MODULE 10

ENVIRONMENTAL IMPACT ASSESSMENT

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10.1 BACKGROUND

Environmental Assessment (EA) is supposed to provide the economic analyst with a good quantification of the biophysical and social impacts from developments. Environmental Assessment generally refers to the broader system of environmental analysis, including project-specific Environmental Impact Assessment (EIA). The EIA process began in North America in the 1970s. Therefore, it has a long history and experiences that can be useful for developing countries just beginning to establish an EIA process. Five years ago, few countries in eastern and southern Africa had an EIA policy. Now, most countries have such a policy and supporting legislation. Traditionally, EIA was designed to operate at the project level; that is to identify impacts and mitigation measures for an individual project. In the past several years however, the EIA process has gradually been extended to sectoral levels, strategic reviews of policy, and even at a global level. This module will briefly discuss strategic and sectoral EIA but focus on project EIA.

10.2 STRATEGIC EA

Strategic Environmental Assessment (SEA) has been defined as "the formalised, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan or program and its alternatives, the preparation of a written report on the findings, and the use of the findings in publicly accountable decision making" (Therivel *et al.* 1992). SEA is a process by which environmental implications are integrated into decision-making above the project level and into non-traditional domains such as policies and programs. The widespread and growing interest in SEA is reflected in the following examples:

- A number of countries, including Australia, Canada, France, Germany, the Netherlands and the United States have legal or policy provisions for undertaking some form of strategic assessment;
- The Commission of the European Communities has given notice of its intent to develop SEA procedures for application to certain policies, plans, and programs of Member States;

- The United Nations Economic Commission for Europe is promoting the application of EA to policies and programs, including those resulting in transboundary impacts; and
- Some development banks, in particular the World Bank and the Asian Development Bank, are incorporating forms of SEAs as part of the review of certain types of operations.

At the macro-economic and national planning levels, progress has been made in recent years on two main fronts: first the development (by governments) of national environmental action plans and strategies, and second, the development of analytical approaches to studying the impacts of macro-economic changes (at the national or sectoral level). While the latter is still in a rather embryonic stage, the former has been done on a broad scale with important lessons emerging. As an example, in module 6 (Case Study 1), a Policy Impact Matrix (AIM) was used to systematically analyse the links between economic policies and the environment in Swaziland. Here we will discuss SEAs as they may relate to intersectoral macro issues such as: environmental sustainability, life style change, structural adjustment, privatisation, poverty, internalising externalities, public expenditure review, and NEAP's, or similar environmental strategies.

The environmental and social disruptions following some macro-economic policies of stabilisation and restructuring should be assessed to counter the negative consequences of such a transition on the environment and people. Some principles, such as subsidiarity should help protect livelihood and culture. A SEA could point out these aspects.

Privatising the factors and units of production, including land, is seen as a way to internalise many externalities and insure more efficient and less polluting units of production. Unfortunately, livelihood and traditions (land) may be destroyed, in the process. In the privatisation process, the resources and units of production may be very unequally redistributed. During the transition period, protection of resources can be replaced by their quick exploitation. SEA would recommend ways to phase and control these changes to minimise the negative social and environmental impacts of privatisation reforms.

Properly pricing resources should help internalise environment externalities, but may also bring greater hardship to some groups in society. Liberalisation under the structural adjustment program will tend to push domestic prices up to the international level.

Depending on the import-export mix, this could, in some cases, damage the environment and impoverish the poor even more, by destroying the safety net established. At the macro and sectoral level, the consequences of these policies will have to be mitigated. The appropriate mitigations could be presented in a SEA.

Public expenditure review is the most important tool to redirect activities in an economy in a given year. Structural adjustment that reduces the public sector but does not improve its efficiency in the medium term could negatively impact the environment (lack of control and management) and bring about cuts in welfare programs (education and health). Good opportunities exist to redirect unproductive expenditures, for instance, in defence or in subsidies that contribute to environmental degradation (energy prices), to beneficial environmental activities. The consequences of budget allocation could also be covered in a SEA.

