Inter-American Development Bank – IDB
Training Program

TRAINERS' COURSE ON ENVIRONMENTAL MANAGEMENT AND ASSESSMENT FOR INVESTMENT PROJECTS

"Fundamentals of Environmental Impact Assessment"

Basic Text

Guillermo Espinoza and Barbara Richards

Inter-American Development Bank – IDB
Inter-American Association of Sanitary and Environmental Engineering - AIDIS
2002

CONTENTS

CHAPTER I

Introduction

1 OBJECTIVES

The document "Fundamentals of Environmental Impact Assessment" introduces the conceptual framework of the environmental impact assessment process as a preventive tool that incorporates the environmental dimension to all new projects and activities and modifications to the existing ones. The text contains concepts, steps, and tools explained in non-technical language so that the reader will readily understand the environmental requirements that need to be reviewed and met before making a start on any human activity. The assessment process is based on the following aspects:

EIA is a comprehensive, broad, and formal analysis.

- Universal accepted requirements for an effective environmental impact assessment through: a) a comprehensive environmental analysis, including the basic aspects of the assessment; b) a broad analysis that seeks to ensure compatibility with other development aspects; and c) a formal analysis, according to legal requirements.

EIA supports sustainable development.

- Technical and administrative requirements that make it possible to incorporate environmental sustainability into the development process, based on innovative and comprehensive management integrated into the sustainable perspective.

EIA is a preventive process.

- Environmental viability of human activities and compliance with prescribed procedures.

- A general framework for the preventive application of environmental protection to cover the specific characteristics of every human activity in particular.

2 MEANING OF THE TEXT

Considering the details involved in applying environmental assessment procedures, the document pursues the following:

- Ensure that the environmental impact assessment process is defined as a preventive management tool to identify and correct the negative environmental impacts of human activity, and to enhance positive impacts.

- Guarantee that environmental resources and elements at risk are described and evaluated considering all protection measures in accordance with formal demands and the state-of-the-art.

- Verify independently the opinions and conclusions of environmental analyses, to create transparency and security for all stakeholders.

EIA considers environmental positive and negative aspects.

- Perform a comprehensive and sound environmental resource assessment to balance the decision-making process. Hence, the importance of including the analysis at the earliest stages of the process.

- Coordinate and integrate actions to ensure full understanding of the environmental influence of the activities and projects undertaken.

3 FEATURES OF THE TEXT

- This text is designed to be used by all stakeholders involved in the environmental impact assessment process. It helps project coordinators to define the main aspects to be included in their environmental impact studies.

EIA is a broad and objective review.

a) The text may be applied to the following functions:

b) To promote compliance with environmental requirements.

c) To provide known and accepted elements to prepare, review, and approve environmental impact studies.

d) To comply with classical environmental requirements demanded by the environmental impact assessment for different human activities.

To facilitate the appropriate use of concepts, steps, and requirements of EIA.

- The following references were used in preparing this text:

a) USEPA Course on "EIA Principles", and its adaptations in Chile, Ecuador, Uruguay, and Peru.

b) Course on "Tópicos de Evaluación de Impacto Ambiental para Ecuador", ["Environmental Impact Assessment Issues for Ecuador"] of CAAM, Ecuador.

c) Course entitled "Procedimientos y mecanismos de evaluación y seguimiento ambiental“ ["Procedures and mechanisms for environmental assessment and follow-up"] for the PROMESA program of Fundación Chile/ IDB.

d) EIA-strengthening programs in Chile (IDB/World Bank), Uruguay (IDB), Panama (IDB), Ecuador (USAID/WRI), Peru (IDB), and El Salvador (IDB).

e) Municipal Environmental Management Program (IDB/CED-Chile).

f) Course on "Participación ciudadana y EIA" ["Citizen participation and the EIA"] (Casa de la Paz/USAID/WRI).

g) EIA Course for the Universidad de Chile, Universidad Católica de Chile and Universidad de Santiago de Chile.

h) Manual de evaluación del impacto ambiental: conceptos y antecedentes básicos, ["Manual for environmental impact assessment: basic concepts and background data"], published by CONAMA in 1994 (Chile).

CHAPTER II

EIA and Sustainable Development

1 GLOBAL ENVIRONMENTAL CHALLENGES

In the last 40 years, changes have occurred with unprecedented speed, causing major political, cultural, scientific, technological, economic, social, and environmental transformations.

Some environmental problems exceed country capability.

In the last half century, humankind has progressed more than in all the ages that went before. Living conditions have improved and the life expectancy of men and women has increased. Communications have developed at an increasingly astonishing pace. Humankind has become more and more adept at taming nature, so much that we now threaten our own environment and, thus, our very survival.

These facts imply substantial changes in the economic and cultural life of our contemporary world. Perhaps the most significant change today is globalization, which, in turn, contributes to serious environmental problems worldwide. Global warming, climate changes, the thinning of the ozone layer, loss of biodiversity, plant mass reduction, and increasing desertification are examples of such deterioration.

2 CONCEPTUAL FRAMEWORK AND SUSTAINABLE DEVELOPMENT

Environmental protection is a requirement for sustainable development.

Although we all know that development is a term relating to growth, stability, and modernization, we need to understand that it is a highly complex concept. Besides its economic or material connotations, it also involves human fulfillment. To reach that stage, however, the population needs a stable, healthy environment in which to grow and obtain its resources. Since the environment provides the scenario and tools to reach higher stages of human fulfillment, it must be protected against all possible threats to safeguard our potential sources of development.

Sustainable development considers economic growth, social equity, and environmental protection.

Sustainable development is traditionally defined as meeting present needs without jeopardizing the capability of future generations to meet theirs. More recently it is being termed a sustained and equitable improvement in life quality based on appropriate environmental conservation and protection measures to avoid exceeding the environment's recovery and waste absorption capacity.

Whichever definition we adopt, however, emphasis is placed on the need for making continuous economic growth compatible with social equity and efficient environmental management. This is a course of action that poor and rich countries must embark on together if they are to succeed, since the environmental issue has become a global

problem; what happens in one part of the world, however remote, can be the cause of an effect elsewhere.

Sustainable development makes environmental policies consistent with other priorities.

All this should be considered when referring to sustainable development, since the measures adopted will have to lead to rational actions in terms of costs and benefits. Only then will environmental policy manage to translate its objectives into palpable signs and succeed in preventing environmental deterioration. Therefore, the vital questions are to that extent environmental quality can be sacrificed to further progress and to what extent growth can be restricted or modified to protect the environment.

Sustainable development is applied to different land area levels.

What type of development is sustainable? Strictly speaking it is not easy to identify any economic activity based on the exploitation of natural resources that actually protects or improves the basic natural resource. This is the case of ore extraction, but it is also valid for living natural resources. The concept of "maximum sustainable performance" has been used for several decades in fishing, but there are many reasons against defining it as a sustainable activity under current exploitation conditions, although in theory, it could be possible. There are also serious doubts, particularly with regard to the most vulnerable forests of both tropical and cold areas, about the technical, environmental, and political viability of such development in the forest sector.

The EIA helps sustainable development.

So the real challenge is to identify and subsequently implement a coherent hierarchy of overlapping sustainable development strategies ranging from individual actions in rural communities to global community management. Obviously, this is a very long chain which implies significant changes in the particular aspirations and lifestyles of different peoples. The United Nations Conference on Environment and Development, held in Rio de Janeiro (Brazil) in June 1992, came up with some answers. But these focused more on analyzing the differences between rich and poor countries and how to adjust the balance in political, economic, and technical terms, rather than on defining new political and economic systems worldwide, which is what sustainable development is really about.

EIA does not , in itself, obtain sustainable development, but it can guide decision-makers in the right direction from the outset by including the costs of environmental protection measures and offering creative alternatives to harmonize the different requirements.

3 THE ENVIRONMENTAL DIMENSION

The environment includes natural and man-made systems.

The term environment, applied to the space where human activities take place, can be interpreted in different ways. It is usually defined as the natural or man-made system where human beings live, with all its social, chemical, and biophysical aspects and the relationships among them.

Environmental protection is in evidence in every decision affecting a tract of land, such as: where to locate and how to run town developments, dumps, industries, etc.; or what effective measures are taken to restore open pit quarries and mines.

Environmental impact is a significant partial or total alteration of the environment.

The concept of environmental impact arises from this daily concern and from the emphasis on "environmentalism" in activities worldwide. The term was first coined to address urban pollution issues; later it was extended to animals, plants and ecosystems. Thus, environmental impact can be defined as the significant alteration of natural and man-made systems and their resources (see ***Figure 2-1***). Therefore, impacts are expressed in different activities and are present both in natural and man-made environments (see ***Figure 2-2***)

Figure 2-1. Development impacts on the environmental dimension

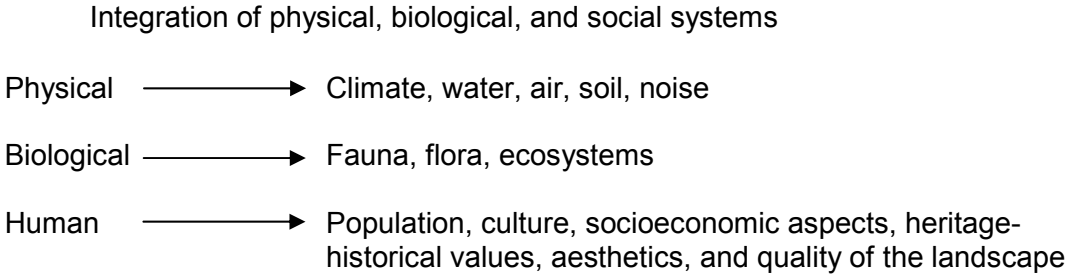
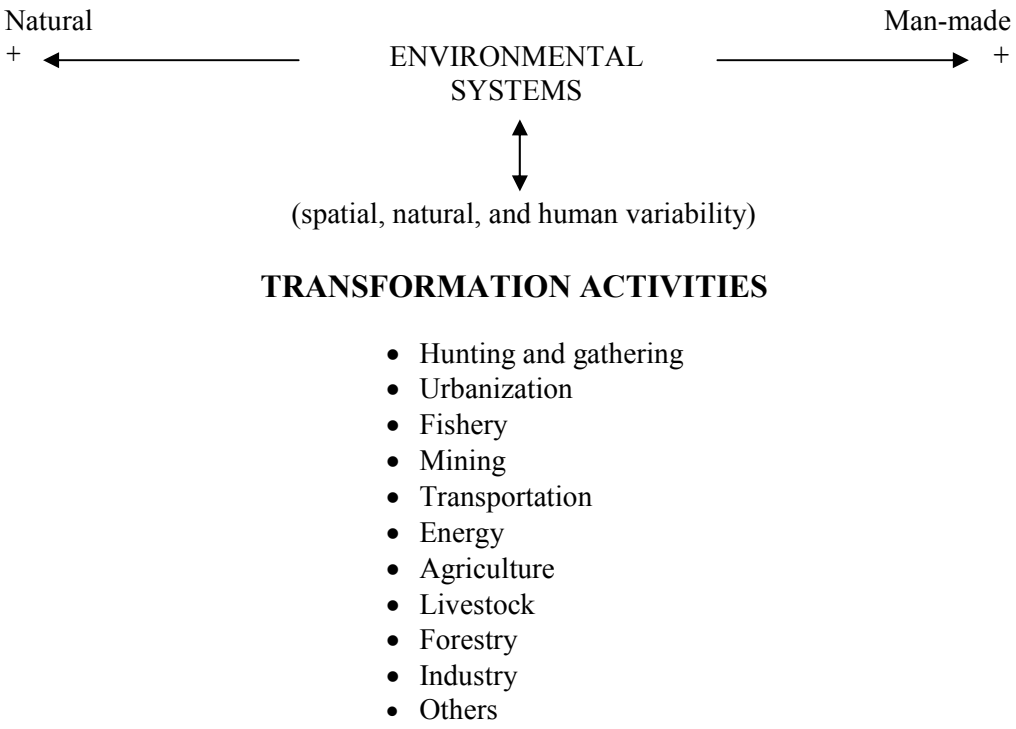


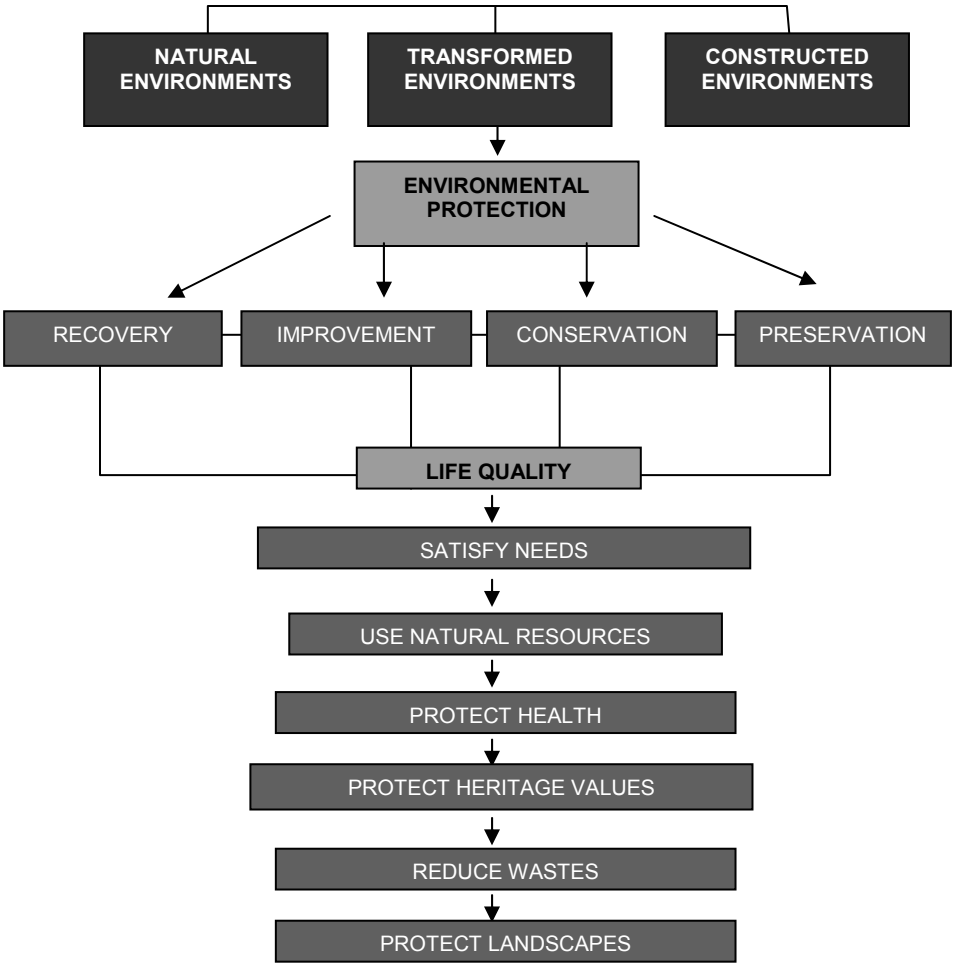
Figure 2-2. Present condition of environmental systems



Impacts on different components of the environment are considered.

The main concern with regard to environmental impact is to establish the type of alterations that constitute a nuisance: noise and fumes in the urban area? sanitation problems? greenhouse effect or ozone depletion?. The answers to these questions constitute the levels of environmental alterations that cause concern to the different countries and human groups (see ***Figure 2-3***). The environmental dimension should be analyzed in depth, both in its natural aspects (soil, flora, fauna), and in terms of pollution (air, water, soil, waste), landscape value, alteration of people's customs, and effects on their health. The characteristics of the human environment should certainly be analyzed, since alterations can affect the quality of life for humankind.

Figure 2-3. Environmental aspects and protection measures

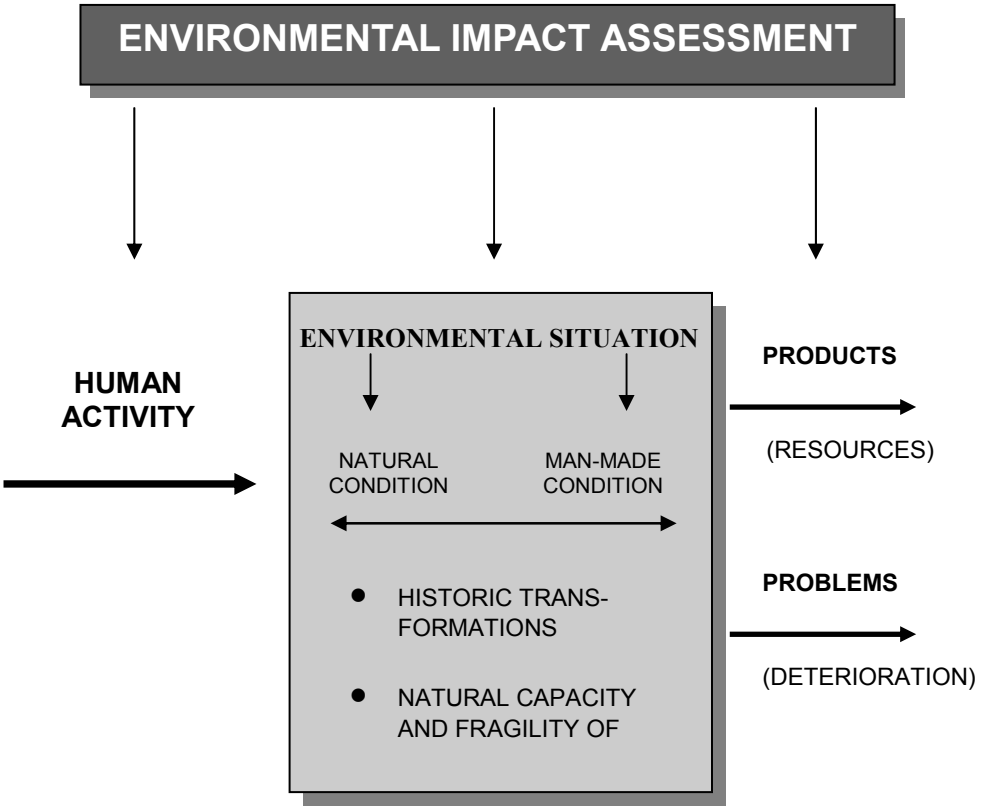


Impacts occur in natural and man-made environments.

What can the role of environmental impact assessment be in this debate? EIA is a preventive management tool which makes it possible to comply with environmental policies, and even incorporates early such policies into the development and decision-making processes. Thus, it evaluates and corrects human activities and prevents, mitigates, or compensates their negative environmental impacts (see ***Figure 2-4***).

EIA applies environmental policies preventively.

Figure 2-4. Incidence of transformation processes on the environment



CHAPTER III

EIA Process

1 ENVIRONMENTAL IMPACT ASSESSMENT

1.1. Conceptual framework

The environmental impact assessment is an innovative process recommended by different international agencies as a valid environmental protection tool and endorsed by the experience gained in developed countries that have incorporated it into their legal systems.

EIA comprises a series of logical steps to review human actions.

WHAT IS EIA?

- **It is an early warning process that verifies the enforcement of environmental policies.**
- **It is a preventive tool used to evaluate the negative and positive environmental impacts of policies, plans, programs, and projects; the EIA proposes measures to adjust impacts to acceptable levels.**

EIA FUNDAMENTALS

- **It assesses the impact of human activities on the environment.**
- **It defines the environment as the integration and relation of social, physical, and biological systems.**
- **It defines impact as the significant positive or negative alteration of the environment by human actions.**

From the above points we can infer that EIA advocates a long-term approach and provides a comprehensive view of human impacts on the environment. It also implies greater creativity and social responsibility in the design and execution of actions and projects. Motivation to investigate new technological solutions, and greater reflection on the planning and decision-making processes are other important elements of environmental impact assessment (see **Table 3-1 and 3-2**).

EIA implies creativity and the search for alternatives to reach viable solutions.

EIA Process: logical steps and technical requirements

System: organization and administration

Studies: analysis tool.

TABLE 3-1. EIA GENERAL CONCEPTS

- EIA is a systematic, reproducible, and interdisciplinary evaluation of the potential impact of a proposed action and its alternatives, on the physical, biological, cultural, and socioeconomic environment of a geographical area.
- The purpose of the EIA is to ensure that significant environmental resources are recognized at the beginning of the decision-making process and are protected through planning and pertinent decisions.
- EIA is an early warning process of continuous analysis that protects environmental resources against unjustifiable or unexpected damages.
- The EIA process transforms environmental laws into a uniform set of technical requirements and procedures to analyze human actions systematically before their implementation.
- An efficient EIA process calls for significant, premeditated, joint efforts on the part of many entities and actors.
- EIA helps solve problems during the decision-making process. It provides the bases for more informed decisions regarding positive and negative environmental impacts.
- The effectiveness of the EIA depends on the relevance given to environmental quality at the national, regional, or local levels.
- The adoption of an EIA system can lead to difficult economic decisions and strong political and social commitments. Private and public interest and community consensus for environmental quality form a sound basis for its effective development.

EIA is a preventive management tool applicable to human actions before they are executed.

TABLE 3-2. EIA PROCESS

Objective: To insert human activities into the environmental policy that supports sustainable development, in order to ensure that:

- Actions are environmentally satisfactory.
- Positive and negative environmental consequences are identified at the initial stage of human activities.
- The prevention, mitigation, and compensation of negative actions are a key element of environmental management.

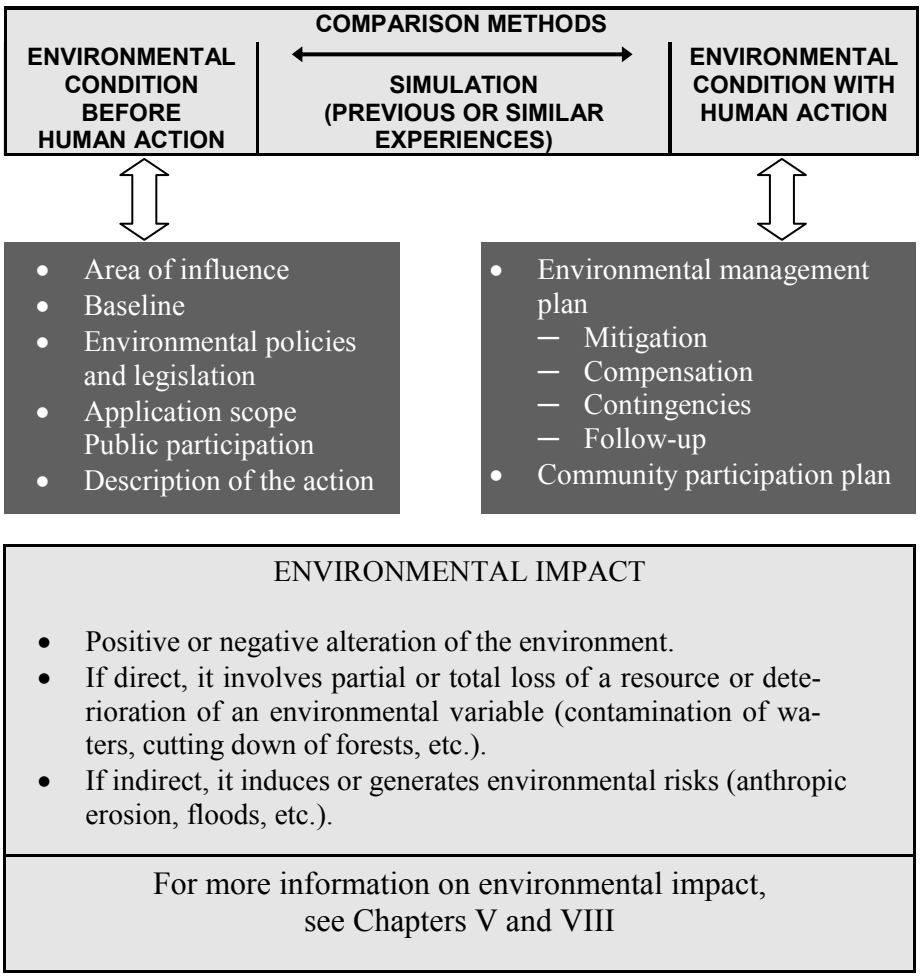
Means:

- To determine whether the human activities proposed are compatible with the environmental policy and legislation.
- To have a single, informed, and transparent procedure especially designed to review and qualify environmental impacts.
- To conduct preventive studies to identify, forecast, and evaluate negative and positive impacts.

It is essential to understand the significance of the potential environmental impacts; and for this purpose there are different methods (not mutually-exclusive) that can be adapted to each situation. In many cases, the EIA introduces a new technology into the environment to solve problems of deterioration. However, the assessment and consultation process should examine not only the implications of the project, but also the environmental risks of the technology itself.

EIA helps in decision-making.

EIA ANALYSIS



EIA simulates the situation after the human action.

EIA considers direct, indirect, cumulative, and synergic impacts.

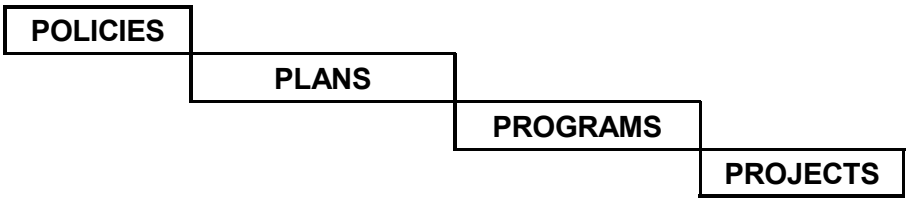
The preventive approach consists in identifying and evaluating the environmental impacts before they are produced; i.e., prior to the execution of any human action. Therefore, the following steps should be considered in the assessment:

EIA focuses on topics of priority relevance to the environment.

a) Identify what should be excluded because it is not environmentally relevant. Also known as "screening."
b) Define key points to be reviewed in the assessment. Also known as "scoping."
c) Use specific methods in each case, such as scenario analysis, preventive environmental standards, and analysis of integrating methodologies.
d) Point out the needs for community information and participation.

EIA requires sufficient information to review expected impacts.

Another important aspect concerns the levels of application of the instrument. We all know that decisions that can affect the environment are taken at different levels. Some examples are:



The strategic environmental assessment (SEA) is applied to policies, plans, and programs.

This implies considering each particular decision according to the level of detail required. At the policy level, the environmental significance of major decisions is evaluated, protection measures are taken and actions and tools are defined for meeting environmental objectives. At the plan and program level, the environment is considered as a whole. It is appraised, classified and the most suitable proposals are selected depending on their potential impact and on political, social, economic and technical conditions. At the project level, details are analyzed for each stage (design, construction, operation, and abandonment) and corrective measures are proposed to eliminate, minimize, or compensate any environmental damages (see **Table 3-3**). **Figure 3-1** shows the planning system for a project cycle linked to the different steps of the environmental impact assessment.

FIGURE 3-1. PROJECT CYCLE AND EIA STEPS

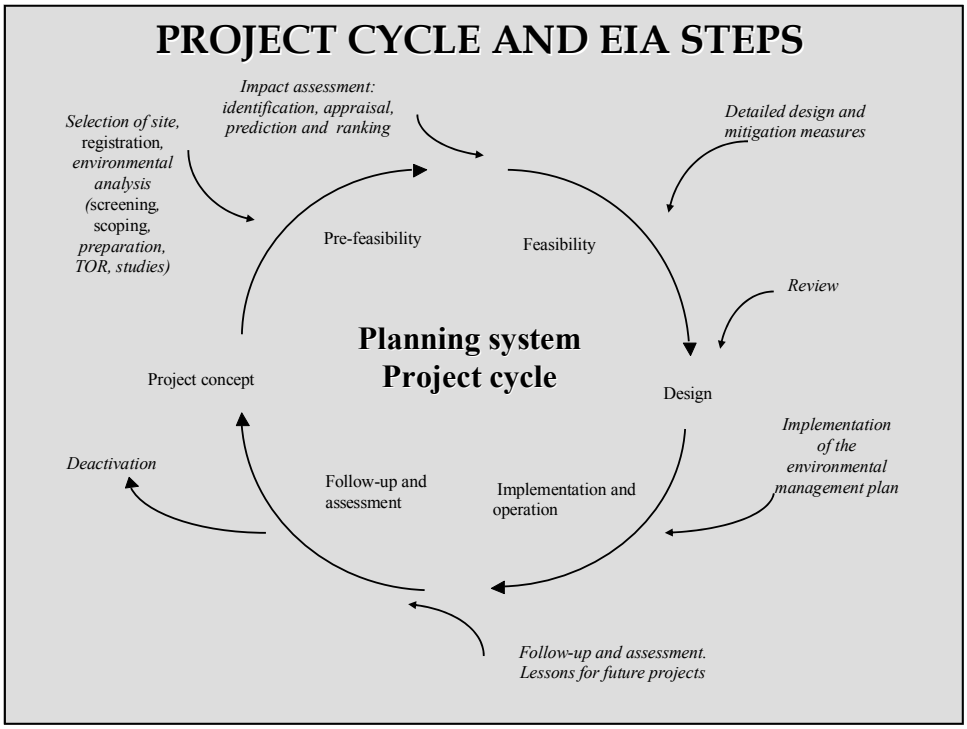
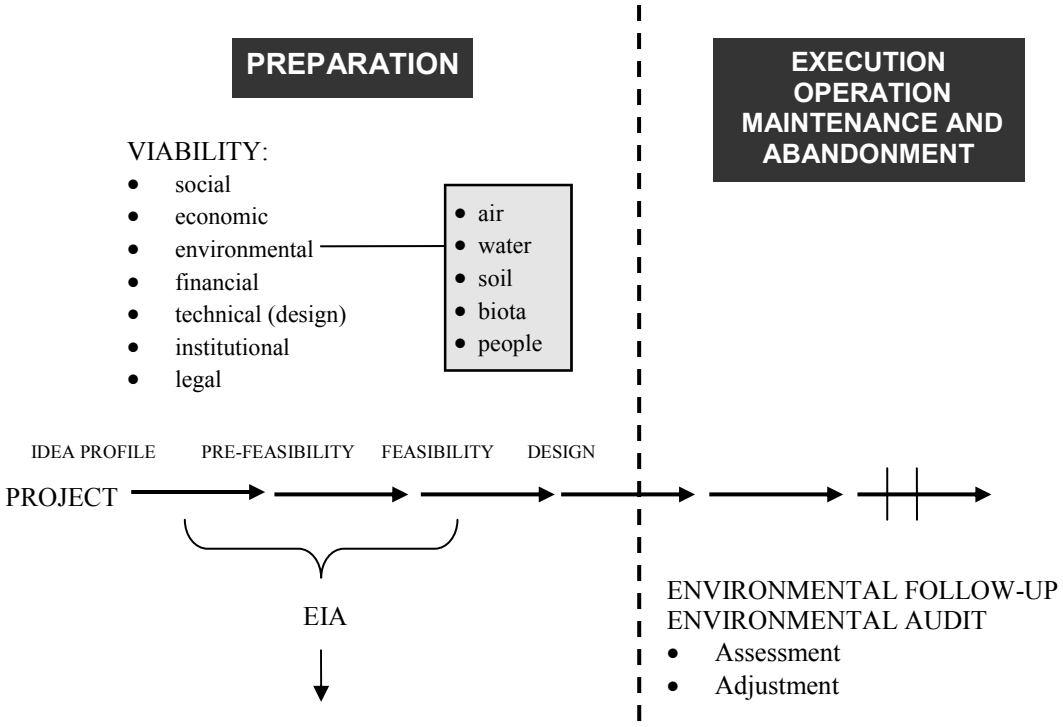


Figure 3-2 presents the scheme used by the IDB with project analysis procedures.

FIGURE 3-2. Scheme relating the EIA to an investment proposal



ENVIRONMENTAL MANAGEMENT PLAN			
ENVIRONMENTAL MEASURES	COST	TIMEFRAME	RESPONSIBLE INSTITUTION
Preventive	$	....	
Mitigating	$	.....	
Compensatory	$	.....	
	$		

TABLE 3-3. CHARACTERISTICS OF ENVIRONMENTAL IMPACT ASSESSMENTS

When are EIAs necessary?

- When they contribute information of relevance to the activities to be carried out.
- When the environment can undergo significant alterations.
- When the environment has values that merit special protection.
- When there are several alternative ways to undertake an action.

How can the impact be manifested?

- Over small areas but with intense alteration.
- Over large areas, but of low individual magnitude.
- In a positive or negative, direct, or indirect way and inducing other changes or risks.

1.2. Scope and criteria of the EIA

EIA is a case-by-case system and its effectiveness depends on the capacity of those who apply it.

International experience has amply shown that it is essential to develop a preventive management tool to identify and correct any environmental problems or situations of conflict that could affect the life quality of the population. A system –with methodologies, criteria, and procedures– is required to evaluate, prevent, and correct negative environmental impacts caused by human activities (see **Figure 3-3** and **Tables 3-4 and 3-5**).

EIA prevents damage through mitigation.

The objective of the environmental impact assessment is to prevent situations of deterioration, to establish the most adequate measures for reducing human impacts to acceptable levels, and to protect environmental quality. A more general definition relates the EIA to an early warning process that makes it possible to apply environmental policies in advance. Policy is defined as the regulatory principles and basic objectives for environmental protection and their articulation with economic, social, and development policies. The policy lays the foundations for preparing laws and regulations which are, in turn, the tools for meeting the objectives described in the policy.

FIGURE 3-3. Conceptual structure of the environmental impact assessment process

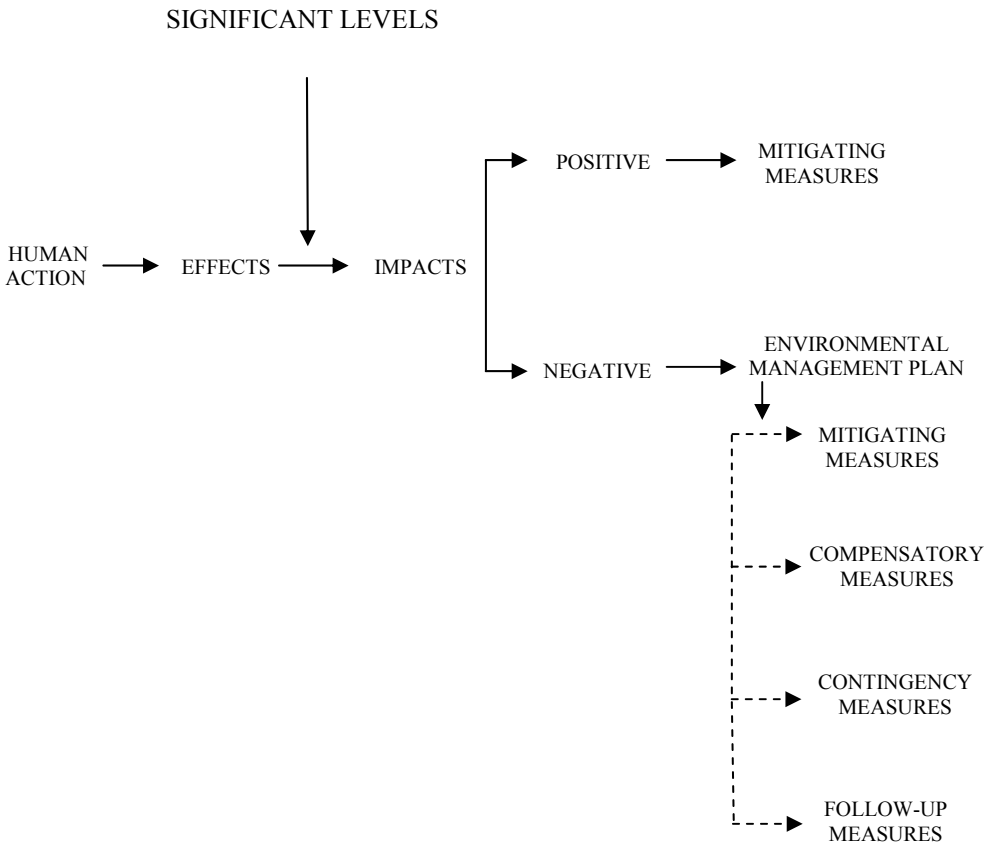


TABLE 3-4. GENERAL EIA BASES

- Preventive and integrated application of environmental policies.
- Systematic inclusion of the environmental dimension in planning and decision-making.
- Making environmental protection compatible with economic growth.
- Prediction and reduction of negative environmental impacts and enhancing of positive impacts.
- Prevention of negative environmental impacts derived from human activities.
- Application of measures to achieve acceptable environmental levels.
- Extensive and integrated knowledge of environmental impacts.
- Generation of a coherent and reproducible set of data to use in making informed decisions.
- Systematic community participation.
- Motivation to save financial and material resources.
- Contribution to decision-making.

