are required to monitor and evaluate the impact of the project—that is, to ensure that the project is having the desired positive impact, to monitor any possible adverse impact, and to guard against unanticipated effects. An analysis conducted in 1998 by the Environment Department on the use of environmental performance indicators in World Bank natural resource management projects initiated between 1994 and 1996 found that most projects use performance indicators, even though there are still weaknesses in the way they are applied (see Box 1).

Box 1
The use of performance indicators in natural resource management projects

In 1998 the Environment Department analyzed the use of performance indicators in World Bank natural resource management projects. Twenty-five projects were studied, including eight water resources projects, seven forestry projects, two natural conservation projects, and eight rural poverty/natural resource management projects.

All 25 projects included performance indicators in their Staff Appraisal Reports, which was somewhat surprising since all of them were prepared *before* performance indicators became mandatory within Bank operations. Furthermore, all of the projects used indicators related to the objectives of the project or its components, although, according to the SARs' own terminology, only seven of the projects contained both output and impact indicators—the latter being the most important from an environmental point of view. The study, however, concludes that most projects *do* contain both output and impact indicators as defined in this note and in the Performance Monitoring Indicators Handbook (1996).

With regard to the quality and monitorability of the indicators: i) more than half of the projects lacked baseline values for comparison; ii) almost half of the projects (10 of 25) had 40 indicators or more to monitor project results—an overwhelming number, even though many of those projects had ranked them in priority order; and iii) many of the impact indicators, were vague in their definitions—usually as a result of the use of imprecise terms like "in an efficient manner" and "to be committed to." On the positive side, most indicators were not very complex and almost all were related to units of measurement, targets or values.

Source: T. Rossing Feldman 1998.

An indicator's defining characteristic is that it quantifies and simplifies information in a manner that facilitates understanding of environmental problems by both decision makers and the public. The goal is to assess how project activities affect the *direction* of change in environmental performance, and to measure the *magnitude* of that change. Indicators that allow a *quantitative* evaluation of project impacts are particularly useful, since they provide more information than just whether the project is improving or degrading the state of the environment. Information on the magnitude of a benefit is required to determine whether it is worth the resources being expended to achieve it. Similarly, information on the magnitude of adverse impacts might indicate whether the harm is justified given the other benefits of the activities in question. Above all, an indicator must be *practical* and *realistic*, given the many constraints facing those who implement and monitor projects. (See Chapter 4 for a more detailed discussion of the criteria that are important to take into account when selecting EPIs.)

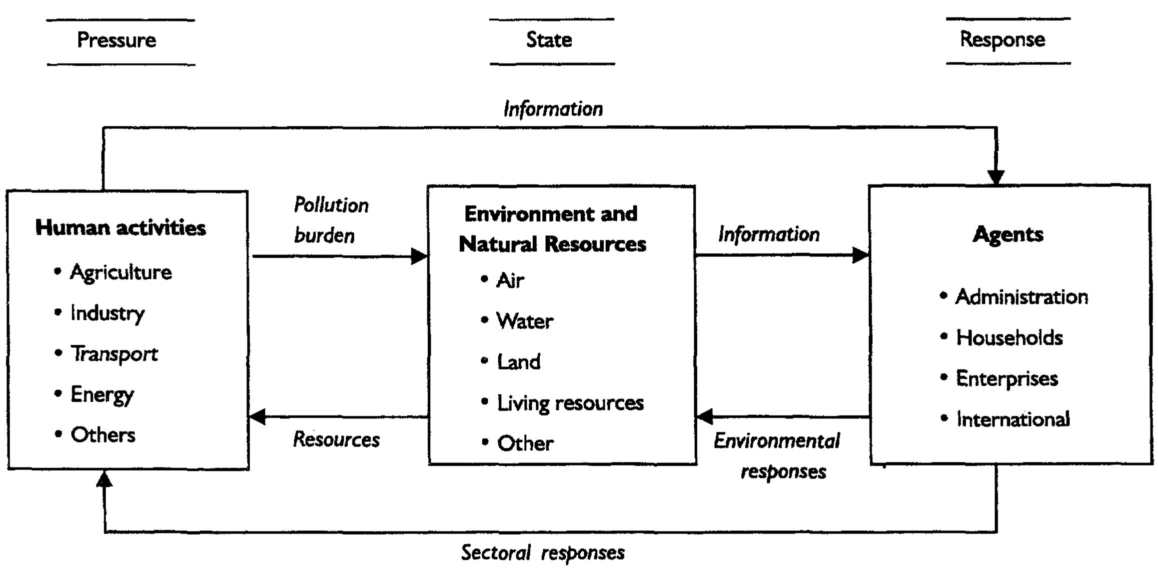
3 A Project Indicator Framework

Indicator frameworks provide the means to structure sets of indicators in a manner that facilitates their interpretation. Frameworks can also aid the understanding of how different issues are interrelated. For national-level indicator sets, the OECD Pressure-State-Response framework is widely used (see Box 2). For project-level indicators, the project cycle

Box 2
Indicator typology—The Pressure-State-Response framework

The pressure-state-response framework (see Figure) was developed by the OECD in 1994 and can be applied at the national, sectoral, community, or individual firm level.

The Pressure-State-Response model



In this framework, three different aspects of environmental problems are distinguished:

- The *pressure* variable describes the underlying cause of the problem. The *pressure* may be an existing problem (for example, soil erosion in cultivated uplands, or air pollution from buses) or it may be the result of a new project or investment (for example, air pollution from a new thermal power plant, or loss of a mangrove forest from port development).

(continued, next page)

Box 2 *(continued)*
Indicator typology—The Pressure-State-Response framework

- The *state* variable usually describes some physical, measurable characteristic of the environment that results from the *pressure*. Ambient pollution levels of air or water are common *state* variables used in analyzing pollution (for example, particulates concentrations in micrograms per m^3 of air; BOD loads to measure water pollution). For natural or renewable resources other measures are used: the extent of forest cover, the area under protected status, the size of an animal population, or grazing density are all *state* variables.

- The *response* variables are those policies or investments that are introduced to solve the problem. Bank projects that have important environmental components can be thought of as *responses* to environmental problems. As such, they can affect the *state* either directly (for example, by installing pollution control equipment or by creating protected areas) or indirectly, by acting on the *pressures* at work (for example, by providing alternative income sources for farmers who would otherwise clear forests).

A similar distinction can be made in the case of projects which have an adverse impact on the environment (for example, port construction might have a direct effect by displacing natural areas and an indirect effect by stimulating additional traffic and hence increased pollution). In some cases, projects also seek to improve the *responses* to environmental problems (for example, by increasing the institutional capacity to monitor environmental problems and enforce environmental laws).

Source: Adriaanse 1993.

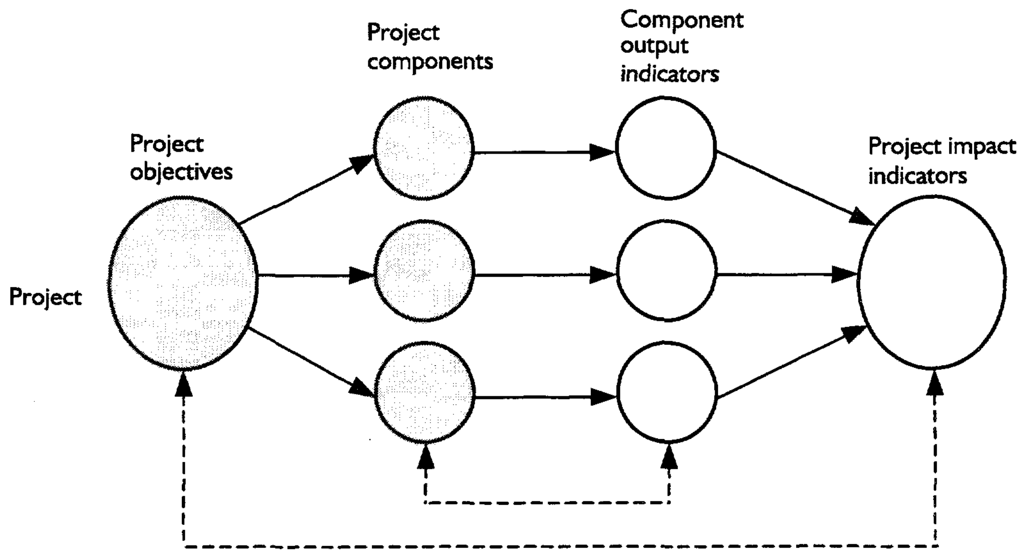
itself can help to provide a framework. This suggests the following classification of indicators:

- *Input indicators*: monitor the project-specific resources provided
- *Output indicators*: measure goods and services provided by the project
- *Outcome indicators*: measure the immediate, or short-term, results of project implementation
- *Impact indicators*: monitor the longer-term or more pervasive results of the project

Note that while the input-output-outcome-impact approach distinguishes between project outcomes and project impacts, the format used in the guidelines intended to assist World Bank task teams in preparing Project Concept Documents or Project Appraisal Documents[3] for investment operations bundles the two together. For this reason, the proposed framework refers to "impact" indicators, including both *outcome* and *impact* indicators. Moreover, this note does not discuss *project inputs* or indicators relating to project inputs. Input indicators are important in tracking the implementation of projects and are therefore key elements of project management. However, their design is generally well developed in the community of practitioners and is therefore not emphasized in the framework presented in this note. They are also usually more straightforward in their design. In comparison, output and impact indicators have not been discussed to the same extent. New, more easily understood approaches for designing indicators of outputs and impacts are therefore required.

The proposed framework is depicted in Figure 1. In this framework, the project has both overall *project objectives* it is designed to meet (e.g., an increase in access to safe water) and *components* by which the implementation of the project proceeds (e.g., installation of water monitoring stations). The implementation of these components, combined in complex ways, leads to the desired *project impacts*, but it may also result in negative externalities, that is, adverse environmental effects.

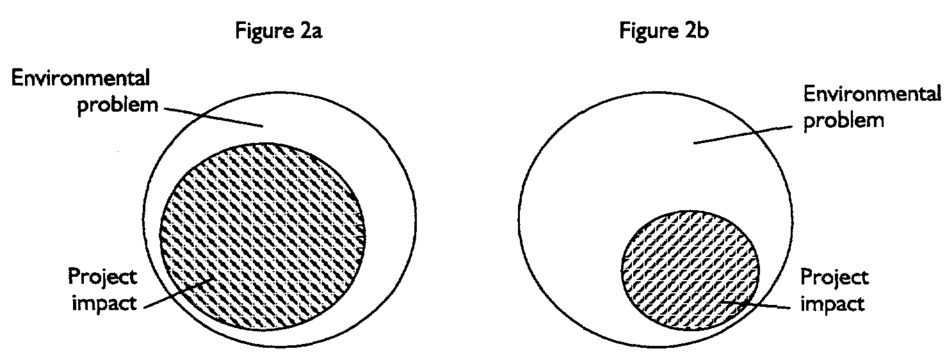
Figure 1. Project and component-level indicators



Indicators are then developed for both the overall project objectives and the components. *Impact indicators* relate to the stated objectives of the project (e.g., percent urban and/or rural population with access to safe water), while *output indicators* relate to the components (e.g., number of water monitoring stations that were installed). The dotted lines in Figure 1 denote the very important linkage between objective or component and its corresponding indicator. In the same way that the project components are closely linked to the overall objectives of the project, the output and impact indicators should be related.

The goal of EPIs is to monitor and evaluate environmental impacts arising from Bank-supported activities. Thus, indicators of both impacts and component outputs are typically required to properly evaluate the impact of projects. Indicators of outputs alone are often insufficient because the link between a given output and the consequent impact on the environment may be ambiguous or of unknown magnitude. This can be illustrated by the two panels in Figure 2, where the extent of an emission reduction project's potential impact on the environmental problem of concern varies greatly. For example, emissions from a given

Figure 2. A project's contribution to overall environmental problems



source may be responsible for the bulk of the environmental problem (Figure 2a). In this case, the link between the project *output* and overall *impact* is clear and unambiguous. In other situations (as seen in Figure 2b) the emission's share of the total environmental problem may be relatively small and even a successfully implemented project may not lead to significant improvements in ambient concentrations. In the former case (Figure 2a) an *impact* indicator that measures ambient pollution levels is a reasonably good proxy for the project's impact. In the latter case (Figure 2b), however, the link is weak and the project's success is best measured by use of *output* indicators (with only weak links to broader impact measures).

This point is important because it is the end result that we are most concerned with. We care about emissions primarily because they increase ambient air pollution and hence health problems. Conversely, indicators of *impact* alone are often insufficient because changes in the condition of the environment depend on the total effect of multiple pressures (and on random factors such as weather). Unless the project's contribution to changes in environmental conditions are measured, the project might be incorrectly blamed for problems it did not cause or credited for improvements it did not help bring about.

Note

3. The Project Concept Paper (PCD) defines the rationale for a proposed investment operation and the framework for its preparation, and flags issues or areas of special concern to the Bank. It serves as the basis for a Bank decision to assist a borrower with project preparation in the early stages of the project cycle. The PCD later evolves into the Project Appraisal Document (PAD).

4 Selecting Environmental Performance Indicators

No universal set of indicators exists which would be equally applicable in all cases. This section focuses on factors that must be borne in mind by World Bank task managers and clients in the countries when selecting EPIs for their projects. Chapter 5 discusses various broad categories of environmental problems, and criteria for selecting appropriate indicators for them.

The selection criteria discussed are:

- Direct relevance to project objectives
- Limitation in number
- Clarity of design
- Realistic collection or development costs
- Clear cause and effect links
- High quality and reliability
- Appropriate spatial and temporal scale
- Targets and baselines

Direct relevance to project objectives. The process of selecting EPIs must start from a precise understanding of the project's *objectives* and of the *environmental problems* being caused or addressed. The selected indicators should then be directly relevant to those objectives. Where negative environmental impacts are by-products of project activities, the Environmental Assessment (EA) process can help to understand the possible impacts and hence to select EPIs.

Vague or overly broad objectives such as "reducing erosion" or "protecting biodiversity" are of little assistance in selecting EPIs (and may well indicate that the project or component itself is not very well thought out). Another reason to select indicators that are as close to the project objectives as possible is to simplify the *quantification of project benefits* (or costs). This is particularly true when the environmental aspect of concern plays an important economic function (for example, soil quality as an input to agricultural production, water quality as an input to agriculture, or fish production). For example, in the case of land degradation, what is most important is to measure the degradation's effect on achievable yield. Indicators that measure various aspects affecting the yield are therefore more useful than indicators of, for example, soil depth. The further the chosen indicator is from the economic endpoint, the more difficult it will be to evaluate the returns to the project.

Limitation in number. It is most effective to be selective and use smaller sets of well-chosen indicators. Using too many indicators risks diluting their usefulness. Priorities may become confused and the details may seem overwhelming for both the developers and the users.

Clarity in design. Since *impact* indicators are linked to overall project objectives, which tend to be fairly general, they may not be as specific as component-level indicators. The *output* indicators at the component level should be detailed and relate to the specific results of the project component. Ideally, this distinction should be maintained in defining the impact and output indicators. In practice, there will be projects where the structure is not so neatly defined and these sorts of distinctions are not easily made. It is, however, important that the indicator is clearly defined to avoid confusion in the development or interpretation.

Realistic collection or development costs. EPIs must be practical and realistic, and their cost of collection and development therefore need to be considered. This may lead to trade-offs between the informational content of various indicators and the cost of collecting them. These trade-offs will obviously vary across technologies and depend heavily on institutional capacity. Certain indicators may be extremely simple or inexpensive to collect, but inadequate for various reasons. For example, forest cover is simple to measure from aerial photographs or by using remote sensing techniques, but it is a poor indicator of the condition of forests, and an even poorer indicator of the condition of natural habitats. More precise indicators may be much more difficult or expensive to collect, however. Sometimes it is possible to supplement coarser indicators with one-time studies that establish the relationship between them and the desired indicator. One way of deciding which indicator to collect or develop is therefore to compare the costs of collection/development to the benefits of the increased information to be contributed by the indicator.