As alluded to above, the consequences of policies, plans, and programs can impact both people and the environment. Poverty is often related to environmental degradation. What is good for people is good for the environment and vice versa. An educated citizenry will pollute and consume less and shift more readily their habits as information on the state of the environment is provided to them.

10.3 SECTORAL AND REGIONAL EA

These EAs take a comprehensive view of a sector, or a region as a whole and shape the direction of planning before the major project decisions are made. They also focus attention on sector or region-wide institutional issues and ways to strengthen environmental management capacity at these levels. Sectoral and regional EAs are normally carried out earlier in the planning process than project-specific EAs and seek to address broader environmental issues, including policy issues and strategic choices. Most Development Banks now strongly encourage use of these instruments. At the same time, good project-specific EAs should incorporate sector or region-wide environmental issues that may influence the project. Furthermore, sectoral and regional EAs cannot substitute for project-specific EA work. Rather, they can make such work much easier by generating information,

eliminating the most negative proposals from an environmental perspective, and allowing project EAs to narrow their scope to site-specific issues.

Projects-Sectoral EA focuses on the major impacts of concern in the sector as a whole and prescribes standard approaches for similar projects to project design and mitigation. Often an "environmental manual" or standards and guidelines for projects and sub-projects design, are prepared. If it follows too narrowly on the project itself, this approach reduces the scope of work for individual EAs of projects in the sector.

Sector Analysis EA applies EA upstream in sectoral planning to help in the design of projects with a sector-wide scope and to address problems at the level of sector policy and regulatory and institutional framework. It is used to set the appropriate laws and institutions so that investments can be spread unhampered. Sector analysis EA helps avoiding inherent limitations of project-specific EAs by moving upstream in the planning process to a stage where major strategic decisions have not yet been made about the sector. This type of EA offers better opportunities not only to analyse existing policies, institutions and plans in terms of environmental issues, but also for supporting environmentally sound sector-wide investment priorities that are fully consistent with such strategies.

Regional EAs determines the cumulative environmental and social implications of multi-sectoral development plans within a defined geographic area over time. If a number of infrastructure components were planned in a region in the future, a regional EA would be undertaken even if only a small component would start in the near future. Regional EA is made when relatively undisturbed rural areas are likely to develop, such as a coastal area, a watershed, etc. The Regional EA would compare the cumulative impacts of the existing land use with the one proposed for development. Sometimes institutions are created at the regional level such as a valley authority, a basin or watershed agency or a provincial planning board. These institutions are then responsible for the Regional EA. Land-use plans should be a particularly effective tool to resolve issues identified through regional EAs. Regional EAs have not been numerous, essentially because ministries are organised along sector lines. Yet environmental issues are essentially intersectoral.

Both sectoral and regional EAs are sometimes called cumulative EAs. Both assess the cumulative impacts of the currently proposed project added to the existing and future

developments in an area or a sector. At the project level, good EAs have always addressed this cumulative issue, or the "tyranny of small decisions." However, the regional and sectoral EAs formalise this trend by changing policies rather than deciding on a particular incremental project. The most obvious example of cumulative impact is found in the limited assimilative capacity of ecosystems. A river may have enough assimilative capacity for one established paper mill for instance, but not if it is in addition to a proposed sewage treatment plant downstream[1].

10.4 PROJECT-LEVEL EIA

10.4.1 Overview

Project-level EA (usually called EIA) generally refers to the environmental assessment of a single project, such as one highway or a cement factory. EIA is defined as the process of evaluating the direct and indirect environmental and social implications of a proposed development project. It has a number of strengths. First, it can be a flexible process and employ a large number of evaluation methods and techniques. Second, EIA is increasingly viewed as a process, not as a mandated document. Third, EIA is becoming more commonly parallel to and part of standard pre-feasibility engineering and economic studies. In general, EIA is focused on a previously selected project and only the better EIAs consider the sector as a whole or the wider implications, such as policies.