EIA is a management tool that anticipates environmental damages.

EIA is applied from the very inception of the project until its works and activities are finally completed

EIA serves to help in decision-making, it does not replace decisions.

TABLE 3-5. MAIN EIA MECHANISMS

- *Environmental impact assessment (EIA):* set of requirements, steps, and stages that should be complied with in order for a preventive environmental analysis to be sufficient in itself, according to international standards.
- *Environmental impact assessment system (EIAS):* organization and management of the EIA according to the situation and capability of those who apply it.
- Environmental impact study: the document(s) that justify the preventive environmental analysis and provide(s) judgment elements to make informed decisions about environmental effects of human activities.

In this context, an environmental impact assessment makes it possible to anticipate future negative and positive impacts of human actions, by increasing the benefits and reducing non-desirable environmental effects. The idea is to recognize the environmental variables of concern from the very beginning and to protect them through pertinent decisions. This brings the planned actions into line with environmental policies and regulations established to protect the environment.

The environmental impact assessment is a warning system that operates through an ongoing process of analysis designed to protect the environment against unjustifiable or unexpected damages (see **Table 3-6**). It is an informed and objective process of linked participatory decisions, that help identify the best options for carrying out a project in such a way as not to cause unacceptable environmental damages.

EIA must focus on significant impacts and relevant information.

It should be emphasized that an environmental impact assessment should be regarded as a tool at the service of the decision-making process, to acquire an extensive and integrated knowledge of the environmental impacts derived from human actions.

TABLE 3-6. IMPORTANT PARTS OF THE EIA PROCESS

- To decide in advance whether an environmental impact assessment is necessary.
- To analyze only the actions that may have a significant environmental impact.
- To incorporate beforehand significant impact criteria, such as:
  - Air and water pollution.
  - Deterioration of protected natural and ecological resources.
  - Undesirable impacts such as landscape deterioration, generation of noise, and others.
  - Discharges of toxic or hazardous substances or waste generation.
  - Cumulative adverse effects.
  - Negative sociocultural impacts.
  - Significant public controversy.
- To clearly define the scope of the EIA and consider:
  - Widespread participation.
  - Determination of key points.
  - Elimination of insignificant points.
  - Allocation of requirements for study preparation and qualification.
  - Identification of the purpose of the action and alternative actions.

EIA provides environmental background information to improve human decisions.

EIA should be made in advance. There is no point in applying it to activities already under way.

An environmental impact assessment is not a decision tool in itself. Rather, it is a methodical, coherent, and reproducible set of data that enables the project promoter, the responsible authority, and the community to make informed and well-oriented decisions. All this is possible when an environmental impact study is presented, and the responsible authority submits it to a participatory review process to determine the quality of the analysis.

It is important to emphasize the preventive character of the process: the idea is to guide the decision-making before any activities are carried out. It is pointless to evaluate actions already implemented or in the last stages of development, unless they are modifications of existing ones and are regarded as new actions. As a prediction tool, the EIA is useful only if it can influence the planning and future development of each human action; thus, its application should begin in the earliest possible phase of the decision-making process. (**Table 3-7**).

Modifications to existing projects often make an EIA necessary.

EIA compares a situation before and after human action.

The environmental impact assessment makes it possible to compare the existing situation with the situation that would result from a specific planned action. The comparison serves to identify the positive impacts and the environmental benefits of the project under evaluation, as well as those negative impacts that will need to be managed if deterioration is to be prevented. Above all, measures must be incorporated to protect the environment and thus make the action viable; otherwise, the action should simply not be executed.

EIA requires objective criteria in order to focus on relevant aspects.

EIA has a wide perspective and complements decision-making.

The environmental impact study is the report containing the environmental analysis.

TABLE 3-7. EIA ATTRIBUTES

- It is integrated by different components of the environment and various disciplines.
- It provides a context for the pertinent elements of the environment.
- It targets the significant impacts.
- It is flexible enough to adjust to each individual case.
- It predicts the consequences after implementing an action.
- It incorporates community participation (agencies, project proposers, community, authorities).
- It reports possible impacts.
- It supports the environmental protection and improvement policy.
- It complements an integrated development of actions, together with political, economic, and social decisions, among others.
- It leads to the abandonment of environmentally unacceptable actions, mitigates the negative impact until acceptable levels are reached, and adjusts changes in time.
- It supports decision-making.

Environmental impact studies should focus on the environmental management plan.

The analysis is presented in a document known as the environmental impact study, which sets forth the arguments to decide, for instance, on the best possible location for an activity if there are alternatives from the environmental perspective. If there are several possible locations, it provides the background information to determine which is the most suitable one in terms of protecting the environment. In the case of a human activity that cannot be relocated, it proposes ways to reduce or prevent the negative environmental impacts.

Some environmental impacts are appraised objectively using standards or regulations, while others are subjective, for example, impact on landscape and on local customs.

The environmental impact study is the report that records the environmental impact assessment process and its different stages. It contains the analysis, prognosis, and measures taken to make an action compatible with environmental protection (see ***Table 3-8***).

TABLE 3-8. LIMITATIONS OF ENVIRONMENTAL IMPACT STUDIES

- It is not always possible to emphasize the interdisciplinary character, although this is essential.
- They use predictive methods based on scientific information that is not always available.
- They use abstract concepts which cannot always compete with sciences that incorporate quantifiable data.
- They need data that are all at the same level and exchangeable on compatible scales.
- Since they have a varied methodological framework, it is necessary to know the land or place affected in order to define its use.
- They use the fragility and quality analysis of the affected
- land, for which there are often no baseline data available.
- They require detailed information that is not always available or is not compatible with the study requirements.
- They have to improve the methods of appraisal for analyzing environmental impacts in the same way as economic and social impacts.
- Some environmental components are difficult to address, such as quality analysis, fragility of the land, and landscape value, among others.

The main elements of EIA are: availability of policies, legal demands, and review and follow-up mechanisms.

2 FUNCTIONAL STAGES OF THE EIA SYSTEM

An environmental impact assessment process has a logical sequence of stages and steps that are of crucial importance when being applied to the human activities under evaluation to comply with the process objective. Their elimination or inconsistency could result in an incomplete analysis and a deficient environmental evaluation of the human activity.

The EIA system requires the availability of political, legal, information, administration, and technical capabilities, among other elements.

Some basic components of an environmental impact assessment are the following:
a) policy definition, b) legal and regulatory bases, c) administrative procedures, d) environmental impact study, e) decision or pronouncement, f) follow-up, g) information systems, h) methodological guidelines.

In order to be efficient and meet the environmental protection goals, an EIA system should have the characteristics presented in **Table 3-9**.

EIA stages: identification and classification; preparation and analysis; qualification and decision; and follow-up and control

TABLE 3-9. BASIC COMPONENTS OF THE EIA SYSTEM

- Establishment of a substantive national environmental policy that sets environmental protection priorities.
- Definition of legal requirements for the EIA process.
- Creation of regulations and requirements to implement the law systematically, strictly, and pragmatically.
- Establishment of an administrative procedure for the preparation, coordination, orientation, and qualification of studies that analyze environmental impacts.
- Identification and clarification of organizational functions and responsibilities within the current legislation.
- Coordination of drafting and reviewing of reports, and of the decision-making process among governmental agents, private agents, consultants, and the general public.
- Ongoing evaluation of the success of the program and those responsible for it.
- Encouragement of community participation at all stages.

When organizing an EIA system, it is necessary to identify in detail the functional stages with the key steps to be taken to apply the principle of prevention of significant environmental impacts associated with the different activities (policies, plans, programs, and projects). The main objective is to facilitate and unify the procedures to provide a clear environmental certification under equal conditions.

The environmental category is the definition of the degree of detail required in the environmental analysis.

Figure 3-4 presents the theoretical scheme of how an EIA would be expressed. The following stages corresponding to the different stakeholder requirements are identified: i) identification and classification, ii) preparation and analysis, iii) qualification and decision, iv) follow-up and control.

The preliminary assessment is a general analysis that identifies the impacts and focuses on the detailed study.

Figure 3-5 shows a system with the procedures formally established by the IDB.

2.1. Stage I: Identification and environmental classification

The identification and environmental classification stage defines the need for an environmental impact assessment and the type of environmental category required. A preliminary evaluation is used based on the following information:

Identification and classification defines the relevance of more detailed studies

a) ***Project description*** in all aspects relevant to the study, including applicable environmental legislation.
b) ***Description of the area of influence.*** The affected area should be defined and the project-related environment described in general terms.
c) ***Possible mitigating measures*** to give sustainability to the project.

This stage provides the following background:

- Identification of the environmental category of the project and justification with clear, brief, concise observations.

- Required level and coverage of the studies, if needed, based on the real impacts arising from the particular project and environmental conditions.
- The need for incorporation into formal processes.

This stage is important because it determines whether the proposed action has significant environmental impacts (negative or positive). In this regard, a referential classification proposal can be obtained for the reviewing authority, who, after making the necessary consultations, grants the final authorization.

FIGURE 3-4. GENERAL SCHEME OF THE EIA SYSTEM

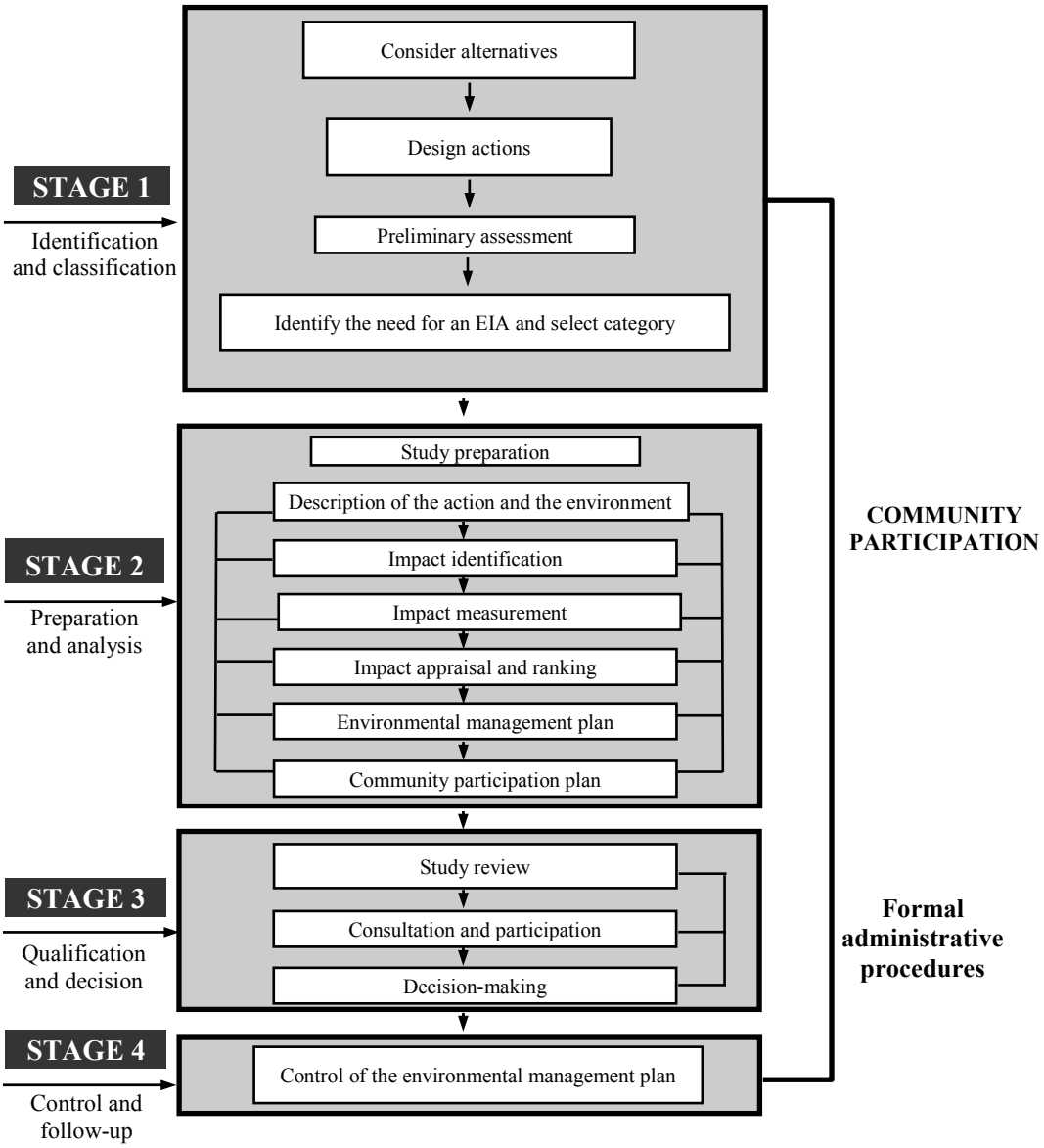
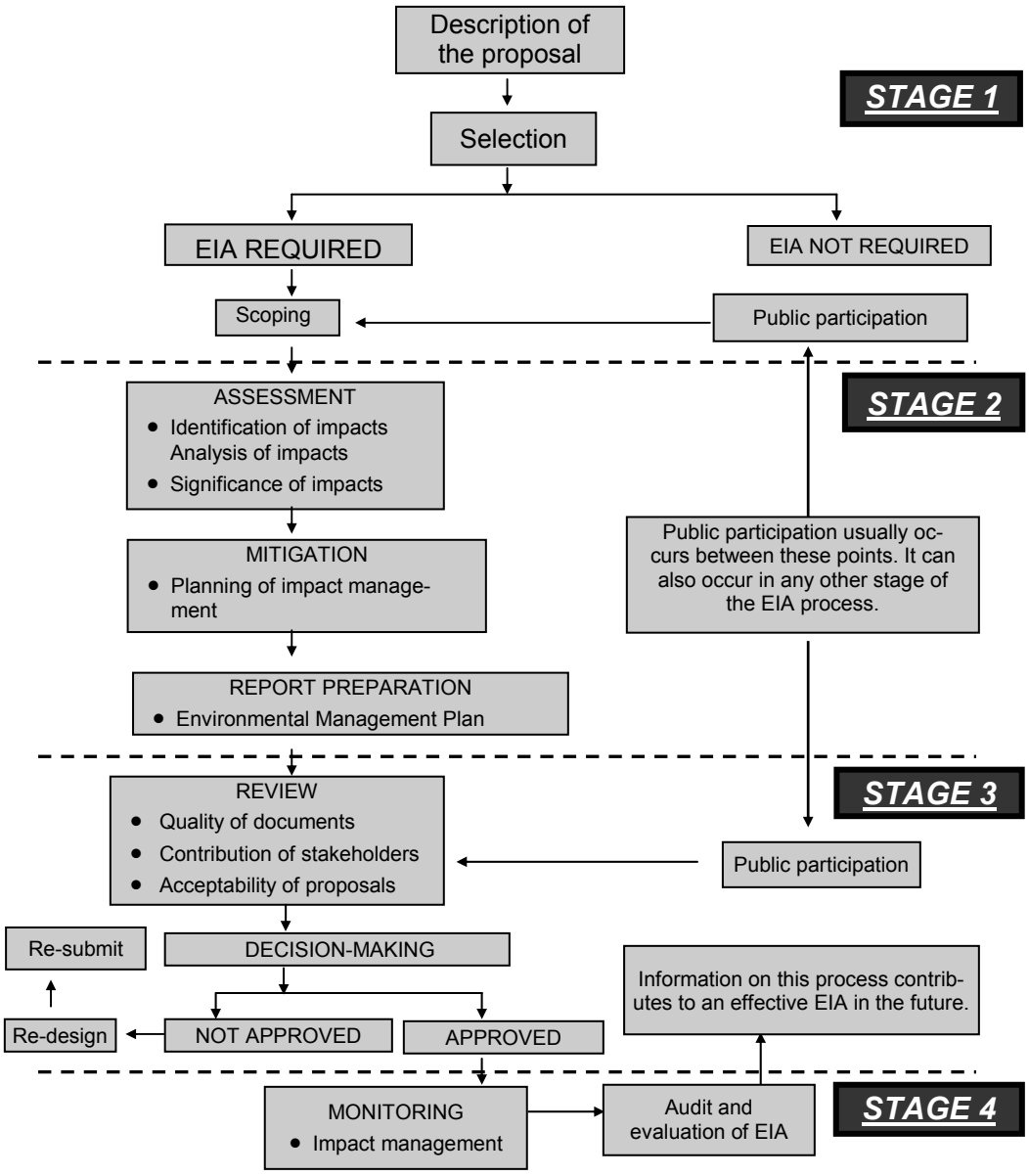


FIGURE 3-5. FLOW CHART OF EIA PROCEDURES IN THE IDB AND ITS RELATION TO THE STAGES OF THE GENERAL SCHEME OF AN EIA SYSTEM



The preliminary evaluation is a key step in the EIA process.

Thus, the key aspect of the identification and environmental classification stage, on which the effectiveness of the EIA system depends, is to identify accurately the level of study required and its coverage. On the one hand, this ensures that adverse environmental impacts will be prevented, and on the other, it minimizes the risk of leaving out aspects of environmental relevance when preparing the corresponding studies.

2.2. Stage II: Preparation and analysis

The preparation and analysis stage corresponds to the valid application of the study scope for a specific project. The significant impacts, identified in the preliminary evaluation, are reviewed and their mitigating and compensatory measures are established. The importance of this stage lies in the detailed environmental impact analysis for the subsequent review and definition of mitigating, monitoring, and control requirements.

The preparation and analysis stage is when the environmental impact study is drawn up.

In addition to describing the proposed activity and the environmental baseline of the area of influence, the environmental management plan is prepared, the follow-up and control task is proposed, and community participation is coordinated.

A. **Description of the environment.** This is a detailed analysis of the environmental conditions liable to be affected by human activity. It identifies the components involved in the affected territory or area of influence, which is defined as the area where impacts occur and mitigation and follow-up actions are implemented.

The baseline of the land affected is the condition prior to human action.

The information obtained should include the environmental variables to be affected and it should provide the basis for the assessment of any future impacts. If the information available is not representative of the environment affected or does not provide elements to evaluate the impact and implement mitigating and follow-up measures, it is pointless to include it in the analysis.

The land affected is the area of influence of the environmental impacts.

B. **Prognosis and analysis of environmental impacts.** This analysis is carried out to review the relevance of critical or irreversible impacts. Structured methodologies are used which make it possible to predict the behavior of possible types of impact. For example, positive and negative impacts, primary and induced impacts, short and long term impacts, and cumulative impacts are analyzed.

Impacts must be reviewed throughout the project cycle.

Once the impacts are known and evaluated, they are assessed and ranked to select those which will be mitigated and compensated. They will be included in the environmental management plan to discuss their advantages and disadvantages from the environmental perspective.

The environmental analysis is based on significant impacts.

C. **Environmental management plan.** To a great extent, compliance with environmental protection programs depends on mitigating and compensatory measures. Indeed, it is these measures that make human actions feasible from the environmental perspective.

The environmental management plan is the central axis of the environmental impact study.

Among the mitigating measures to be considered are:

- Prevent impact by not executing the action.
- Reduce impact by limiting its magnitude.
- Rectify impact by restoring or remediating the environment.
- Reduce or eliminate impact with protection and maintenance actions.

Mitigation helps manage significant impacts.

The mitigation is an ongoing process during the environmental impact assessment and starts when the action is identified and adjusted (in the design phase) with a view to reducing or preventing certain kinds of significant impacts.

Compensation is used only when impacts cannot be mitigated.

In the event that the mitigating measures are not sufficient to reduce environmental impacts, compensatory mechanisms may be considered. These are designed to create environments similar to those affected or to support environmental protection programs. Under no circumstances will compensation trade off environmental resources against non-environmental ones, such as money, fellowships or jobs; the only valid compensation is the replacement of what is environmentally impacted by a similar situation.

Depending on the type of environmental analysis, this stage should include a description of the proposed action and the environmental baseline of the area of influence; the identification, measurement, appraisal, and ranking of environmental impacts generated by the action; and finally, the definition of the environmental management plan, the follow-up and control plan, and the community participation plan.

2.3. Stage III: Qualification and decision

Qualification is the formal stage where the authority deals with the environmental impacts of a project.

The qualification and decision stage corresponds to the formal review of environmental impact studies by the authority to confirm the adaptation and relevance of the measures proposed in the management of significant negative impacts derived from specific actions. The review focuses on determining the quality of the document to find out whether it effectively complies with: a) the formal and administrative aspects; b) the minimum technical quality requirements; and c) the environmental sustainability of the project.

The importance of this stage is that it is here that decisions are made: projects are approved, rejected, or modifications of studies are requested. The effectiveness of the EIA process is determined to a large extent, as well as the appropriateness of adopting the mitigating and follow-up measures considered in the studies as a means of ensuring environmentally sound actions.

Review is a formal process which requires objective procedures.

During the review, potential environmental risks, damages, and benefits derived from a human action must be verified. The background information of the environmental impact study is analyzed, including all relevant aspects of the proposed action and any environmental implication.

2.4. Stage IV: Follow-up and control

The follow-up and control stage is the time for an analysis of the environmental behavior of a project.

During the follow-up and control stage, the main task is to verify that the environmental management plan for the post-project implementation period is being duly executed. It is determined whether the actions taken conform to the environmental protection criteria governing the EIA process, as well as to the recognized area of influence and current environmental legislation.

This stage is important because it guarantees that the action and all related activities, mitigating measures, and control and follow-up mechanisms protect the environment satisfactorily. At this stage, the effectiveness of the environmental analysis is verified and commitments made by those responsible for the action are fulfilled.

Follow-up and control verifies the effectiveness of the environmental analysis.

To this end, three types of action are included in accordance with the environmental management plan: i) control by the authorities; ii) community claims; and iii) follow-up in accordance with the proposals of the environmental impact study.

The environmental impact assessment means, ultimately, that a permanent relation is maintained with the human activity to be undertaken, from the design phase to the abandonment. From the beginning of the construction and especially during the operation and abandonment, compliance with environmental protection measures should be monitored permanently. The idea is to maintain a linkage with the activity to be aware of its relation with the environment.

Control is the responsibility of the competent authorities.

The EIA process guides the actions until their abandonment.

Among the follow-up actions commonly used are:

a) Monitoring of water, air and soil quality, and waste generation.
b) Flora and fauna samplings used as bioindicators.
c) Reports on the environmental situation of the project and evolution of the plan for compliance with protection measure.
d) Reports on the evolution of sociocultural aspects.
e) Complementary environmental studies, if appropriate.

Follow-up plays an important role when a plan is drawn up and indicators are used.

CHAPTER IV

Experiences in the Management of EIA Systems

This chapter discusses the main managerial aspects of EIA systems. The objective is to identify key points for the proper application of the process and recognize the needs, limitations, and characteristics of environmental impact assessment systems in different countries.

1 REQUIREMENTS FOR IMPLEMENTATION OF AN EIA

An EIA system requires explicit environmental policies.

Experience shows that the application of an EIA process without a sound basis can affect country development and environmental protection. The following are key aspects in setting up a system:

1.1. *Explicit and consensual definition of an environmental protection policy.* It should clearly express the idea of the environment desired and specify the conditions required (e.g. in natural resources, environmental quality, human health, landscaping, etc.). The lack of these definitions generates tense and conflictive situations due to the variety of opinions regarding an environmental issue; it turns the environmental analysis into a mere academic exercise without practical effects for environmental protection.

An EIA system calls for explicit environmental policies at the national, regional, and local level.

The establishment of a policy is the sound basis on which the environmental impact assessment is constructed. This policy can express the national, regional, or local government decision to protect the environment as a means of safeguarding the life quality of the population. This includes protection of cultural heritage, wildlife areas, flora and fauna; reduction of unacceptable levels of air, water, and soil pollution; and monitoring of the landscape, health of the population, and effects on natural resources. Thus, managerial bases are established to tackle adverse environmental situations and a framework is created to encompass all reactive and preventive tools designed for such effects.

The environmental policy is expressed in the definition of standards, protected areas, and habitats, among others.

The definition of the main principles governing environmental policy and, above all, their application to specific situations, make it possible to solve in advance issues of importance to a country, region or location. Thus, the environmental impact assessment can be defined as an instrument to identify and mitigate adverse impacts and it becomes an efficient planning tool for working towards the goal of sustainable development.

In this way, environmental rules, standards and criteria are established and disseminated to support environmental decisions.

EIA requires a legal framework to make requirements mandatory.

1.2. *Establishment of a legal framework to generate a single, clear, methodical process.* Functions and institutional responsibilities should be clearly expressed. Unclear definitions, different institutional initiatives, and a lack of common rules for all can become a problem for any EIA system. This usually leads to parallel procedures with different requirements, a situation which causes confusion among investors, inspectors, and the community at large.

Legislation includes laws and regulations that should encompass the different EIA stages.

Laws translate the intention of protecting the environment into formal requirements and procedures that regulate different aspects of interest to society. In the case of an environmental impact assessment, the regulation specifies, for example, all the human activities for which an EIA is required; the contents and procedures for reviewing and observing assessment reports; and public services or institutions that have the authority to review the contents of impact studies and approve proposed actions. Furthermore, they establish requirements for community participation in an EIA.

EIA requires efficient administrative proceedings.

1.3. *A fast, clear, and coherent management capable of coordinating the institutions involved.* An EIA system should not create bureaucracy or complexities that contribute to ineffectiveness and lack of transparency. The latter point is important because the projects assessed are often large-scale ones and it is common to face pressures that seek to influence the final decision. Unless there is a sound management offering reliability to stakeholders, the process may not be applied with valid results.

The objective of an administrative procedure is to implement a homogeneous system to make the drafting and reviewing of the process reports more efficient. However, activities subject to such a procedure differ in complexity and potential impact range. Thus, timeframes also vary. The time required to perform a study depends on factors such as the complexity of activity planning or the acquisition of sufficient data. Setting deadlines for studies without knowing how long they will take to complete could result in unrealistic or incoherent requirements.

The EIA demands new capacity building in the public sector.

The establishment of schedules should emphasize only the periods required by the authority to perform its review. Furthermore, any timeframes set up should take into account the time needed to analyze the range of proposed background data. The regulation should standardize the review periods to prevent disagreements or conflicts during this stage.

The environmental impact study contains information on the EIA application.

1.4. *Environmental impact study.* This is a key element of the system. Using this analysis, a group of experts from different disciplines can identify the environmental impacts of human activities. Furthermore, they quantify them and propose mitigating and compensatory measures to prevent or reduce negative environmental impacts. They also determine actions to enhance positive effects.

Experience of countries with environmental impact assessment (EIA) systems shows that the scope of the study must often be reduced when the environmental impact is minimal. When there are clear policies and standards, a statement of compliance with environmental requirements could be sufficient. This is determined during a preliminary evaluation, when the scope of the environmental analysis is defined.

An EIA system can reduce the scope of the study.

The environmental impact study investigates, evaluates, and documents information that allows stakeholders, especially the community, public services, responsible institutions, and the project designer to be aware of the risks and benefits of a proposed activity. This information is registered in a formal document, including background information, nature of the proposed project, and environmental implications. For example, the characteristics of the action and the environment are described, the possible environmental impacts are discussed, and measures are established to prevent, reduce, rectify, or compensate the negative impacts and emphasize the positive ones.

The document should contain a summary of the whole process, from the initial decision, preliminary environmental impact assessment, definition of the scope of action, to the presentation of the detailed environmental impact analysis. All this has to be documented and form part of a public file to be used as a source of information and a record of the procedures applied.

1.5. *Creation of conditions for the implementation of a system.* This makes it possible to build up the system capabilities, to meet actual requirements, and to maintain credibility in the community. Adopting a system hurriedly has not given good results in developing countries; it has discredited the EIA as an instrument to prevent environmental impacts and has hindered development activities. Thus, it is always desirable to establish periods of transition agreed on by all participants, while building minimum system-management skills.

The environmental impact study is a formal document whose requirements are specified in the EIA system.

1.6. *Establishment of a continuous follow-up and feedback process.* Experience has taught us the need for verifying the application of the system, reviewing successes and failures of the program, and carrying out the necessary adjustments. The absence of this process is a serious constraint for the proper application of the instrument; this should therefore be an ongoing process for system managers.

Conditions should be created for the application of the EIA.

Once a project has been approved, its implementation is periodically monitored to make sure that the terms or conditions of the approval are being complied with. Such conditions could include specific protection or mitigation measures –such as air emission or water discharge monitoring–, periodic presentation of environmental reports or other activities deemed necessary to ensure an adequate management of adverse environmental impacts.

Follow-up is a main EIA requirement.

Follow-up is weak in current EIA systems.

Local communities can be given the responsibility for some functions, but it is usually a role taken on by public institutions with jurisdiction in the control of works, activities, and processes of a particular project. The environmental impact study provides a follow-up and control plan, which is then inspected by the competent authorities and can also be controlled at other levels of authority.

1.7. *Development of human capabilities and availability of resources*. Deficiency in the capabilities of individuals involved can make a system unsustainable; thus, public and private sector training is vital. It is also essential to have information available for decision-making. The absence of these elements spells out failure for any system of environmental impact assessment.

Community can contribute to follow-up

1.8. *Consensus among stakeholders*. The installation of an EIA often involves strong decisions or effects on political, economic, and social aspects. The rejection of a procedure by the different stakeholders (public and private sector, academics, NGOs, politicians, and community in general) can even stop the system from being applied at all, and thus signify failure to comply with the prescribed requirements. It is therefore important to achieve consensus among stakeholders to accept and respect the system. Only then will the EIA become an effective tool in environmental protection and be conducive to the sustainable development of human actions.

Skilled human resources support efficient EIA systems.

1.9. *Citizen participation, especially in affected communities*. For environmental decisions to be viable, EIA procedures have to be public and informed so that the decision-making process will be completely transparent. The risks are that non-responsible participation might be encouraged or that adequate mechanisms for the people to express themselves may not have been set up. The non-existence or poor regulation of citizen participation can slow down decisions and restrict actions or make them not representative of general interests and thus, not acknowledged by the community. A good EIA should inform the stakeholders about the costs and benefits of the proposed action and should generate a dialogue on preventive, mitigating , and follow-up measures.

Consensus among stakeholders facilitates the application of the EIA.

1.10. *Decision or pronouncement*. Since the study contains the specified background data, it is a public document that should be reviewed by authorities, community, and institutions involved if it is to be a reliable source of information. Normally, it is checked for compliance with the formal requirements stipulated in laws and regulations, as well as for the quality of information, relevance of methodology, impact measurement, and scope of mitigating, compensatory, and follow-up measures.

The EIA calls for specific and efficient mechanisms of citizen participation.

When all stakeholders have participated from the beginning and played their several roles in the study, the review is smoother. On the other hand, if the participation starts when the document has already been completed, the review can be more conflictive.

The need to incorporate a final-decision or pronouncement stage into an environmental impact assessment system is a key aspect. A procedure cannot be considered complete unless it is subject to a final decision on the relevance of the environmental conditions set down in the document. The decision resulting from the analysis should be accessible to all stakeholders, together with the approval or rejection of the action and its reasonable alternatives, level of environmental impact acceptance, and mitigating or compensatory measures to face adverse damages.

The decision is the prerogative of the authority.

The decision of the competent authority should be thoroughly documented, and should allow him/her to control any environmental impact caused by human activities. The decision should be supported by explanations and justifications based on the pre-established assessment criteria and mentioning the objective review of the study and any observations received during the assessment.

The revision of the EIA document requires community involvement (citizen participation).

2 CONCLUSIONS REGARDING EIA SYSTEMS IN SOME COUNTRIES

Decisions require transparency and mechanisms to deal with community concerns.

2.1. Conclusions on the installation of the EIAS

In the last 30 years, environmental impact assessments have increasingly been carried out in response to the concern of investors or international organizations and to legal requirements that some countries have established. Although there is a growing awareness of the advantages of incorporating preventive environmental analyses since they make it possible to reduce environmental costs and potential conflicts regarding environmental degradation, tangible results show that great challenges still exist and there is still plenty of room for improvement in the application of EIA systems.

The following are some general requirements for the introduction of an EIA system based on the experience of several countries:

a) Definition of the kinds of activities subject to an environmental impact assessment system.
b) Generation of environmental criteria to distinguish the need for the assessment and the degree of detail required for the proposed project.
c) Development of the administration of the procedure by means of guidelines acknowledged by all concerned (timeframes, review teams, reception and follow-up of studies, identification of institutions with legal jurisdiction, etc.).
d) Definition of the contents of the environmental impact study.
e) Drafting of methodological guides for presentation of the environmental impact studies according to project category.
f) Preparation of terms of reference for different activities and projects.

Current EIAS require significant adjustments if they are to meet their objectives.

g) Definition of a program for the adoption of environmental quality regulations and standards adapted to conditions in the country.
h) Production of manuals to guide the project or activity manager on how the review should be performed.
i) Improvement of the reviewing capacity, availability of basic information and of assessment methodologies applicable to specific situations.
j) Establishment of at least the following eight steps in the system design:
   - Consideration of assessment alternatives
   - Design of the best alternative
   - Determination of the need for the study
   - Definition of the study contents
   - Preparation of the study report
   - Report review
   - Decision on the action proposed
   - Impact control during execution.

There are 10 main points central to the installation of an EIA system.