Clear identification of causal links. The causal links must be clearly identified in order to design appropriate measures. For example, in the forest sector, observing the *rate* of deforestation alone provides an incomplete picture. If this information is supplemented with an indicator of incentives for forest clearing (for example land ownership policies), one is getting closer to the underlying cause of the problem.

The case of air pollution provides another example of the difficulties in establishing clear cause and effect links. Ideally, the project's impact on morbidity and mortality would be measured, since reducing them is generally the intended outcome. Morbidity and mortality themselves can be measured relatively easily, and most researchers agree that air pollution has adverse effects on health. But establishing a clear link between morbidity or mortality and any given source of emissions (an output indicator) remains extremely difficult, despite recent progress in this area (Ostro 1994, Cropper and others 1997, Eskeland and Xie 1998). In most such cases, the only feasible solution is to fall back on indicators of ambient concentrations or, if the source has been established as contributing significantly to total pollution, of emissions.

High quality and reliability. Indicators, and the information they provide, are only as good as the data from which they are derived. Ideally, an indicator should represent a reliable measure, that is, it should have a sound scientific basis. However, if the "ideal" indicator is not available (e.g., because of data problems or questions of reliability), a second-best proxy is often used.

Appropriate spatial and temporal scale. Project activities may have an impact far *beyond the area* in which the project is active. There may also be *lags in time* before project effects are felt and noticed. Changes in the long-term status of biodiversity, for example, often only manifest themselves over time periods much longer than typical Bank projects. Where feasible, it is therefore highly desirable that the selected indicators take into account the appropriate spatial and temporal scale.

Targets and baselines. The goal of EPIs is to monitor and evaluate the long-term environmental effects arising from Bank-supported activities. This implies a need to measure the environmental problem at three points in time (see Box 3 for an example):

Box 3

Baselines, intermediate targets, and end targets—An example

This sewerage and reuse project in the Republic of Tunisia will assist the government in: (a) improving service levels of urban sewerage up to the average level of potable water service; (b) promoting efficient reuse of effluent from sewage treatment plants for agricultural purposes; (c) reducing urban and coastal pollution; (d) improving *Office Nationale de l'Assainissement* (ONAS) cost recovery and financial capacity, with the long-term objective of making it more autonomous and self-financing; (e) introducing appropriate new sewage treatment technology; (f) providing technical assistance to develop private sector participation in the sewerage sector; and (g) acquiring environmental monitoring and management equipment, tools, and studies.

In order to measure the project's performance in relation to the above-mentioned objectives, a number of indicators have been proposed. Furthermore, baselines, intermediate targets, and end targets have been included for all of the indicators. The Table presents a selection of the indicators.

Indicators with baselines, intermediate targets, and end targets

	Indicator	*Baseline*	*Intermediate target*	*End target*
Output	Network cleaned (km)	5370	8000	9950
	No. of employees	4073	4723	4750
	No. of waste water treatment plants	50	75	95
	No. of employees per connection (000)	6.3	5.6	4.8
Impact	Area irrigated with treated sewage (ha.)	0	1000	6000
	Percent of network cleaned	75%	80%	84%
	Percent of water treated	90%	95%	96%
	Percent of water collected	78%	82%	86%
	No. of connections (000)	650	850	990
	Percent reuse of treated water	22%	33%	37%
	Ratio average tariff / average cost of supply	80%	102%	118%

Source: World Bank 1997c, Hamilton 1998.

A. *Baseline levels* of the indicators establish pre-project conditions, which is crucial for the interpretation of the indicators after project completion.

B. The project's contribution to a change in environmental performance, both directly and indirectly, must be measured when the project is ongoing so that there is time to modify the project design if the contribution is negative or not as positive as anticipated. On occasions, it may be possible to identify *intermediate targets.* Indicators should be selected that can measure whether or not the intermediate targets have been reached.

C. For most indicators it is desirable to have specified *end targets,* against which the final results of the project are measured. The lags in time that may occur before the effects are felt need to be taken into account when assessing whether or not the targets have been reached.

After selecting and measuring indicators it is still necessary to *interpret them.* The absolute level of the indicator can serve as a diagnostic tool during project implementation, as long as there exists a benchmark to which the value can be compared (e.g., safe drinking water standards from the WHO or the US EPA). The appropriate comparison, however, is generally not to the pre-project situation but to the counterfactual situation of what would have happened in the absence of the project. Even an increase in emissions may be considered evidence of success if they would have increased even more had the project not been implemented. In some cases, control groups can be used to measure conditions in areas not affected by the project. In others, modeling techniques should be used to predict what would have happened without the project.

5 Representative Environmental Areas

This section provides some examples of EPIs used in the major categories of environmental problems normally encountered in World Bank work: air and water pollution, changes in natural resources such as forests, water and biodiversity, global environmental concerns (specifically greenhouse gas emissions and protection of the ozone layer), and institutional problems.[4] The level of specificity varies across sectors. In some cases, such as air and water pollution, widely accepted norms exist on which indicators to measure and how to measure them. In others, notably biodiversity and institutional development, indicators are much more difficult to define and experience in using them is limited.

The discussions in this section are not meant to be exhaustive or to serve as step-by-step guides to indicator selection. In several cases, more extensive guidelines have been compiled and should be consulted more detailed recommendations. Examples of EPIs from some sectors are given in the boxes within this section as well as in Annex 1, where more general examples from each sector are brought together. For two examples on how to select and design EPIs for projects, see Annex 2, where an environmental project in Lithuania and an environment management project in Malawi are presented. For more examples on environmental indicators, World Bank task managers are encouraged to go to the Environmental Economics and Indicators Web site,[5] where lists of indicators for each of the areas discussed below as well as for mineral resources, coastal and marine resources, fisheries, solid waste and hazardous waste/toxic chemical can be found.

Forestry

Forest conservation, forest management, and the impact of deforestation are worldwide concerns that have long been of interest to the World Bank. The Bank's objectives for the forestry sector, as,articulated in the 1991 Forest Policy paper (World Bank, 1991) and the Operational Policy series (OP 4.36 Forestry),[6] are to promote the sustainable and conservation-oriented management of forest resources and forest lands to meet the needs of both present and future generations, giving particular attention to the needs of the rural poor. To achieve these objectives, the policy statements suggest nine specific aims to guide Bank involvement in the sector. Of these, three are clearly *environmental management objectives:* reduction of deforestation; preservation of intact forest areas; and enhancement of the environmental contribution of forested areas (key areas here include watershed protection, carbon sequestration, biodiversity conservation, wildlife conservation, and social amenity). A further two have important *environmental dimensions*: ensuring appropriate policy and institutional settings for sustainable forest and conservation-oriented forest management; and support for international efforts to promote forest conservation and sustainable forest management.

Management projects for forests may have several different objectives, such as timber production, watershed management, carbon sequestration, non-timber forest benefits, and biodiversity. In developing an indicator set it is important to consider the project goals. For example, an indicator such as deforestation rate can give a good first cut at identifying areas with significant pressures on forests. Once these areas have been identified, a more detailed understanding of the specific circumstances is necessary to develop appropriate project interventions. These will differ, for example, if population exerts pressure on forests to meet fuelwood needs or by clearing areas for agricultural use. The broad indicators of impact can then be supplemented by specific indicators which monitor how the project's interventions are working (e.g., rates of adoption of stoves or area served by rural electrification, for a project designed to alleviate demand for fuelwood). Measures of remaining forest cover and the rate at which it is being lost would then indicate whether the intervention is successful not just on its own terms but also in terms of meeting sectoral objectives.

Box 4 provides an example of a forest and parks protection project in Haiti that uses EPIs for the monitoring and evaluation of the project. Further examples of EPIs that might be used in forestry projects are presented in the matrix in Annex 1. Forestry indicators are discussed further in "Performance Indicators in Bank-Financed Agricultural Projects" (AGRAF 1995).