Project-level EIA also has a number of weaknesses. First, a single project-level EIA has little leverage beyond the influence of the single project. Project level EIAs can be piecemeal regards to sector or regional planning. EIAs have to be repeated for each sector or regional project. An EIA rarely influences which projects are selected before the assessment is carried out. As a result, project-level EIAs are mainly reactive, at a time when pro-action becomes increasingly necessary. In the worst cases, EIA does not begin until a fairly well defined project is proposed, then it is forced into reacting to a relatively rigid proposal. Ideally, EIAs should always address the outcome of the no-project alternative, emphasising that EIA is a public process rather than a single study[2]. On the other hand, the no-project outcome must account for the costs of no project such as power outages, bad roads, ineffective schools, and

[1] Annexure 1 provides several examples of sectoral and regional EIA from around the world.

inefficient or unsafe water supply. EA should help decision-makers ascertain the when, where, how and cost of proposed projects as well as the no-project option.

Second, EIA is often weak on indirect and synergistic impacts unless the EIA team is unusually qualified and well funded. Some still think of EIA as a mandated document, rather than part of feasibility or as a valuable tool for standard project selection and design. Occasionally in the worst cases, an EIA becomes a post-project justification or mitigation exercise. In addition, project conditionality applying to environmental concerns is difficult to enforce.

10.4.2 Project-Level EIA and the With-Without Analysis

Simply put, an EIA describes the impacts on the environment with and without the project in a similar manner to an economic analysis. To do this systematically, different attempts to categorise the elements comprising the environment, also called attributes, have been made (Box 10.1 provides one example). Changes in the environmental attributes provide indicators of changes in the environment. The EA describes, quantifies, then aggregates the effects of project activities on these attributes.

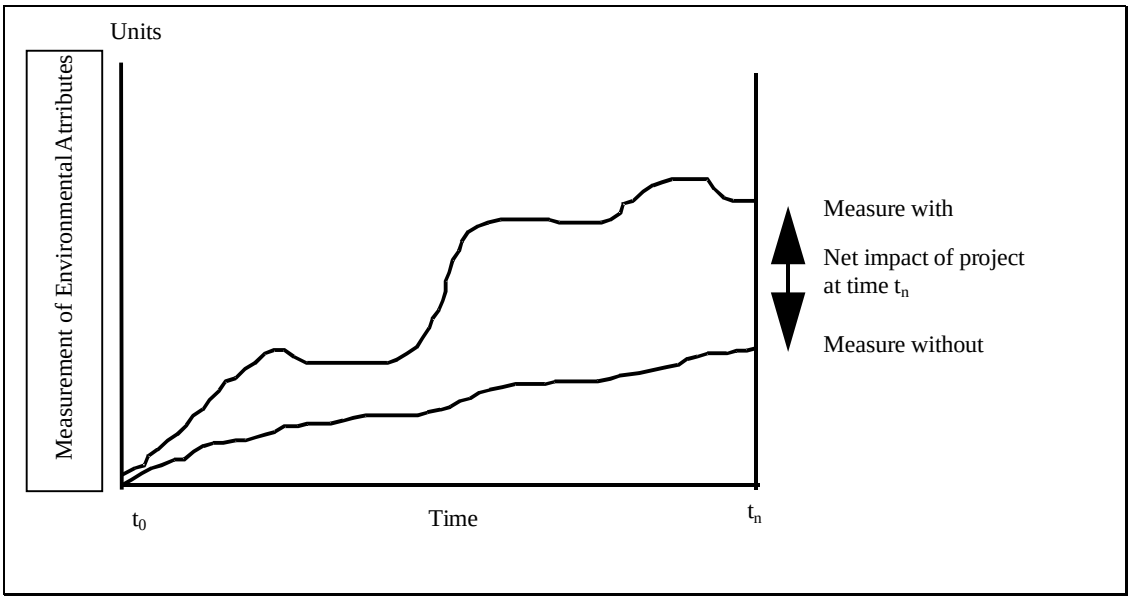
[2] Annexure 2 provides an example of a no-project result from a project-level EIA in South Africa.