2.2. Conclusions regarding the operation of the EIAS

2.2.1. General

a) The early concern regarding the methodology for predicting impacts and adopting decisions emphasized first and foremost the EIA administrative procedures in themselves, and subsequently, the crucial relationship between the EIA and its broader context of decision-making and environmental management.
b) There is a tendency to codify through the standardization of studies and generation of guidelines.
c) The EIA systems have been perfected with the gradual incorporation of additional elements as experience has been gained. These elements include methods to determine the coverage of environmental impact studies for purposes of study review and impact control.
d) There is an increased interest in the quality of the EIA: better reports, more opportunities for consultation and participation, and greater influence in decision-making, for example, are demanded.
e) There is greater concern to increase EIA effectiveness in order to reduce environmental impacts or improve mitigating or compensatory measures and ensure efficiency in terms of costs, time, and human resources.
f) Many variables can already be clarified by the time the EIA is undertaken; therefore, some kind of evaluation of policies, plans, and programs is needed (known as strategic environmental assessment).
g) Not all countries use strategic environmental assessments, although progress has been made in this respect and many of the classical stages applied to projects could be used at the different levels described.
h) Emphasis is placed on the analysis of direct and indirect impacts, but not on the analysis of cumulative impacts that are easier to review when evaluating programs and plans.
i) It is difficult to integrate EIA information with decision-making.
j) Mitigating measures and impact follow-up and control systems are weak.

EIA emphasizes administrative procedures.

Methods are needed to define the scope of the studies and for the review of the studies by the authority.

k) Citizen participation processes need to be better developed.
l) The quality of many environmental impact studies is deficient and they often contain irrelevant information. Stakeholders, especially the responsible authorities, must be trained to improve the usefulness and focus of the EIA.
m) There is a need for guidelines and directives for EIA systems, which will be useful tools for project managers, those who prepare studies, those who do the reviewing, consultancy firms, and the community in general.
n) It is necessary to research and develop methodologies and procedures, especially in the area of preliminary assessment, review methods, mitigating and compensatory measures, community participation, system control, and strategic environmental assessment.
o) Greater emphasis needs to be placed on how to improve mitigating and compensatory measures and how to save costs, time, and human resources.

A strategic environmental assessment is required.

2.2.2. Specific conclusions. Three key elements of the system are presented below: the list of typical projects, environmental criteria used in assessments, and typical contents of environmental impact studies.

GENERIC LIST OF PROJECTS TYPICALLY INCLUDED IN THE SYSTEMS

a) Aqueducts, reservoirs or dams, drainage, drying, dredging, significant defense or alteration of natural water bodies or courses.
b) High voltage electric power lines and their substations.
c) Power plants.
d) Reactors and nuclear and related facilities.
e) Airports, bus, truck and railway terminals, railroads, service stations, etc.
f) Highways and roads.
g) Ports, waterways, shipyards, and maritime terminals.
h) Urban or tourist development projects.
i) Urban development plans, intercommunity, community regulatory and sectional plans, industrial or real estate projects that modify these or are executed in areas declared latent or saturated.
j) Mining development projects, including exploration, exploitation, processing plants, and waste disposal.
k) Pipelines, gas pipelines, mining ducts or similar.
l) Industrial facilities, including agroindustries.
m) Slaughterhouses, breeding farms, dairy industries, and industrial feedlots.
n) Forestry development or exploitation projects.
o) Cellulose, pulp and paper industries, wood processing plants, and sawmills.
p) Intensive exploitation projects, cultivation and processing of hydrobiological resources.
q) Production, storage, transportation, disposal, or reuse of toxic, explosive, radioactive, inflammable, corrosive, or reactive substances.
r) Environmental sanitation projects, such as water supply and sewerage systems, water treatment plants, household solid waste processing plants, sanitary landfills, submarine outfalls, and treatment and disposal systems for industrial wastes.

Cumulative impacts should be emphasized.

Citizen participation is still insufficient.

Methodologies are support tools and not objectives in themselves.

Projects identified as worthy of being included in an EIA system have been identified.

FREQUENTLY USED ENVIRONMENTAL CRITERIA

- Health risks for the population.
- Significant alteration of natural resources.
- Human resettlement or significant alteration of life styles and habits.
- Effects on resources and protected areas.
- Significant alteration of scenic value.
- Alteration of monuments or sites of anthropological, archaeological, historical, and cultural value.

CONTENTS OF ENVIRONMENTAL IMPACT STUDIES

- Project description.
- Scope definition.
- Environmental elements or baseline.
- Impact identification and quantification.
- Mitigating and compensatory measures.
- Risk prevention and accident control.
- Follow-up and control mechanisms.
- Citizen participation plan.

3 SOME EXAMPLES OF EIA SYSTEMS

To show how varied the situations are in different countries, the following paragraphs give examples of EIA systems in the United States, Spain, Ecuador, and Chile. The idea is to illustrate their specificity rather than provide an exhaustive analysis.

3.1. The United States

The National Environmental Policy Act of 1969 (NEPA) urges federal government offices, responsible for projects requiring permits or financing, or any other action classified as important, to prepare a prior environmental assessment before work is started on construction of the project.

Certain environmental criteria should be reviewed in the EIA.

In the United States, the environmental issue has been addressed according to each individual resource or topic; thus, there are specific laws for air quality, water quality, rare and endangered species, noise sources, hazardous waste disposal, drinking water supply, toxic production, preservation of historical and archaeological sites and tourist rivers, coastal protection due to adverse development, and protection of agricultural land and ocean resources. In this regard, the NEPA has a holistic approach since it makes it obligatory to examine all environmental impacts and compare alternatives at the beginning of the project qualification process. Its goal is to reduce environmental impacts through an exhaustive analysis.

The environmental impact assessment is performed by two means: a) an environmental assessment (reserved for a brief assessment of a specific project; its goal is to determine whether an environmental impact study is necessary or not) and b) Environmental impact study or EIS (including a detailed impact analysis and assessment). These two ways of proceeding document the assessment process of a project and they begin with the basic environmental report for the leader agency. The environmental impact study is carried out directly in major projects.

Environmental impact studies have standard contents.

Both assessment tools have the following steps:

EIA has been applied for 30 years in America.

a) To describe the purpose of, and the need for, the proposed action.
b) To describe the proposed action and its alternatives, including the no action alternative.
c) To describe the specific physical, biological, and human environment.
d) To describe project impacts and detailed alternatives.
e) To identify the preferred alternative and mitigating measures for significant environmental impacts.
f) To carry out the follow-up to ensure compliance with the mitigated project.

The NEPA does not demand competent agencies to select the alternative with the least environmental impact, but it must analyze all the alternatives.

In the United States the use of the EIA is a long-standing tradition.

The projects submitted to the NEPA are those requiring important federal actions, such as permits and financing, and which could significantly impact the environment. National safety projects and those recognized as not causing impacts or not requiring federal actions, are excluded.

If the project needs the approval of a federal agency and if the action is important, it should be submitted to the NEPA. The decision has to be made on a case-by-case basis, although most agencies have drawn up a list of actions with no potential impact, called "categorical exclusions".

To determine whether a project affects the environment significantly, an environmental assessment is made with a non environmental impact statement (NEIS) or note of intention to prepare an environmental impact study (EIS). The NEIS establishes that there are no significant impacts and the leader agency prepares a document of "no significant impact", which concludes the procedure. Many promoters prepare changes in their projects in order to mitigate impacts and avoid the need for detailed EISs.

The United States establishes categories for environmental impact studies.

The decision to continue with a detailed study is based on significant impacts and the following criteria are used:

- Effects on health and public safety.
- Proximity to sensitive public lands, such as green areas, agricultural lands, swamps, tourist rivers, critical ecological areas, historical and cultural resources.
- Level at which the project can be controversial.
- Uncertain effects.
- Presence of cumulative impacts.
- Violation of local, state, or federal environmental standards or regulations.

In the United States all project alternatives must be environmentally evaluated.

These criteria can be subjective, which is one of the problems in EIA application. To avoid this subjectivity, the EIA often depends on environmental regulations.

The first step to accomplish an environmental impact study is to publish a note in the Federal Register informing that an EIS will be prepared and describing the project. Then, potential environmental problems are identified. A draft EIS is prepared and presented to the community in a public assembly. The leader agency answers any observations and prepares the final report. Then, the leader agency records the decision. The promoters and public may appeal the decision in a court of law.

The request for a detailed study depends on significant impacts.

The typical contents of an environmental impact study are: introduction, purpose and need, description of the proposed activity and its alternatives, description of the existing environment, impact assessment of the proposed activity and its alternatives, identification of mitigating measures, requirements regarding permits, public participation and agency coordination, and references and identification of those who prepared the documents and appendices.

A series of different institutions are involved in the EIA. The agency undertaking federal action is the responsible entity. When there is more than one, they can reach an agreement to name a leader institution. If there is no agreement, the Council on Environmental Quality may assign a leader institution and the others remain as cooperation agencies. The leader agency should identify which individuals and institutions have competence and jurisdiction in the area and issues concerned. When the project designer is a private agency, it can present a list of consultants. The agency chooses from this list and designates, under a formal work agreement, an advisory firm to prepare the environmental impact study. This consultant is often paid by the project designer and directed by the leader agency.

Members of the community participate in different ways. In the first instance, during the definition of key points or scoping, when they are formally notified by the Federal Register or by bulletins transmitted through the written press, radio, and television that an environmental impact study is being prepared and the main topics need to be determined. During and after the scoping meeting, the public may make formal observations, and the leader agency is responsible for answering those observations.

The other occasion for community participation is when the draft report is sent to previously identified individuals for review. The team who prepares the study may consult informally with the community to make sure that they are addressing community concerns adequately. During the formal consultation (after the draft report has been published and distributed) a list is drawn up to identify who will be consulted. All oral and written observations arising from the formal consultation must be responded to, and they must also be published in the final report.

The public may comment on the decision report and question it in court.

All significant projects that are not expressly excluded should be submitted to the NEPA. There is also a list of projects that always require a study. Projects implying a

construction or operation are often included in the NEPA, as well as vehicle license concessions, tax or expenditure programs, authorized postal equipment and, in general, all activities that may cause significant impacts.

It is relevant to focus on potential environmental problems.

It is possible for projects to avoid the NEPA: such is the case when federal actions are not required and when there are laws in place that give States the right to issue permits as strict and demanding as the EIAs. There are different requirements or "small NEPAS" with different coverage in 12 of the 50 U.S. States.

Some of the main weaknesses that arise in the application of the NEPA are associated with:

a) The lack of an accepted set of methods and criteria to ensure the objectivity of the environmental impact assessments.
b) The fact that environmental impact studies and statements are so extensive and time-consuming.
c) The inadequacy of the response to how cumulative impacts should be assessed.
d) Absence of control of mitigating measures during the construction and operation phases of the projects.

The EIA system involves many institutions.

The community participates in defining the scope and reviewing the study.

3.2. Spain

The framework for environmental assessments in Spain is the Royal Legislative Decree 1302 (June 28, 1986) and the regulation approving its enforcement. This legislation is valid for both public and private works and came into force when Spain joined the European Community. The Decree sets down a list of activities that should be submitted to an environmental impact assessment. The projects included on that list show three interesting characteristics:

a) Generic projects that due to their hazardousness can cause significant environmental impacts.
b) In some cases, the size of the projects is limited depending on their minimum scope and the production size and volume.
c) In other cases, environmental criteria are established for a specific project.

Projects relating to national defense and those approved specifically by a State law are expressly excluded. A project can also be excluded in exceptional situations, by the decision and resolution of the authorities. In such cases, the government must explain to the European Commission the reasons for the exemption, make the exemption information available to the community concerned, and review the desirability of performing a different type of assessment.

In the United States the EIA is compulsory for States.

Spanish legislation demands that projects include an environmental impact study based on:

a) General description of the project, its activities, and probable future requirements.
b) Examination of viable alternatives and justification of the solution adopted.
c) Environmental inventory and description of key ecological and environmental interactions related to the environmental criteria.

d) Impact identification and appraisal, both in the proposed solution and its alternatives.
e) Measures to reduce, eliminate, and compensate significant adverse environmental effects, including possible alternatives.
f) An environmental surveillance program to guarantee compliance with the measures prescribed in the study.
g) A summary with conclusions regarding viability, review of different alternatives, proposal of corrective measures, and the surveillance program.

Environmental impact studies have been extensive.

The criteria for performing the assessment are linked with the direct and indirect effects on the population, fauna, flora, soil, air, water, climatic factors, noise, vibrations, odors, luminous emissions, landscape, and material goods, including historical-artistic and archaeological heritage.

Emphasis must be placed on the control of impact mitigation.

To facilitate the preparation of the environmental impact study the information required is supplied by the Administration to the project proposer and individual in charge of the study.

The procedure established can be summarized in the following way:

a) Firstly, the project designer communicates to the Administration's General Bureau for the Environment, Ministry of Public Works and Urbanism (Dirección General del Ambiente del Ministerio de Obras Públicas y Urbanismo), the intention of carrying out a project and presents a report summarizing its main characteristics.
b) The Administration consults the people and institutions presumably affected by the project and their comments are included in the environmental impact statement formulated by the environmental body. The administrative environmental body is the General Bureau for the Environment, of the Ministry of Public Works and Urbanism.
c) The Administration gives the project designer the results of the consultations and the most significant aspects that should be taken into account in the implementation of the environmental impact study.
d) The project designer prepares the environmental impact study and once the report has been submitted, the document is presented to the public and reviewed.
e) Finally an environmental impact statement is issued indicating the desirability of carrying out the project and establishing the conditions for its implementation, including the follow-up in accordance with the environmental surveillance program. This statement is sent to the Administration which emits the administrative resolution authorizing the project. The statement is made public.

Spain has categoric project exclusions, such as those for national defense.

In Spain, the demand for EIAs began once it joined the European Community.

3.3. Ecuador

Ecuador has different laws, decrees, and regulations individually calling for environmental impact studies. The country does not have a single EIA system but there are different demands at various levels. Among the main legislation calling for studies are:

a) **Executive Decree No. 1802 on "Basic Environmental Policies of Ecuador",** which stipulates environmental impact studies and environmental mitigation programs as compulsory preventive instruments for activities that could deteriorate or pollute the environment.

b) **The regulation for oil activities in Ecuador,** which prescribes environmental effect statements, environmental impact studies, and environmental management plans. These are used for prospecting, exploration, perforation, development, exploitation, transportation and storage, industrialization, and marketing projects. The regulation requests separate studies for each stage and sets different contents for each one of them.

c) **The law for the prevention and control of environmental pollution**, which establishes the EIA in its regulations:

- Regarding water resources, environmental impact studies are required for activities that may cause harmful health effects or environmental degradation. Furthermore, it describes the activities and contents of the study and stipulates that its authorization is required to grant the permit.
- With regard to soil, it demands environmental impact studies for activities that may cause harmful health effects or soil deterioration. In addition, it specifies that a regulation will determine the activities involved and the minimum contents.
- In solid waste management, it requires an environmental impact study for transfer stations, solid waste management with special characteristics, and sanitation services for final waste disposal in the sea; it contains another regulation to specify those purposes.

The authority provides the information required for the EIS.

d) **The mining law and its regulation**, which establishes that mining and foundry and refining plant concessions should carry out environmental impact studies and environmental management plans to prevent, mitigate, control, remediate, and compensate environmental impacts resulting from their activities.

The preliminary assessment is a key step for the Spanish system.

e) **The regulation on the use of mercury in mining activities**, which calls for impact studies and environmental management plans.

The statement establishes the environmental conditions that the project must comply with.

f) **The regulation for the application of ordinance 2910 of the Municipality of Quito** for the prevention and control of pollution produced by industrial effluents, discharges, and atmosphere emissions. In order for the environmental certificate to be granted, it demands that an EIA be presented in accordance with the specifications of the Municipal Bureau for Hygiene and the Atmosphere (Dirección Municipal de Higiene y Ambiente).

g) **Environmental requirements of the National Financing Corporation, Private Banking, and the State Bank**: although they do not have special legislation for such purposes, an EIA is a requisite for the granting of loans to private investors and the public sector (especially municipalities) and to adapt the procedures established by the Inter-American Development Bank (IDB).

The following are some institutions that, either by legal mandate or because they make studies a requisite for the granting of loans, are directly associated with the EIA process:

Ecuador does not have a comprehensive EIA system.

In Ecuador there are sectoral demands for EIA.

Ecuador has environmental demands required by different institutions.

- Ministerio de Energía y Minas (Ministry of Energy and Mines)
- Consejo Nacional de Desarrollo (CONADE) (National Development Board - CONADE)
- Subsecretaría de Saneamiento Ambiental del Ministerio de Desarrollo Urbano y Vivienda (Subsecretariat for Environmental Health of the Ministry of Urban Development and Housing)
- Ministerio de Agricultura y Ganadería (Ministry of Agriculture and Livestock)
- Consejo Nacional de Recursos Hídricos (National Water Resource Board)
- Dirección General de la Marina Mercante y del Litoral (DIGMER) (General Bureau of the Merchant Navy and the Coast - DIGMER)
- Comité Interinstitucional de la Protección del Ambiente (Interinstitutional Committee for Environmental Protection)
- Ministerio de Industrias, Comercio, Integración y Pesca (Ministry of Industry, Trade, Integration, and Fisheries)
- Dirección Municipal de Higiene y Ambiente del Municipio de Quito (Municipal Office for Hygiene and the Environment, Quito City Hall)
- Ministerio de Obras Públicas (Ministry of Public Works)
- Corporación Financiera Nacional y Banca Privada (National Finance Corporation and Private Banking)
- Banco del Estado (the State Bank).

The information obtained confirms that, in the last decade, EIAs have been used with different characteristics and emphasis in Ecuador. This varied use has been expressed in non-unified sector demands that need to be strengthened and coordinated if proper preventive management is to be achieved in the country.

Briefly, Ecuador's experience with EIAs can be summarized as follows:

a) Ecuador does not have a single national compulsory system to evaluate environmental impacts derived from human activities. Permit concession in different institutions is evidenced by different EIA requests that depend on linked institutions.

b) The authority that coordinates the application of environmental policies is trying to establish a single environmental impact assessment system that will integrate both the public and private sectors and civil society in general.

Environmental impact studies have different demands and formats.

c) Environmental impact studies are requested through several different institutions, mainly due to legal mandates and in particular by requirement of international agencies. The studies, which do not have common guidelines, reflect different demands and formats. This leads to contradictions, for example, in the case of the mining sector where an EIA is requested when the mining title has already been granted. This results in a limited application of the study results. Moreover, environmental impact studies are basically oriented to establishing baselines, rather than placing emphasis on the mitigation of impacts.

d) The rules of the game are not the same for the public and private sector. The Corporación Financiera Nacional grants loans to private investors, following the prior presentation of an environmental impact study. Therefore, the Corporación has published an internal manual to regulate the EIA contents for four categories of studies, and it has introduced a procedure for making decisions regarding the degree of detail required in the studies. It keeps a register of skilled consultants and terms of reference for requesting different types of studies. Since September 1994 they have been in an ex-post evaluation phase, reviewing the application of measures. However, these requirements differ from those of the State Bank, the entity which grants loans to the public sector, especially to municipalities.

Ecuador requires a single consolidated EIA system.

International agencies have particular EIA demands.

e) Ecuador has a large number of environmental protection standards related to water, air and soil quality, solid waste, noise, soil conservation, protection of forests, native vegetation, fauna, and indigenous communities, which should facilitate the application of a single consolidated system. It is well known that rules and regulations are not being complied with, that better control and follow-up is required to monitor their application, and that such follow-up regulations should make it possible for an adequate EIA system to be installed.

Follow-up is a weakness in the EIAs of Ecuador.

3.4. Chile

The Chilean system is designed to identify ways of enhancing positive environmental impacts and minimizing, attenuating, or counteracting negative environmental impacts. Within that context, it is a flexible procedure whose scopes and analytical techniques vary according to each individual project and it is based on a global framework supplied by Law 19.300 on General Bases of the Environment. This law was passed in 1994 and its regulations were promulgated in 1997. The Chilean system is based on:

a) A set of projects for which an EIA is compulsory.
b) Six criteria defining the environmental framework for assessing projects.
c) A formal review by CONAMA or COREMAS and the environmental service entities, whereby environmental permits are granted.
d) An environmental impact study or statement with technical contents conducive to performing the assessment.
e) A procedure introducing a formal mechanism for citizen participation during the review of environmental impact studies.
f) An administrative procedure defining functions, timeframes, and operation mechanisms.

According to Law No. 19.300, environmental impact is the environment alteration directly or indirectly induced by a project or activity in a given area. It can be assessed through an environmental impact statement or study. The procedure starts with a list of projects and activities that need to be assessed, because their particular characteristics mean that they usually have a significant impact on the environment. The EIA is required for public and private projects alike.

If an investment proposal or activity is included on the list, it must be submitted to the environmental impact assessment system. If it is not on the list, it does not require an assessment although the project designer can voluntarily submit the project to the system. In either case, current environmental regulations must be complied with. Since there are no Chilean regulations, the Swiss standards are used as reference.

Chile has a system based on the EIA of investment projects.

Once it has been determined that the project or activity should be submitted to the system, the next step is to define whether an environmental impact study or statement needs to be conducted, as an assessment instrument. Article No. 11 of the Law lays down six environmental criteria. The scope of the project or activity is then defined to predict whether environmental criteria will be affected significantly by any of the characteristics of the project or of the environment where it will be installed. The idea is to determine whether any aspects of the project can result in significant impacts on the criteria established by law and to define the causes.

Environmental criteria considered in the EIA are established by law.

The criteria are: a) health risk for the population due to quantity and quality of effluents, emissions, or wastes; b) significant adverse effects on quantity and quality of renewable natural resources, including soil, water, and air; c) human resettlement or significant alteration of human life-styles and habits; d) location near to the population, resources and protected areas likely to be affected, as well as the environmental value of the land, e) significant alteration of scenic or tourist value of an area in terms of magnitude or duration; and f) alteration of monuments, sites of anthropological, archaeological and historical value, and, in general, all elements of cultural heritage.

Chile has a list of projects that must prepare an EIA.

If the environment involved is not significantly affected, the project designer should submit an environmental impact statement indicating that the project or activity complies with current environmental regulations and that it will not have an adverse environmental impact. This document can also contain voluntarily proposed actions to improve the environment, which become compulsory once they have been presented and reviewed by competent entities.

The law specifies very clear responsibilities. Public institutions act as guides and reviewers; the executing agency is responsible for the environmental assessment and may hire third parties, if appropriate.

The definition of significant impacts is key in the Chilean system.

The management of the environmental impact assessment system is based on the environmental institutionalization defined for the country. The Comisión Nacional del Ambiente (CONAMA) (National Commission for the Environment) coordinates and inspects the application of the system, uses the installed capacity of different State sectors, and strengthens their environmental competence. The Executive Director of CONAMA is responsible for the installation and operation of the system and for investigations in the event of disputes during the environmental assessment. Furthermore, in national projects or activities, this agency coordinates the activities stipulated in the procedure described below. The Advisory Committee of CONAMA deals with environmental assessments since it is involved in the establishment of standards and definition of regulations of interest to the system, and also in the consultations requested by the Board of Directors in cases of disagreements arising during the revisions.

The Comisiones Regionales del Ambiente (COREMAS) (Regional Commissions for the Environment) are those which qualify the documents after receiving contributions from public entities and services, and observations from community organizations and affected population. The COREMAS are decentralized CONAMA offices. They are headed by "intendants" and made up of a regional director and regional secretaries of the ministries (SEREMIS) who form the Board of Directors of CONAMA. Furthermore, there is a Technical Committee made up of regional public service directors legally authorized to review environmental impact studies and statements. If a project affects two or more regions, CONAMA will operate the system at the national level.

The Chilean system encompasses public institutions related to the environment.

The environmental impact assessment system incorporates sector institutions. All ministries and institutions with legal jurisdiction in the environmental issue should participate jointly in decisions involved in the environmental impact assessment, depending on the environmental implications of each project or activity. The system is based on the "one-stop window" concept, since once the study or environmental impact statement is approved, environmental licenses are granted.

In the community area where the project works or activities are carried out, municipalities disseminate study abstracts published at the expense of the project designer. They also publish the list of statements that were processed in the previous month, prepared by COREMA or CONAMA, as the case may be, and undertake actions on environmental damages. Municipalities are usually included in the qualification of environmental impact studies.

The Chilean system is decentralized in 13 regions.

The Chilean system is quite new. As recently as 1990, CONAMA promoted the bases for the design and setting up of a system for the prevention of environmental impact in the country. Hence, it is a recently introduced process in Chile, which is still being implemented. It started in 1993 with a Presidential Decree (Instructivo Presidencial) that promoted voluntary environmental impact studies and this remained in effect until 1997, when the regulations for the application of Law No. 19.300 on the General Bases of the Environment were promulgated. This whole process emerged in response to the demands and collective awareness-building with regard to the EIA process in Chile. Its basic characteristics are: a) it is a voluntary system; b) the procedure is based on Law No. 19.300, currently in force; and c) the procedure is incomplete since key topics are yet to be developed, such as citizen participation and the use of environmental impact statements. Curiously, although the presidential decree was based on Law No. 19.300, this law had not been passed at the time, and was still being debated.

Public institutions review the EIAs in a complementary way.

The Chilean system limits formal citizen participation to more detailed studies.

Chile has a successful voluntary EIA system.

CHAPTER V

Preliminary Assessment

This chapter describes the following steps of the preliminary assessment: the scopes of the instrument, description of the proposed activity, description of the affected area, definition of significant impacts, definition of the study coverage, and environmental protection criteria. It also includes generic contents for the preparation of terms of reference which are a key tool for describing the scope of a detailed EIA.

1 SCOPE

The preliminary assessment is applied during the initial stages of the preventive environmental analysis to determine the relevance of a detailed study, to focus on significant impacts, and to define what will be included in the more specific analysis. It helps identify requirements that need to be met if environmental sustainability is to be achieved.

The preliminary assessment supports the EIA scope.

As a tool, it reduces uncertainty regarding the decision and represents a step forward in the development of a detailed environmental impact assessment. The preliminary assessment is useful insofar as it reviews the required environmental coverage and provides decision-makers with background data.

A good preliminary assessment requires the following information:

The preliminary assessment requires basic information.

- General description of the project
- Applicable environmental legislation
- An estimate of significant environmental impacts
- A general description of the area of influence
- Mitigating measures to manage potential impacts.

2 DESCRIPTION OF THE PROPOSED ACTION

The purpose is to ensure that the main characteristics of the action are known, such as: activities, stages, and aspects related to infrastructure, size, and production. Related actions, as well as the aspects that influence on their design and execution, should

The project description is a key element for identifying the presence of potential environmental impacts.

should also be described. The description of the proposed action should include the following:

The location area of a project is not necessarily the same as the affected area.

- General background (identification of the agency responsible, beneficiaries, project designer, and parent organization).
- Objective.
- Geographical and political-administrative location.
- Land area involved.
- Estimated investment.
- Duration and scheduling of the different stages.
- Detailed description of the construction stage, including the activities and requirements to implement the physical works.
- Description of the operation stage considering activities and requirements.
- Description of the abandonment stage, including activities to be implemented.
- Environment-related legal and administrative framework, especially in reference to complying with standards and obtaining permits.
- Types of inputs and wastes, including raw materials used and their volume; energy sources; quantity and quality of solid, liquid, or gas emissions, as well as the rate of generation; disposal and management of wastes; resource management plans; volume and rate of resource extraction; origin of the inputs; and any other aspect of relevance in identifying environmental impacts.

3 DESCRIPTION OF THE AFFECTED AREA

The affected area includes the places where environmental impacts are produced.

The description uses available information.

It is necessary to define the environmental components of the area involved and to identify its geographic location, type of landscape, elements and natural and human values, access, and level of anthropic intervention. Basically, it involves defining not only the location, but the potentially impacted land area, either directly or indirectly. The environmental variables are defined in terms of the environmental protection criteria that are affected by each particular activity. The description usually contains the following environmental parameters:

Variables considered must be impact-related.

- Physical environment (water, air, soil)
- Biotic environment (vegetation and flora, fauna)
- Socioeconomic environment (social and economic structure, demographic, and socioeconomic background)
- Man-made environment (urban structures, rural settlements)
- Cultural environment (aspects of cultural, archaeological, or anthropological interest)
- Landscape (visual or aesthetic environment).

4 DEFINITION OF SIGNIFICANT IMPACTS

An impact is a significant alteration of the environment.

The definition of significant impacts identifies positive and negative impacts derived from the design, construction, implementation, operation, or abandonment of a project. The following should be taken into account:

- Direct, indirect, and cumulative impacts and their environmental risks.
- Representative environmental variables to identify impacts and justify the scale, resolution level, data volume, information replicability, definition of impact thresholds, and identification of critical or inadmissible impacts, as well as positive impacts.
- Regulations and standards governing the issues and geographical area of concern. If there are none, those of other countries may be used or those suggested by international organizations that the authority or competent agency determines as applicable or that have been previously accepted.

Standards and regulations help define what we mean by "significant".

The identification and analysis of impacts is based on:

- The physical environment, including the effect on climate, geology, geomorphology, hydrogeology and edaphology, noise generation, electromagnetic fields and radiation, and air and water quality deterioration.
- The biotic environment, including species listed in a conservation category, or alteration of ecosystems.
- Socioeconomic environment with relevant information on habits and life quality of affected communities, especially those protected by special laws.
- The man-made environment, including infrastructure works, parks, recreation areas, land use and possession, soil classification according to aptitude, and insertion into a land management plan or area under official protection.
- The historical, archaeological, anthropological, paleontological, and religious heritage, including identification and description of national monuments and other protected areas.
- Landscape heritage, with identification and description of areas of particularly high value.

The preliminary assessment considers environmental factors likely to be affected or those that explain the impacts.

Environmental impact studies are not encyclopedic geographic compendia.

Once the significant impacts have been identified, it should be determined whether they can be mitigated with familiar methods or whether it is necessary to analyze other alternatives that will ensure proper impact management.

5 DEFINITION OF THE STUDY COVERAGE

The preliminary assessment can conclude with the selection of a category of environmental impact study.

Once the above-mentioned information has been collected and analyzed, it can be decided whether a more detailed analysis will have to be prepared and if so, the activity should be classified under one of the environmental impact study categories. The selected category is related to the project implications on one or more of the environmental protection criteria, as well as to the relevance of mitigating measures. The following circumstances usually arise:

Detailed studies are viable only in cases of significant impacts.

- If no impacts are present or identified under the acceptability levels or standards, detailed studies are not normally required.
- If environmental impacts are present, but their mitigation measures are known and accepted, background data are required to certify the proposed measures.
- If potential significant impacts are identified and there are not sufficient background data to understand them in detail or the mitigating or compensatory measures are not known or accepted, impacts should be reviewed at greater depth and in such cases detailed studies will be requested.

The preliminary assessment defines the scope of the detailed analysis.

6 ENVIRONMENTAL PROTECTION CRITERIA

In defining environmental requirements, the following list of topics should be considered. The topics are generic and global and their relevance and application should be confirmed in each case.

The environmental policy requires the definition of explicit protection criteria.

a) Generic topics of concern to public health

The preliminary assessment identifies when or under which circumstances an environmental criterion is affected.

- Deterioration of water bodies or courses used as drinking water sources.
- Modification of water uses destined to different human consumption purposes.
- Deterioration of water sources used for aquaculture.
- Use of inflammable, toxic, corrosive, or radioactive substances during the different project stages.
- Emission of liquid or gas effluents (or both) that contain non-regulated pollutants or exceed the standards.
- Generation of emissions or wastes that affect human health.
- Generation of noise, vibrations, or radiation during the different stages of the project, especially in populated areas.

- Production of solid, domestic, or industrial wastes that, due to their characteristics, represent a sanitary hazard.
- Proliferation of pathogens and sanitary vectors due to project activities.

b) Generic topics relevant to renewable natural resources

- Deterioration of water bodies or courses
- Groundwater deterioration
- Alteration of the quality of surface (continental or marine) water and ground water
- Air quality deterioration
- Generation of annoying noises
- Storage, collection, transportation, recycling, or final disposal of solid waste, including hazardous wastes
- Generation, storage, transportation, or disposal of industrial wastes, either liquid, solid or gas
- Air, water, or soil emissions in the form of gas, powder, effluents, or others
- Alteration of soil conservation
- Deterioration of fragile areas with gradients that favor slope destruction
- Promotion of soil erosion
- Deterioration of soils or areas under protection
- Presence of activities that cause salts or pollutants to accumulate on the soil
- Deterioration of vulnerable, rare, insufficiently known, or endangered species
- Introduction of exotic species not present in the land area involved, particularly when they replace endemic species or relicts
- Alteration of endemic biota
- Changes in the conservation status of species
- Exploitation of species listed in a conservation category
- Felling of native trees
- Interruption of the continuity or dynamics of plant formations
- Extraction, exploitation, or management of native fauna or other natural resources
- Definition of new rules for the conservation of natural resources.

Natural resources include water, soil, fauna, flora, and ecosystem aspects.

The deterioration of natural resources due to pollution is an important issue for the EIA process.

Biodiversity takes on relevant roles in the environmental protection objectives.

Impacts on the population, its culture and its habits are considered in the EIA.

c) Generic topics relevant to socioeconomic and cultural environments

- Resettlement of human communities located in impact areas
- Deterioration of human groups protected by special provisions
- Permanent or temporary obstruction of access to resources needed for adjacent communities to earn their livelihood
- Processes conducive to the rupture of social networks or alliances
- Changes in the local demographic structure
- Temporary or permanent relocation of human communities
- Significant alteration of life-styles and habits, especially in the case of ethnic groups of high cultural value

Life-styles and relocation of human communities are addressed in the environmental impact assessment.

- Alteration of religious ceremonies or other cultural manifestations of the affected population, community, or group.

d) Generic topics relevant to protected and environmentally valuable areas

Protected areas are legally defined.

- Deterioration of environments regarded as areas for the reproduction of species that are important because of their conservation status, endemism, or cultural or tourist interest, etc.
- Alteration of habitats relevant to fauna, such as nesting places, breeding grounds, or feeding places.
- Deterioration of unique or fragile ecosystems
- Modification of biodiversity in the area of influence
- Deterioration of relict or endemic species
- Alteration or interruption of species' migration or regular movement routes within the area of influence
- Loss of habitats of animal or plant species that have a restricted distribution or conservation problems
- Deterioration of lakes, lagoons, or wetlands that contain species listed in a conservation category
- Notable modifications or damage to fragile ecosystems
- Use or modification of ecological flows
- Alteration of the natural capacity of hydric regulation in river basins (flood levels, deposits, etc.)
- Alteration of protected areas.

The environmental value reflects the attributes of the environment to be protected.

e) Generic topics relevant to the landscape

Landscape alteration can deteriorate quality of life.

- Construction of works that modify the landscape
- Deterioration, intervention, or exploitation of land areas of scenic value
- Obstruction of visibility
- Permanent or temporary destruction of landscape values of benefit to the population
- Loss of scenic beauty.

f) Generic topics relevant to historic and archaeological monuments and cultural heritage

The man-made environment has cultural heritage values considered in the EIA.

- Deterioration or modification of historic, public, or archaeological monuments, typical areas, natural sanctuaries, etc.
- Alteration of old constructions or cultural heritage buildings with historical, architectural, or archaeological value
- Deterioration of public meeting places where cultural expressions of the affected people, community, or group take place.

7 THE EIA AND TERMS OF REFERNCE

7.1. Purposes and scope

The objective of the terms of reference (TOR) is to define the requirements for assessing those specific variables that, due to the nature of the activity and the affected area, acquire greater relevance in the identification, mitigation, or compensation of significant environmental impacts. The goal is to define the work scale, the information required, the volume of data to be used, and the use of quality indicators, among others.