Biodiversity

Biodiversity conservation is a fundamental requirement for sustainable development because species extinction and irreversible losses of ecosystems or genetic diversity within species compromise the future options of both present and future generations. Biodiversity is commonly defined as three different levels; *genetic* (diversity within species), *species* (change in number of species and population size), and *ecosystem* (changes in natural habitats). Each level is influenced by three types of pressures: *physical* (e.g., habitat alteration); *chemical* (e.g., exposure to contaminants); and *biological* (e.g., release of alien species, and fishing). The selection of EPIs is dependent on the combinations among these levels and pressures.

Under the Bank's existing Forest Policy and the proposed Operational Policy on Natural Habitats, the Bank adopts, and expects its borrowers to adopt, a precautionary approach to natural resource management to protect biodiversity and other key environmental values. Despite the high level of uncertainty associated with conservation management, there is a strong conceptual understanding of both the threats to biodiversity and the key resource management requirements for biodiversity conservation, which is backed by considerable resource management experience in applying these concepts. This understanding suggests a number of overall goals that activities having an impact on biodiversity should aim for. Performance indicators can be developed for each of these broad goals, which they would then need to be supplemented by additional indicators tailored to the project's specific objectives and to the interventions carried out under it.

Habitat conservation is one of the most important goals, since habitat destruction has been identified as the most significant threat to mammal and bird populations. Habitat destruction in turn is largely driven by human activity that results in disturbance or over-exploitation of natural habitats through activities such as logging or hunting or through land-use change for agriculture, infrastructure development, or human settlement. A number of indicators can be used to monitor the impact on natural habitats. "Monitoring and Evaluation Guidelines for Biodiversity Projects" (1997) discusses the difference between "measuring biodiversity values of an area and monitoring the impact of management of biodiversity." This

Box 4
Forest and Parks Protection Technical Assistance Project in Haiti

In response to the Haitian Government's strategy, the overall objective of this project is to start the initial phase of intervention for the protection of critical remnants of Haiti's forest ecosystems and for slowing the pace of degradation of Haiti's natural resources. The project is planned to establish the institutional, policy and financial foundation for the Government of Haiti to sustain protection of critical ecosystems on a nation-wide basis. The three specific objectives of the project are to: (a) provide institutional support for strengthening the Government's institutional capacity to develop, monitor and enforce a national forest and parks protection system; (b) initiate key activities to protect and manage the La Visite and Pic Macaya National Parks and the Pine Forest National Forest Reserve, and; (c) reduce pressure on the above-mentioned protected areas by increasing on-farm productivity and off-farm employment options conserving natural resources, and enhancing the management capacity of local organizations in the buffer areas of the three targeted areas. The project components are listed in Table A and Table B below.

The overall performance of the project is being monitored, primarily based on a set of performance indicators for each of the individual components. The project documents have divided the indicators into performance indicators and impact indicators. Table A lists the output indicators together with the corresponding targets. The impact indicators have not been compared to any targets, but instead to a so-called "desired impact." This is shown in Table B.

Table A. Output indicators and targets for a forest and parks protection project

Project component	*Indicator*	*Target*
Natural reserve management (pine forest and national parks)	* % of boundaries established	100%
	* No. of Advisory Councils functioning effectively	3 Councils functioning effectively and autonomously
	* No. of park and forest ranger teams functioning effectively	3 ranger teams formed per reserve that regularly report violations to justice authorities
Buffer zone development (technology generation and transfer, and buffer zone small investment facility)	* No. of sub-projects financed and successfully functioning	250 sub-projects functioning effectively
	* Technology adoption rate	4,450 farms with agroforestry configurations; 2,050 farms using soil conservation techniques; 1,050 farms introduced crop diversification
Institutional reform and strengthening (project coordination, and training and technical assistance)	* No. of agencies effectively using strategic planning and budgeting	Associated agencies (4) functioning efficiently
	* No. of persons trained by category	60 new forest and park technicians; 10 natural resource management specialists

Table B. Desired impact and indicators for a forest and parks protection project

Project component	*Desired impact*	*Indicator*
Natural reserve management	Increase biodiversity	* Survival of key species on verge of extinction and population levels of threatened species
	Reduce encroachment and habitat destruction	* Change in area affected by encroachment and habitat destruction from 1997 baseline
	Develop Ecotourism	* No. of ecotourism related infrastructure units developed
		*No. of paying visitors
Buffer zone development	Increase farm productivity and farm family income	* Crop yields
		* On and off-farm income

Source: World Bank 1996b.

distinction is normally very important to make since many of the indicators that are commonly listed as biodiversity indicators measure values, but do not indicate the reason for the change in value. One example cited in the publication is the number of species threatened with extinction. While this indicator can be used for comparison between different areas, it cannot be used to interpret a change. If the number decreases it can be because: i) the threatened species have recovered, ii) some of them have become locally extinct, or iii) all of the originally threatened species are now extinct and a smaller number of new species are now threatened instead. It is important, therefore, to consider the project specifics, such as adjacent areas, areas required to sustain different species (*number* of species is not enough. One also needs information on which *types of species* are of concern), spatial and time scale effects, and other aspects.

Special attention needs to be devoted to identifying and monitoring the state of *critical* natural habitats, that is, sites that are vital for the continued viability of important species. The establishment and maintenance of effective, representative protected areas are important both in terms of ensuring the conservation of ecosystem diversity and as a tool to conserve specific habitats. Many indicators of the state of habitats and pressures upon them remain relevant to this objective. In addition, indicators can be developed to monitor protected areas *per se*. For example, change in the proportion of critical natural habitats in protected areas might indicate the adequacy of the current system of protected areas. For an example of indicators for a biodiversity conservation project, see Box 5.

The matrix in Annex 1 provides several examples of EPIs that can be used in projects affecting biodiversity. Biodiversity indicators are discussed further in the Bank's "Monitoring and Evaluation Guidelines for Biodiversity Projects" (1997), as well as in "Guidelines for Monitoring and Evaluation for Biodiversity Projects" (World Bank 1998a).

Land use

Since 1945, an estimated 1.2 billion hectares of land have been moderately or strongly degraded worldwide as a result of human activity, implying that productivity has been significantly reduced. Human activities can produce a diverse range of both harmful and beneficial impacts on the quality of land. Agriculture is one example; while it can lead to soil erosion, salination of soils through irrigation, and nutrient depletion, it may also act as a sink for greenhouse gases, and prevent flooding and landslides if practices are sound. Agriculture may also affect the conservation of biodiversity and landscapes. For example, the species level may be affected by excessive use of nutrients and pesticides, and by "domesticated" species affecting the number, population and distribution of species in natural habitats (thereby affecting the ecosystem level).[7]

The effects on the environment of land use projects are usually complex. They can differ depending on, for example:

- The technology, management practices used, and other aspects that impose or reduce pressure on the land
- The policy environment in the country
- The type and quality of the land
- The location of the project.

The selected indicators must therefore take these site-specific attributes into consideration in order to measure the proper effects of the project. Indicators of land use should measure the quality of land resources, changes in the capability of land to produce desired goods and services, and the existence of negative external impacts due to patterns of land management systems. They should also provide information about pressures exerted on land resources through land management systems, changes in

Box 5

The Cape Peninsula Biodiversity Conservation Project

South Africa ranks as the third most biologically diverse country in the world. The Cape Peninsula Biodiversity Conservation Project has as its development objectives to ensure rehabilitation and sustainable protection of the globally significant flora and related fauna of the Cape Peninsula, including surrounding marine ecosystems, and to initiate conservation planning and conservation activities for the entire Cape Floral Kingdom.

In order to achieve its sustainable development and global environmental objective of better conserving and sustainably using the unique biodiversity of the Cape Peninsula and the Cape Floral Kingdom, this project will: (i) facilitate the establishment and strengthen initial management of a new Cape Peninsula National Park, the area of which roughly corresponds to the current Cape Peninsula Protected Natural Environment; (ii) expand NGO-managed community-based conservation activities in support of the new national park and throughout the Cape Floral Kingdom by supplementing the capital resources of the Table Mountain Fund; and (iii) support the preparation of the first comprehensive conservation strategy for the entire Cape Floral Kingdom. The Table below lists a selection of the indicators presented in the Project Appraisal Document.