Box 10.1: Environmental Attributes for Projects

Air		*Ecology*	
1.	Diffusion	27.	Large animals (wild and domestic)
2.	Particulates	28.	Predatory birds
3.	Sulfur oxides	29.	Small game
4.	Hydrocarbons	30.	Fish, shellfish, and waterfowl
5.	Nitrogen oxide	31.	Field corps
6.	Carbon monoxide	32.	Threatened species
7.	Photochemical oxidants	33.	Natural habitat and vegetation
8.	Hazardous toxicants	34.	Aquatic plants
9.	Carbon dioxide		
Water		*Sound*	
10.	Aquifer safe yield	35.	Physical effects
11.	Flow variations	36.	Psychological effects
12.	Oil	37.	Communication effects
13.	Radioactivity	38.	Performance effects
14.	Suspended solids	39.	Social behaviour effects
15.	Thermal pollution		
16.	Acid and alkali	*Human Aspects*	
17.	Biochemical oxygen demand (BOD)	40.	Lifestyles
		41.	Psychological needs
18.	Dissolved oxygen (DO)	42.	Physiological systems
19.	Dissolved solids	43.	Community needs
20.	Nutrients		
21.	Toxic compounds		*Economics*
22.	Aquatic life	44.	Regional economic stability
23.	Fecal coliforms	45.	Public sector review
		46.	Per capita consumption
Land			
24.	Soil stability	*Resources*	
25.	Natural hazard	47.	Renewable resources
26.	Land-use patterns	48.	Non-renewable resources
		49.	Aesthetics

The EIA measures attributes with and without the project, or an activity within the project at a given point in time (Figure 10.1). The measure of attributes may change over time without the activity. The impacts have to be measured in terms of the "net" changes in the attribute at a given point in time. The main steps in an EIA are thus, (1) describe baseline the situation; (2) identify the potential impacts (through screening, scoping); (3) measure the impacts; (4) aggregate impacts on the environment; and (5) propose mitigation measures to minimise the environmental impacts which need to be monitored during the project.

Figure 10.1: Measure of impact with and without a project



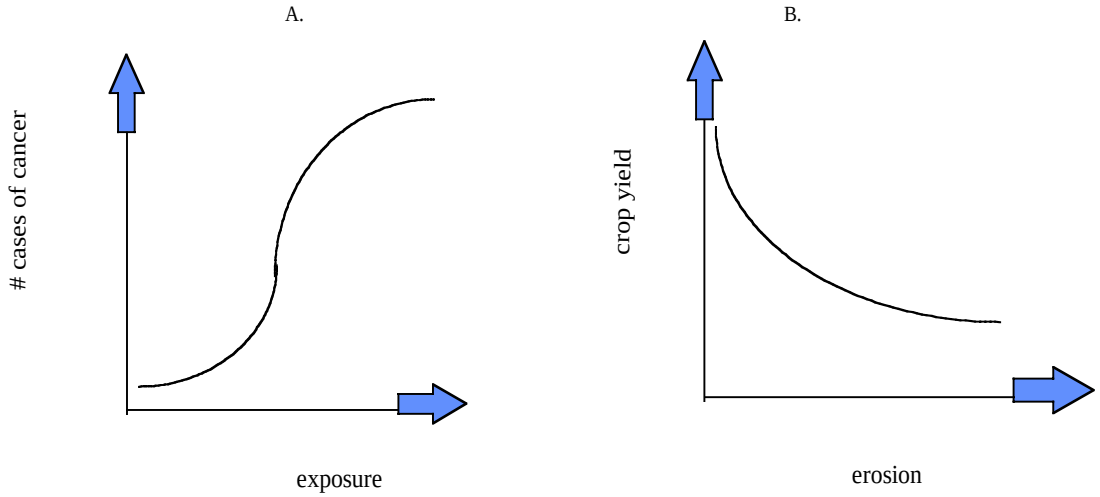
The nature and importance of the impact is determined by the conditions of the environment without the project. The stressors may have impacts beyond the boundary and time frame of the project. Baseline analysis is more than making a statement on the initial environment of the proposed project. Because projections of future environmental conditions that may affect the project should also be made, it is necessary to adopt a dynamic and not static approach to the study of the environment. In effect, the baseline analysis should permit a comparison of project-induced environmental changes with other expected environmental changes in the no-project situation. This dynamic approach may be more challenging, but will engender useful additional studies and dialogues. It should take account of: (a) past trends in environmental quality over time, (b) community preferences or competing demands regarding resource utilisation, and (c) other current or proposed development programs and projects under study. The quality of the analysis of baseline conditions establishes the viability of the appraisal of the impacts, and therefore of the EIA itself.