The TORs are documents that define the scopes, coverages, and requirements for the environmental impact studies.

The terms of reference define the contents and scope of detailed environmental impact assessments based on the information obtained during the preliminary assessment. The terms of reference should have the following characteristics. They should:

- Encompass activities and elements considered in the design, construction, operation, and abandonment stages of the proposed project.
- Cover the area of influence and any significant environmental impacts.
- Adequately compare the pre-project situation with the post-project one.
- Select techniques and methods for obtaining the required background data, variables under study, accuracy level, time, costs, and need for a technical team. A rule of thumb is to select the simplest, least costly, and least time-consuming method that will satisfy the study needs.
- Justify and validate the data and sources of information used in the environmental analysis.

The TORs should consider the variability of the area of influence of the impacts.

Baseline information is important to satisfy the demands of the TORs.

7.2. Scoping

The answers to the following questions will help define the scope of environmental impact studies.

A. Introduction

a) What are the objectives of the terms of reference?
b) What are the objectives of the environmental impact study?
c) What activity is going to be assessed?
d) What legal provisions are associated with the project?
e) What relationship does the proposed activity bear to other environmental works?
f) What are the special requirements of the environmental analysis?

The TORs should clearly specify their objectives and guidelines.

B. Project background

a) What are the characteristics of the activity? Activities that imply risks or cause impacts should be emphasized.
b) What differences may be expected during the design, construction, operation, and abandonment?

The TORs include the legal framework.

c) What are the most relevant activities that will be undertaken?
d) What are the legal and regulatory aspects and the administrative frame of reference? If dealing with large multi-component projects, the governing standards and legislation should be identified, and it should be determined which permits or authorizations will be required from the sectors involved.
e) What agencies and institutions are involved?
f) What is the specific location (include map)?

C. Description of the area of study

The TORs define the area of influence and the project location.

a) What is the project's area of influence?
b) What environmental aspects are of special concern?
c) What physical, biological, chemical, social, cultural, and landscape elements are going to be measured in the study?

The TORs define the methodologies that will be used in the EIA.

d) What methods are suggested?
e) What scales should be used on the required maps?
f) What are the characteristics of the baseline and other data required?
g) What is the reliability or deficiency level stipulated for such data?

D. Prognosis and impact measurement

The TORs define environmental impact categories or the criteria to define them.

a) What methods will be used to identify environmental impacts?
b) How will the identified impacts be quantified?
c) What methodologies will be used to predict impacts?
d) How can the impacts be described in terms of: character (negative or positive), condition (reversible or irreversible), period (short, medium, or long-term), scope (cumulative, synergistic, direct, indirect), etc.?
e) What standards will be used for the environmental impact assessment?

E. Environmental management plan

The TORs should expressly request an environmental management plan.

a) At what stages of the project will the mitigating, corrective, compensatory, and other measures be used?
b) What type of measures will be used?
c) How are the significant environmental impacts handled during mitigation and compensation?
d) How are the measures selected?
e) How will the schedule of activities be defined?
f) What will be the reaction with regard to risk prevention and accident control?

g) What are the objectives, specific tasks, and budget of the plan?

F. Monitoring program

The TORs should establish the framework for preparing a follow-up program.

a) Which relevant environmental issues should be included?
b) Which specific variables will be submitted to environmental follow-ups?
c) What detection limits and what standards will be used?
d) What are the contents of the follow-up program?

G. Community involvement

Formal and informal community involvement should be contained in the TORs.

a) Who should be involved in the community participation process?
b) How will the project be reported to the public?
c) What procedures will be used for community participation?
d) What aspects will be considered in the community participation plan during the development and review of the study?

H. Professional team

a) What criteria will be used to define the composition of the working team?
b) What special requirement is needed to form the team?
c) What information is required to characterize the team?

I. Contents and format of the study

The TOR should indicate the aspects of major concern in the study.

a) What points should be included in the report?
b) What special requirements are there in terms of scale, language, and cartography?
c) How many copies are requested and how should the study be presented?

CHAPTER VI

Information Needs

1 IMPORTANCE OF INFORMATION FOR THE EIA

Information is a key element in the EIA.

The description of the affected environment, including its characteristics and variables, is a determining factor in predicting the significant impacts of a particular action. The information used should be complete enough to qualify changes occurring as a result of human activity; it should be available at the right level of detail; and it should use methods of analysis appropriate to each situation. The information should make it possible to recognize, qualify, and monitor the behavior of environmental impacts. Since information is case-specific, it depends on the type of action and the characteristics of the environment involved.

ADEQUATE INFORMATION REQUIREMENTS

The information should have the following qualities:

- Relationship between environmental variables and the background data necessary to characterize them
- Representativeness of data and background
- Adequate spatial and temporal coverage
- Data quality and validation
- Work scale consistent with assessment requirements
- Data sufficient in quantity and quality to interpret impacts or other objectives of the analysis.

2 DATA INFORMATION AND ANALYSIS SYSTEMS FOR ENVIRONMENTAL VARIABLES

Information systems are instruments to support the appropriate application of the EIAs.

Valid information requires standardized methodologies and procedures.

An environmental information system is a set of background data based on information provided by different stakeholders, who have previously agreed on common procedures and methods for the generation, storage, processing, and distribution of information relevant for strategic decision-making. This allows the availability of an integrated background to support strategic and tactical decision-making, scientifically based on causes and environmental impacts.

The system should share clearly identified common objectives and include prescribed sequences of information procedures and flows. Generally, the purpose of all information systems is to facilitate the assessment of environmental issues and to provide the

The lack or excess of information hinders the preparation of environmental impact studies.

scientific data necessary to manage natural resources and environmental quality rationally. Hence, data collection is not an objective in itself, but rather a means of assessing the environment; the objective is to provide background data that will contribute to improving the environment and managing it accordingly.

The use of a working scale compatible with environmental elements is important.

The main difficulty is to determine just what we mean by environmental data and information. In operational terms, we can define environmental data as those data that indicate the structure, state, and functioning of natural and artificial elements that interact in space and time to form a global system. Since it is a complex task to identify the state and processes taking place, we need to select indicators of state, change, and trend. One of the greatest difficulties is to establish the baselines, i.e., to simulate a condition which may show significant levels of environmental deterioration or impact in the future.

The interactions of the following physical, chemical, biological, and sociocultural objects and attributes help to characterize the environment: air (weather and climate, pollution, etc.), water (hydrological cycle, physical, chemical and biological features, water management and use, watershed management), natural renewable and nonrenewable resources (soil, flora and fauna, mineral, energy and biological resources, the management, tenure and property of such resources, and their levels of contamination and degradation), and sociocultural aspects (quantity, structure, and dynamics of human populations, economic and cultural activities, life quality levels). See **Table 6-1.**

The right information is that which enables us to identify, measure, and assess environmental impacts.

TABLE 6-1. SUMMARY OF DATA AND ELEMENTS THAT COULD BE REQUIRED TO DEFINE THE CONDITION OF THE ENVIRONMENT

1. Environmental variations

- Climate, radiation, and anomalies and changes in the climate
- Water resources
- Forest resources
- Soil resources
- Marine resources
- Sea condition
- Air pollution
- Water pollution
- Soil pollution
- Condition or loss of flora
- Condition or loss of fauna
- Condition or loss of soil
- Condition of landscape and protected areas
- Socioeconomic and cultural aspects
- Natural risks
- Solid waste

TABLE 6-1. SUMMARY OF DATA AND ELEMENTS THAT COULD BE REQUIRED TO DEFINE THE CONDITION OF THE ENVIRONMENT (CONTINUED)

2. Techniques useful for producing environmental information

- Cartography
- Photographic and satellite images
- Legal instruments (standards, regulations, jurisprudence, legislation)
- Data sampling and collection systems
- Surveys (demographic, economic, social, etc.)
- Environmental audits
- Analysis of technologies and processes

Table 6-2 lists some of the elements most commonly analyzed in environmental impact studies.

TABLE 6-2. ITEMS TO BE INCLUDED IN A DESCRIPTION OF THE ENVIRONMENT FOR ENVIRONMENTAL IMPACT STUDIES

- **Water**
  - Groundwater (location, description of aquifers, recharge areas, level of use, etc.)
  - Surface water (location and description of areas that could be affected by the project; identification of use of surface water; description of drainage areas and channels; discussion on potential for floods, sedimentation, erosion, and eutrophication of water sources).
- **Air**
  - Climate (rainfall, temperature, radiation, fog, wind, etc.)
  - Air quality (description of existing air quality levels; identification of sources of pollutants; fragile receptors in the area; description of supervision programs; etc.).
- **Soil**
  - Subsoil (composition, depth, etc.)
  - Surface (types and distribution, characteristics, uses, etc.)
  - Topography (altitude, gradients, relief variations, orientation, etc.).
- **Flora and fauna**
  - Vegetation and terrestrial and aquatic flora (identification of types and characteristics of local species;)
  - Land and aquatic fauna (identification and discussion on wildlife species and their characteristics)
  - Fragile areas (identification and characteristics).
- **Landscape**
  - Sites of special interest due to their physical, biological, or cultural features
  - Sites of interest due to their tourist value.

TABLE 6-2. ITEMS TO BE INCLUDED IN A DESCRIPTION OF THE ENVIRONMENT FOR ENVIRONMENTAL IMPACT STUDIES (CONTINUED)

- Social, cultural, and economic aspects
  - Present land use and zoning
  - Land use plans (utilization or master plans, including the project area and surroundings; discussion of future trends or development pressures, etc.)
  - Characteristics of the population (parameters, growth projections, etc.)
  - Sociocultural features (ethnic minorities, habits, population of special interest, etc.)
  - Visual resources (physical description of the community; natural areas of significant scenic value; identification of structures with significant architectural design; etc.)
  - Historic and archaeological resources (listed historic areas or structures, according to national or community designation; sites of potentially significant archaeological value; etc.)

Field visits are the key means of getting to know the affected area.

The previous knowledge of the affected area influences the detail of description. If the knowledge is limited, it is recommended that a brief description of the general characteristics be made and that later it be determined which parts require a more detailed description. If there is adequate scientific information, the description should include only those environmental components that could possibly be affected. In both cases, there are proven techniques that can be used to collect, produce, and qualify information. See **Table 6-3**.

TABLE 6-3. FORMAT FOR OBTAINING RELEVANT INFORMATION TO CHARACTERIZE ENVIRONMENTAL IMPACTS

Type of impact	Nature of impact	Environmental variables	Frequency	Information source	Indicators
Silting up of ports	P	Dragging and depositing of material	Monthly	Ministry of Public Works	Ton average/ month
Heavy metal pollution	P	Cd Cr Pb	Daily	Ministry of Health Statistics	ppm of the official standard

Nature of the impact:

P: Primary **S**: Secondary **T**: Tertiary **A**: Cumulative

In almost all cases, data are transformed into environmental information as the analysis of the following elements progresses: a) interactions and their comprehensive contribution to the global condition, b) modifications caused by human activity, and c) effects of disturbances caused by society on different manifestations of life.

The use of indicators is relevant in the EIA.

Accordingly, components should be described not only according to their isolated attributes, but also in the context of their interactions. One way of analyzing the interactions that contribute to a holistic view of the environment is to use the many different conceptual models from specific disciplines. Among these are models on the following topics that can be applied in different places or regions:

The information on environmental variables provides an important background to the EIS.

a) The energy cycle in the atmosphere: balance of radiation, reflection (albedo) and dispersion in the atmosphere, emission of long-wave energy, transfer of sensitive heat (temperature) and latent heat (evaporation) to the atmosphere. All according to places, natural units, and regions.

b) The hydrological cycle: evaporation and evapotranspiration, atmospheric moisture (relative and absolute moisture, points and nuclei of concentration), condensation (clouds, fogs, mists), precipitation (rainfall and solid forms), infiltration, runoff, and water storage (groundwater, snow, and glaciers). All at specific points, area, watershed, and other natural units.

The selection of impact-related information is essential.

c) Water, air, and soil pollution cycle: emission of particles (total and breathable), transportation and diffusion by air-water or through the soil, suspension in dry and liquid media, dry precipitation and rainfall (acid rain), emission or deposit (concentration in the air, water, and soil).

d) Biogeochemical cycles or element-transformation cycles, such as carbon, phosphate, nitrogen, or sulfates when passing through the atmosphere, hydrosphere, lithosphere, and biosphere.

e) Trophic chains: primary, secondary, and tertiary productivity levels; trophic levels; prey-predator or producer-consumer-reducer relationships.

f) Demographic cycles: population dynamics, relationship between birth and mortality rates, levels of morbidity and risk for populations, growth curves and rates, migratory balances.

Information must be sufficient to allow a dynamic analysis of environmental factors.

g) Economic cycles: economic growth rates, composition and evolution of the gross domestic product, main activities, occupation, and labor productivity.

h) Social components indicating accumulation in socioeconomic cycles: society's values regarding the environment, educational levels, quality of housing, saving and investment rates, added value levels, population per services (e.g. hospitals, supermarkets, etc.).

Information should be adjusted to the scales of the environment and the project.

Each model supplies a great many data from which we can estimate the physical, chemical, biological, and human characteristics of the environmental elements at different phases and in different conditions. However, such indicators barely analyze interactions among structures, states, and operations of natural or artificial ecosystems.

In an EIA it is important to define at the earliest stage what information will be required.

An important condition for developing any information system is to be aware of the availability, quality, origin, and characteristics of data and background information relevant to fulfilling the functions assigned. In short, data on resources and interactions among different natural, artificial, socioeconomic, and cultural components of the selected ecosystems are required.

3 USE OF ENVIRONMENTAL INDICATORS

The interest in sustainable development and increasing public concern to prevent negative environmental impacts make it imperative to build capacity to assess environmental conditions and detect in advance any change-related conditions and trends. It is also essential to ascertain the environmental performance, i.e. to find out how prevention policies are being implemented and whether the environmental regulations are being complied with. The need thus arises to develop environmental indicators to be used as tools that will steer human activities towards a sustainable future.

Indicators are used to verify the quality of environmental impacts and to measure compliance with goals.

Environmental indicators are used to: a) report on the environmental condition, b) identify the relationships among the pressures imposed by different human activities on environmental quality, and c) prepare responses with which to tackle the pressures caused by deterioration. In this context, environmental indicators can be regarded as social well-being or economic development indicators, which are widely accepted by the international community.

Since indicators must be considered within a dynamic context, they are subject to a constant review to ensure that they reflect the changing nature of political prospects and public perceptions with regard to the severity of different environmental problems.

Indicators are synthetic and cover specific purposes.

Indicators are variables selected from a large database, they synthesize information, and cover specific purposes. Hence, there is no single universal set of environmental indicators, but rather sets of indicators responding to specific reference frameworks and purposes. They measure environmental performance with regard to the present environmental quality, changes in quality levels, and related objectives.

Indicators correspond to parameters and indexes that assess environmental elements affected by human activities, as well as the quantity and quality of selected natural resources. The different stages of an environmental impact assessment where indicators are needed are the following:

a) In the description of impacts on the physical, biological, and human attributes that represent the environment. The attributes of interest, from a systemic perspective, are those that characterize the interfaces representing the environment.

b) In the identification and appraisal of affected environmental components.

c) In the comparison of the affected environment with other standards, including individual and collective preferences, decision criteria, uncertainty in the representation, and synthetic indexes.

d) In the establishment of mitigation and follow-up measures for project activities.

Indicators are necessary for impact description, appraisal of environmental components, and mitigation and follow-up.

An indicator is defined as a generic pattern that synthesizes the state of knowledge of an attribute relevant to the analysis under way. The index is the product of that indicator's measuring process. Formally, the construction of an indicator and its related index can be defined as the establishment of a correspondence between reality and the numbers or data representing it.

The use of indicators is key in the follow-up program design.

Table 6-4 presents a set of relevant environmental problems and issues and the proposed indicators.

TABLE 6-4. PROPOSED INDICATORS FOR RELEVANT ENVIRONMENTAL ISSUES

Parameter Problem	Examples of cause indicators	Examples of state indicators
Climate change	Emissions of greenhouse gases. Emissions of CO_2.	Atmospheric concentration of greenhouse gases. Global mean temperature.
Water pollution	Intensive use of water resources. Annual extraction of surface water and groundwater. Household water consumption per capita. Household and industrial discharges in water bodies.	Frequency, duration, and extension of water shortage periods. Concentrations of Pb, Cd, Hg, and pesticides in fresh water. Concentration of fecal coliforms in water. Water temperature.
Eutrophication	Emissions of N and P in water and soils. Use of N and P in aquatic crop food. Use of N and P in fertilizers and animal feed.	Biological oxygen demand and dissolved oxygen demand. Concentrations of N and P in continental and marine waters.
Water and soil acidification	Index of acid substances. Emissions of SO_x and NO_x.	Excess of critical pH values in water and soils. Concentrations of acid rainfall.

TABLE 6-4. PROPOSED INDICATORS FOR RELEVANT ENVIRONMENTAL ISSUES (CONTINUED)

Parameter Problem	Examples of cause indicators	Examples of state indicators
Pollution	Heavy metal emissions. Organic compound emissions.	Concentration of heavy metals and organic compounds in the environment and living species.
Urban environmental quality	Growth rate of urban population. Number of vehicles in use. Inventory of polluting industries, emissions of SO_x, NO_x, VOC in urban air. Density of urban traffic. Level of urbanization. Noise levels.	% of population in urban areas. Areas and population in marginal settlements. Population exposed to air and noise pollution. Environmental water conditions in urban areas. Index of housing units by state of conservation. % of population with sanitary services.
Air pollution	Inventory of stationary and mobile sources. Number and rate of increase of industries and automobiles.	Concentration of particles, microparticles and gases in the atmosphere. Levels of soil, water, and forest pollution by emission and deposit.
Conservation of biodiversity and landscape	Alteration of habitats and wildland conservation. Annual rate of wood production. Annual rate of firewood consumption. Annual rate of export of endemic species.	Percentage of threatened or endangered species with regard to the total of known species. Changes in biomass. Extinction rate of protected species. Deforestation rate.
Wastes	Generation of municipal, industrial, and nuclear hazardous wastes. Heavy metal emission. Organic compound emission. Pesticide consumption.	Area polluted by toxic wastes. Quality of polluted water and soil. Quality of affected biota and ecosystems. Human health effects.
Earth and soil degradation desertification and erosion)	Erosion risks. Current and potential use of soil for agriculture. Loading capacity (head of cattle per surface).	Area affected according to degree and type of erosion. Erosion index (sediment production). % of loss of horizon A from the soil. Surface area affected by desertification.

CHAPTER VII

Contents of Environmental Impact Studies

1 CHARACTERISTICS OF ENVIRONMENTAL IMPACT STUDIES

The environmental impact study (EIS) plays a major role since it documents the environmental impact analysis of a particular activity. This includes a description of the activity, different alternatives for its implementation, baseline, mitigation or compensation measures, and monitoring and control programs. It is the source of relevant information on the expected environmental impacts of a proposed project.

The environmental impact study should include the results of the assessment.

The environmental impact study is the set of technical, scientific, systematic, and interrelated analyses, whose objective is to identify, predict, and assess any significant positive or negative impacts that one or more anthropic actions may have on the physical, biological, and human environment. The information contained in the study should lead to conclusions on the impacts of a specific project; it should prescribe measures to mitigate and monitor them; and in general, it should propose the reduction or elimination of their level of significance.

The environmental impact study should cover the management plan adequately.

Environmental impact studies have certain unique characteristics, without which they could not comply with the objectives and advantages assigned and serve as a useful tool in environmental protection. The following basic aspects are included in an EIS:

a) The studies are predictive and are based on scientific information.
b) The interdisciplinary nature of the analysis ensures a comprehensive view of the variables under study.
c) The analysis and harmonization of work scales and the generation of data at one same level are important for establishing relationships.
d) Initial knowledge of the activity or project to be implemented and familiarity with the general characteristics of the project location area are decisive factors for a sound analysis.
e) The most significant aspects in determining environmental impacts can be selected based on fragility (or resistance to impacts) and quality (or environmental appraisal) of the affected land area.

Environmental impact studies are regulated by the pertinent legislation.

The environmental impact study allows us to compare pre-project environmental situations or dynamics with the post-project situation. Thus, the existing environmental situation is compared with that expected as a consequence of the activity. Through a simulation process, both direct and indirect impacts are evaluated.

The environmental impact study documents entirely the EIA process.

2 KEY TOPICS OF AN ENVIRONMENTAL IMPACT STUDY

2.1. Description of the environment and of the project

The study should have enough information to explain the baseline of the affected territory and review environmental impacts

The relevant topics of the analysis determine the geographical area that needs to be incorporated into the environmental impact study. The EIS seeks to compare current environmental conditions with those that could be triggered by the different components of the proposed project or activity and their reasonable alternatives. Therefore, it is necessary to know exactly which environmental components could be affected in some way by the activity. The description should be done in the affected land area, i.e. where the environmental impacts occur and mitigating and follow-up measures should be implemented. The information should be sufficiently detailed for the analyst to understand the characteristics of the natural and human resources that could be affected.

If the information fails to characterize the affected environment or to provide the elements needed for assessing impacts and performing mitigation and follow-up, there is no point in including it in the environmental impact analysis. The lack of relevant information indicates poor quality work, since it means that background data which would enhance the analysis of environmental impacts have been omitted.

Each environmental impact study is specific for the related area and projects.

Although details contained in the description of the environment and the project vary according to the nature of the proposed project and the affected resources, the description always includes aspects of geology, topography, soils, ground and surface water resources, land and aquatic communities, fragile areas, air quality, land use, demography, noise, socioeconomy, infrastructure, transportation, and cultural resources, among others. Elements that explain the environmental impact or that provide a clear idea of the environmental significance of the project are also generally included. The golden rule is to omit unnecessary information and concentrate on relevant background data.

2.2. Prognosis and analysis of environmental impacts

The methodologies for environmental impact assessment of the alternatives should be adequately described in the study.

The prognosis and analysis of significant environmental impacts depend largely on the knowledge of the physical, biological, socioeconomic, and cultural processes that can be affected by the proposed activity. As a way of interpreting impacts, the "no action" alternative can be taken as the baseline situation against which environmental impacts generated are compared. Since the significance of the impacts is a crucial criterion for incorporating them into the prognosis, attention should be given to irreversible impacts or those considered important in the environmental components under study.

Impact identification and quantification are commonly performed through structured methodologies, aimed at extrapolating and characterizing environmental conditions predicted to

take place during the implementation of a project. These range from simple lists for cause-effect analyses to more sophisticated mathematical models. What the different methodologies have in common, however, is their objective, namely to ascertain the significance of potential impacts; they vary according to the elements analyzed.

The environmental impact study identifies, appraises and ranks environmental impacts.

Once the significance of the environmental impacts and their alternatives, if any, has been determined, it is possible to compare and make decisions with regard to the environmental advantages and disadvantages of each option. The environmental comparison between one and another of the alternatives is probably the most difficult aspect to quantify in the process: environmental risks and benefits can be estimated, but it is difficult to express them in economic units. The latter point is important, since environmental assessments are traditionally incorporated into a series of other assessments necessary for the implementation of human activities, such as cost-benefit and engineering feasibility, which can be easily expressed in economic units.

2.3. Mitigation, compensation, and follow-up of significant negative impacts

Although the baseline, prognosis, and quantification of environmental impacts are important in the environmental impact assessment, the following should also be taken into account:

a) Mitigation or design and execution of activities aimed at reducing significant environmental impacts.

b) Compensation, replacement, or substitution of damaged resources or ecosystems by others of similar conditions and importance.

c) Follow-up or set of planned decisions and activities designed to monitor compliance with agreements established in the assessment and to provide specific information on the conditions of environmental and social variables in the area under study and their behavior in time.

d) Control or the series of actions taken by governmental agencies aimed at enforcing environmental regulations and the environmental conditions for approving an activity.

Mitigation, compensation, and follow-up of impacts should be covered in sufficient detail in environmental impact studies.

The basic concept associated with mitigation is that negative environmental impacts can be avoided or reduced with careful modifications in the design of the proposed activities. These impacts are often identified in good time and are assigned the additional protection level they call for. The project design is modified during the planning stage.

Mitigation acquires different forms in environmental impact studies.

Mitigation could include: a) avoiding the impact completely by not going ahead with the activity; b) reducing impacts by limiting the degree or magnitude of the activity and its implementation; c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; and d) reducing or eliminating the impact with conservation and maintenance work.

The reduction of significant negative impacts is achieved by carefully analyzing the different options that are presented throughout the environmental impact assessment, by modifying the selected alternative, and by restoring the impacted elements.

Elimination and mitigation of impacts should be addressed carefully in the environmental impact study.

Compensation means creating environments similar to those affected by the activity or, for instance, considering the donation of land or funds for an environmental program. It must be emphasized that compensation should always be effected with the same environmental currency, i.e., with resources that will make it possible to recompose impacted areas and restore them to their original conditions.

Compensation is an alternative mitigation mechanism.

It is an erroneous practice to grant fellowships or build community facilities in exchange for an activity that deteriorates the local environment or life quality. This does not meet the objectives of protective measures since it does nothing to reduce or eliminate significant environmental impacts produced by human activity.

When a proposed project or activity has been approved, its implementation should be monitored with a follow-up program to ensure that the environment is being protected. Measures can include the periodic presentation of reports on the affected environmental variables or other steps to make sure that the project does not have an adverse impact on environmental quality. Follow-up activities can be executed not only by the pertinent authority or project designer, but also by other agencies of affected sectors; all of them have a role to play in verifying that the agreements are being enforced.

One chapter of the environmental impact study should explain the follow-up program.

The anticipated measures are incorporated into a program (with objectives, resources, schedules, institutions in charge, instruments, etc.) included in both the environmental impact analysis and the formal pronouncement of the authority. Ongoing surveillance throughout the project life-cycle is the mechanism to confirm that the project is effectively complying with the environmental protection policy.

3 CONTENTS OF ENVIRONMENTAL IMPACT STUDIES

The TORs should define the contents of the environmental impact study.

3.1. General

The minimum contents of an environmental impact study are described below so that they will serve as reference for specific cases. The analysis of the different points to be considered or the selection of specific aspects should take place while the terms of reference for each project are being agreed on. The objective here is to provide basic guidelines and the generic aspects that should be included in an environmental impact study, regardless of the specific details that will need to be included for each individual type of project or activity.

TABLE 7-1
GENERIC CONTENTS OF AN ENVIRONMENTAL IMPACT STUDY

- Detailed description of the project, with emphasis on the characteristics or activities that imply risks or cause impacts.
- Determination of environmental impacts
  a) Characteristics of the baseline and other data to be used, including comments on their reliability or deficiency
  b) Impact description (negative, positive, reversible, irreversible, short or long term, etc.)
  c) Identification of measures to reduce or mitigate impacts
  d) Quantification and allocation of resources or economic appraisal of mitigation measures and environmental impacts
  e) Identification of studies to fill information gaps.
- Environmental description in the area of study
  a) Physical environment
  b) Biological environment
  c) Social and cultural features
  d) Others (specify any sampling, map, or special resource required).
- Description of legal and regulatory aspects.
- Description and analysis of alternatives
  a) Description of alternatives
  b) Environmental comparison of alternatives.
- Development of the environmental management plan:
  a) Objectives
  b) Execution requirements
  c) Tasks and schedule
  d) Budget
  e) Responsible entities.
- Development of the follow-up program.
- Identification of institutional requirements regarding the implementation of mitigating and follow-up measures.
- Example of an environmental impact assessment index :
  a) Summary
  b) Political, legal, and institutional framework
  c) Project description and purpose
  d) Environmental description
  e) Analysis of alternatives
  f) Significant environmental impacts
  g) Environmental management plan
  h) Needs for training and environmental management
  i) Follow-up program
  j) Participation of the public and other agencies
  k) Bibliography
  l) Annexes (maps, technical documentation, samplings, methods, etc.).

The generic contents of a study are: project description, baseline, identification and description of impacts, environmental management, and follow-up plan.

3.2 Specific

The project should be described in such a way as to explain potential impacts.

3.2.1 Project description. In this first phase, activities that could have significant environmental impacts during the construction, implementation, operation, and abandonment stages of the project are described. Among others, the following aspects are included:

a) Executive summary.
b) Description of the project and identification of the project designer, type and amount of investment, project stage, technology, objectives and justification, general description of additional works complementary to the project.
c) Legal and administrative framework. The legal and administrative aspects associated with the environmental implications of the project should be specified, especially with regard to complying with standards and obtaining environmental permits.
d) Location. Justification of the geographical and political-administrative location of the project and derived environmental impacts.
e) Scope of the project. The area of influence is established and the land area is described in terms of significant environmental impacts. The size of the project, production volume, number of workers, electricity and water requirements, health care, education, roads, and transportation are also described.
f) Types of inputs and wastes. Raw material used and their volume, energy sources, quantity and quality of solid, liquid or gaseous emissions are described, as well as the waste generation rate and waste disposal and management, resource management plans, volumes and rate of extraction, origins of the inputs, and other relevant aspects for an accurate identification of the environmental impact of the project.

The baseline is the environmental condition prior to the proposed human action.

3.2.2. Background information on the area of influence of the project (baseline). This part should include environmental parameters only insofar as they represent significant environmental impacts.

The baseline takes into account information regarding significant impacts.

a) Description of waste deposits or treatment, current use and value of soil, property division, degree of industrial-residential progress, land-use capacity, topography, protected area category, and basic equipment and infrastructure, among others.
b) Description of location, extension and abundance of fauna or flora, characteristics and representativeness of ecosystems. The quality and fragility of the environments concerned are also analyzed.
c) Description of the physical environment (surface and ground water, air, and soil) with regard to its characteristics (physical and chemical parameters, pollution, etc.) and dynamics.
d) Description of national monuments, areas of aesthetic, historic-archaeological or cultural value, among others.
e) Description of demographic parameters, socioeconomic aspects, quality of life, number of people affected, customs, and cultural features and values, among other variables.

3.2.3. Identification, analysis, and appraisal of impacts. This part of the EIS identifies positive and negative impacts of the different project stages, namely: construction, implementation, operation, and abandonment. In the appraisal of impacts and selection of techniques, the following steps should be taken:

The environmental impact study should explain the methodologies used to review impacts.

a) Analyze the pre-project environmental situation (background or baseline) in comparison with possible environmental transformations.
b) Predict direct and indirect impacts and risks on physical-natural, socioeconomic, cultural, and aesthetic environmental components.
c) Emphasize the relevance of the methodologies with reference to: i) nature of the activities undertaken, ii) environmental variables affected, and iii) area involved.
d) Use representative environmental variables to measure the impacts and justify the scale, resolution level and volume of data, replicability of information, definition of impact thresholds, and identification of critical or unacceptable impacts and positive impacts.
e) Take into account the country's regulations and standards on the topic and geographical area.

3.2.4. Environmental management plan. Once environmental impacts have been identified, analyzed, and quantified, the following aspects are included:

a) Analysis of steps that could be taken with regard to the activities producing adverse impacts.
b) Description of processes, technologies, and actions that have been considered to reduce negative environmental impacts.

An environmental management plan contains:

The plan contains mitigation and compensation measures, risk assessment, contingency measures, and impact follow-up.

a) A program for the mitigation of negative environmental impacts during the construction, operation, and abandonment stages of the project.
b) A compensatory program to reduce negative environmental impacts for which there is no possibility of mitigation.
c) A risk prevention and control program with measures to deal with any accidents that may occur in the infrastructure or inputs during the construction, operation, and abandonment of the project.
d) A contingency program describing the actions to be taken to counteract the risks identified in the previous point.
e) A follow-up, assessment and control program with the necessary background information to verify the evolution of environmental impacts, follow the baseline pattern adequately, review mitigation and compensation actions, and perform audits to adapt the project to the desired environmental condition.

4 CONTENTS OF THE STRATEGIC ENVIRONMENTAL ASSESSMENT

The strategic environmental assessment is applied to situations such as land management, definition of new energy alternatives, watershed management, and colonization programs, among other human activities. Its generic contents are described below.

The strategic environmental assessment is applied to policies, plans, and programs.

4.1. Description of policies, plans, or programs. Identification and description of activities that could have significant environmental impacts once the policy, plan, or program is applied. The following points should be included in the description of the policy, plan, or program:

- General background and planned activities.
- Objective.
- Identification of individual parts and activities.
- Estimated investment, if appropriate.
- Schedule of the different stages.
- Justification of generation and implementation.
- Explanation of how the information was obtained on which the policy, plan, or program design was based.
- Implementation with public or private agencies involved.
- Requirements for adequate application, as well as measures for maintenance and future evolution.
- Specification of legal and administrative aspects associated with the environmental topic of the policy, plan, or program.

The strategic environmental assessment allows to review cumulative impacts and impose environmental conditions for the territory use or implementation of human actions.

4.2. Rationale. This part identifies, among others, the activities that could affect the environmental protection criteria, for example, the generation of atmospheric emissions; noise; odors; vibrations; electromagnetic fields; radiation and energy; discharges of any type of effluent, indicating sites for dumping, final disposal, and treatment; generation of solid wastes, management, transportation, intermediate and final disposal and treatment; movement of materials; vegetation cuttings; and actions aimed at resettling human groups.

Conditions are also identified and established for the implementation of investment projects associated with the application of a policy, plan, or program, for instance, hydroelectric, fuel transportation, real estate projects, etc.

4.3. **Objectives.** The objectives of the policies, plans, or programs should be clearly stated, indicating the beneficiary groups and areas involved. It is also necessary to identify the objectives of the strategic environmental assessment which seeks to reduce, mitigate or compensate possible negative environmental impacts resulting from the implementation of the policy, plan, or program.

The area involved in the strategic environmental assessment depends on impacts expected.

4.4. **Scope, in terms of the activity area.** This point is associated with the identification of the scale of action of policies, plans, or programs and the area involved. Certain aspects need to be considered:

- Political and administrative location at the national, regional, provincial, or community level.
- Geographical area involved in the policy, plan, or program and its area of influence, which depends on the possible environmental impacts.

The selection and comparison of alternatives is important in the strategic environmental assessment.

4.5. **Alternatives.** This point identifies why a given policy, plan, or program has been selected rather than others that could involve different aspects.

4.6. **General baseline.** The general baseline consists of the information on the area that will be environmentally impacted. It varies according to the scale of application of the policy, plan, or program, and the geographical area affected. It includes the environmental parameters that represent significant environmental impacts, as well as the scope of the policy, plan, or program.

4.7. **Identification of environmental impacts.** Significant positive or negative environmental impacts are identified, using methodologies that should be duly justified and described in the report. The identification should:

- Analyze the previous environmental situation (background or baseline) in comparison with the expected environmental transformations.
- Predict direct, indirect, and cumulative impacts and risks on environmental components.

4.8. **Environmental impact assessment.** At this stage, positive and negative impacts derived from the application of the policy, plan, or program should be assessed. The impact assessment and technique selection should:

- Emphasize the relevance of the methodologies with reference to: i) scope of action of the policy, plan, or program, ii) environmental variables affected, and iii) area involved.

- Use representative environmental variables to measure impacts and justify the scale, resolution level and volume of data, replicability of information, definition of impact thresholds, and identification of critical or inadmissible impacts and positive impacts.