Indicators for a biodiversity conservation project

	Indicator	
	Output	*Impact*
Biodiversity indicators	Ha./year of land cleared of initial infestation of alien invasive species; Comprehensive visitor data maintained at controlled access points; Seasonal visitor surveys of unmanned access points to the Park; % of total vegetation requiring a regular fire regime to be subject to controlled burning; No. of visitor use of trails and gateways; % of conservation work cost out-sourced to entrepreneurs from the program; The proclamation of a marine national park surrounding the Cape Peninsula by year 5; M&E, EIS and study results utilized by park management.	No indigenous species added to the list of rare and/or threatened species (Red Data list); No additional plant species becoming extinct; No infrastructural damage to private property outside the National Park; All invasive alien seed bearing plants removed by year 6; All natural areas previously infested with invasive aliens in maintenance phase by year 6; 80% reduction of area burnt in uncontrolled wildfires by year 6; Implementation of an agreed marine protection plan.

Source: World Bank 1998b.

the state of land quality over time, and societal responses to pressures on, and changes in the state of, land quality. For an example of indicators for land use and other natural resource management aspects, see Box 6.

An effort is underway within the Bank and in close collaboration with UNDP, FAO, and UNEP to develop land quality indicators (LQI) that can be used to assess many of these aspects.[8] Furthermore, the Bank is involved in a regional

Box 6
Natural resources management in Tunisia

The indicators presented in the Table below are used as performance indicators in a natural resources management project in Tunisia. The project's objectives are sustainable natural resources management, in particular of crop and range land in severely degraded zones, and agricultural productivity improvements, attained with greater involvement of resource users.

More specifically, the project's components are Participatory Development Plans, Soil and Water Conservation, Rehabilitation and Development of Small-Scale Irrigation Systems, Agriculture and Rangeland Development, Rural Infrastructure, Women's Support Activities, and Institutional Strengthening.

Indicators for a natural resources management project

	Indicator	
	Output	*Impact*
Natural Resources Management Indicators	*Improvement of natural resource management:*	Active community development committees (no.)
	No. of Participatory Development Plans	Ratio of perennial / annual crops
	No. of staff trained	Ha. of soil and water protection
	No. of adaptive research operations initiated	Improved small scale irrigation area (ha.)
	No. of thematic studies	Proportion of communities w access to roads
	Improved agricultural yields:	
	Rural income increase	Proportion of households w access to drinking water
	No. of spate irrigation and water recharge works	Vegetation cover increase
	No. of livestock (heads)	Natural / cultivated land cover
	Animal feed consumption (ton)	Ha. of improved lands
		Milk yield increases, (t.)
		Crop yield increases (wheat, olives, tomatoes) (t/ha.)

Source: World Bank 1997b, Hamilton 1998.

project, initiated and managed by the International Center for Tropical Agriculture (CIAT) in Colombia, which is designed to develop rural sustainability indicators for improved decision-making (see Box 7).

Air pollution

Declining air quality can have adverse impacts on human health. Air pollution can also adversely affect economic activity (e.g., through damage to agricultural crops or structures) and the amenity value of the environment (e.g., through damage to forests and reduced visibility). There are an increasing number of sources of pollution: energy and fuel use, vehicular emissions, and industrial production. In most urban industrial areas, the origin of unacceptably high levels of air pollution can generally be traced to industry, transport, domestic fuel use, and the combustion of fossil

Box 7

Indicators of rural sustainability—An outlook for Central America

This project is intended to respond to the specific requirements of the Latin American and Caribbean region. The objective is to develop a regional approach to indicators and information, which would allow integration and harmonization with global and international initiatives, and to make the indicators accessible to decision makers at local, national and regional levels.

Several of the indicators would be most useful at a more aggregated level than project level (i.e., the national or regional level), while others could be used at either a project level or a more aggregated one. The spatial and temporal effects of a project may, however, call for indicators at both levels. Hence, where feasible, it is highly desirable that local/project level indicators be comparable to regional- or national level indicators. The Table below presents examples of the indicators proposed for land use and agriculture.

Regional/National/Local indicators for land use and agriculture

	Indicators	
Land use and agriculture	*Output*	*Impact*
Scale: Regional to National	Land use index (actual/potential) Agriculture as a % of BNP	Land use changes Food production index
Scale: National to State	Crops/pastures surface Agricultural land per capita Irrigated land Crops/pastures production Livestock carrying capacity Import/export of food products	Percentage of area of crops Change in consumption of food Soils degradation Agricultural productivity % of grain feed by livestock Production/supply of food products
Scale: State to County/Farm	Potential agriculture yields Crops prices Input prices Pesticides and fertilizer use Average size of farms Erosion rate Nutrient balance in soils Organic material in soils	Yields gap Accessibility to markets % of crops affected by plagues Poisoning by agr. chemicals Net income per farm Areas affected by erosion, salination, etc. Restored/rehabilitated land

Source: CIAT-World Bank-UNEP 1998.

fuels. Additionally, there exist natural sources such as windblown dust, pollen, forest fires, and volcanoes. The primary focus is on emissions from human activity since little can be done about natural factors.

There are a wide variety of pollutants of concern from the point of view of health and environmental impacts. A number of site-specific studies have examined pollution risks. Although results vary, there are some important consistent findings:

- Health problems have typically been associated with indoor pollution and airborne particulates—measures of which include Total Suspended Particulates (TSP) and, for the more damaging smaller size particles, PM_{10} and smaller—and ambient lead
- Damage to structures, forests, and agricultural crops tend to be primarily linked with SO_2 and ground-level ozone.

Information on appropriate procedures for monitoring these indicators is readily available.

Similar measures are used for both outputs and impacts, depending on whether emissions or ambient levels are being measured. Although monitoring data on pollutant generation is not readily available, information can be culled from other sources. The World Bank has developed some interim techniques to arrive at estimates of emissions, namely, the Decision Support System for Industrial Pollution Control (DSS/IPC) and the Industrial Pollution Projection System (IPPS). The emissions estimates are derived from assumed emissions factors (pollutant emission per unit of output) for different economic activities.

Even though the ultimate objective of a project is to mitigate damage to human health, monitoring such effects directly is extremely difficult because of substantial uncertainties over the exposure of different population groups to pollutants, their response to different levels of exposure, and the cumulative nature of damage. It is common, therefore, to fall back on monitoring indicators of ambient concentrations or of emissions to gauge a project's impact. These indicators can be quite useful as long as prior research has established the causal links.

The matrix in Annex 1 lists the most commonly used indicators of air pollution, which may need to be supplemented by additional EPIs depending on local conditions, as discussed above. Additional details and discussion can be found in documents on the *Industrial Pollution Projection System* (Hettige and others 1995) and in the *Pollution Prevention and Abatement Handbook 1998: Toward Cleaner Production* (World Bank 1999).

Water pollution

The contamination of surface waters from faecal discharge due to inadequate sewage networks and waste treatment facilities in urban areas is a major environmental problem in many countries. Surface and ground water pollution from the industrial and agricultural sectors and high levels of salinity are other significant problems. Acidification of surface waters from air pollution is a more recent phenomenon and can be a threat to aquatic life.

Water pollution is of concern for two main reasons. Perhaps the most important is the potential for serious health problems: water pollution has been associated with outbreaks of waterborne diseases such as cholera and gastro-enteric diseases. The impact of water pollution on health can be either direct, through consumption of contaminated water, or indirect, through bio-accumulation of contaminants in fish. The other main reason for concern is the effect of water pollution on the productivity of water-based economic activities such as fisheries and irrigation.

Understanding of the impact of water quality on human health and aquatic life has improved enormously in recent years. Four broad measures of water quality have come to be widely used and are listed in the matrix in Annex 1:

- Faecal coliform concentration
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Heavy metals concentration.

These indicators can generally be used as either *output* or *impact* indicators, depending on where measurements are taken. Used together, they provide a very good picture of the overall health of the water body or of the threats to it. In some cases, however, some of these indicators may not be applicable and can be omitted (e.g., heavy metal contamination may not be a factor if there is no industry). Conversely, these indicators may have to be supplemented by additional indicators that measure more precisely the effects that the project is having (e.g., contamination by specific pollutants likely to be associated with project activities, such as pesticides and fertilizers in an agricultural project).