- Take into account the country's regulations and standards on the topic and geographical area. If unavailable, other countries' rules or those suggested by international organizations should be used.
- Associate negative environmental impacts with policy, plan, or program activities that cause them, environmental elements that trigger them, and the expected changes.

The formulation of environmental goals is a result of the strategic environmental assessment.

It should be noted that environmental impacts can be appraised using models, simulations, measurements, or mathematical calculations. The environmental conditions with the worst case impact statistics will be considered. When the environmental conditions cannot be quantified, the assessment will be qualitative.

4.9. Definition of environmental goals. The report should define the environmental goals of the policy, plan, or program and an environmental plan detailing the measures to be taken to meet those goals.

4.10. Definition of the environmental plan for goal achievement. The environmental plan facilitates compliance of the proposed environmental goals, mitigation of negative impacts, enhancement of positive impacts, citizen participation throughout the process, and follow-up of proposed actions.

Therefore, once the environmental impacts resulting from the application of the policy, plan, or program have been identified, analyzed, and quantified, the following aspects are considered:

The SEA considers positive and negative environmental impacts.

- Analysis of possible measures for activities that generate undesirable impacts.
- Description of processes to reduce negative environmental impacts.
- Implementation of environmental follow-up and control systems whose objective is to adequately follow the evolution of the baseline and of the actions contained in the strategic environmental assessment.
- Description of the program of activities designed to ensure the participation of the organized community.

5 METHODOLOGICAL GUIDELINES FOR THE STUDY IMPLEMENTATION

One way to support the preparation of environmental impact studies and improve their contents is by publishing methodological guidelines, which become important tools for these purposes. They are important mainly because they provide guidance and baseline information, which are useful for the preparation of studies.

Methodological guidelines facilitate the preparation of environmental impact studies.

The publication of methodological guidelines can be qualified as a timely action since they provide advice on the contents and methods to be used in the environmental impact study. In the technical area, they are important, since to date there are only a limited number of publications or specific studies available, and even these are difficult to access.

Methodological guidelines reflect the experience acquired in environmental impact studies.

Methodological guidelines on environmental impact assessment attempt to homogenize and synthesize the knowledge and experience gained on different human activities. In addition, they make background information available to public institutions, technicians, professionals, and the population at large in its participation and awareness raising role.

Methodological guidelines are not recipes for preparing an EIA. They merely orient the executors.

The usefulness of methodological guidelines materializes in a series of monographs referring to different human activities. Available guidelines refer to roads and railways, dams, thermal plants, strip mining, toxic waste treatment facilities, airports, chemical plants, reforestation, among others. They seek to cover the growing demand for guideline documents to address the task of assessing different activities environmentally.

Guideline contents are structured according to the logical process of preparation of an environmental impact study. The generic document includes the casuistry arising from the relationship between the project and the affected environment. At the same time, it is an aid for those who try to study and solve problems derived from that relationship. Guidelines do not establish rigid rules or principles that can be used as molds to prepare environmental impact studies, but offer a series of general criteria and guidance that can be used and compared with the specific studies.

Methodological guidelines seek to save costs, time, and money and to make sure that the environmental impact studies are properly focused.

CHAPTER VIII

Environmental Impact Assessment Methodologies

*This chapter is based on the text “Manual de evaluación de impacto ambiental”. (CONAMA,1994).

1 BASIC ASPECTS

1.1. Background

The methodologies used to assess environmental impacts can be associated with: a) relations between land elements and human activity; b) specific measurements and information necessary to estimate impacts; and c) mitigation, compensation, and follow-up measures. These background data contribute to an accurate identification, prediction, and interpretation of impacts on different environmental components.

Information can be obtained by measuring the capacity and impact on the environment. Capacity is the natural condition of a land area to absorb pressures without damage and is related to aspects, such as altitude to repopulate a specific forest species or a lithologic type to resist soil erosion.

The capacity of a territory is its natural condition to absorb environmental pressures.

Capacity also refers to the loading capacity, which can mean, for example, the number of organisms of a given species that can live in an ecosystem without deteriorating it or the maximum number of animals that can survive the most unfavorable annual period in an area.

The loading capacity is a good example of the environmental capacity of a territory.

On the other hand, the impact analysis leads to the concept of alteration. A forest repopulation that modifies the landscape and an urbanization that affects local fauna are examples of impacts. Thus, it is necessary to predict and study the environmental implications of possible activities, which may be positive or negative.

Considered as a whole, positive or negative impacts determine the development of a human activity in a given land area.

A negative environmental impact juxtaposes the concepts of fragility, singularity, and rarity with the technical aspects analyzed in capacity studies. On the other hand, a positive impact enhances the environment's capacity to support activities derived from favorable actions and processes of human activities.

The impact is related to the fragility of the territory affected by human actions.

1.2. Characteristics of environmental impacts

An environmental impact is a significant alteration of the land's vulnerability due to human activity. The impact can be multiple, for example, one given land area can present risk of erosion whereas aquifer pollution may not be under risk. This diversity should always be revealed in the environmental impact assessment. An environmental alteration, corresponding to either the vulnerability or fragility of the land area, can have the following characteristics:

Impacts are described according to their nature, magnitude, significance, duration, etc.

The significance of the impact depends on the relative importance or quality of the affected environment.

Reversibility means the environment's returning to its previous condition with or without the help of human action.

The area of influence is the space affected by the environmental impacts.

a) The beneficial or detrimental character of the impact with regard to the situation prior to the action.
b) The magnitude represented by extension, quantity, and intensity of the impact. For instance, it answers questions such as: how many hectares are affected?, how many species are threatened?, what is the volume of pollutants or percentage above the standard limit, etc.?
c) The significance of the impact and its relative importance (impact quality). For example, ecological importance of eliminated species, intensity of effluent toxicity or environmental value of a land area.
d) The type of impact, i.e., direct, indirect or synergistic (the latter accumulates and increases with the presence of several impacts, which end up exceeding the sum of the individual impacts).
e) The duration of the impact refers to the behavior of predicted environmental impacts in time: whether it is short-term and then stops; whether it appears rapidly; if it is long-term or intermittent, etc.
f) The reversibility of the impact, which considers the possibility, difficulty, or impossibility of returning to the situation previous to the action or project. There are reversible, terminal, and irreversible impacts.
g) The impact risk and its probability of occurrence.
h) The spatial area or area of influence, the land area receiving the environmental impact, which does not necessarily coincide with the location of the proposed action. It informs about the dilution of the impact intensity, which is not lineal to the distance from the source that induces it; when environmental characteristics are more sensible, the impact severity will increase (the example of toxic accumulation in ravines with impermeable soils is relevant).

Environmental impacts, individualized according to the previous characteristics, can be classified as shown in **Table 8-1**.

TABLE 8-1. CLASSIFICATION OF ENVIRONMENTAL IMPACTS	
Classification criteria	**Types of impact**
Character	Positive impact: it represents environmental benefits; e.g. sanitation or recovery of degraded areas. Negative impact: it causes harm or deterioration to a component or global environment.
Cause– effect relation	Primary impact: it is usually produced at the same time and place and often associated with the construction, operation, and maintenance of a facility or activity. They are obvious and quantifiable. Secondary impact: it is an indirect or induced change that could occur subsequently or in different places as a result of the implementation of an action.
Time of occurrence	Latent impact: it occurs some time after the beginning of the activity that caused the impact. Immediate impact: it is manifested at the beginning of the proposed activity. Critical time: period during which the highest degree of impact takes place.
Interrelationship of actions with alterations	Simple impact: it is manifested on a single environmental component, without inducing new alterations, accumulation, or synergy. Cumulative impact: it results from past, present, and reasonably expected future actions.
Extension	Specific impact: it produces a localized alteration. Partial impact: it implies an appreciable incidence in the area under study. Extreme impact: it is identified in a large part of the land area. Total impact: it is present throughout the environment under study.
Persistence	Temporary impact: it implies a non-permanent alteration and is usually brief. Permanent impact: it entails an indefinite alteration.

Impacts should be classified in clearly differentiated categories.

TABLE 8-1. CLASSIFICATION OF ENVIRONMENTAL IMPACTS (CONTINUED)

Classification criteria	Types of impact
Recovery capacity of the environment	Irrecoverable impact: it impedes environmental recovery. Irreversible impact: those that make it impossible or extremely difficult for the environment to revert to its original condition. Reversible impacts: those that allow a measurable recovery of the environment in the short, medium, or long term due to natural processes. Fugitive impacts: those that allow immediate recovery once the activity is over, and do not require mitigation practices.

Source: **Jure, J. and S. Rodríguez, 1997**. Aplicabilidad del sistema de evaluación del impacto ambiental a los planos reguladores comunales. Dissertation to obtain the degree of Engineer in environmental management. Instituto Profesional INACAP (modified).

When impacts are characterized, some collateral circumstances should be considered to explain the patterns of certain phenomena, since they act as amplifiers on other environmental elements. For example, some environmental elements are not vulnerable to certain impacts, such as altitude or other physiographic parameters. This is particularly important in the case of landscapes where a visual impact will have greater or smaller degree of severity depending on the surface from which it can be seen and the place where it is produced; constructing a building on a mountain summit is always more striking than building on a slope.

Effect is any change in the environment. Impact is a significant alteration.

The difference between effect (any environmental change) and impact (significant alteration of the environment) is important.

The impact's significance can also be linked to its reversibility. The need for qualifying irreversible deterioration, resource depletion, and the beginning of accelerating negative processes has led to the definition and use of the term impact threshold. The threshold marks the limit after which the impact is considered inadmissible and the activity would be rejected.

Impact thresholds define the criteria or limits of acceptability.

The above circumstances and characteristics define the degree of severity or benefit derived from human activity in a land area. An accurate environmental impact assessment is expressed through a scale of impact levels, which facilitates decision-making. There are different ways of defining and qualifying impacts. An example of levels that can be used is:

Impacts should be classified in clearly differentiated categories.

a) Compatible impact. Lack of impact or immediate recovery once the activity has ceased. Mitigating practices are not required.
b) Moderate impact. The recovery of initial conditions requires some time. Simple mitigating practices are needed.

c) Severe impact. The magnitude of the impact calls for specific mitigating practices in order to recover the original condition and an extensive period will be needed.
d) Critical impact. The magnitude of the impact goes beyond the acceptable threshold. A permanent loss of environmental quality occurs without possibility of recovery, even if mitigating and compensatory measures are taken.

Tables 8-2 and **8-3** show some examples of impact appraisal and classification methods. Note that different criteria and values are applied for each variable. It should be emphasized that the environmental impact assessment is by no means easy, because of the lack of universally accepted methodologies. Therefore, it is important to specify the procedures and scope of the technique used in each case.

Appraisal and classification methods should be selected case by case.

TABLE 8-2. ENVIRONMENTAL IMPACT APPRAISAL

CRITERIA USED

Character (positive, negative, or neutral; the latter is the one below the acceptable threshold according to environmental regulations).

Level of disturbance in the environment (significant, regular, or limited).

Importance from the point of view of natural resources and environmental quality (high, medium, and low).

Risk of occurrence (very probable, probable, unlikely).

Extension of the area or land involved (regional, local, specific).

Duration (permanent throughout the project, average or during the project operation, and short or during the project construction stage).

Reversibility to return to initial conditions (reversible if human assistance is not required, partial if human assistance is required, and irreversible if a new environmental condition needs to be generated).

IMPACT CLASSIFICATION

Character (C)	Positive$^{(1)}$	Negative$^{(-1)}$	Neutral$^{(0)}$
Disturbance (D)	Important$^{(3)}$	Regular$^{(2)}$	Limited$^{(1)}$
Significance (S)	High$^{(3)}$	Medium$^{(2)}$	Low$^{(1)}$
Occurrence (O)	Very probable$^{(3)}$	Probable$^{(2)}$	Unlikely$^{(1)}$
Extension (E)	Regional$^{(3)}$	Local$^{(2)}$	Specific$^{(1)}$
Duration (D)	Permanent$^{(3)}$	Average$^{(2)}$	Short$^{(1)}$
Reversibility (R)	Irreversible$^{(3)}$	Partial$^{(2)}$	Reversible$^{(1)}$
TOTAL	**18**	**12**	**6**

TABLE 8-2. ENVIRONMENTAL IMPACT APPRAISAL (CONTINUED)

IMPACT APPRAISAL Total impact = C X (D + S + O + E + D + R)	
Negative (-)	
Severe	**≥ (-) 15**
Moderate	**(-) 15 ≥ (-) 9**
Compatible	**≤ (-) 9**
Positive (+)	
High	**≥ (+) 15**
Medium	**(+) 15 ≥ (+) 9**
Low	**≤ (+) 9**

Source: prepared by the author

TABLE 8-3. APPRAISAL OF AN IMPACT SIGNIFICANCE

1. SIGN	Beneficial	+
	Detrimental	-
	Predictable but difficult to qualify without detailed studies	x
2. INTENSITY: Qualitative scoring	Low	1
	Average	2
	High	3
3. EXTENSION	Specific	1
	Partial	2
	Extensive (the whole area)	3
4. TIME OF OCCURRENCE	Immediate	3
	Medium term	2
	Long term	1
5. PERSISTENCE	Temporary	1
	Permanent	3
6. REVERSIBILITY OF THE EFFECT	Impossible	4
	Long term	3
	Medium term	2
	Short term	1

TABLE 8-3. APPRAISAL OF AN IMPACT SIGNIFICANCE (CONTINUED)

7. POSSIBILITY OF INTRODUCING MITIGATION MEASURES	In project	P
	In works	W
	In operation	O
	Not possible	N

IMPACT SIGNIFICANCE
3 (intensity value) + 2 (extension value) + occurrence value + reversibility value

Source: Gómez Orea, 1994, modified.

1.3. Methodology selection

Methodologies and techniques to assess environmental impacts are designed to measure direct impacts as well as cumulative impacts and potential risks. The impact analysis includes socioeconomic, cultural, historic, ecological, physical, chemical, and visual variables in so far as they are generated in a land area affected by the activity and represent priority environmental alterations derived from human activities.

Any method of reviewing impacts should distinguish natural variations from modifications caused by human activity.

The first criterion in selecting the methodologies and techniques is to determine the need to measure the capacity of an environmental variable or the impact it generates. The second criterion is related to behavior in time. Nature is considered as a state of balance occasionally disturbed by natural or induced events. This perception is due probably to ecological changes occurring in temporary scales higher than human ones. This adds another complication to the use of techniques and methods, since environmental disturbances caused by a project and its environmental effects should be compared not only with the initial situation, prior to the action, but also with possible system conditions in accordance with the natural dynamics of change.

Methods for measuring specific variables are wide and recognized by several disciplines.

To obtain the information required in environmental assessments, the use of measurement methodologies and techniques is important, as they make it possible to adequately predict, identify, and interpret impacts on different environmental components.

The measurement of specific environmental variables implies selecting the methods and techniques most suited to the affected environment, the type of activity to be undertaken, resources available, and quality of information, among other aspects.

Methods to assess impacts arise from the Leopold matrix.

The boom of measurement methods began at the end of the 1960s. The classical procedure of the Leopold matrix for the identification, analysis, and assessment of environmental impacts was published in 1971. Since then, several methodological tools have been developed. The key point is the measurement of qualitative aspects. The appraisal of an area where endangered animal or plant species subsist or any modifications in the trophic chain, are problems that can often be solved only through the qualification of variables.

One of the difficulties in all methods is the impact appraisal, since variables of different origin and scope are compared.

The use of methods to identify environmental modifications is a relatively easy task compared to the qualification of those modifications. Although all aspects and parameters can be measured, it is difficult to appraise them. It is one thing to know that the freon organochlorine gas of aerosols destroys the ozone in the stratosphere and to proceed to measure its reduction rate, but it is quite another thing to measure the significance and the impacts triggered by this destruction.

Despite these difficulties some methods are widely used, even though their real usefulness is still under discussion and attempts are made to improve their scope (for example, the Leopold matrix). Environmental impact assessment methodologies refer to approaches developed to identify, predict, and appraise the alterations of an action. The assessment consists in recognizing what physical, chemical, biological, socioeconomic, cultural, and landscape variables or processes can be significantly affected. It should be noted that an undetected or underestimated impact will make any analysis unsatisfactory, however sophisticated the methodology used.

Methods combine qualitative and quantitative elements under specific parameters of application.

The measurement can be quantitative or qualitative; both are equally important, even though they require specific criteria for their proper definition. Prediction implies selecting impacts that could effectively occur and are important because of their behavior. It is important to compare them with indicators of the desired environmental quality. **Table 8-4** lists some examples of methods for identifying impacts (Leal, 1997).

TABLE 8-4. ENVIRONMENTAL IMPACT ASSESSMENT METHODS

a) Meetings of experts. This method is useful when the impact to be studied is specific and limited. If it is not so, neither speed nor thoroughness can be demanded because of interdisciplinary conflicts. The Delphi method has been very useful.

b) Checklists. Detailed lists to identify impacts rapidly. There are merely indicative lists and quantitative lists that use standards to define the main impacts (for example, air pollution according to number of households).

c) Simple cause-effect matrices. They are limited matrices that relate the affected environmental variable with the human activity that induces it.

d) Graphs and flow charts. They seek to determine chains of primary and secondary impacts with existing interactions and are used to define the types of impacts expected.

e) Environmental cartography or map overlay. Set of maps that represent the main environmental characteristics. For instance, synthesis maps define soil capacities for different uses, protection levels, and constraints on development in each area.

f) Networks. Expanded flow charts with primary, secondary, and tertiary impacts.

g) Geographic information systems. Computer programs that do not identify impacts, but rather attempt to assess their importance.

h) Matrices. Double-input tables with environmental characteristics and expected activities of the project. The corresponding impact is identified by intersecting each row with each column. The Leopold matrix is a good example. In more complex matrices, sequences between primary and secondary effects can be deduced.

There are different methods for analyzing environmental capacity and environmental impacts. In fact, there are so many that the selection of the method is crucial to the success of the assessment. It is not advisable to use a unique (single) formula due to the limited time perspective and the great complexity of interactions; even more, a rule of this type should never be defined within the scope of environmental sciences (**see Table 8-5**).

The selection of an assessment method can define the quality of an environmental impact study.

TABLE 8-5. SYNOPSIS OF ASSESSMENT METHODS VS. ENVIRONMENTAL IMPACT ASSESSMENT ACTIVITIES

EIA methods	Scoping	Impact identification	Description of affected environment	Impact prediction	Impact assessment	Decision-making	Communication of results
Analogous (case study)	x	x		x	x		
Checklists (simple, descriptive)		x	x				x
Checklists focused on decision					x	x	x
Environmental cost-benefit analysis				x	x	x	
Expert opinion		x		x	x		
Expert systems	x	x	x	x	x	x	
Indices or indicators	x		x	x	x		x
Laboratory tests and scale models		x		x			
Landscape assessment			x	x	x		
Literature review		x		x	x		
Mass balance (inventories)				x	x		x
Matrices	x	x		x	x	x	x
Follow-up (baseline)			x		x		
Follow-up (field study of receptors close to analogous cases)				x	x		
Networks		x	x	x			
Map overlays with GIS			x	x	x		x
Photography montage			x	x			x
Quantitative modeling (conceptual)			x	x			
Quantitative modeling			x	x			
Risk assessment	x	x	x	x	x		
Scenario building				x		x	
Trend extrapolation			x	x			

X = Direct use potential for the activity
Source: (Canter 1998)

Checklists allow us to identify impacts.

2 DESCRIPTION OF SPECIFIC METHODOLOGIES

2.1. Checklist

The checklist is a complete, coherent list of environmental factors potentially affected by human activity. Its main goal is to identify the possible consequences of a proposed activity and ensure that no relevant alteration is omitted during the first stage of the environmental impact assessment.

The checklist should identify impacts on:

soil (land uses, unique physical characteristics, etc.)
water (quality, flow alteration, etc.)
atmosphere (air quality, temperature variation, etc.)
flora (endangered species, deforestation, etc.)
fauna (rare species, endangered species, etc.)
resources (natural landscapes, swamps, etc.)
recreation (loss of fishing, camp sites, countryside walks, etc.)
cultural aspects (indigenous communities, changes of habits, etc.).

The following types of lists are considered:

Simple lists ensure that all aspects are considered.

- **Simple lists** that contain a list of environmental factors with impact or a list of characteristics of impact-producing activities or both, and serve as an aide-memoire. They ensure that a particular factor is not omitted in the analysis. Table **8-6** shows a simulated example for a mining waste reservoir.

Descriptive lists not only identify, but also analyze impact mitigation and characteristics of the impacts.

- **Descriptive lists** that guide the assessment of impacted environmental parameters. For instance, they suggest possible mitigating measures, bases for a technical estimate of the impact, bibliographic references, or data on the affected groups.

TABLE 8-6. EXAMPLE OF A CHECKLIST TO IDENTIFY ENVIRONMENTAL IMPACTS ON MINING WASTE ACCUMULATION AREAS

IMPACTS GENERATED	PROJECT STAGE			
	DESIGN	CONSTRUCTION	OPERATION	ABANDONMENT
1. Water				
1.1. Pollution				X
1.2. Flow reduction			X	
1.3. Change of use		X		
2. Air				
2.1. Pollution				X
2.2. Increased noise		X		
2.3. Presence of bad odors				X
3. Climate				
3.1. Temperature change			X	
3.2. Increased rainfall			X	
3.3. Increased evaporation			X	
3.4. Increased cloudiness			X	
4. Soil				
4.1. Soil loss		X		
4.2. Dunes				X
4.3. Acidification		X		
4.4. Salination		X		
4.5. Swamp formation		X		
4.6. Drainage problems		X		
5. **Vegetation and fauna**				
5.1. Loss of biodiversity		X		
5.2. Extinction of species		X		
5.3. Effects on endemic species		X		
5.4. Effects on protected species		X		
6. Population				
6.1. Loss of resources				X
6.2. Cultural alterations				X
6.3. Loss of archaeological sites		X		
6.4. Population transfer		X		
7. Others				
7.1. Loss of landscape		X		X

Graded lists establish criteria to review several environmental elements.

- **Graded lists**. **Table 8-7** shows a graded list for a forestry development project. Criteria are established to assess a set of environmental elements. Their minimum acceptable values (MAV) as specified in the environmental quality standards and criteria are compared, as well as value variations (VV), for three project alternatives: without action (WA), average investment (AI) and major investment (MI). The negative environmental impact (NEI), if any, is indicated for each case. Since this is an illustrative case, criteria units should be adapted to each case.

Questionnaires are based on systematic questions.

- **Questionnaires.** Set of systematic questions on generic environmental categories. There are usually three answers (yes, no, don't know) with regard to the specific impact. The questionnaire enables us to find out how much information is available on the impact. The answers can provide a qualitative idea of the relative importance of a given impact, be it negative or positive. The environmental analysis of a project is a systematic procedure of questions and answers with the addition of quantitative and qualitative information if necessary (**Table 8-8**).

Checklists allow us to identify impacts and compare alternatives.

TABLE 8-7. GRADED LIST OF IMPACTS OF A FORESTRY DEVELOPMENT PROJECT

Element	Indicator	MAV (acceptability criterion)	WA		AI		MI	
		Units	VV	NEI	VV	NEI	VV	NEI
Air quality	Standard	3	4	YES	4	YES	4	YES
Recreation	Camp sites	5,000 sites	2,800	YES	5,000	NO	6,000	NO
	Winter sports	1 million visitors	700,000	YES	1 million	NO	2 million	NO
Threatened species	Kingfisher	35 pairs	50	NO	35	NO	20	YES
Water quality	Standard	3 ppm	3	NO	3	NO	4	YES
Wildlife	Deer	25% less	10%	NO	10%	NO	30%	YES
Economy	Cost: Benefit	1:1	3:1	NO	4:1	NO	4.5:1	NO
Employment	Jobs	Current number	9,000	NO	9,500	NO	10,000	NO

Source: CONAMA, 1994, modified.

Checklists are useful because: a) they structure the initial stages of an environmental impact assessment, b) they help define significant impacts, c) they ensure that no essential factor is omitted from the analysis, and d) they compare different project alternatives.

TABLE 8-8. PARTIAL LIST- QUESTIONNAIRE ON IMPACTS FOR A FORESTRY DEVELOPMENT PROJECT

Is there any terrestrial ecosystem similar to those indicated below that could be classified as significant or unique due to its size, abundance, or type?

Forest	YES x	NO ___	DON'T KNOW ___
Plain	YES ___	NO x	DON'T KNOW ___
Steppes	YES ___	NO x	DON'T KNOW ___
Desert	YES ___	NO x	DON'T KNOW ___

How would you qualify these ecosystems?

Pristine	YES x	NO ___	DON'T KNOW ___
Moderately degraded	YES ___	NO x	DON'T KNOW ___
Severely degraded	YES ___	NO x	DON'T KNOW ___

TABLE 8-8. PARTIAL LIST- QUESTIONNAIRE ON IMPACTS FOR A FORESTRY DEVELOPMENT PROJECT (CONTINUED)

Is there a tendency to alter those ecosystems by cutting, burning, etc., in order to transform soil for agricultural, industrial, urban use, etc.?

YES ___NO ___ DON'T KNOW _x_

Does the population use those ecosystems for its benefit? For example in:

Feeding	YES _x_	NO ___	DON'T KNOW ___
Medicinal plants	YES ___	NO _x_	DON'T KNOW __
Wood	YES ___	NO ___	DON'T KNOW _x_
Fibers	YES ___	NO ___	DON'T KNOW _x_
Skins	YES ___	NO _x_	DON'T KNOW ___
Food for animals	YES _x_	NO ___	DON'T KNOW ___

To what extent will the project need to clean or alter the soil of this ecosystem?

A small area	YES ___	NO ___	DON'T KNOW _x_
A medium area	YES ___	NO ___	DON'T KNOW _x_
A large area	YES ___	NO ___	DON'T KNOW _x_

Does the project use raw material from those ecosystems?

YES _x_ NO ___ DON'T KNOW___

Some deficiencies or limitations of questionnaires are: a) they are rigid, static, one-dimensional, linear, and limited to individual impact assessment; b) they do not identify indirect impacts, likelihood of occurrence, or risks associated with the impacts; c) they give no indications regarding the spatial location of the impact; and d) they do not rank the relative priority of the impacts.

2.2. Flow charts

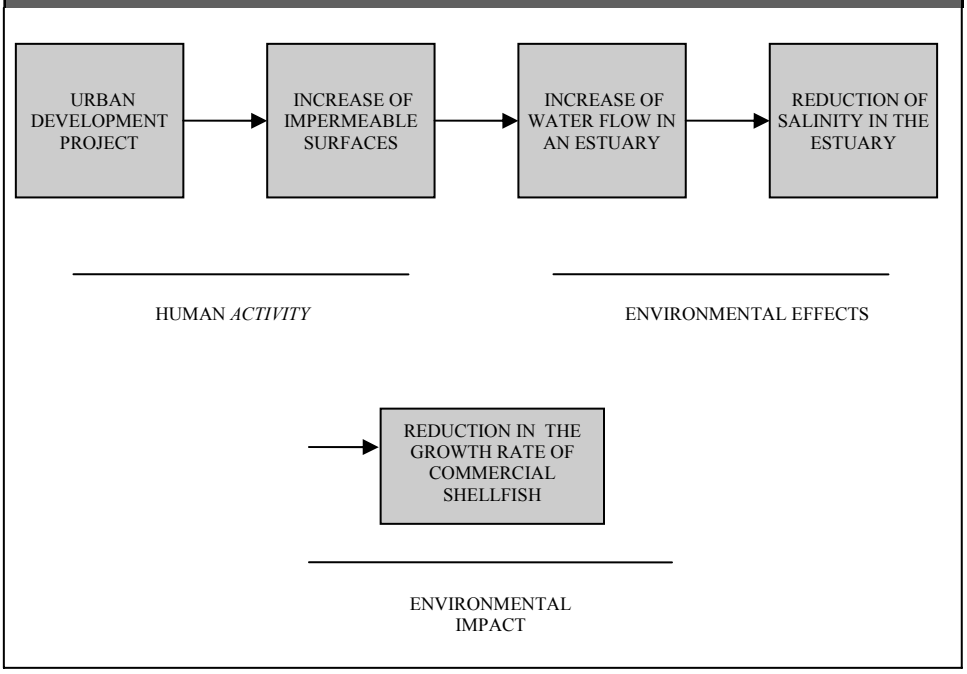
Flow charts allow us to identify indirect impacts.

Flow charts are used to establish causal relationships, usually linear, between the proposed action and the affected environment. They are also used to discuss indirect impacts. Their application is complex when there are multiple activities and environmental impacts involved. The use of flow charts has therefore been restricted, but they are useful when impacts are relatively simple.

Charts establish cause-effect relationships.

They have the advantages of being quite easy to create and of providing a cause-effect relationship that can be useful. However, they do not facilitate impact quantification, but merely show linear cause-effect relationships. As an environmental impact assessment methodology, flow charts are strictly complementary with matrices and other alternatives. (See **Figure 8-1**).

FIGURE 8-1. FLOW CHART FOR THE IDENTIFICATION OF IMPACTS IN AN URBAN DEVELOPMENT PROJECT



2.3. Networks

Networks identify indirect and cumulative impacts.

Networks are an extension of flow charts to incorporate long-term impacts. Environmental components are usually interconnected and form webs or networks, and it is often necessary to identify secondary and tertiary impacts. The impact-causing conditions in a network are determined based on lists of project activities.

A network should rank primary, secondary, and tertiary impacts hierarchically to obtain their corresponding interactions (**Table 8-9**).

Networks are useful for establishing interactions.

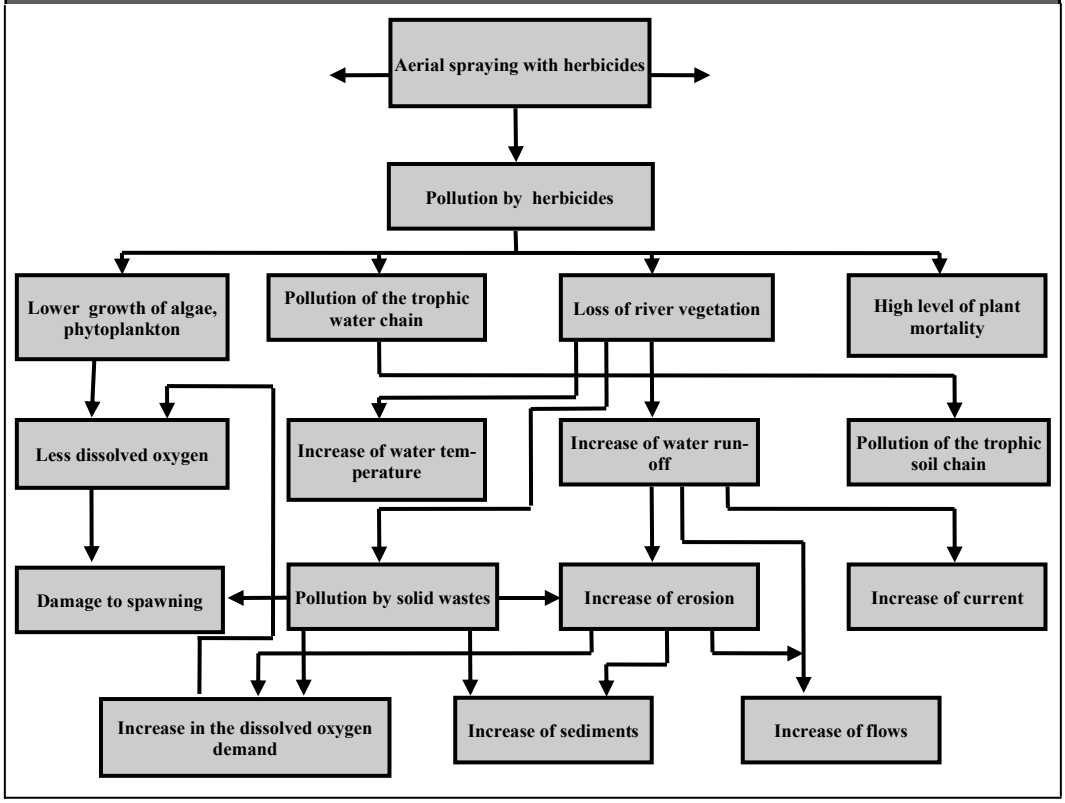
Networks are useful to detect indirect or secondary impacts; in complex projects or projects with many components, they can prove useful in identifying mutual interactions. They also provide helpful summaries of the global impacts of a project (**Figure 8-2**).

Their main disadvantage is that they do not provide criteria to decide whether a specific impact is significant or not and when the network is crowded it may be difficult to interpret the information.

TABLE 8-9. IDENTIFICATION OF IMPACTS USING NETWORKS

Primary impacts	Secondary impacts	Tertiary impacts
1. Deforestation of slopes	1.1. Soil loss	1.1.1. Silting up of channels (sedimentation)
		1.1.2. Port embankment
	1.2. Increased water runoff	1.2.1. Flooding of river sites
		1.2.2. Lack of water during droughts
2. Reduction of ecological flow	2.1. Lack of drinking water	2.1.1. Agricultural losses
		2.1.2. Loss of drinking water quality
	2.2. Loss of habitat	2.2.1. Reduction in fish population
		2.2.2. Reduction in biodiversity
3. Air pollution by particles	3.1. Loss of landscaping	3.1.1. Discontent due to environmental quality
		3.1.2. ----------
	3.2. Respiratory diseases	3.2.1. Labor absenteeism
		3.2.2. Increased medical costs

FIGURE 8-2. EXAMPLE OF NETWORK OF IMPACTS CAUSED BY THE SPRAYING OF HERBICIDES FROM THE AIR



2.4. Panel of experts

The expert panel is based on the experience and judgment of an expert group.

This ad-hoc method is not a guide for an environmental impact assessment. Rather, it is a systemized consultation with specialists familiar with a project or related topics. This methodology depends on the type of experts available and helps to: a) identify a range of impacts rather than defining specific parameters for future aspects, b) determine mitigation measures and c) implement follow-up and control procedures. Its advantage lies in the lack of formality and the ease with which the assessment can be adapted to the specific circumstances of an action. Although it depends on background, experience, and the availability of the team of specialists, it is fast and easy to conduct with minimum effort. On the other hand, ad-hoc teams will have to be formed for each different type of project, and no panel can be exhaustive.

Representativeness is a constraint for the expert panel.

One of the problems is to form a representative team of experts for the analyzed topics.

Expert panels deal with specific environmental problems.

Expert computer systems for data processing and decision support are currently used. They are actually man-machine interaction systems that solve problems in a specific domain. Expert systems are geared to problems rather than methodologies. **Tables 8-10** and **8-11** show the kind of outputs produced by a panel of experts.

TABLE 8-10. DEFINITION OF KEY IMPACTS

Key impact	Reasons
1. Reduction of irrigation water	1.1. Farmers are affected
	1.2. Agricultural production drops
	1.3. It limits crop diversity, especially in permanent crops
2. Loss of water quality	2.1. Water flow pollution
	2.2. Water treatment becomes mandatory
	2.3. Potential transmission of diseases through certain crops
3. Loss of fish habitats	3.1. Flow alteration limits the habitat
	3.2. Reduced number of fish
	3.3. Reduced diversity of fish

TABLE 8-11. IDENTIFICATION OF ENVIRONMENTAL CONCERNS AND VARIABLES TO ESTIMATE IMPACTS	
IMPACTS	**ENVIRONMENTAL VARIABLES**
1. Reduction of irrigation water	1.1. Maximum, average, and minimum flows 1.2. Surface covered by effective irrigation 1.3. Loss of crops due to lack of irrigation
2. Loss of water quality	2.1. Organic concentration 2.2. Heavy metal concentration 2.3. Total loads of each pollutant
3. Loss of fish habitats	3.1. Percentage of flow lost with regard to ecological flow 3.2. Number of fish sightings 3.3. Comparison of fish diversity with and without impact

2.5. Environmental cartography

Transparency overlapping is a common EIA method.

Graphic methods have been used in several categories of environmental analysis, particularly in spatial projection. The most frequent procedure is to overlap transparencies with different maps to show individual impacts on a given land area and estimate the global impact. Maps can identify, predict, and assign a relative value to each impact. Map overlay allows to compress the set of impacts established independently, relate them with different characteristics (such as physical, land area, and socioeconomic aspects of the population in that area) and thus establish a global impact. To prepare the maps, aerial photographs, topographical maps, field observations, expert and stakeholder opinions, etc. are taken into account. The maps must have the same scale and a suitable level of resolution for the topic under analysis.

Map overlay assumes the same work scales and similar level of resolution for the information used.

The procedure most used is slide overlay. An example is given in **Figure 8-3.**

GISs are modern versions of map overlay.

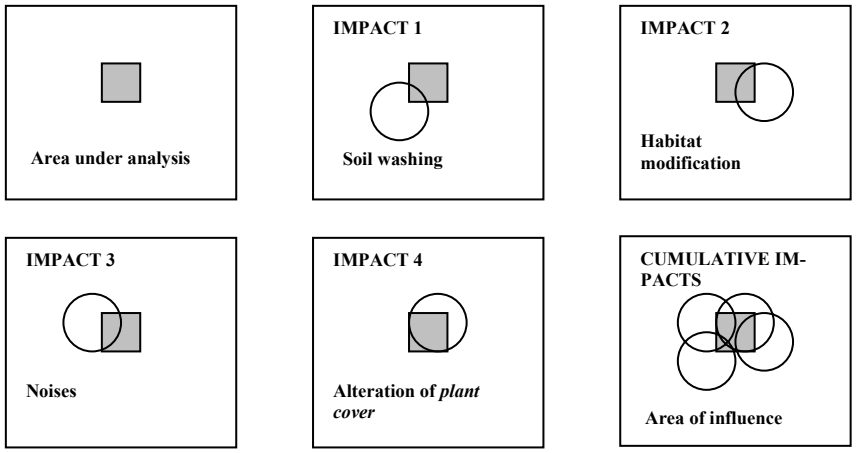
Some software packages that have been developed in this area have considerably increased the applicability and efficiency of these maps. They have also been applied as complements of lists and matrices.

Cartography reflects the special behavior of impacts.

They are useful in the case of spatial variations that cannot be identified with matrices. They are important when localized environmental impacts are related with health indicators or spatially differentiated socioeconomic characteristics. They also serve in the assessment of alternate linear choices, such as pipelines, roads, and transmission lines.

Their greatest constraint derives precisely from their advantage, i.e. the fact that they consider only limited impacts expressed in spatial coordinates. Probability, dynamics, and reversibility are missing. Impact scope limits are usually unclear and many variables can not be overlapped.

FIGURE 8-3. EXAMPLE OF CARTOGRAPHIC OVERLAPPING



2.6. Cause-effect matrices

Cause-effect matrices relate environmental impacts with project actions.

Matrices may be used with several technical and ecological data, but there must be familiarity with the area affected by the project and with the nature of the project. Specialists, personnel, authorities responsible for environmental protection within the sanitary, agricultural, natural resources, and environmental quality scope, and the public involved must be consulted, since they can help identify possible impacts rapidly.

Matrices distinguish the origin of environmental impacts.

Cause-effect matrices consist of a list of human activities and another list of environmental impact indicators related in one matrix. They are useful in identifying the origin of certain impacts, but have limitations when it comes to establishing interactions, defining secondary or tertiary impacts, and conducting temporal or spatial actions. (**Table 8-12**).

TABLE 8-12. EXAMPLE OF A CAUSE-EFFECT MATRIX WITH IDENTIFICATION AND APPRAISAL OF ENVIRONMENTAL IMPACTS

Environmental impact / Project actions		Design	Construction	Operation	Abandonment
Air	Quality	A	A	U	A
	Noise	A	A	A	A
Water	Quality	A	A	A	U
	Quantity	A	U	A	A
Soil	Erosion	A	U	C	A
	Productivity	A	U	C	A
Flora	Abundance	A	U	C	A
	Representativeness	A	U	C	C
Fauna	Abundance	A	U	U	A
	Representativeness	A	U	U	A
Landscape	Beauty	A	U	A	U
	Visual	A	U	A	A
Population	Relocation	A	C	C	C
	Habits	A	C	C	C
Others	Ecosystems	A	A	A	C

Impact qualification: Unacceptable: U, critical: C, acceptable: A

There are several types of interaction matrices available.

Several different types of interaction matrices have been developed. The early ones were static blocks, but now they can adapt to specific problems, to characteristics of certain environments, or to the possibilities of applying them when information is insufficient.

The following are the two types of matrices most frequently used in environmental impact studies:

a) **The Leopold Matrix** developed in the seventies by Dr. Luna Leopold and colleagues for construction projects; it is especially useful when large environmental impacts are expected. This matrix identifies impacts and their origin, without giving them a value. However, it enables us to estimate the importance and magnitude of an impact with the assistance of a group of experts and other professionals involved in the project. In this respect, it represents progress over the simple interaction matrices.

The Leopold matrix is one of the most frequently used models.

The Leopold matrix consists of 100 activities that can cause environmental impacts and 88 environmental characteristics, resulting in a matrix of 8,800 cells. In each cell, the impact magnitude and importance are distinguished on a scale from one to ten. Impact magnitude refers to the physical quantity; whether it is large or small will depend on the comparison pattern, and it can be positive or negative, depending on whether the modification identified is desirable or not. Importance only receives positive values through a weighting and can differ a great deal from magnitude. In the case of a pollutant, for example, that strongly degrades a water flow in a remote region, without valuable fauna or human settlements, the incidence can be small. In other words, it has high magnitude but low importance.

The Leopold matrix must be adapted to each case.

An example is given in the following chart:

		Environmental characteristics				
		A	B	C	D	E
Actions	A		7/9			
	B				9/5	

The matrix has a total of 17,600 numbers to be interpreted. Because of the difficulty of handling such a large quantity of information, this methodology is often partially or segmentedly restricted to significant impact analysis.

Just as not all the activities listed in the matrix are applicable, there can also be specific interactions that are not listed and thus, certain impacts may not be identified. When doing the identifications, it should be considered that in this matrix, impacts are not exclusive nor final; therefore, it is important to identify first-degree impacts for every specific activity to avoid considering them twice or more times.

The application of the Leopold matrix can be summarized in the following steps:

- Delimit the area of influence.
- Determine the project activities in the area.
- For each activity, determine what elements will be affected (by marking them on the interaction grid).
- Determine the importance of each element on a scale of 1 to 10.
- Determine the magnitude of each activity on every element on a scale of 1 to 10.
- Determine whether the magnitude is positive or negative.
- Determine how many project activities affect the environment and divide them into positive and negative activities.
- Add the results for the activities.
- Determine how many environmental elements are affected by the project and divide them into positive and negative.
- Add the results for the environmental elements.

The original methodology proposed by Leopold considers a fractional number for each cell, where the magnitude is the numerator and the importance is the denominator. The sum of results is indicated in the arithmetic averages that result from dividing the numerator by the denominator (to obtain a decimal number) and then adding it algebraically to the analyzed column. The final arithmetic average is the result of dividing the number obtained for the total of interaction cells (marked with the diagonal) in the respective row or column.

Other matrices have been derived from the Leopold matrix.

This form of aggregation makes the analyzer "lose the feeling" of what she/he is adding and subtracting and does not let him/her see how representative a certain interaction is with regard to the total of cause-effect relations established.

The Leopold matrix has subjective problems that need to be solved when filling out the cells.

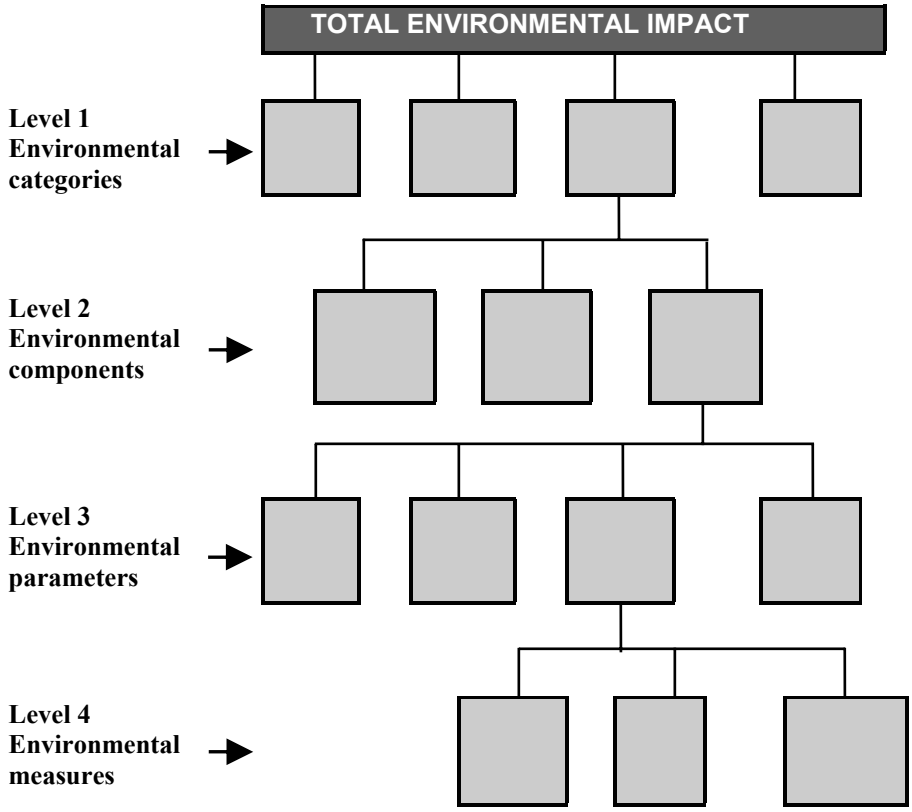
b) **The Battelle method.** This method was designed to assess the impact of projects related to water resources, although it is also used in the assessment of linear projects, nuclear plants, and others. This method is a checklist with weighting scales, description of environmental factors, and allocation of important units.

The system has four levels:

Level	Type of information	Proposed desegregation
I	General	Environmental categories
II	Intermediate	Environmental components
III	Specific	Environmental parameters
IV	Very specific	Environmental measures

Batelle establishes quantitative methods to estimate impacts.

These levels are related in the following way:



The categories represent major groupings with similar domains (ecology, environmental pollution, aesthetics, human interest). Components are contained in groups of similar parameters (water, air, soil, etc.). The parameters represent significant environmental units or aspects (noise, metals, etc.). Measures correspond to the data required for estimating a parameter accurately.

Batelle proposes an impact classification based on environmental categories, components, parameters, and measures.

Environmental variables are organized in 4 categories, 17 components, and 78 environmental parameters to assess water projects. The relative importance of each variable is assigned by consensus of a group of experts, based on the information provided by stakeholders (company, community, local government, NGOs, etc.).

Batelle establishes comparable units for different environmental variables.

Once the list of variables responding to the above requirements has been obtained, the Battelle model applies comparable units, called environmental impact units (EIU), which represent actual measurements. Conversion of actual data into EIU is performed as follows:

Batelle requires environmental data to be transformed into comparable units.

- Step 1. Data are transformed into their corresponding environmental quality index.
- Step 2. The parameter importance is weighted, according to its relative environmental significance.

Batelle requires environmental data to be transformed into comparable units.

- Step 3. Based on 1 and 2, the net impact is expressed, as the result of multiplying the quality index by the weighting index.

To perform this procedure, the significance of the environmental quality index must be defined.

The value that a specific aspect – for example, BOD_5, SO_2 – has or will have in a given situation, cannot be defined in terms of admissible, non-admissible, good, or bad. Because it is physically measurable, its value is variable and each one has a degree of quality between deficient and optimal. To obtain comparable quality values, 1 is assigned to the optimal side and 0 (zero) to the deficient side; values between the two define the different states of quality.

Batelle has a complexity associated with information availability which makes it possible to determine environmental quality.

The function that relates the environmental quality index to any parameter can be linear, with positive or negative slope or any other degree, and it can differ according to the physical and socioeconomic environment of the project. Nevertheless, the Battelle model refers to the United States context, which means that its use in other situations has to be carefully analyzed (Páez, J.C. Introducción a la evaluación de impacto ambiental. CAAM, 1996).

Batelle compares pre-project and post-project situations.

This method estimates the environmental quality expected without the project and subsequently, with the project. The difference in environmental impact units between the two conditions can be:

- Positive, when the environmental quality with the project surpasses the situation without the project and the global impact is beneficial.
- Negative, when the environmental quality with the project is lower than the situation without the project and the global impact is adverse.
- Zero, when there is no global added impact.

Batelle results enable us to compare different variables.

The most significant advantages of the method are:

- The results are quantitative and can be compared with those of other projects regardless of their type or who carried them out.
- It is a systematic method for comparing alternatives. In a way it facilitates decisions, since the environmental quality alteration for each alternative is expressed in figures.
- Some emphasize the validity of the method to perceive the environmental degradation as a result of the project, both as a whole and in its different sectors.
- Weighting is carried out through Delphi-type procedures, which minimize the subjectivity of one individual or dominant group.

The most notable disadvantages can be summarized as follows:

Quality indexes should be developed for each country or ecosystem involved.

- The environmental quality indexes available were developed in the United States for a specific environment; therefore, they are not valid for different environments.

The Batelle methodology was developed for hydraulic projects.

- The method was developed for hydraulic projects. It therefore needs to be adapted whenever a different project is analyzed.

- The list of indicators is limited and arbitrary and does not consider relationships between environmental components or cause-effect interactions.

With regard to value functions, the following should be emphasized:

- They are rigid and do not admit the dynamism of environmental systems. Indicator values can fluctuate throughout time, both with and without a project. For example, animal populations considered within the "ecology" category vary throughout the year. However, values introduced in the function to determine environmental quality are fixed.

The method does not identify variations within the categories.

- As already mentioned, value functions can result in an erroneous perception of objectivity, even when subjective factors may have played a part in their preparation. In fact, the environmental quality parameter-value correspondence can vary from one society to another and from one period to another, and there is always a subjective component, as in landscape. However, the subjective aspect can decrease with a better knowledge of the environment and how it behaves in response to human activity.

Subjectivity plays an important role in Batelle.

There are even cases when the subjective component of the function is obvious, such as that related with the landscape. Thus, a wide consensus is essential for its preparation.

3 SPECIFIC METHODS FOR SOME ENVIRONMENTAL VARIABLES

3.1. Water quality

There are several different methods for analyzing water quality.

To select models for water quality analysis, the consultant must be familiar with the criteria and standards established in national regulations; these are expected levels of concentrations that ensure the quality for specific uses. A model is a representation that simulates environmental conditions and their response to certain incentives. The most frequently used are mathematical models; physical models are also used when situations are too complex to be analyzed mathematically. Mathematical models can be one-, two- or three-dimensional, depending on environmental characteristics, as described below:

- **One-dimensional models:** used to represent flows in water streams.
- **Two-dimensional models:** used for wide rivers, where the concentration of pollutants is different on the two sides of the river.
- **Three-dimensional models:** used for studies of groundwaters and complex surface water systems.

Models should be used in terms of their compatibility with environments and supporting information.

Models can be dynamic or stationary. Dynamic models provide information on water quality, both in direction (or downstream of a discharge) and time. Stationary models imply only spatial variation, for example, a continuous and constant discharge.

These models are a powerful tool in water quality analysis. The validity of a model depends on the quality of information available. Therefore, a critical analysis of data and results is always performed. In many cases, models cannot be applied because information is non-existent, or of poor quality, or it is not comparable with the model area. See **Table 8-13**.

TABLE 8-13. EXAMPLES OF WATER QUALITY MODELS

Model	Characteristics and observations
Mixing area models	Simple mass balance models. They rapidly estimate the impact on water quality.
Dissolved oxygen models	Based on the Streeter-Phelps equation; they incorporate multiple terms including effects of benthos and the breathing of algae. They are applied to discharges of wastes demanding oxygen. They are usually one-dimensional, although they can be bi- and tri-dimensional.
Thermal discharge models	They consider algebraic additions of temperature in form of heat (energy). They make it possible to determine impact areas (bi- or tri-dimensional) due to discharges of cooling water.
Runoff models	They establish effects in terms of runoff quantity and temporal distribution.
Groundwater models	There are one-, two- and three-dimensional models. They consider both water and pollutant transportation. They can also include thermal effects. Applicable to saturated and unsaturated media.
Water quality models	They include hydrological models and are numerous. Examples: • Qual II. Stationary and dynamic condition. Applicable to rivers. It simulates chlorophyll, ammonia, nitrates, nitrites, phosphates, BOD, dissolved oxygen, coliforms, preservative substances, and temperature. • WASP and others developed by the Environmental Protection Agency (USEPA) and the United States Geological Survey (USGS).

3.2. Air quality analysis

As in the case of water, air quality uses predictive models.

The air quality analysis can fulfill several purposes, especially the prediction of possible effects of an activity and the impact on human health, flora, and fauna of a given land area. It also enables us to verify the efficiency of emission control mechanisms of an industrial process.

Simulation requires consistency between models and environmental elements.

Modeling of possible environmental impacts from air emissions predicts the behavior of pollutant concentration. This implies using an appropriate methodology to simulate how the environment is affected by certain emissions, and evaluating the effects of the proposed project and its alternatives. The atmospheric diffusion models are key elements in the analysis of sources of emissions that discharge gases or particles into the atmosphere. They predict pollutant concentrations in time and space, and consider meteorological variables and atmospheric stability.

Quality prediction based on models is reliant on the information available.

Numerous diffusion models have been developed for different sources of emissions (fixed, mobile, etc.) and different pollutants. These models can be divided into two types:

- **Physical models**, where the phenomenon is reproduced on an appropriate scale. This is usually in the form of a wind tunnel where a scale model is built of the facility that will produce the emissions, and of the surrounding topography. Atmospheric conditions are reproduced and air currents and temperature profiles are programmed.

- **Numerical models,** where the phenomenon under study is simulated in a microcomputer. It is not as accurate as the physical model, but it is less expensive and time-consuming. These models indicate the order of magnitude of the concentrations and of the distances associated with relevant impacts.

The market offers models widely used.

Both types of models can be combined with positive results. The market offers several models to predict environmental concentrations generated by fixed and mobile sources, both for gases and particles. Some useful models in air quality analysis are:

- Diffusion models for stack plumes (continuous fixed emission), recommended for small sources.
- Models for instantaneous fixed emission.
- Diffusion models for area sources (overlapping of several plumes).
- Diffusion models for mobile sources.
- Statistical models for particle diffusion.

Data frequency and representativeness are key factors in the use of models.

A key point in the application of atmospheric diffusion models is the feeding of the parameters to be considered. This implies a previous decision with regard to the number of observations on which the input parameter and its degree of representativeness is averaged in terms of daily, monthly, or seasonal variations.

The key variables for a diffusion model are:

a) Quantity and type of emissions generated by the activity.
b) Quantity and type of emissions generated by other activities in the area of influence.
c) Atmospheric stability in the area of influence.
d) Roughness of the terrain.
e) Wind speed and direction.
f) Air quality monitoring data in the area.

3.3. Soil degradation analysis

Universal models exist to estimate soil degradation.

For the identification and analysis of soil degradation processes, the following methods are used: direct observation and measurement, parametric methods, mathematical models, cartographic methods, and teledetection data.

a) **Direct observation and measurement**. Field observations or manifestations of degradation are included, as well as physical and chemical measurements to evaluate the existing processes. For example, the first case uses the appearance of roots in the soil, variations in the species of flora and fauna, or changes in land coloration. Direct field and laboratory measurements can be the only source of data or they can serve as a guide to verify results of teledetection or simulation of processes. Examples of measurements are soil depth, physical and chemical analyses, and analyses of nutrients and permeability, among others.

An EIA requires direct measurements of soil quality.

b) **Parametric methods**. These methods allow us to infer soil degradation based on environmental factors involved in process development. The following function is used:

D = f (C, S, T, V, L, M)

Where:

D = Soil degradation
C = Climatic aggressiveness factor
S = Soil factor
T = Topographical factor
V = Natural vegetation factor
L = Land use factor
M = Exploitation factor

Estimation of erosive processes resulting from interacting factors is a traditional method of reviewing impacts.

The solution of the equation gives a numerical indication of the speed of degradation. It should be recognized that processes are described only approximately, commensurate with the state of our knowledge of each factor.

Mathematical models provide an approximate estimate of soil degradation.

c) **Mathematical models**. Models created to study soil degradation processes, such as erosion by water and wind, give satisfactory results under diverse conditions. It should be stressed that there is no widely tested mathematical model to predict soil degradation. However, the universal soil loss equation (USLE) can be used.

The basic equation can be expressed as follows:

E = R * K * SL * C * P

Where:

E = Estimated soil loss by surface unit for a specific period.
R = Rainfall factor; number of erosivity index (EI) units for a specific period or measurement of the erosive strength of a rainfall.
K = Soil erosion factor; erosion rate by erosivity index unit for a specific soil.
SL = Topographical factor, including both the length and gradient of the slope
C = Plant cover and farming factor.
P = Factor of erosion control practices.

d) **Soil cartography**. Soil mapping represents the distribution of soil types or other edaphic units of a fairly extensive area. It can represent one or more characteristics, such as vulnerability to erosion, permeability, productivity, etc.

Soil cartography is used in the EIA.

e) **Teledetection data**. This term refers to the use of black and white aerial photographs, multispectral images taken from satellites, radar images, etc. When dealing with large scales, the use of teledetection enables us to assess certain degradation processes with a high degree of accuracy; in the case of small scales, some data related to the degradation processes can be inferred.

The interpretation of satellite images and aerial photos supports the EIA.

The technical bases for using these methods are developed through the interpretation of the landscape: type of landscape, form of relief, slope, and drainage type, specific land features, stratigraphy, plant cover elements, human land use, and other specifically human factors (location of villages, dams, irrigation canals, etc.).

3.4. Analysis of flora and fauna

The measurement of flora and fauna is based on traditional biological or ecological methods .

Because of the diversity of individuals and species and the interactions and associations among them, there is no methodology for all cases, except for general guidelines or principles. Hence, the first step in carrying out studies of flora and fauna is to design a research plan in keeping with the goals proposed and the information available in inventories and up-to-date scientific publications.

Methods should be adjusted to specific species and places.

The description of biotic communities is probably the most time- consuming aspect in an environmental impact study. Communities vary considerably in extension, from those restricted to small water bodies up to biomasses stretching for thousands of kilometers. The inclusion of a list of species is not the best practice in the preparation of environmental impact assessments. In this context, the level of detail of the descriptions should be sufficient to meet the specific needs of each case. Some habitats or biotic communities probably require more in-depth treatment, especially those containing a great diversity of species or individuals at risk.

Methods are based on direct and indirect estimates.

Techniques to study fauna include direct detection of individuals, by sighting, capture, animal remains, or indirect estimates based on indicators of presence or activity, such as tracks, excrement, nests, or remains of bones excreted or regurgitated by predators. There are also complex capture-labeling-recapture techniques to specify population density and age. Capture techniques need to be adapted to different organisms (fish, birds, reptiles, rodents, bats, cetaceans, etc.).

Each measurement technique depends on the type of organism.

The selection of the method for describing vegetation depends on several factors, according to the purpose of the study. The description of the physiognomy and structure of the vegetation in general does not call for the identification of all species, nor are complicated samplings required. On the contrary, when describing flora, all species must be identified and exhaustive sampling must be performed. The former methods are called physiognomic and the latter floristic.

The recognition of plant formations is used in defining vegetation.

In terrestrial ecosystems, the most practical method of defining a community is by recognizing plant formations through physiognomic methods. Among these are stratification of the vegetation, the structural description method of Dansereau and the Fosberg-IBP scheme. All the methods use descriptive categories to characterize vegetation in greater or lesser detail and they all use some kind of symbolic representations. Stratification or height of major components, abundance, density, form of life, and the size, shape, texture, and function of leaves are some characteristics used.

The conservation categories of local species are relevant information for the EIS.

The floristic identification is important to determine whether any of the species in the area of study are classified in a conservation category. Such identification is prescribed by national and international agencies for trees, shrubs, cacti, and some herbs.

The relationship between animal and plant species or groups of species allows us to use biological indicators to establish conditions of presence or absence.

3.5. Landscape analysis

Landscape measurement has a high level of subjectivity.

When analyzing environmental impacts, the landscape should be treated the same as any other resource liable to be affected by a given human activity. A study of the landscape can be based on the following criteria:

Landscape is the visual and aesthetic quality of the environment.

a) The value of the landscape corresponds to the set of interrelations among other elements (water, air, plants, rocks, etc.) and its study requires previous research.
b) Landscape encompasses an important fraction of the plastic and emotional values of the natural environment; it is therefore recommended that a study of the landscape be based on visual qualities or values.

Parameters vary from one area to another depending on the objectives proposed in each study. Hence, there are different techniques to inventory, identify, and subsequently assess the condition of the landscape. The properties mainly addressed are visibility, fragility, and quality, as described below:

a) Visibility encompasses possible observation points from which the activity is visible. Some techniques used are: in situ observation, manual profile determination, automatic methods, search by sector, and grids. Manual methods of creating visibility maps may be used or a microcomputer.

Visibility is an important parameter to estimate impacts.

b) Fragility refers to the set of characteristics of the land area related to its capacity to respond to changes in the properties of its landscape. It is used as a guide for locating the possible facilities or their elements in such a way as to produce the least possible visual impact. Biophysical, perceptive, and historical-cultural factors usually affect fragility. Proximity and visual exposure can also be considered.

Fragility is associated with the capacity of response to change.

c) Quality or beauty of the landscape: these values also need to be assessed in terms comparable to those used for other resources. Perception of the landscape depends on the sensitive conditions or mechanisms of the observer, educational or cultural conditions, and the relationship between the observer and the observed object. Although the formal quality of the objects that make up the landscape and the relations with its environment can be described in terms of design, size, shape, color, and space, there are many differences when measuring the relative value of each and its weight in the total composition. The following methods have been established for this purpose:

Landscape quality depends on the appraisal of stakeholders.

- **Direct methods.** The appraisal is made based on the observation of the whole landscape:

  i) **Accepted subjectivity**. It is the simplest, though the least objective method, but it is accepted because of the degree of subjectivity that the landscape itself possesses. The result can correspond to a parceling of the land area classified in visual quality categories, for instance, excellent, very good, good, fair, and poor.

  Accepted subjectivity classifies the landscape in visual categories.

  ii) **Controlled subjectivity**. Based on a universal scale of landscape values to establish comparable figures in different areas. Certain categories such as spectacular, superb, distinguished, pleasant, vulgar, and ugly are used. It is carried out with the participation of specialized personnel, using universal scales to ensure that the subjective assessment of different sites is comparable.

  Controlled subjectivity is based on a universal scale of values.

  iii) **Shared subjectivity**. This is similar to the accepted subjectivity method. The appraisal is performed by a group of professionals who should reach consensus, thereby eliminating extreme positions within the group. In brief, the aesthetic appraisal of the landscape is discussed.

  Shared subjectivity focuses on aesthetic appraisal based on a consensus.

  iv) **Representative subjectivity**. In this case, the appraisal is carried out by a representative group of the society. Surveys are used in order to classify the selected landscapes. Photographs serve as a support tool.

  Representative subjectivity uses surveys.

- **Indirect methods.** These include qualitative and quantitative methods that assess the landscape and analyze and describe its components. Some of the methods considered are:

  i) **Methods of appraisal through landscape components**. Physical characteristics of the landscape are used, for instance, topography, land uses, presence of water, etc. Each unit is appraised in terms of the components and subsequently, partial values are added to obtain final data.

  Landscape appraisal uses landscape components.

ii) **Methods of appraisal through aesthetic categories**. Each unit is appraised in terms of the aesthetic categories established, and partial appraisals are added or harmonized in one single value. Categories such as unit, variety, contrast, etc., are used. Its key point is related to the selection of the components to be used and the criteria that represent them.

The objectivity of subjective elements poses a problem in a landscape study.

- **Mixed methods.** These methods combine the two previous ones and the appraisal is carried out directly using a component analysis that weights the participation of each component in the total value.

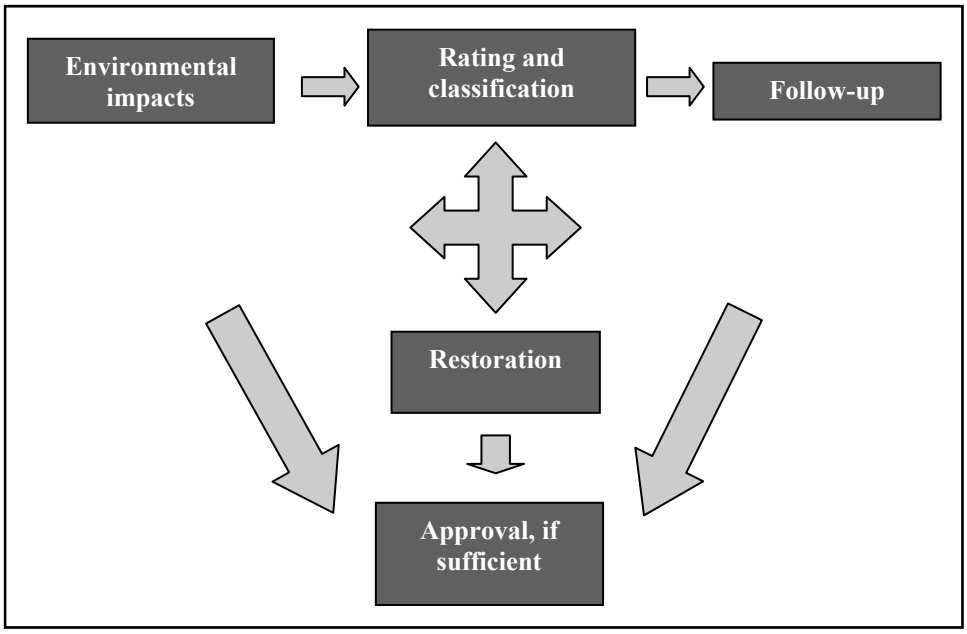
CHAPTER IX

Mitigation and Compensation

Mitigation is the design and execution of measures to reduce, mitigate, or minimize the negative impacts of a project, work, or activity on human or natural environments. Mitigation can restore one or more environmental components to pre-impact quality; if this is not possible, it can reestablish the basic properties.

Mitigation reduces environmental impacts to acceptance threshold levels.

The environmental management plan identifies measures to mitigate and compensate significant environmental impacts. It includes a program with mechanisms for the execution of actions aimed at minimizing negative environmental impacts and strengthening the positive ones during the construction, operation, and abandonment of projects, works, and facilities; and a program with compensatory measures to restore the environment.



The environmental management plan contains measures to mitigate, compensate, and monitor environmental impacts.

Compliance with environmental protection programs depends to a large extent on the mitigating and compensatory measures, since it is these measures that make human activities viable from the environmental perspective.

Mitigation makes projects viable.

The purpose of mitigation is to set in motion predesigned actions to reduce environmental impacts to acceptable levels. Compensatory measures aim to produce a positive alternative effect to match an identified adverse effect and they are implemented only in areas where significant adverse impacts cannot be mitigated.

Compensation is used when it is impossible to mitigate impacts.

COMPENSATION

- **Set of measures aimed at restoring irreversible environmental effects generated by an action or group of actions in a given area, through the creation of an environment similar to the deteriorated one, in the same place or elsewhere.**
- **It produces a positive alternative impact which is the counterpart of the adverse impact identified.**
- **It is carried out only in areas where significant adverse impacts are present.**

Mitigation involves additional costs. It is far better not to produce impacts.

When establishing preventive measures to reduce or eliminate impacts, we must work on the premise that it is always far better not to produce impacts than to have to set up mitigation measures. Mitigation involves an additional cost that, although low in comparison with the global value, can be avoided if the impact is not produced. It should be added that, in most cases, mitigating measures eliminate only part of the alteration while other benefits derived from impact reduction, such as, for example, the possibility of making use of certain chemicals, are lost.

Mitigation starts from the moment a project is created.

Moreover, it has been emphasized that impacts can be greatly reduced if a project has an adequate environmental design and follow-up is carried out during the construction, operation, and abandonment stages. It is important to remember that the cost can be reduced significantly if mitigation is applied at an early stage.

Mitigation includes avoiding, reducing, rectifying, and eliminating environmental impacts.

Another important aspect is the spatial and temporal scale of the application of mitigating measures. Most of such measures have to be applied through agreements with affected organizations or people. Regarding the time of application, it is desirable to do it as soon as possible to avoid non-desirable secondary impacts, for instance, erosion on slopes that have been left without vegetation.

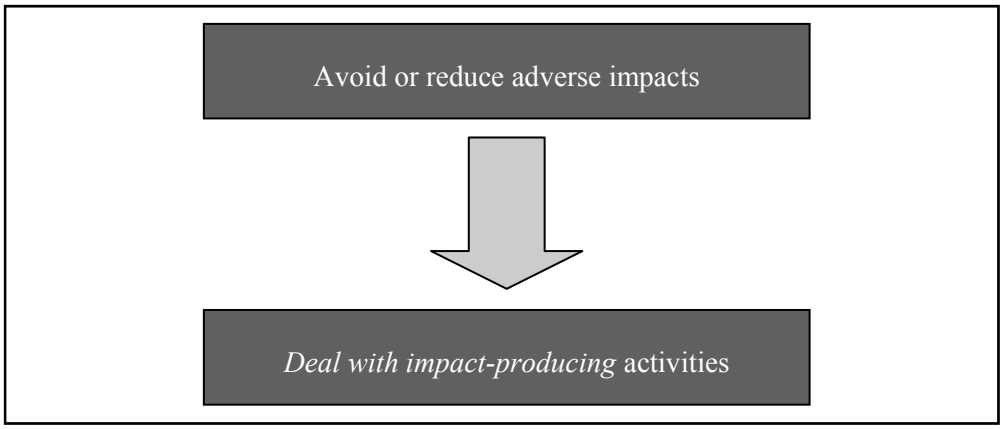
Restoration replaces environmental components.

In the EIA, negative impacts are reduced by analyzing different alternatives that present themselves throughout the process. Mitigation is the design and execution of activities aimed at reducing significant environmental impacts resulting from the implementation of a human action. They can: a) avoid the impact completely if a given activity is not carried out; b) reduce impacts by limiting the intensity or magnitude of the activity and its implementation; c) rectify the impact by repairing or restoring the affected environment; and d) eliminate the impact gradually with conservation and maintenance operations carried out during the whole of the project lifetime. These measures restore one or more environmental components or elements to a quality similar to the pre-project condition, or if not possible, they reestablish the initial basic properties.