The procedures required for measurement of water quality indicators are problem-specific but are generally well understood. Sampling methods differ depending on whether the water body of interest is a lake or a stream. Timing of measurements is often an issue, since concentrations can vary substantially as the waterflow varies; a given pollutant may cause few problems when waterflow is at its peak but have a major impact at times of low waterflow. Interpretation of results can be undertaken in a number of ways, depending on the specific objective to be achieved. Institutions such as WHO or the US EPA have developed standards for drinking water quality, for example, although their applicability to developing countries is sometimes questioned. For an example of selected indicators for water pollution, see Box 8.

Box 8
Water and sanitation services in Gaza

The project is designed within the framework of a program addressing the priority needs for the West Bank and Gaza (WBG) as originally defined in the water and wastewater component of the three-year Emergency Assistance Program. The objective of the program is to improve the quality, quantity and management of water and wastewater services in the WBG. *It includes equipment procurement; upgrading and extension of munici-pal water supply networks; rehabilitation, extension and construction of municipal storm-water and sewerage networks; improvement of village water distribution and related programs; the drilling of new wells; and improving management of water and wastewater services.*

For Gaza, the program includes: (a) the provision of an International Operator to implement a Service Improvement Program together with the provision of operating capital for the Operator; (b) finance for investment in rehabilitation projects and provision of additional water and wastewater facilities in areas where they are most urgently required (through bilateral funding); and (c) Technical Assistance (TA) and Institutional Capacity Development.

The indicators proposed to measure the project's performance are listed in the Table below.

Indicators for a water and sanitation services project in Gaza

	Indicator	
	Output	*Impact*
Water and sanitation services indicators	*Improving quantities of water supplied* Survey network for leaks (km. of pipe) Service connection replacements (no.) Meters repaired (no.) Meters replaced (no.) *Improving water management* - Water services: Percent of accounts in arrears Conversion of illegal connections to legal (no.) Map and model water network (%) - Wastewater services: Develop and implement preventive maintenance system	*Improving quantities of water supplied* Percentage of water accounted for *Improving quality of water* Per cent of water network disinfected Percent reduction in BOD Percent reduction in COD Percent reduction in total suspended solids *Improving water management* Per cent of managers and technicians retrained

Source: World Bank 1996c, Hamilton 1998.

Global environmental problems

Measuring the impact of projects on global environmental problems such as climate changes or damage to stratospheric ozone encounters significant scale problems. No single project is likely to have any measurable impact on these problems. Measuring the *impact* of a problem, therefore, does not generally fall within the scope of project-level monitoring. Measuring the outputs of a project is feasible, however (and is required under OP10.04).

Climate change. Climate change is linked to a number of important effects on the global life-support system: sea level rise is just one of the most dramatic potential impacts; major shifts in primary agricultural production areas are another. The main greenhouse gases (GHG) generated by human activity are CO_2, methane, and nitrous oxide. The degree to which these GHGs affect climate change depends on their concentrations in the atmosphere and their ability to absorb heat, also known as the global warming potential. For instance, the global warming potential of methane is said to be 25–30 times that of an equivalent amount of CO_2 (IPCC 1994). Concern for GHG emissions and climate change is usually expressed in terms of either reducing new emissions or off-setting emissions by reductions elsewhere on the planet (for example, carbon sequestration and carbon offsets).

Although monitoring global climatic effects is impractical at the project level, emissions of GHGs give an indication of the impacts being generated. These emissions can either be measured directly (if the project involves interventions in major producers of GHGs such as thermal power plants) or estimated from the project's impact on economic activity (using emissions factors by activity). In either case, baseline data on pre-project emission levels will be required. The most commonly used indicator in this area is some measure of carbon emissions (or other gases that contribute to global warming) or a measure of the percent reduction in carbon emissions from some base scenario. When multiple GHGs are involved, the global warming potential can be used as a weighting factor.

Stratospheric ozone. The ozone layer blocks ultra-violet radiation that is harmful to humans and all living resources. The degeneration of the ozone layer is precipitated by the existence of ozone-depleting substances (ODSs) such as chlorofluorocarbons (CFCs) and halons. The effect of these substances depends on their concentrations in the atmosphere and their ability to break down ozone. The latter is referred to as the ozone-depleting potential. While the production of ODSs itself does not damage the ozone layer, the subsequent use of these substances and their release into the atmosphere results in damage to the ozone layer. Substitutes with zero or near zero ozone-depleting potential are being developed.

Here too, monitoring global effects is impractical and work therefore focuses on measuring changes in outputs from project activities. The consumption and hence emissions of ODS can be used as a measure of the outputs being generated by economic agents. At the national level, monitoring production, net of exports and adding imports, can be taken as a proxy for the country's contribution to the problem. At the project level, the project's contribution to national production and consumption can be used as a proxy. Different ODSs can be weighted by their ozone-depleting potentials to arrive at a composite measure of the impact of any given reduction of ODS. Many countries have committed themselves to phasing out ODSs and replacing them with substances with low or zero ozone-depleting potential. The ratio of ODS consumption to production, relative to a baseline and, where relevant, to a target, should also be monitored.

The matrix in Annex 1 provides several examples of output indicators for global environmental problems; no impact indicators are provided, since it is unrealistic to hope to link any specific project with changes in the state of global problems. Additional details on climate change and ozone depletion problems can be found in publications of the Environment Department (World Bank 1995b and 1995c, and Martinot 1998).

Institutional issues

The success of environmental policy initiatives is contingent on a well-functioning network of institutions that can support the formulation, implementation, and regulation of environmental objectives. In many of the Bank's client countries such support systems are either non-existent or embryonic. Capacity-building initiatives, therefore, are one of the most important and challenging areas for environmental lending. These efforts can have a far-reaching impact, since they form the foundation for integrating environmental concerns into mainstream policy development. The stronger the institutional framework, the better and more timely the response to environmental problems is likely to be, independent of any assistance the Bank may be able to furnish through specific projects. To date, however, the success in environmental institutional development has been mixed.

The major performance indicators for institutional development can be grouped in four broad areas: legal framework, institutional framework, staff development, and technical capability. In some cases, indicators simply note the presence or absence of particular features, such as laws or agencies dealing with specific environmental problems. Other indicators attempt to quantify the effort devoted to environmental matters (e.g., by looking at the number of staff in environmental agencies or examining environmental expenses as a percentage of the government budget). Both these types of indicators must be used with considerable caution, however. Institutional development is as much about quality as it is about quantity, so numerical or presence/absence indicators alone can be very misleading.

There are several problems with these so- called "commitment" indicators. For example, having a biodiversity strategy is only the first step. Next, the strategy needs to be implemented. Finally, it must have a positive effect on biodiversity. Enforcement efforts will be ineffective unless the enabling frameworks and capability are in place. Good qualitative knowledge of local conditions is indispensable if the indicators are to be properly interpreted. A problem with qualitative as opposed to quantitative indicators is the difficulty in standardizing them so as to allow meaningful analyses of changes over time.

Institutional issues are not solely about the existence and capacity of governmental institutions. In many cases, public attitudes towards environmental problems are crucial, since most decisions about matters affecting the environment are ultimately taken by individual agents such as farmers, industrial producers, and consumers. In addition, public attitudes towards various types of environmental services are critical to valuing these services correctly. For example, the evolution of public attitudes can be monitored through opinion surveys. The number and membership of active environmental NGOs also gives an indication of public attitudes. For some examples of institutional indicators, see Box 9.

Box 9

Institutional capacity in pollution control and abatement projects

This box presents indicators used in two different projects: a pollution abatement project in the Arab Republic of Egypt and an industrial pollution control project in the Democratic and Popular Republic of Algeria. Both projects have as their broad objective to assist the Government in reducing industrial pollution causing adverse health effects and/or ecological degradation. The projects consist of two main components:

- A technical and institutional support component that would provide technical assistance, studies, training, monitoring and pollution control equipment, and field vehicles to support sub-components (for example to strengthen the technical and administrative capacity of regional branches)
- An investment component. For one of the projects this component consists of a Pollution Abatement Fund that will provide financing for environmental investment in public and private enterprises. For the other project it covers environmental investments in a fertilizer complex and in an iron and steel complex.