EXAMPLES OF MITIGATION

- Changes in the technological process to eliminate organic effluents in fish meal plants.
- Replanting of vegetation on slopes after road construction.
- Cleaning of materials in decantation dams for flow management.
- Planting of trees beside highways to eliminate noise.
- Training of people for new kinds of jobs.

A satisfactory EIA is one that corrects negative environmental impacts.



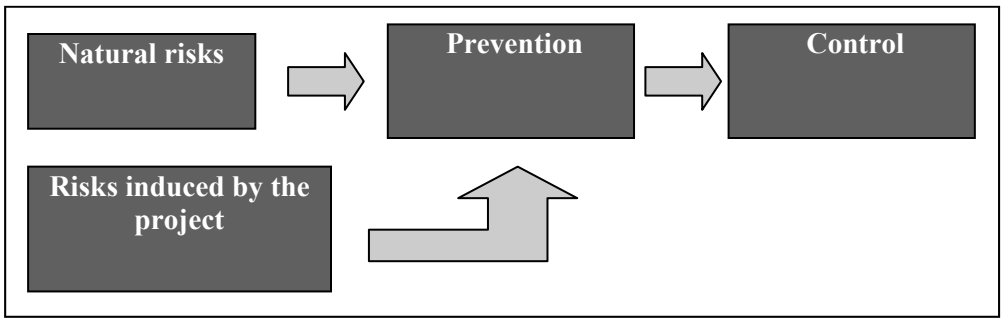
Mitigation measures should be detailed in the EIS.

It is often thought that if impacts have been identified and measured, the study can be assumed to be correct. However, this is not enough. No EIS can be satisfactory if it does not explicitly incorporate the elimination, neutralization, reduction, or compensation of significant environmental impacts, specially during the execution phases (construction, operation, and abandonment).

It is important for mitigation measures to be a high-quality and detailed technical element, and not merely a list of good intentions. Properly used, mitigation is a meaningful instrument, and one that supports decision-making in an efficient way.

Mitigation also includes the management of measures for the prevention and control of accidents in projects that imply certain human or natural risks.

Mitigation includes impacts caused by natural or human agents.



Environmental standards constitute thresholds to apply mitigation measures.

To determine what levels of mitigation should be applied, national quality environmental regulations can be used. If none have been established, those of other countries can be taken as reference. Environmental policy criteria and principles explicit in the legislation or implicit in the management approach must be followed, particularly those regulating the different environmental variables.

TORs can establish environmental requirements for mitigation.

If such instruments are not available, the terms of reference of the environmental impact study should clearly specify environmental requirements. Mitigation measures should be established for all the important phases of the project and for all significant and unacceptable impacts. In the event that the mitigating measures are not sufficient to reduce environmental impacts, compensatory mechanisms are considered. These are designed to create environments similar to those affected or to support environmental protection programs.

Mitigation is a key ingredient of the EIA.

The establishment of mitigating measures is one of the crucial chapters of the EIA, making it possible to go beyond project-related decisions and make a meaningful contribution to environmental and land-use planning. **Table 9-1** lists potential negative impacts of a lake port project with its possible mitigating measures.

TABLE 9-1. MITIGATING MEASURES FOR A LAKE PORT PROJECT

IMPACT	MITIGATING MESURES	ACTIONS
Elimination and alteration of flora and fauna in dredged sites.	Minimize impacts on local flora and fauna.	Operation
	Study rare or endangered species.	Information
Noise has become an annoyance for local residents.	Reduce noise level, especially at night, by rescheduling operations.	Operation
Creation of turbidity plumes.	Create temporary dams or barriers to reduce the transportation of suspended material outside the project area.	Works
Loss or alteration of the shore characteristics.	Study lake coastal processes: geology, geomorphology, and hydrology; and implement measures to prevent erosion and sedimentation.	Information
Degradation of air quality from dredging operations.	Monitor air quality and reduce operations, if necessary.	Stations
Effects on local culture.	Assess the sociocultural environment before implementing the project. Include community opinions.	Participation

TABLE 9-1. MITIGATING MEASURES FOR A LAKE PORT PROJECT (CONTINUED)

IMPACT	MITIGATING MESURES	ACTIONS
Elimination of archaeological sites.	Assess the area of sediment deposit and modify it or establish measures to rescue or protect sites of interest.	Works
Disappearance of bentonic species or shellfish, for example, due to silting.	Assess the area of sediment deposit and modify it or establish measures to rescue or protect the sites of interest.	Works
	Control water turbidity.	Operation
	Limit dredging during periods of reproduction.	Operation

Source: José Leal. 1997. "Guía para la evaluación del impacto ambiental de proyectos de desarrollo local". ILPES.

CHAPTER X

Review and Qualification

1 SCOPE AND MEANING

This chapter presents criteria and procedures for reviewing and qualifying environmental impact studies. Its purpose is to offer a support instrument to help comply with the review stipulated in the EIA process.

The review qualifies the quality of an EIA.

The purpose of the review is to qualify the environmental impact analysis, with particular emphasis on the environmental management measures to verify whether they are really protecting the environment and complying with the prescribed formal requirements. The method is based on three qualification criteria subdivided into specific contents. They serve as a guide for qualifying the study globally. According to this scheme, the review must not focus only on refutation of the results of a specific environmental analysis, or that reviewers replace the results with their own conclusions. Any weakness, omission, or error in the documents should be detected. These can occur when:

An exhaustive review detects weaknesses of environmental impact studies.

a) Tasks have not been fulfilled.
b) Inadequate methods have been used for impact identification and assessment.
c) Biased or incomplete information has been introduced.
d) The most significant impacts have not been analyzed adequately.
e) Insufficient emphasis has been placed on the environmental management plan and the mitigating and compensatory measures, and little significance has been attributed to follow-up and control measures.

The review should include the elements to qualify an environmental impact study.

Once the review team has qualified the study, a final report should be prepared with the decision background. The report should contain:

a) Summarized project background
b) Identification of the governing legislation
c) Main comments made by the public, if any
d) A synthesis of the assessment and technical considerations that support the decision
e) Relevant environmental impacts and measures of the environmental management plan and follow-up program
f) Environmental qualification of the project
g) Recommendations to accept, reject, or modify the study
h) Specific environmental requirements
i) Review team.

The review is the basis for the final decision regarding the EIS.

2 REVIEW FRAMEWORK

Formal-administrative technical-content and environmental-sustainability aspects are reviewed.

2.1. General contents

When reviewing the environmental impact analysis the relative importance of criteria should be weighted. The good judgment and experience of the reviewers play an impor-

tant role, since there may be factors that have not been considered or others that are not pertinent for a specific activity. Qualification criteria are related to the following subjects:

a) Formal and administrative aspects referring to formal relevance, terms of reference, presentation format, language, and generic requirements.
b) Technical and content aspects, including description of the action, affected environment, quality of information and of methodologies used for the identification and ranking of environmental impacts, and quality of the report.
c) Environmental sustainability, based on measures for mitigation and management of environmental impacts, development of impact follow-up and control programs, and citizen participation.

There are tools that can be used by reviewers.

2.2. Review mechanism

The following checklist is designed to evaluate formal, technical, and sustainability characteristics of an environmental impact study. As part of the qualification, the review team should issue a judgment on the relevance of the study based on the background data obtained. This implies a summary in list form and a technical judgment of positive and negative environmental impacts of the project, to serve as a guide to the authorities concerned and facilitate decision-making.

The reviewer should follow these steps:

a) Read the **contents** of the analysis included in the qualification list, study them, and reflect on the information requirements and qualification criteria.
b) Identify the information required. If the communication of results and fulfillment of formal and administrative aspects are not adequate, the reviewer should request the project coordinator to rewrite the study report and explain its deficiencies. If the communication of results is appropriate and the study provides the necessary information, the review team should continue with the analysis.
c) Study the specific tasks that should have been carried out to comply fully with the requirements described.
d) Seek answers to the questions in the tables. The information required can be found in the study itself; it may be necessary to look for it and **not presume that it is implicit**. The study can be qualified negatively if information is repeatedly found to be lacking.

An objective review verifies that the information is explicit. It neither interprets nor makes assumptions.

Carefully review the qualification system to understand its logic, since this system will be used to deal with each review criterion.

f) Decide on the appropriate qualification and record it in the qualification summary list. Each content should be evaluated as satisfactory **only if there is sufficient explicit background information in the study** to make an informed decision without having to seek external support.

A good study contains the information needed to explain both the impacts and the measures that will be taken to eliminate or reduce them.

The qualification is based on the questions proposed in **Table 10-1**. The questions can, of course, be modified or complemented.

It should be possible to make a partial qualification, a global qualification, and a final qualification of the environmental impact study.

Partial qualifications use the following criteria:

Partial qualification

A	**Totally acceptable.** The topic is addressed fully in the document. The information is well presented and there are no incomplete data. It can be considered satisfactory, although there may be some minor omissions and inadequacies of approach.
P	**Partially acceptable.** Topics are considered, but there are significant omissions and inadequacies of approach. Substantial modifications or complements are necessary.
D	**Deficient.** The background data are unsatisfactory, poorly presented and biased. They are not acceptable.
NA	**Non-applicable.** The review criterion is not applicable or it is irrelevant to the environmental impact study.

Partial qualification depends on the approach of each topic.

For each step, the set of questions must be answered to describe how documents address negative and positive impacts and to determine whether the information is sufficient to ensure sustainability of decisions and environmental protection.

The study is reviewed step by step and then qualified globally.

For the global qualification, individual questions should be answered and the following criteria should be applied:

- **Good quality.** When the partial qualification summary list has only **A** qualifications.
- **Intermediate quality.** When the partial qualification summary list has some **P** qualifications.
- **Poor quality.** When the partial qualification summary list has P and D qualifications.

For the final qualification, the following criteria are used:

Complete study: it has only good quality qualifications in the three general topics (formal and administrative, technical and content, and environmental sustainability aspects).

Objective review methods are necessary. This text proposes a tool.

- **Incomplete study**: it presents at least one intermediate quality qualification in a general topic.
- **Deficient study**: it presents at least one poor quality qualification in a general topic.

The list should be answered starting with the more detailed questions and working down to the less detailed ones. In the first place, partial qualification is answered based on the specific analysis of an environmental impact study. Once these background data have been completed, the global qualification is answered based on the criteria described. The final qualification is established only after the previous questions have been answered.

An environmental impact study should comply with formal, technical, and environmental requirements.

The methodology and categories proposed enable the reviewers to assign a global qualification to the study without losing the detail of the situation in each particular Topic.

TABLE 10-1. SUMMARY FOR DOCUMENT VERIFICATION							
Name of the study:_____ **Final qualification:**_____						**Year of study:**_____	
SUBJECTS		**Partial qualification**					
Topics	**Review contents**	**T**	**P**	**D**	**NA**	**Observations**	
1. Formal and administrative aspects	1.1. Does it comply with the format specified in the regulations or specific guidelines?						
	1.2. Does it comply with basic requirements established in laws, regulations, or guidelines with regard to extension, index, etc.?						
Global Qualification: Complete _____ Incomplete _____ Deficient _____	1.3. Are the classical components of an environmental impact study included?						
	1.4. Is the language simple, direct, and easy to understand?						
	1.5. Does it include an executive summary?						
	1.6. Are the public involved or affected by the project identified?						
	1.7. Are the working teams and those responsible for the study identified?						
	1.8. Are the modifications made to the document during the formal review easily identified?						
	1.9. Is the document easy for the public to read?						
	1.10. Are sources of information and bibliographical references specified?						

Qualification: **T**: Totally acceptable **P**: Partially acceptable **D**: Deficient **NA**: Non-applicable

TABLE 10-1. SUMMARY FOR DOCUMENT VERIFICATION							
Name of the study:_____							**Year of study:**_____
SUBJECTS		**Partial qualification**					
Topics	**Review contents**	**T**	**P**	**D**	**NA**	**Observations**	
2. Technical and content aspects	2.1. Are project objectives clearly described?						
	2.2. Is the project clearly justified?						
Global Qualification: Complete _____ Incomplete _____ Deficient _____	2.3. Are possible project alternatives analyzed and described?						
	2.4. Are there enough background data to describe the project and its characteristics, including economic and social aspects during the different stages of design, construction, operation, and abandonment?						
	2.5. Is the legislation governing the project clearly identified, as well as the framework for decisions?						
	2.6. Are the duration of the project's construction, operation, and abandonment stages, and its connections with other activities or projects indicated?						
	2.7. Are the project's relationships with the population's activities described and its implications for such activities, including the indication of individuals who will be displaced?						
	2.8. Are the project location and its connections properly described and presented?						
	2.9. Are legal restrictions regarding the project's location indicated, such as development plans, protected areas, national monument areas, etc.?						
	2.10. Are the reasons for, and scope of, the environmental impact study clearly justified?						

Qualification: **T**: Totally acceptable **P**: Partially acceptable **D**: Deficient **NA**: Non-applicable

TABLE 10-1. SUMMARY FOR DOCUMENT VERIFICATION							
Name of the study:_____						**Year of study:**_____	
SUBJECTS		**Partial qualification**					
Topics	**Review contents**	**T**	**P**	**D**	**NA**	**Observations**	
	2.11. Is the affected area or area of influence of the project beyond the location area clearly identified?						
	2.12. Are the project's effects on the environment included, as well as the most significant changes that it will cause?						
	2.13. Is there a detailed description of relevant environmental components of the site selected for project location and its surroundings, including maps?						
	2.14 Are environmental elements directly and indirectly associated with the project identified and adequately covered in the baseline?						
	2.15. Have inventories and surveys descriptive of the current situation (baseline) of the environment that will be affected been consulted (or prepared if none currently exist)?						
	2.16. Is the physical environment described adequately?						
	2.17. Is the biological environment described adequately (flora, fauna, ecosystem)?						
	2.18. Is the human environment, including cultural aspects and habits, described adequately?						
	2.19. Is the landscape described adequately?						
	2.20. Is environmental quality (pollution) described adequately?						

Qualification: **T**: Totally acceptable **P**: Partially acceptable **D**: Deficient **NA**: Non-applicable

TABLE 10-1. SUMMARY FOR DOCUMENT VERIFICATION							
Name of the study:_____							**Year of study:**_____
SUBJECTS		**Partial qualification**					
Topics	**Review contents**	**T**	**P**	**D**	**NA**	**Observations**	
	2.21. Is the environmental value of the affected area described adequately?						
	2.22. Are methodologies for the baseline described adequately? Are they applied correctly?						
	2.23. Have the significant project impacts on the environment been indicated and described, and established from the baseline (pre-project situation)?						
	2.24. Does it clearly indicate whether impacts are positive or negative; cumulative; of short, medium, or long term; permanent or temporary; direct or indirect; etc.?						
	2.25. Does it explain how impacts and methodologies were identified?						
	2.26. Are significant project impacts adequately ranked and appraised and are methodologies described correctly?						
	2.27. Are impact characteristics and patterns adequately described?						
	2.28. Are prediction methods described and are they appropriate for the expected environmental disturbances?						

Qualification: **T**: Totally acceptable **P**: Partially acceptable **D**: Deficient **NA**: Non-applicable

TABLE 10-1. SUMMARY FOR DOCUMENT VERIFICATION						
Name of the study:_____						**Year of study:**_____
SUBJECTS		**Partial qualification**				
Topics	**Review contents**	**T**	**P**	**D**	**NA**	**Observations**
3. Environmental sustainability	3.1. Does the document present a well-structured environmental management plan with a description of the proposed measures?					
	3.2. Does the document include a program of applicable and sufficiently detailed mitigating measures?					
Global Qualification: Complete _____ Incomplete _____ Deficient _____	3.3. Are mitigation actions and management measures justified?					
	3.4. Is there an adequate, sufficiently detailed risk-prevention and contingency program in case of accidents?					
	3.5. Have alternatives been considered for the installation of the project? Have the advantages and disadvantages of each alternative been discussed in terms of unexpected impacts? Have the reasons for the final choice been specified?					
	3.6. Have pertinent actions for processes, design, technology, and operation been considered in terms of their environmental effects, and have the reasons for the final decision been specified?					
	3.7. Have adverse impacts been taken into account in defining mitigating, risk-prevention, contingency and compensatory measures and is any evidence offered that such measures will be effective?					
	3.8. Has significant impact prevention been addressed adequately?					
	3.9. Are environmental improvements with the project's EIA clearly identified?					

Qualification: **T**: Totally acceptable **P**: Partially acceptable **D**: Deficient **NA**: Non-applicable

TABLE 10-1. SUMMARY FOR DOCUMENT VERIFICATION							
Name of the study:_____						**Year of study:**_____	
SUBJECTS		**Partial qualification**					
Topics	**Review contents**	**T**	**P**	**D**	**NA**	**Observations**	
	3.10. Are control measures considered for impacts, as well as a schedule for their application?						
	3.11. Is a budget included for mitigating and compensatory measures?						
	3.12. Is there a commitment on the part of the project coordinator to carry out the indicated control measures, and are detailed implementation plans included?						
	3.13. Is a follow-up program proposed for major impacts during the construction, operation, and abandonment?						
	3.14. Is there a budget to finance the follow-up program?						
	3.15. Is there a participation plan which explains how the public have been involved in the project?						
	3.16. Has there been sufficient public consultation, and is there evidence of the public's participation in the environmental impact study?						

Qualification: **T**: Totally acceptable **P**: Partially acceptable **D**: Deficient **NA**: Non-applicable

CHAPTER XI

Follow-Up and Control

1 GENERAL ASPECTS

The objective of the follow-up is to ensure that the relevant variables of the environmental impact study evolve as specified in the environmental management plan.

The follow-up verifies that the measures adopted are effectively mitigating the environmental impact.

Once an environmental impact study has been reviewed and approved by reviewing institutions, compliance with the environmental protection measures must be guaranteed. It is therefore necessary to monitor pollution, submit periodic reports, conduct complementary studies, and use tools to verify environmental quality.

The follow-up guides the project during the construction, operation, and abandonment.

The follow-up program ensures compliance with protection measures contained in the environmental impact study. The follow-up, both of the project and the impacts generated, can be considered as one of the most important components in the planning and design of environmental management programs. Its purpose is to verify the severity and distribution of negative impacts and, especially in the case of unexpected impacts, to ensure the development of any new mitigation measures or compensation that may be required.

The follow-up verifies the evolution of environmental impacts identified in the EIA.

Control is indispensable to guarantee that the application of measures does not stray from the original goals or become diverted from environmental objectives. Control is the framework necessary for evaluating results and improving management decisions.

The environmental impact study should include a phase of systematic data collection and organization of information to follow the evolution of the environmental impact. The purpose of the follow-up program is multiple and could be summarized in the following points:

a) To verify that the measures proposed in the environmental impact study are being applied.
b) To provide information that could be used in impact verification to improve prediction techniques.
c) To supply information on the quality and timeliness of the mitigation measures adopted.
d) To verify impacts when prediction is difficult.
e) To introduce new measures in cases where those applied are not sufficient.
f) To become an important source of data to improve the contents of future environmental impact studies. Many environmental predictions are made using the compared scenario technique; thus, the information gathered during follow-up is highly relevant.
g) To identify alterations unforeseen in the environmental impact study; if any are detected, new measures should be adopted.

The follow-up provides feedback on decisions and measures.

The follow-up complements EIA decisions.

The follow-up program should be detailed enough to apply measures and ensure that the original environmental purpose does not become distorted.

Follow-up programs are being used as an environmental management component and they are key means of verifying the quality of the study and the environmental sustainability of human activities. As their effectiveness depends on careful planning, it is helpful to consider the following premises:

Abundant data are collected by public agencies and even private entities. These data need to be identified, gathered, and interpreted.
The high cost of the environmental follow-up program and its joint use by different agencies requires carefully coordinated planning.

2 PREPARATION AND DEVELOPMENT OF THE ENVIRONMENTAL FOLLOW-UP AND CONTROL PROGRAM

Objectives establish environmental goals.

2.1. Phases of the follow-up program

A good follow-up program should include these phases:

Data are adjusted to the variables that are to be verified.

a) Objectives. They should identify the affected systems, types of impact, and selected indicators. For the program to be effective, indicators should be minimum, easily measurable, and representative of each affected system.
b) Data collection and analysis. This phase includes data collection, storage, access, and classification by variables. The frequency of data collection will depend on the variable being controlled.

The interpretation of results enables us to understand the actual environmental situation.

c) Interpretation. The most important aspect of a follow-up program is the interpretation of the information collected. Therefore, changes occurring naturally must be distinguished from those induced by human activity. Measuring deviation from pre-project conditions is not totally valid; nowadays, we are aware that natural systems have fluctuations of different amplitude and frequency, produced by natural changes. To interpret changes it is necessary to have a database covering a long period prior to the project or to set up control areas.

Feedback makes it possible to make decisions to improve the environmental situation.

d) Feedback of results. Results can be used to modify initial objectives. For this reason, the follow-up program should be flexible and find a point of balance between the desirability of not making changes to achieve the longest possible time series and the need to modify the program so that it reflects environmental problems adequately.

Clearly, the follow-up program is conditioned by the impacts to be produced in each case, and it is impossible to set up in advance generic programs that will cover each and every one of the environmental impacts and projects involved. The environmental follow-up and control program should be project-specific and its scope will depend on the magnitude and quality of the anticipated impacts.

2.2. Preparation of the follow- up and control program

The follow-up can involve the following:

- **Monitoring air and water discharges**
- **Submitting periodic reports of the project status**
- **Conducting supplementary field studies**
- **Carrying out additional analyses**
- **Conducting audits to confirm the impacts predicted in the environmental impact study.**

While preparing a specific program, the following phases can be considered:

a) Identification of impacts to be considered in the follow-up program according to the analysis of the environmental impact study.

The follow-up is used to verify impacts identified in the EIA.

b) Definition of program objectives with regard to the affected population, health, natural elements used by the population (soil, drinking water, etc.), biota of environmental value and abiotic components of the natural environment

c) Determination of data that will be built into the program. See **Table 11-1** and **11-2**. Among them:
   - Selection of impact indicators (parameters that have to be measured in order to evaluate impact magnitude).
   - Determination of data frequency and collection. The frequency should be the minimum necessary to analyze the trend and the cause-effect correlation. For some parameters, the time of collection can be more important than frequency; for example, in a water quality analysis downstream from an industrial effluent, measurement is crucial in emergency periods since those values are unusual.
   - Identification of sampling sites or collection areas, which depends on the location of the activities producing the impact; identification of the most affected areas, and the points where the parameters useful for a global understanding of the problem can be measured.
   - Selection of data collection and storage methods (statistical tables, graphs, maps, etc.).
   - Definition of criteria for selecting access to data by users.
   - Compatibility among information formats.
   - Determination of data analysis methods.
   - Scheduling activities, evaluating program and personnel costs, defining personnel responsibilities.

The use of indicators facilitates impact follow-up.

The follow-up defines the quantity and quality of information required.

d) Verification of background and other data available, including frequency, collection date, sampling location, and collection methods.

e) Program of response to identified trends:
   - General response to weaknesses found.
   - Specific response to impacts that have reached critical levels, including halting or modification of the activities responsible and impact correction.

The follow-up allows decision making to correct negative environmental situations.

Periodic reports allow to follow the environmental evolution of a project.

f) Analysis of the viability of the follow-up and control system to focus the scope of the objectives, select alternative impact indicators, define sampling frequency, and identify data collection methods.

g) Preparation of periodic reports with the levels of impact resulting from the project, effectiveness observed in the corrective measures, accuracy and correctness of the environmental impact study, and program enhancement and adaptation.

The follow-up program must be detailed.

TABLE 11-1. EXAMPLE OF CONTENTS OF A MONITORING PROGRAM

Activity	Executor or supervisor	Time required	State control institution	Information required
Fauna sampling	Universidad de la Cruz	Semi-annual data for 5 years	Fauna control institution	No. of species per sighting
Water quality	CTI Consultants	2 years	General Environmental Health Directorate	Daily samples of heavy metals

TABLE 11-2. EXAMPLE OF ENVIRONMENTAL VARIABLE FOLLOW-UP

	Activity to be developed according to environmental variable	Environmental variables that can be measured	Parameter to be measured	Quality indicator
1. Water	Water flow measurement	Flows	m^3/s	Historical average
2. Air	Quality situation	Suspended particles	PM_{10}	Standard
3. Soil	Productivity loss	Concentration of Na and K	Daily averages (ppm)	Standard
4. Flora	Deforestation rate	Forest masses	Coverage	Loss of 30% of baseline coverage
5. Landscape	Landscape deterioration	Visual quality	Perception	Acceptability average
7. Population	Resettlement of people	Migrants	No. of people	Baseline value

Indicators may have a legal base or be supported by widely accepted criteria.

2.3. Enforcement of the proposed program

The data should correspond to the environmental impacts identified.

The enforcement of the program can contain the following phases:

a) Data collection

b) Data analysis:
- Determine the level of action and of impact.
- Define the location of actions and impacts.
- Determine the duration of actions and impacts.
- Correlate activity and impact data.

c) Evaluation of the significance of impact levels:
- Identify the impact trend, as well as the rate of change or increase, if any.
- Identify impacts that exceed the prescribed levels.
- Evaluate the effectiveness of the corrective measures.

The follow-up results in a response program.

d) Program of response to identified trends by halting or modifying the activities responsible and correcting additional impacts.

e) Preparation of periodic reports with:
- Levels of impact resulting from the project
- Effectiveness of the measures applied
- Accuracy and correctness of the environmental impact study
- Enhancement and adaptation of the plan.

Indicators are essential for decision-making and have three principal functions, enabling us to:
- Know the pre-project state, observe evolution in time, and distinguish spatial differences.
- Establish cause-and-effect relationships, make comparisons, and classify impacts.
- Modify lines of action and formulate future decisions, evaluate the scope of past decisions and design strategies.

The follow-up adapts decisions to the specific situation.

2.4. Evaluation of the monitoring and control program

The following should be verified to evaluate the results of the monitoring program:

a) Fulfillment of administrative procedures. This type of information determines if the administrative procedures described in the study have been complied with. The following aspects are included:

- Applicable legal requirements according to the type of action.
- Compliance with processes in the areas of information, participation, and dissemination of results of the EIA and with the environmental implications of the project during its different stages of implementation.
- Meeting and adjusting the schedule for the implementation of actions and their administrative implications.

Compliance with administrative procedures facilitates follow-up and control.

Compliance with the environmental management plan should be verified.

b) Compliance with the environmental management plan. The degree of comance with the impact mitigation and compensation commitments is verified. The plan also includes measures for the prevention and control of accidents caused by risk situations, as a result of the prediction and evaluation of environmental impacts of the project or activity. The elements to be considered are associated with aspects such as:

- Degree of coherence of implemented measures with regard to identified and evaluated impacts.
- Effectiveness of adopted measures.
- Efficiency of the process of implementation of mitigating and compensatory measures.
- Compliance with timeframes and deadlines assigned for the implementation of the corresponding measures.

The current environmental situation must be verified.

c) Compliance with environmental sustainability. Detection of those environmental aspects that have not responded favorably to the measures applied and that therefore call for a modification of the environmental management plan.

To define sustainability, significant adverse impacts are considered. The criterion applied is the verification of the predicted degree of deterioration, in comparison with that observed during the assessment.

3 ENVIRONMENTAL AUDITS

The audit verifies compliance with environmental conditions.

The environmental audit is a practical tool for the preparation of the environmental situation diagnosis to discern the situation of existing liabilities. It makes it possible to evaluate positive and negative aspects, according to current regulations and available technology. Thus, the audit is an instrument used to evaluate a given action in terms of its compliance with the legislation and regulations, and at the same time, it facilitates the development of environmental protection concepts consonant with national and international standards.

The audit enables us to verify compliance with the measures included in the EIA.

Unlike an environmental impact study, which predicts impacts, the audit identifies, describes, and records the specific impacts that are indeed occurring on the environment.

In the EIA the environmental audit consists of a detailed analysis of the level of fulfillment of the environmental demands and measures stipulated in the environmental impact study, and it proposes the adjustments needed to deal with the impacts that were not identified in the EIS. In many countries, the audit is a legally defined activity with stringent application principles.

The environmental audit is used in industry to meet the requirements of environmental regulations, to prevent violation of such regulations, and to eliminate the risk of sanction by the authorities. It is also used to determine capital expenditure and optimize the com-

The environmental audit can be performed by two entities:

a) By the industry itself, either with its own personnel or by hiring external personnel.
b) By the entity that performs the control, designated by the State authorities.

The audit calls for impartial judgment on the part of third parties.

In either of the two situations, an audit team has to be formed, which should respect the confidentiality of industrial secrets. This team should have access to sample analyses and certified measurements, which must be performed by authorized laboratories.

The audit team should incorporate one or two specialists who are thoroughly conversant with the general operation of the company or project. A member of the company familiar with the specific management and operation of the plant or production line of the project is often included in the team. The participation of company personnel ensures that the company's general interests will be looked after.

Auditors must become familiar with the operation of the company, plant, or project.

The composition of the audit team depends on resource availability and audit purposes. The auditor can be one person who audits specific areas on a regular basis or a multidisciplinary team that audits several areas, plants, or production lines simultaneously.

Documents subject to industrial and professional confidentiality may be used in audits, since they can contain sensitive information regarding legal violations and other type of equally-sensitive material.

In some cases a questionnaire can be prepared to guide the auditor. This can be sufficiently general to cover different aspects or exhaustively detailed for plants or production lines of greater complexity. Its meticulous preparation is time-consuming; nevertheless, it can provide satisfactory results.

Checklists are a support for auditors.

Checklists are the second type of document used in the audit. They are usually answered with a YES or NO and a brief explanation of the negative answer. The experience and judgment of the auditor are an essential factor in filling them out.

The above-mentioned documents are complemented with those containing directives for interviews, to guide the auditor in his contacts with the project personnel (operators, engineers, supervisors, etc.). Interviews can play an important role in the audit, since they sometimes bring aspects not formerly envisaged to the attention of the auditor, provide feedback, and sharing of relevant information.

Interviews provide valuable information.

Everything that happens in a company can be a reason for an environmental audit. As a first step, industries have been classified according to the nature of their production lines (metal-mechanics, food, etc.) and aspects that require immediate action have been listed.

The auditor can also observe the emission or discharge points, extract samples from equipment, observe waste treatment and disposal and even, depending on his diligence, perform the follow-up to the final disposal site.

The audit includes measurements and samplings.

During the audit, the plant operations, personnel, and occupational safety systems should also be examined frequently. Warehouses containing raw materials, end-products and hazardous materials, can also be checked (see **Table 11-3**).

The audit reviews operations and procedures.

The audit has six phases: preparation, information, evaluation, adaptation, costs, and report.

TABLE 11-3. DESCRIPTION OF AN AUDIT METHOD WITH SIX PHASES OF ANALYSIS

Phase I: Preparing the audit

a) identification of the company
b) definition of audit coverage (comprehensive or partial)
c) formation of the audit team in accordance with the requirements
d) identification of comparable scenarios
e) activity planning
f) preparation of the timetable of visits and activities
g) preliminary reconnaissance visits
h) research appraisal.

Phase II: Producing information

a) collection of data and information using checklists
b) preparation and filling-out of new checklists for specific sectors that should be detailed with regard to process and treatment technologies, limit values, and organization of the company's environmental management
c) preparation of a retrospective study of the company location and the possible damages to soil, surface water, groundwater or air, which provide background information on previous situations.

Phase III: Evaluating the information obtained

a) comparison of the positive and negative aspects according to legal standards
b) determination of environmental impacts caused by the company
c) determination of the toxicity of wastes and emissions
d) proposal of immediate measures
e) allocation of priorities to sections or facilities impacting the environment, to investigate them in greater detail.

Phase IV: Environmental adaptation from the company's technical and organizational standpoint

a) proposal of alternatives using available technology in order to prevent environmental damage
b) proposal of possible raw material substitution
c) proposal of alternatives to develop or improve treatment of wastewater, air pollutant emissions, and industrial wastes.

Phase V: Defining costs

In this phase the associated costs and financing alternatives of the recommendations made in the previous phase are studied.

Phase VI: Preparing the report

The auditors draft the final document, which should contain the recommendations for the company management.

CHAPTER XII

Citizen Participation

1 PARTICIPATION IN THE EIA PROCESS

Citizen participation is important throughout the EIA process.

The nature of environmental phenomena and the characteristics of human activities are such that conflicts often arise when making decisions or taking preventive and corrective measures. This is particularly relevant in the environmental impact assessment where scenarios are simulated before the execution of plans, programs, and projects. Thus, citizen participation is a key element to facilitate prevention and solution of conflicts; to give greater transparency to decision-making on human actions and to protect the environment; improve life quality and ensure that activities and projects will be compatible with community interests. The public should be informed and should discuss, participate, and verify environmental decisions.

Citizen participation takes place at three stages of the EIA process: preliminary assessment, preparation of the study, and review of the study by the authorities.

In the EIA process, citizen participation takes place at the following stages:

a) Request for background information during the environmental classification stage to determine the scope and coverage of the study.
b) The citizen participation plan during preparation of the study
c) Formal consultation during the review stage, including public assemblies.

Participation is a two-way information and communication process among several stakeholders.

ASPECTS THAT LIMIT PARTICIPATION

- Different points of view with regard to perception and care of the environment.
- Different views and concepts of environmental policies.
- Limited experience in citizen participation.
- Absence of definitions of environmental issues, which makes agreements difficult.
- Absence of tradition in the use of environmental management tools.
- Inappropriate use of formal and informal spaces available for citizen involvement.

2 INFORMAL PARTICIPATION

Formal participation is considered in legal mandates.

Participation, as a two-way communication process, should be understood in formal and informal terms; i.e., whether or not it is explicitly indicated in legal mandates. If participation were limited to complying with a legal obligation, the needs

and scopes of environmental management would not be satisfied and its usefulness would be greatly reduced.

Participation should be promoted from the beginning.

Community involvement should be encouraged from the very beginning, and areas of consensus should be identified. Participation facilitates four key aspects: a) it offers a space to the different stakeholders; b) it makes multiple interactions possible; c) it allows different opinions to be expressed; and d) it channels different environmental perspectives.

Citizen participation requires specific stimulation mechanisms.

Informed community participation in an organized, responsible and timely way –with diverse approaches, interests and opinions– is a powerful instrument for the prevention and resolution of environmental conflicts arising from activities undertaken in a given location.

WHO SHOULD PARTICIPATE?

- The public whose environment is affected by an action.
- All those interested in environmental aspects, including project designers, citizens, and authorities.

HOW TO PARTICIPATE?

- By formal participation, as stipulated in the country's legislation.
- By informal participation from the earliest stage of the project.

To understand the participation process, we must bear in mind that there are different visions and interests which need equal opportunities for expression. Although in terms of environmental regulation, individual perceptions and biases cannot be regulated in a homogeneous way, they should nevertheless be taken into account throughout the different stages of the EIA, particularly in the initial phases.

Participation supports the EIA by providing environmental information.

Participation is a civil right which, if exercised systematically and responsibly, can prevent confrontations and polarization of positions which end up justifying interests of a different nature behind apparent environmental arguments. Citizen participation can also settle disputes to the satisfaction of all parties concerned. Dialogue and transparency build environmental sustainability into human actions.

The EIA requires that channels for citizen participation be put in place to encourage extensive dialogue among the society at large, decision-makers, and promoters.

The concept of broad participation has not been sufficiently understood as a means of making more beneficial environmental decisions, and the scopes and spaces that offered by environmental assessment tools are still largely unknown.

The public's degree of involvement reflects their participation culture.

Some think that participation should be governed by more legal regulations. However, participation has to do with the initiatives taken by the different stakeholders to save time and money, as well as with the community-involvement culture that has grown up in this context. In other words, informal participation not only prevents disputes, but it is desirable for all parties and makes for a better expression of environmental impact assessment processes.

Participation helps to give:

- **Reliability to results**
- **Viability to decisions**
- **Transparency to the EIA process.**

3 CITIZEN PARTICIPATION PLAN FOR ENVIRONMENTAL IMPACT

The use of a participation plan facilitates participatory processes.

Due to the extent of environmental issues, it is desirable to have a citizen participation plan that defines participation objectives and selection of methodologies appropriate for the people and institutions involved. For example, in the case of an environmental impact assessment system, it should not be forgotten that those directly affected in terms of health or environment alteration should participate. Within this scope are those people whose health or immediate environment could be affected by pollution problems, deterioration of environmental and cultural components, etc. Groups or individuals who, although not affected directly, report negative effects on natural resources, water bodies, soils, etc. can also participate. These include grassroots organizations, environmental organizations, NGOs, citizen action groups, specialists, academics, etc.

Citizen participation must involve the affected parties.

The public should be involved in the environmental impact study from the earliest possible stages and throughout the EIA process. This involvement complies with three aspects: i) requirements for the study review are met; ii) the community is incorporated into environmental decision-making, giving transparency to the process; and iii) preventive action is undertaken with regard to difficult situations generated by lack of information to the community.

Participation facilitates the preparation of environmental impact studies and guarantees the transparency of the process.

The plan should include the steps that will be taken to involve the community or conduct public consultation during the study, and it should also propose mechanisms for citizen involvement during the review. The citizen participation plan has the following objectives:

a) Systematically to apply legal provisions on citizen participation established for the EIA process.

b) To promote citizen participation during the earliest stages of the environmental impact study.

c) To request community assistance in the identification, comparison, and selection of reasonable alternatives for the proposed project or activity.

d) To inform the different sectors of the affected public about significant changes in the proposed project or activity.

e) To request the assistance of the community, and in particular of environmentalist groups, for the description of environmental conditions that could be potentially affected.

f) To anticipate potential conflicts systematically and promote discussions among the affected parties.

Participation facilitates the resolution of environmental conflicts.

g) To request comments by groups that have participated in environmental councils, informal workshops, or information sessions sponsored by institutions responsible for the review or preparation of the environmental impact study.

The participation plan is an integrating element, involving affected and interested parties.

PARTICIPATION PLAN

When drawing up a citizen participation plan, the following questions should be answered:

- **What is the objective of the plan?**
- **What activities should be undertaken and how should the participation process begin?**
- **What activities can be executed simultaneously?**
- **How much time should be estimated for results to become apparent?**
- **How should technique application be evaluated?**
- **What actions should be taken when a conflict arises?**
- **How should citizens be incorporated into the implementation of technical studies?**
- **How many resources should be allocated for the activities?**

Participation mechanisms are adjusted to each case, according to the characteristics of the parties involved.

The preparation and implementation of a citizen participation plan is no simple task, especially when the proposed human activity involves a range of interests and can affect a large number of people. Thus, it is important to consider the following aspects:

- The form of participation in an environmental impact assessment process can vary according to organizations, potential environmental impacts, and the organizational capability of those affected, among other aspects.

- The exclusion of groups or individuals, albeit unintentionally, will probably give rise to resentment, which can generate additional conflicts or errors in the EIA process. The identification of potential stakeholders is crucial, since it determines who should be convened and what techniques should be used to promote participation. The techniques selected should be adequate for working with specific groups,

Exclusion of citizens can limit the EIA process.

Contents of the participation plan

- Plan of action
- Technical, administrative, and support personnel required
- Budgetary requirements and financing
- Data collection techniques
- Dissemination and communication techniques
- Identification of key opportunities for citizen participation in the environmental impact assessment process.

Early participation involves citizens during the preparation of the environmental impact study.

Specific mechanisms and techniques that should be developed by the promoter of the environmental impact study will depend on the nature of the proposed project, characteristics of the area of influence, communication conditions, knowledge, and interaction in the affected community.

The results of the participation plan should be presented in the environmental impact study. The following aspects should be explicitly described:

The participation plan should be self-sufficient.

- Activities carried out and dates of implementation
- Number and identification of participants
- How representative the participants are of the affected public
- Techniques used and form of weighting community opinions and comments.
- Graphic documents (posters, leaflets, fliers, photographs, etc.) to enable the public to verify compliance with the plan of activities.
- Evaluation of the participation plan, identifying achievements and difficulties of the process.

The public should be informed about the project and the environmental impact study.

During the review stage, there is usually a consultation period during which the community can express its opinion and comments on the environmental impact study.

Study abstracts are published in national or regional newspapers, municipalities, radio, and television to disseminate the procedure. The abstract should contain the following information:

a) Name of the project and its promoter
b) Project location (locality, community, or more extensive areas)
c) Brief description of the proposed project
d) Synthesis of environmental impacts expected
e) Period for the reception of comments.

The environmental impact study should be widely disseminated.

In addition, a copy of the environmental impact study can be sent to institutions that made comments during the environmental classification stage. These institutions express their opinions on environmental aspects of the project and the area of influence; their answers, as well as any comments from the general public, should be submitted to the authority within the prescribed period. The reception of comments is systemized to facilitate the analysis and review of the environmental impact study.

The public assembly meeting is a tool for disseminating environmental impact studies.

The procedure concludes with formal public assemblies with the participation of those institutions that have participated in the environmental classification and review phases. The promoter is given sufficient time to explain the project, environmental impact study, environmental impacts identified, and the mitigation and follow-up measures that will be implemented. In the same way, organizations and the public in general are given the opportunity to ask questions and make comments. Care must be taken to ensure that equal opportunities are given to all participants. Finally, the results of the public assembly are used to facilitate decision-making and authorization of the proposed project, if the study is approved.

4 PARTICIPATION TECHNIQUES

The following techniques can be used to incorporate the community into the EIA process:

Assemblies are public meetings.

a) **Assemblies.** Assemblies are used to present projects that are going to be carried out or any preliminary ideas regarding the application of a management tool. They are also used to glean the first impressions of the community concerning the project, to disseminate process results, and to analyze the way in which community opinions were incorporated into the environmental decision.

The survey analyzes a representative sample of citizens.

b) **Surveys.** The main purpose of a survey is to obtain information from a large number of people, whose answers are classified in pre-defined categories. The analysis will show, among other aspects, trends, characteristics, opinions, and prejudices of the surveyed group. It must be taken into account, however, that survey results cannot predict future behavior with certainty.

The interview is a technique for use with key stakeholders.

c) **Interviews.** Interviews make it possible to know the opinion of individuals and groups. They can be free or directed. They work to the greatest advantage when the universe is small or representative of the affected group. They can encompass specific topics since they are directed to individuals with specific knowledge.

d) **Consultation forums** The advantage of these forums is that they not only provide information on the process, but also elicit the opinions of the community involved.

e) **Informative meetings.** This is a technique whereby a limited number of people – leaders, academics, public authorities– are invited to receive specific information and express their opinions. These meetings do not require a great deal of planning.

The meetings have specific purposes.

f) **Information dissemination techniques.** They are tools to provide information massively through written or audiovisual material, pamphlets, panels, leaflets, radio, newspapers, local television, etc. The use of Internet to disseminate results is becoming increasingly important.

5 RESOLUTION OF CONFLICTS IN THE ENVIRONMENTAL IMPACT ASSESSMENT

5.1. Conflicts

A conflict is a situation of tension arising from a clash of interests. In the environmental context, conflicts acquire particular features due to their complexity and public status since they are confusing and dynamic situations that encompass different interests.

Environmental disputes reflect tension among stakeholders.

Environmental conflicts can be about land use, transportation problems, solid waste, management of nonrenewable natural resources, location of investment projects, or definition of standards and plans, among many others. They can include scientific, economic, and legal topics with different degrees of public acceptance. Conflicts can be regarded as a process where antagonistic interactions prevail over cohesive ones. As such, they go through clearly distinguishable stages: they are born, grow, and develop.

It is important to detect conflicts about environmental issues.

Interactions during conflicts have the following characteristics:

- **Interactions can be between two or more persons, small groups or large organizations.**
- **There are interactions where people participate with their actions, opinions, values, discourses, functions, and whatever authority or influence they wield in their society.**
- **Interactions can become aggressive.**
- **Interactions can take the form of processes constructed by the parties.**

Environmental conflicts are expressed in different ways.

Conflicts present the following stages: prevention, evasion, temporary solution, and resolution

During a conflict, there are two phases: a) potential stage, in which not all the stakeholders realize that they are part of a conflict; and b) manifest stage, in which it is possi-

ble to recognize stakeholders who assume identifiable behaviors. Four classical stages are recognized in conflict management:

- Prevention, the planning of activities aimed at identifying potential areas of conflict to remove or minimize the causes.
- Evasion, a reaction tending to deny that there are incompatible objectives associated with a given situation.
- Temporary solution, which aims mainly at altering the symptoms of a conflict, and often results in a non-sustainable agreement with the possibility that the conflict will flare up again.
- Resolution, an agreement accepted by all parties to eliminate the cause of the conflict.

A conflict solved implies an agreement that is satisfactory to all parties.

5.2. Solution of environmental conflicts

Conflict management requires specific skills and capacities.

A wide range of techniques for solving conflicts are disseminated in different institutions worldwide. An environmental conflict is solved when an agreement is reached that is satisfactory for all stakeholders, thereby ensuring that the work, project, or activity can go ahead as planned. It includes satisfaction of the legitimate interests of the parties concerned and important degrees of equity in the solution. Thus:

The sooner steps are taken to solve a conflict, the better the results.

- All stakeholders should responsibly accept the final result and recognize that the agreement grants them the maximum degree of satisfaction possible.
- If one of the stakeholders is affected, it will not be possible to reach an agreement.
- The agreement is possible and stable if all stakeholders are committed to its implementation.
- The process to reach the agreement should not damage relationships between people who live or work together.
- The agreement incorporates independent control mechanisms to guarantee compliance with its terms.

Environmental conflict management requires professional capacity and specific personal skills. Prompt intervention is an indispensable requirement. Once a person has taken up a stance, his/her energy is focused on highlighting the selected alternative or criticizing the rejected one. At the same time, the desire to keep up appearances, not to appear weak, or not to give in, makes it very difficult for the individual to change his/her position. The conflict acts as a centrifugal force that separates stakeholders and reduces or completely removes interaction among them. Such separation consolidates partial perceptions and undermines efforts to solve problems. Thus, it is essential to act quickly and effectively.

While recognizing the merits of the judicial system and its contribution to the institutionalization of basic principles of social harmony, one has to admit, nevertheless, that its high costs and slow pace reduce its effectiveness. However, even if the system were more effective, the very fact of having a third party decide what is fair and unfair and designate winners and losers can destroy any future relationship among the people involved.

Some traditional ways of settling disputes are:

Arbitration, trial, and administrative decisions are traditional ways of settling disputes.

a) **Arbitration.** A private, voluntary process whereby the parties appoint an arbiter to settle the most controversial points, with the prior agreement that they will abide by the arbiter's decision. It can be used when parties do not want to take the case to trial. The arbiter acts alone, examines the different standpoints and decides on a solution.

The trial system lacks flexibility and does not always ensure the solution of the dispute.

b) **Trial.** Society has traditionally attempted to settle disputes by trial. The judge makes a decision in accordance with current laws. It is a structured, inflexible process. The judicial procedure distorts reality; not only is it detrimental to a faster, less costly solution, but it also fails to deal with the true root of the conflict. Communication between the parties is in the hands of specialized professionals, and therefore beyond the control of the parties.

Negotiation, mediation, and facilitation are alternatives for settling disputes.

c) **Administrative decision.** Process in which one of the parties involved in the dispute –the local, regional or national government– decides for all. This type of solution may not be adhered to by all parties, in which case the conflict can continue or another means of settlement will have to be found.

Some alternative ways of solving conflicts are:

d) **Negotiation.** Process through which parties come together face-to-face to state their interests and analyze together the possibilities of reaching a decision satisfactory to all parties. Willingness to make concessions is an indispensable requirement for success in this process.

Negotiation is useful at any stage of the EIA.

Negotiation can be present from the moment conflicting interests are foreseen, and it can extend beyond decisions, up to the stage of control and follow-up of the options adopted. Basically, it is an exchange of promises, based on trust. It is necessary to take into account that negotiation takes place at different levels. A negotiating team has to pay attention to what is happening on its own internal front, in addition to what occurs on the other side. It is probably true to say that parties are going to be more willing to accept results from a negotiation than from a judicial resolution imposed on them from outside. However, these two ways are not mutually exclusive, and can be used to complement each other.

Negotiation requires capable teams.

In negotiation four elements can be distinguished:

- People (who should be separated from problems)
- Interests at stake (which should be the focus of attention)
- Options (there should be several, so that a good decision can be made)
- Criteria (which should be as objective as possible, based on scientific data, equity, and efficiency).

In complex matters, negotiation should be conducted by teams with a chief or leader, a secretary, and technicians. Within the team, different functions are distinguished, such as facilitator, spokesman, lobbyist, and secretary. The negotiating team should have an expert in each topic under discussion.

e) **Mediation.** Technique through which an impartial third party facilitates conciliation among opposed parties. The mediator plays an important role. Mediation is an alternative way of settling a dispute, which avoids the parties' having to go to court.

A third party considered to be impartial takes part in mediation.

Mediation is an assisted negotiation. The support of a mediator can be indispensable once the environmental conflict is declared and parties have tense and polarized positions. Parties need to agree on who should be the mediator; i.e. they should find a person who is considered trustworthy by all the stakeholders involved. For a mediation process to be successful, all parties should have an incentive to reach an agreement.

The mediator must be considered trustworthy by the different stakeholders.

The mediator does not have the authority to make decisions on behalf of the parties, but rather helps the parties themselves to reach an agreement. It is therefore essential for the mediator to gain the confidence of all stakeholders. The mediator should also help the parties to develop creative solutions.

The mediator conciliates positions.

The mediator should educate the parties on the process to be carried out and help them to understand the perceptions, positions, and interests of each party. Furthermore, he should promote communication among the parties, propose alternatives for settling the dispute, and help those involved to approach an agreement. The mediator convenes the parties, helps define the matters implicit in the conflict, offers a third-party perspective on the problem and the solutions, and directs the solution process. He also proposes a way to handle technical information and stresses the importance of the parties' learning to handle direct contact with their public opponents.

Mediation is a useful way of reaching agreements between the project designer and the affected parties.

The mediation process has six stages:

- **Beginning of preliminary contacts between the mediator and parties.**
- **Intervention of the mediator in the conflict and establishment of rules to guide the process.**
- **Collection of information on the conflict and identification of the points to be settled.**
- **Development of options to solve each of the points.**
- **Evaluation of agreement options and comparison with alternatives of other parties.**
- **Conclusion of a global or partial conflict agreement and preparation of the plan for the ratification, execution, and control**.

f) **Facilitation.** Voluntary process to solve conflicts before they reach a critical level. It is less formal and emphasizes agreement through collaboration. This process helps define the problem and points in debate, so that the group can build a consensus. It differs from a competitive system which involves obtaining the greatest possible advantage.

Facilitation is a process that helps to formulate agreements.

Facilitators act as moderators at big meetings and make sure that all present are able to express themselves and are listened to. The facilitators are not expected to offer their own ideas or to participate actively in encouraging the parties to reach an agreement.

g) **Negotiating table.** When there are evident differences among stakeholders, it is possible to convene all parties to interact jointly in search of a solution. A negotiating table can follow these five steps:

The negotiation table summons parties to reach a viable solution for all.

- Agreement on the work methodology, timetable, and expectations
- Shared definition of problems and interests involved
- Exchange of solutions and alternatives for the interests involved
- Construction of a new acceptable alternative for all parties
- Drafting of an alternative implementation agreement and its ratification with the signature of the parties.

CHAPTER XIII

Glossary

1 DEFINITIONS AND BASIC CONCEPTS

- **Compensation.** Measures to restore the irreversible environmental effects generated by an action, through the creation of a scenario similar to that deteriorated in the same or different place.

- **Contamination.** Degree of concentration of chemical, physical, biological, or energy elements above which the population health and environmental quality are at risk.

- **Control.** Group of actions prepared by state agencies that must comply with regulations and environmental conditions during the execution of a project.

- **Cumulative impacts.** Impacts resulting from a proposed action that increase with collective or individual impacts from others actions. Its final incidence is equal to the total of partial incidences.

- **Direct impacts.** Primary impacts of a human action that occur at the same time and in the same place.

- **Ecology.** Science that studies the distribution and abundance of living beings.

- **Ecosystem.** Basic unit of study of nature.

- **EIA system.** Organization and management of a process according to the reality and capacity of who applies it.

- **Emission standards.** Values that establish the maximum allowable quantity of emission of a pollutant, measured in the discharge source.

- **Environment.** Biophysical and sociocultural environment that conditions, favors, restricts, or enables life.

- **Environmental audit.** Evaluation of actions already executed designed to identify and measure the magnitude of environmental damages and its associated risks to compare them with results of environmental impact studies or environmental quality indexes.

- **Environmental component.** Any element of the environment.

- **Environmental deterioration.** Modification that reduces the environmental quality as a consequence of a human action.

- **Environmental impact.** Significant alteration of the environment directly or indirectly induced by a project or activity in a given area.
- **Environmental impact assessment process.** Set of requirements and stages that should be fulfilled so that a preventive environmental analysis complies with international standards.

- **Environmental impact study.** Document that sustains the preventive environmental analysis with criteria to make informed decisions with regard to the environmental implications of human activities.

- **Environmental management plan.** Detailed establishment of actions required to prevent, mitigate, control, and compensate possible negative environmental impacts. It also accentuates positive impacts. The environmental management plan includes monitoring, participation, and contingency plans.

- **Environmental policy.** Definition of regulatory principles and basic objectives that the society intends to reach with regard to environmental protection.

- **Environmental quality.** Ecological structures and processes for sustainable (or rational) development, biodiversity conservation and improvement of live standards of the human population. It can also be understood as the set of properties to recognize basic environmental conditions.

- **Environmentally critical ecosystems.** Those that have lost its capacity of recovery or self-regulation.

- **Environmentally sensitive ecosystems.** Those highly susceptible to deterioration by the introduction of external factors.

- **Follow-up.** Set of planned decisions and activities to safeguard compliance of environmental agreements established during an environmental impact assessment process.

- **Mitigation.** Design and execution of works or activities to minimize the negative impacts of a project, work, or activity on the human and natural environment.

- **Monitoring.** Spatial and temporary acquisition of specific information on the state of environmental variables to feed the environmental monitoring and control processes.

- **Preliminary evaluation**. Contrast of an action with environmental protection criteria to decide on the need and scopes of the impact study.

- **Prevention.** Design and execution of works or activities designed to prevent, control, and avoid possible negative impacts of a project, work, or activity on the human and natural environment.

- **Prevention measures.** Design and execution of works or activities designed to prevent and control possible negative impacts and effects of a project, work, or activity on the human and natural environment.

- **Qualification.** Process to decide if an environmental impact study fulfills the contents and formal expression required for its approval.

- **Quality indicators.** Information about the state of an environmental element.

- **Quality standards.** Conditions that, in accordance with the current legislation, should be fulfilled by the different elements that compose the environment.

- **Risk analysis.** Study or evaluation of the circumstances, eventualities, or contingencies that can risk human health or the environment during the development of a project, work, or activity.

- **Sustainable development.** Process of sustained and equitable improvement of population life quality, based on environmental protection and conservation measures in order to avoid exceeding the capacity of the environment to recover and absorb the wastes produced, and maintain or increase economic growth.

- **Terms of reference for the EIA.** Document that contains the general guidelines that should be considered in the preparation of an environmental impact assessment.

CHAPTER XIV

Bibliography

Bibliographic references related to environmental impact assessment are included to disseminate the most relevant titles on this topic.

- **AGUILO, M., & RAMOS, A. 1991.** Directrices y Técnicas para la Estimación de Impactos. Universidad Politécnica de Madrid, España.

- **AGUILO, M.; et al. 1991.** Guía para la Elaboración de Estudios del Medio Físico: Contenidos y metodologías. Ministerio de Obras Públicas y Transportes. Tercera edición. Madrid.

- **ASCHER, W. 1992.** Coping with the Disappointing Rates of Return on Development Projects that Affect the Environment. World Bank, Washington, D.C.

- **BORCOSQUE, L. 1991.** Evaluación del Impacto Ambiental. Métodos y Técnicas Cartográficas.

- **CAAM. 1995.** Plan para la incorporación de un Sistema de Evaluación de Impacto Ambiental en el Ecuador. Quito, Ecuador.

- **CASA DE LA PAZ. 1999.** Sistematización de Experiencias en Participación Ciudadana y Bases Metodológicas para la Resolución Colaborativa de Conflictos Ambientales en Chile. Proyecto "La Participación Ciudadana en la Resolución de Conflictos Ambientales: Hacia un Modelo de Desarrollo Social y Ambientalmente Sustentable" (Fundación Ford - CONAMA - Casa de la Paz). Santiago, Chile.

- **CENTRO DE ESTUDIOS PARA EL DESARROLLO (CED). 2000.** Guía para la Evaluación Ambiental de Pequeños Proyectos. Programa "Generación de políticas, planes y programas ambientales y mejoramiento de la capacidad de gestión a nivel municipal". Santiago, Chile.

- **CIDIAT (Centro Interamericano de Desarrollo e Investigación Ambiental y Territorial). 1994.** Métodos de identificación de efectos y de evaluación de impactos ambientales. En: II Curso Postgrado sobre Evaluación de Impactos Ambientales. FLACAM. La Plata, Argentina. s.n.

- **COMISION NACIONAL DEL MEDIO AMBIENTE. 1993.** Seminario-Taller sobre Evaluación de Impacto Ambiental. Santiago, Chile.

- **COMISION NACIONAL DEL MEDIO AMBIENTE. 1993.** Instructivo Presidencial: Pauta para la Evaluación de Impacto Ambiental de Proyectos de Inversión. Santiago, Chile.

- **COMISION NACIONAL DEL MEDIO AMBIENTE. 1994.** Manual de Evaluación de Impacto Ambiental; conceptos y antecedentes básicos. Santiago, Chile.

- **COMISIÓN NACIONAL DEL MEDIO AMBIENTE (CONAMA) 1995.** Metodologías de planes de control y fiscalización ambiental y auditorías ambientales. SGS Ecocare. Informe final. Diciembre. Santiago. Chile.

- **CONESA VICENTE** 1995. Auditorías Medioambientales: guía metodológica. Ed. Mundi-prensa. Madrid

- **CORPORACION FINANCIERA NACIONAL.** Manual de Evaluación Ambiental para Proyectos de Inversión. Quito, Ecuador.

- **COUNCIL ON ENVIRONMENTAL QUALITY. 1992.** Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. Washington, D.C.

- **COUSILLAS MARCELO J. 1994.** Evaluación del Impacto Ambiental, análisis de la Ley 16.466 del 19 de Enero de 1994. Instituto de Estudios Empresariales, Montevideo.

- **COWLES, R.V. 1990.** Environmental Impact Assessment in the Planning Process for Mining Projects. Energy Law 90: Changing Energy Markets, The Legal Consequences. International Bar Association Series. London.

- **DAVIS, R. 1996.** 25 Años de NEPA: Como funciona , sus fortalezas y debilidades. Centro de Estudios Públicos. Documento de Trabajo Nº 246, Abril. Chile.

- **DURAN DE LA FUENTE, H. 1991.** Políticas para el control del impacto ambiental de la actividad industrial y minera. En: Schwember, ed. Protección del Medio Ambiente: Seminario AIC-TECNIBERIA. 1990. Santiago, Asociación de Ingenieros Consultores de Chile.

- **ECONOMIC COMMISSION FOR EUROPE (ECE). 1991.** Policies and Systems of Environmental Impact Assessment. United Nations. Environmental Series No. 4. New York.

- **ECONOMIC COMMISSION FOR EUROPE (ECE). 1990.** Post-project Analysis in Environmental Impact Assessment. United Nations. New York.

- **ECONOMIC COMMISSION FOR LATIN AMERICA AND THE CARIBBEAN (CEPAL) 1991.** Evaluación del Impacto Ambiental en América Latina y el Caribe. CEPAL. Santiago.

- **ENVIRONMENTAL LAW INSTITUTE. 1991.** Environmental Impact Assessment: Integrating Environmental Protection and Development Planning. Washington, D.C.

- **ENIVIRONMENTAL PROTECTION AGENCY OF THE UNITED STATES / COMISION NACIONAL DEL MEDIO AMBIENTE. 1993.** Principios de Evaluación de Impacto Ambiental. Alfabeta Impresores. Santiago, Chile.

- **ESCRIBANO B., M.M; et al. 1991.** El Paisaje. Ministerio de Obras Públicas y Transportes. 117 pp., Madrid.

- **ESPINOZA, G.A. 2000.** Informe de Consultoría: Apoyo a Planes de Acción del BID en Temas Ambientales en El Salvador. Santiago, Chile

- **ESPINOZA, G.A. 1998.** Informe de Consultoría. Guía de Procedimientos y Mecanismos de Evaluación y Seguimiento Ambiental (PROMESA). BID. Santiago, Chile.

- **ESPINOZA, G.A. 1998.** Informe de Consultoría: Políticas y Procedimientos de Evaluación de Impacto Ambiental para el Perú. Santiago, Chile.

- **ESPINOZA, G.A. 1997.** Informe de Consultoría: Diseño Conceptual y Operativo del Sistema de Evaluación de Impacto Ambiental en Uruguay. BID.

- **ESPINOZA, G.A. 1996.** Experiencia Internacional en EIA. Informe preparado como parte del programa de fortalecimiento institucional. DINAMA/Dames & Moore. Montevideo.

- **ESPINOZA, G.A., et al. 1995.** Manual de Participación Ciudadana en el Proceso de Evaluación de Impacto Ambiental. Participa, Casa de la Paz, Práctica. Santiago, Chile.

- **ESPINOZA, G.A., S. GARCIA, F. VALENZUELA Y J. JURE, 1997**. Algunas Experiencias Derivadas de la Aplicación del Sistema Voluntario de Evaluación de Impacto Ambiental en Chile. Documento de Trabajo N°35 de octubre de 1997. Comisión de Medio Ambiente, Centro de Estudios para el Desarrollo - CED. Santiago, Chile.

- **ESPINOZA G., X. ABOGABIR Y O. SALAZAR. 1998.** Instrumentos de Gestión Ambiental y Participación Ciudadana. Casa de la Paz. Santiago, Chile.

- **ESPINOZA, G. y O. SALAZAR. 1998.** Participación Ciudadana en el Sistema Voluntario de Evaluación de Impacto Ambiental en Chile (Período 1994-1997). Casa de la Paz. Santiago, Chile.

- **GARCIA, M.P. 1990.** Hacia una matriz integral de impactos: Aproximación metodológica a proyectos de desarrollo minero-industrial latinoamericanos. En : CANALES, J. (ed.) Efectos Demográficos de Grandes Proyectos de Desarrollo. NU/CEPAL/CELADE. CELADE, San José.

- **GÓMEZ OREA, DOMINGO, 1994.** Evaluación de Impacto Ambiental. Editorial Agrícola Española S.A., Madrid.

- **GROSS, C.M.F. 1992.** Una aproximación a la problemática de los impactos: Los impactos de obras hidroeléctricas. Revista Interamericana de Planificación Vol. 25, No. 98.

- **INTER-AMERICAN DEVELOPMENT BANK. 1990.** Comité del Medio Ambiente. Procedimientos para Clasificar y Evaluar Impactos Ambientales en las Operaciones del Banco. BID, Washington, D.C.

- **INTER-AMERICAN DEVELOPMENT BANK. 1990.** Estrategias y procedimientos para Temas Socio-Culturales en Relación con el Medio Ambiente. BID. Washington, D.C.

- **INTER-AMERICAN DEVELOPMENT BANK. 1991.** Aplicación de los Procedimientos Ambientales en el Sector de Saneamiento y Desarrollo Urbano. Washington, D.C.

- **INTER-AMERICAN DEVELOPMENT BANK / CENTRO DE ESTUDIOS PARA EL DESARROLLO (CED). 1998.** Proyecto "Generación de políticas, planes y programas ambientales y mejoramiento de la capacidad de gestión a nivel municipal". Santiago, Chile.

- **INTER-AMERICAN DEVELOPMENT BANK / CENTRO DE ESTUDIOS PARA EL DESARROLLO (CED). 1999.** Proyecto “Apoyo para el Mejoramiento de la Gestión Ambiental en los Países de América Latina y el Caribe”. Santiago, Chile.

- **INTER-AMERICAN DEVELOPMENT BANK. / CENTRO DE ESTUDIOS PARA EL DESARROLLO (CED). 1999.** Proyecto "Gestión Ambiental en América Latina y el Caribe". Santiago, Chile.

- **JERNELOV, A. y MARINOV, U. 1990.** Un enfoque de la evaluación del impacto ambiental de proyectos que afecten al medio ambiente marino y costero. Oceans and Coastal Areas Programme Activity Centre. PNUMA. Nairobi.

- **JICA. 1990.** Environmental Guidelines for Dam Construction Projects. Japan.

- **JILIBERTO R. Y MANUEL ALVAREZ – ARENAS, Ed. 2000.** Evaluación Ambiental Estratégica de Política, Planes y Programas: una aproximación analítica. Talleres BORPISA, Madrid.

- **JORDAN, J.M. 1992.** Evaluación del Impacto Ambiental. EIA. Valparaíso, Chile.

- **JURE, J., S. RODRÍGUEZ. 1997.** Aplicabilidad del Sistema de Evaluación de Impacto Ambiental (SEIA) a los Planes Reguladores Comunales (PRC), Informe para optar al Titulo de Ingeniero de Ejecución en Ordenación Ambiental. Santiago, Chile.

- **KEMP, R. 1990.** Environmental Impact Assessment. Theory and practice. Journal of Rural Studies 6:448-449.

- **KETTERING FOUNDATION. 1994.** International Civil Society Workshop. Kettering Foundation, USA.

- **LEAL, J. 1990.** Environmental impact assessment as a method of incorporating the environment into planning, Vol. 1. En: PNUMA/CEPAL/ILPES. The Environmental Dimension in Development Planning. ECLAC, Santiago.

- **LEAL, J. 1991.** Estado del arte en métodos de evaluación del impacto ambiental. En Schwember, ed. Protección del Medio Ambiente: Seminario AIC-TECNIBERIA 1990. Santiago Asociación de Ingenieros Consultores de Chile.

- **LEAL, J. 1997.** Guías para la Evaluación de Impacto Ambiental de Proyectos de Desarrollo Local. ILPES. Santiago, Chile.

- **MINISTERIO DE OBRAS PÚBLICAS (MOP).** 1993. Metodologías para la evaluación de impacto ambiental de obras públicas. Apuntes de curso realizado por MOP, 26 al 30 julio. Tema 8.11.

- **MINISTERIO DE OBRAS PUBLICAS Y URBANISMO. 1989.** Guías Metodológicas para la Elaboración de Estudios de Impacto Ambiental. 2, Grandes Presas. Madrid.

- **MOPT. 1990.** Guías Metodológicas para la elaboración de estudios de impacto ambiental: repoblaciones forestales. Tercera edición. Madrid, España.

- **MOPT. 1991.** Guía para la elaboración de Estudios del Medio Físico: Contenidos y metodologías. Tercera Edición. Madrid, España.

- **MOPT. 1991.** Guía Metodológicas para la elaboración de estudios de impacto ambiental: Carreteras y Ferrocarriles. Madrid, España.

- **PAEZ, J.C. 1996.** Introducción a la Evaluación de Impacto Ambiental. CAAM, Ecuador.

- **PATRIDGE, WILLIAM, L. 1994.** Participación Popular en Evaluación Ambiental en América Latina. Nota de Divulgación Nº 11. Departamento Técnico para América Latina, Banco Mundial, Washington D. C.

- **PIMENTEL, G. y PIRES, S.H. 1992.** Metodologías de avaliacao de impacto ambiental: aplicacoes e seus limites. Revista de Administracao Publica, Vol. 26, Nº 1.

- **PISANI P. y G.A. ESPINOZA. 1994.** Breve descripción de los Aspectos Básicos del Sistema de Evaluación de Impacto Ambiental en Chile. Instituto Nacional de Investigaciones Agropecuarios. VI Simposio sobre Contaminación Ambiental: Impacto Ambiental de Metales Pesados, pp 176-185.

- **RIEBSAME, W. 1990.** Evaluación de las implicaciones sociales de las fluctuaciones del clima: Guía para los estudios de los impactos del clima. Comisión Permanente del Pacífico Sur; PNUMA. Oceans and Coastal Areas Programme Activity Centre. CPPS/PNUMA. Nairobi.

- **ROMAGGI, M. 1992.** Metodologías para la Gestión Ambiental: Evaluación de impacto ambiental, planificación física integrada, cuentas patrimoniales. Documento MAM-72. Programa de Capacitación ILPES/CEPAL. Santiago.

- **SUBIRA B., R. 1991.** Los Estudios de Impacto Ambiental CEPAL/ILPES. Doc. MAM-46. Santiago.

- **SUROSWSKI, A. 1992.** La Variable Población en la Gestión Ambiental: Un ejemplo de evaluación de impacto ambiental. CELADE, Santiago.

- **TESAM.S.A. 1996.** Preparación y Publicación de Metodologías de Evaluación de Impacto Ambiental. Informe Borrador Final. CONAMA, Chile.

- **WEITZENFELD, N. 1996.** Manual Básico de Evaluación de Impacto en el Ambiente y la Salud, de acciones proyectadas. Centro Panamericano de Ecología Humana y Salud. Organización Panamericana de la Salud, OMS. Metepec. México.

- **WOOD, C. 1995.** Environmental Impact Assessment, a comparative review. Longman Scientific and Technical, Longman Group Limited. Longman House, Burnt Mill, Harlow. England

- **WOOD, C. 1996.** Evaluación de Impacto Ambiental: Un análisis comparativo de ocho sistemas de EIA. Centro de Estudios Públicos. Doc de Trabajo Nº 247, Abril. Chile.

- **THE WORLD BANK. 1991.** Libro de Consulta para Evaluación Ambiental. Vol. I, II y III. Trabajo Técnico No. 139. Washington, D.C.

- **THE WORLD BANK. 1991.** Guidelines for Environmental Assessment of Energy and Industry Projects. Washington, D.C., World Bank.

- **YOUNG, L. 1990.** Agricultural Policies in Industrial Countries and their Environmental Impacts: Applicability to and comparisons with developing nations. World Bank, Environment Working Paper No. 25. Washington, D.C.