Examples of the proposed indicators are presented in the table below.

Indicators for institutional issues

	Indicators	
	Output	*Impact*
Institutional capacity in pollution control and abatement projects	No. of plants where monitoring is complete No. of audits completed No. of Pollution Abatement Action Plans No. of trained technical staff No. of staff trained in environmental law Promulgation of new environmental regulations (no.) No. of pollution permits negotiated No. of enforcement actions No. of air monitoring stations No. of water monitoring stations No. of staff trained in finance Capital base	No. of environmental professionals in the Egyptian Environmental Affairs Agency and Environment Management Units Funding for industrial pollution control ($US)

Source: Hamilton 1998.

Notes

4. Some areas are not covered by this note (for example, water management) since separate performance indicator notes have been compiled for those. For other areas (for example, coastal and marine resources, fisheries, mineral resources, solid and hazardous waste, and toxic chemicals) the experience is still too limited to be discussed in any detailed way.
5. http://www-esd.worldbank.org/eei.
6. The forest policy is being reviewed during the fall of 1998. The revised policy and a new strategy are scheduled to be completed before the end of FY00.
7. For a more detailed discussion on agriculture and environmental indicators, see OECD (1997).
8. For more information on the Land Quality Indicators Program, please see http://www.ciesin.org/lw-kmn/.

6 Summary

Selecting appropriate Environmental Performance Indicators to assess and evaluate the performance of World Bank projects in relation to environmental issues is a complex task. It is probably neither possible nor desirable to develop a small set of 'universal' indicators. For projects with explicit environmental objectives, these objectives give concrete guidance to the identification of appropriate EPIs. In other cases, the EA process serves as a guide to selection of EPIs in cases where environmental impacts are unintended or indirect. Once the areas to be monitored have been identified, specific indicators can be selected to monitor how the project is affecting the pressures on the environment and the end result of these pressures. Where possible, it is desirable to select indicators that will be comparable to broader measures of environmental health, or comparable across projects.

This note discusses specifically output and impact indicators. The first category can be defined as indicators that measure goods and services provided by the project, while the latter measure the immediate, or short-term, and longer-term or more pervasive results of project implementation. The *output* indicators should relate to the components of the project and the *impact* indicators to the stated objectives of the project. Which indicators to select for a project is determined by a series of selection criteria of which the direct relevance to project objectives, limitation in number and clarity in the design of indicators selected, and realistic costs of collection or development are among the most important. These, as well as other selection criteria are discussed in the note. Furthermore, the specific characteristics of the environmental area that one wishes to measure and monitor are relevant in the choice of indicators. This note analyzes some of these characteristics for a number of representative environmental areas: forestry, biodiversity, land use, air pollution, water pollution, global environmental problems, and institutional issues.

Annex 1 — Matrix of Representative Environmental Performance Indicators

This table provides some *examples* of EPIs used in the major categories of environmental problems that are normally encountered in Bank work; it is *not* meant to be exhaustive. The indicators are grouped according to whether they are output or impact indicators. More examples for the same areas as well as for water management, minerals, fisheries, coastal and marine resources, solid and hazardous waste, and toxic chemicals can be found on the Environmental Economics and Indicators Unit's Web site (http://www-esd.worldbank.org/eei). Since input indicators are already measured by Bank projects and are relatively well explored, they are not listed in the matrix below. Examples of such indicators are best provided with a specific project in mind since they are hard to generalize. (Annex 2 provides some examples of *input* indicators for the Lithuania Siauliai Environment Project. See the main text for a detailed discussion.)

Matrix of Representative Environmental Performance Indicators

	Type of indicator			
	Input (*These are project specific.*)	***Output*** (*Most of these will also be project specific since they should be linked to the project components. However, below are some of the more general listed.*)	**Impact** (*Change in this type of indicator measures environmental impacts of a project.*)	***Comments***
Forestry		▪ Per capita wood consumption; ▪ Incentives for forest clearing; ▪ Percentage of total forest area clear-felled; ▪ Area replanted with timber species.	*Deforestation:* ▪ Rate of deforestation; ▪ Area of forest; ▪ Area of forest land converted for other uses; *Preserving intact forest areas:* ▪ Area of roadless forest; ▪ Forest fragmentation index; ▪ Ratio of managed forest to non-managed forest; ▪ Protected forest as a percentage of the total forest area; ▪ Percentage of harvested area left to natural regeneration; *Watershed protection:* Proportion of watershed with appropriate cover.	The appropriate impact indicators depends on the objective; output indicators are often similar across objectives, but the appropriate resolution changes (for example, to focus on particular watersheds).
Biodiversity		▪ Encroachment into natural habitats; ▪ Legal and illegal hunting offtakes; ▪ Upstream pollution sources; ▪ Total natural area converted by development; ▪ Area of secondary forest;	▪ Rate of change from dominance of non-domesticated species to domesticated species; ▪ Area of natural habitat; ▪ Habitat fragmentation index; ▪ Proportion of habitat adjoining incompatible land uses; ▪ Population status of selected indicator organisms; ▪ Changes in the bio-geochemistry of soils and waterways; ▪ Species threatened with extinction or extirpation; ▪ Percentage of area dominated by non-domesticated species; ▪ Total area of rainforest in protected areas; Area of rainforest in indirect use (parks, ecological stations, biological reserves)	Special attention needs to be devoted to identifying and monitoring the state of *critical* natural habitats. It is also important to make the distinction between measuring biodiversity values of an area and monitoring the impact of management of biodiversity. Many of the indicators that are commonly listed as biodiversity indicators measure values, but do not indicate the reason for the change in value.
Land use		▪ Nutrient removal in excess of fertilizer applications and natural regeneration; ▪ Erosion rates; ▪ Ratio natural/cultivated cover; ▪ Vegetation cover increase.	▪ Nutrient balance (of N, P, K, and of other nutrients depending on the specific crops being grown); ▪ Soil depth; ▪ Organic matter content; ▪ Total Factor Productivity (TFP); ▪ Ratio of perennial/annual crops; ▪ Ha. of soil protection; ▪ Arable land affected by waterlogging ▪ Arable land affected by erosion.	Appropriate indicators are very site-specific. Indicators of land use should measure the quality of land resources, changes in the capability of land to produce desired goods and services, and the existence of negative external impacts due to patterns of land management systems.

Water pollution	Discharges of human and industrial wastes: ▪ Faecal coliform counts; ▪ Biological Oxygen Demand (BOD); ▪ Chemical Oxygen Demand (COD); ▪ Heavy metals concentrations.	Concentrations of pollutants in water bodies: ▪ Faecal coliform counts; ▪ Biological Oxygen Demand (BOD); ▪ Chemical Oxygen Demand (COD); ▪ Heavy metals concentrations. ▪	The same indicators can serve as measures of output or impact, depending on where they are measured.
Air pollution	Emissions of ▪ Particulates (TSP, PM_{10} or smaller); ▪ SO_2; ▪ Lead.	Ambient concentrations of ▪ Particulates (TSP, PM_{10} or smaller); ▪ SO_2; ▪ Lead.	The same indicators can serve as measures of output or impact, depending on where they are measured.
Global environ-mental problems	Climate Change: ▪ Emissions of greenhouse gases : – CO_2; – CH_4. Stratospheric Ozone: ▪ Emissions of ozone-depleting substances (CFC, Halons); ▪ Implementation of ozone-depleting substance phase-out.		Measuring the impact of specific projects on a global problem is unrealistic.
Institutional Capacity	▪ Number of staff trained in environmental law; ▪ Promulgation of new environmental regulations; ▪ Number of environmental audits completed.	▪ Existence of environmental laws and agencies; ▪ Active NGOs; ▪ Number of trained staff in environmental agencies; ▪ Number of laboratory facilities; ▪ Share of environmental expenses of total budget.	Institutional development is as much about quality as it is about quantity, so numerical or presence/absence indicators alone can be very misleading.

Annex 2 — Examples of the Use of EPIs in World Bank Projects

— Tables begin on next page —

A. Lithuania Siauliai Environment Project

Objectives	*Input* *(Resources provided for project activities)*	*Output* *(Goods, services and direct outputs of project activities. Details to be determined at "detailed design" phase)*	*Risks* *(The output is dependent on…)*	*Impact* *Impacts that correspond to the individual objectives*	 *Overall impacts*
To reduce pollutant loads from the Siauliai areas into the Upper Lielupe River Basin.	- IBRD loan (US $6.20 mill.) - Bilateral grants (US $8.54 mill.) - Government (US $7.6 mill.) - Municipality (US $0.4 mill.) All funds will be utilized for procurement of equipment, works, consultants, and technical assistance (training).	- Rehabilitated Sewer Network; - Rehabilitated WWTP; - New WWTP; - Pollution control measures at pig farms; and - Pollution control measures for agricultural run-off. WWTP = Wastewater treatment plant	- Problems with availability of local funding.	- Increased amount of treated wastewater, from 40,000 m^3/d – 50,000 m^3/d. - Reduced pollution level (at the treatment plants' outlets and at a number of other locations as follows: ▪ Mouth of Lielupe river ▪ N 250 t/y – 18 t/y ▪ P 56 t/y – 15 t/y ▪ At WWTP ▪ BOD 1,000 t/y – 200 t/y ▪ Suspended solids 1,000 t/y – 200 t/y ▪ N 500 t/y – 360 t/y ▪ P 75 t/y – 20 t/y N = nitrogen; P = phosphorus; BOD = Biological Oxygen Demand. Reduced pollution levels at selected points downstream from agricultural pilot sites and pig farms (baseline to be determined).	- Lower health care costs (by X%); - Increased tourism revenues (by Y%); and - Increased international political goodwill (measured through…). (Baselines to be determined)
To improve the quality, reliability, and cost of water aupply and wastewater services in Siauliai.		- Rehabilitated equipment; - New equipment; - Restructured water utility; and - Trained people;	- Ability to adjust tariffs; - Revenue collection difficulties; - Political difficulties with organizational restructuring (staff reduction).	- Improved drinking water quality; ▪ Decrease of iron content; ▪ Softer, potable water; - Reduced number of breaks and trouble calls on ▪ Water supply and distribution system ▪ Wastewater collection and conveyance system (baseline to be determined) - Adequate operating ratio (<85%) - Adequate working ratio (<70%) for the water utility	
To improve regional & local environmental quality monitoring and enforcement system in the Upper Lielupe river basin		- Monitoring and laboratory equipment; - Other equipment; - Trained people; - Management plans for industrial pollution reduction and sludge; - Emergency management plan;	- Potential coordination difficulties between concerned parties.	- Regular and accurate monitoring of water quality; - Regular enforcement visits at pollution sources (quantified definitions would be determined when drafting management plans).	

B. Malawi Environmental Management Project

	Objective (*Output* indicators measure component objectives, while *impact* indicators measure project development objectives)	**Indicator**	**Measurement**	**Assumptions** (Assumptions behind the choice of indicator, as well as for a positive result of the project)
	Improved environmental capacity and coordination	▪ Functioning lead Ministry, functioning committees, donor groups, NGOs ▪ Functioning EIA process ▪ Functioning Environmental Information Systems	▪ Efficient allocation of resources, client satisfaction. Records of meeting, and account of decision taken. ▪ Numbers of EIAs approved ▪ Number of users, size of databases, number of projects using systems	▪ Very efficient financial monitoring and control system ▪ Sufficient trained personnel to conduct and analyze EIAs
	Better trained groups working on environmental management in Malawi	Numbers of people, communities trained	Qualitative: surveys, client consultation, continued flow of resources	Timely delivery of high quality training courses
	Enhanced environmental education	▪ Quantities of materials distributed ▪ Materials prepared and disseminated through formal and non-formal education ▪ Development and supply of materials	▪ Quantitative: Numbers of training courses (to be included in training program to be developed during 1997). ▪ Qualitative: training effectiveness (post-course evaluation). Annual Report on training. ▪ Annual Report and Work Plan	▪ Effective coordination of effort among different Government agencies, NGOs and donors to minimize duplication of effort and maximize leverage of ESP resources ▪ Full collaboration with all elements of formal and non-formal education system, synergy with other initiatives
Outputs	Enhanced community mobilization and implementation of local environmental activities	▪ Numbers of communities mobilized for natural resources/environmental management ▪ Numbers of communities implementing co-management and environmental micro projects	▪ Quantities: Effectiveness (to be evaluated during annual work review and planning exercises). Community satisfaction. ▪ Annual evaluation numbers) of communities, projects and participants	Maintenance of Government commitment to community empowerment
	Institutional capacity building and strengthening of the environmental information systems	Procurement and distribution of inputs, provision of training resources	Annual Report on progress and procurement and disbursement indicators	▪ Maintaining the momentum of capacity development, with necessary staff. Continued commitment of resources. Effectiveness of capacity to procure inputs and manage financial systems ▪ Maintain commitment and resource application. Sufficient capacity to implement programs. NGOs are sufficiently motivated and organized to continue work.
	Community based environmental management	Timely supply of financial resources	Annual Report and Work Plan	Efficient management of program and line Departments
	Environmental actions and studies	Diverse	Annual Report and Work Plan	

B. Malawi Environmental Management Project *(continued)*

	Objective (*Output* indicators measure component objectives, while *impact* indicators measure project development objectives)	***Indicator***	***Measurement***	***Assumptions*** (Assumptions behind the choice of indicator, as well as for a positive result of the project)
Impact	Improved policy and institutional framework	▪ Adoption of National Environment Policy and Environment Management Act. Role of MOREA and EAD established and agreed ▪ Promulgation guidelines and regulations under the EMA ▪ Revision and review of sectoral policies and legislation	▪ NEP adopted in Feb. 1996, EMA enacted in June 1996. EMA sets out role of EAD, and Public Services Commission expedites recruitment of staff. ▪ Guidelines and regulations by Dec. 1997 ▪ Policies and legislation: forestry 9/98, fisheries 9/98, parks and wildlife 9/98, soil conservation 9/98, land tenure 9/98, water/irrigation 9/98	Improved policies will actually make a difference and that there will be sufficient capacity and political will to implement the new policies.
	Improved capacity to manage natural resources and environment at all levels	▪ Increased staffing for MOREA ▪ Effective coordination of: – National Council for the Environment – Parliamentary Committee – Technical Committees on the Environment – ministries – NGOs – donors ▪ Preparation of annual workplans ▪ Effective establishment of environmental focal points network ▪ EIS – Establishment of effective EIS ▪ Training	▪ Full staffing complement achieved and maintained 12/96, and annually monitored thereafter ▪ Frequency of meetings (e.g twice per year, at least three times per year, monthly) ▪ Annual Review process ▪ Official designation of focal points by 12/97 ▪ Demonstration pilot for Shire River system – mapping and data input accomplished ▪ Establishment and implementation of training programs for MOREA, line Ministries, NGOs, communities. Annually thereafter, numbers of training courses and people trained.	▪ Capacity development will be sustainable – staff turnover, political support for institutions concerned remains high. Must maintain momentum through training and replacement of staff when turnover occurs. ▪ Availability of funding. ▪ Incentives for data collection and supply sufficiently strong for focal points and other to supply data.
	Effective empowerment of communities for CBNRM	Areas of forest and public land brought under effective management by communities	▪ Forest resources co-managed hectares/ numbers of communities mobilized and empowered annually ▪ National parks and wildlife areas co-managed, numbers of communities mobilized ▪ Agreement by Ministry of Finance on revenue sharing by communities	▪ Community empowerment provides sufficient incentive for communities to take control of their resource base. ▪ Government commitment to co-management remains strong.
	Enhanced environmental awareness	Greater public awareness and informed population	▪ Surveys, active participation of all levels of society in environmental management ▪ Newspapers, radio, dance groups, environmental clubs, choirs	Continued support t political level and active participation by groups including parliamentarians, Ministers, traditional leadership structures.

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