Identifying impacts involves two aspects: the *stressors*, or sources of impacts i.e. what causes the impacts created by a project activity, and the *receptors*, or the attributes (refer again to Box 10.1). This identification is done through a *screening* followed up by a *scoping* procedure. The *screening* determines if a project needs a full EIA, a partial EIA or none. The *scoping* identifies the project's main environmental impacts and the depth of the analysis

required. The terms of reference of the EIA are often established at that point. The nature and importance of the impact is determined by the conditions of the environment without the project. The stressors may have impacts beyond the boundary and time frame of the project.

For each type of potential important impact or environmental concern, the analysis should predict the nature and significance of the expected impacts, or explain why no significant impacts are anticipated. Some environmental effects are quantifiable, while others may need to be described qualitatively. Impacts should be quantified in terms of their physical effects on human health and welfare, and on ecosystems. The impact of a stressor on a receptor, or environmental attributes, may be modelled by dose-response functions (Figure 10.2). Such information is not often readily available and can be costly to gather. Often the dose function are transferred from other studies and modified for the difference in geography, duration of exposure and population specifics.

Figure 10.2: Illustration of dose response functions



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Once all the impacts of a project have been identified and quantified as well as possible, one has to value the impacts and develop a new project cash flow integrating the environmental impacts. However, such an ideal situation in which a dose-response exists and can be valued and entered into a cash flow is often the exception. Attributes may have to be aggregated or compared to each other. Some type of ranking relying on expert judgement may have to be

developed using a Delphi method for instance. The comparison then becomes multi-criteria[3] rather than trying to reduce all costs and benefits into monetary measures. It also has greater potential to capture non-use values.

In an EIA, mitigation measures may be proposed to avoid or diminish environmental and social impacts. Then, new activity or production processes can be proposed resulting in a new input-output schedule and cash flows. In an economic appraisal, the alternatives can then be compared in terms of the economic viability (Net Present Value, Internal Rate of Return). If benefits are difficult to estimate, the analysis can focus on cost-effectiveness[4]. If changing the project or introducing different activities or technologies is not possible, the analyst will see if the negative components of a project or the project itself should not be eliminated altogether. If not, compensation can be sought which can be materials for reconstruction, prevention, shadow project to follow a no-net-loss policy, or financial such as compensation for loss of property or some property right.

10.4.3 Detailed Project-level EIA Process

Various institutions and countries implement different project-level EIA processes. However, they all follow the logic of the with-without analysis just presented. The World Bank process is provided as one example (Figure 10.3). The reader should be reminded that the Bank process is geared to support loan disbursements and thus some of the steps might not occur in other countries where financing is through internal resources or various donors.

a) Screening

Screening is used to decide the nature and extent of the EIA to be carried out. The environmental review process begins with environmental screening at the time a project is identified. In the screening, the Bank team determines the nature and magnitude of the proposed project's potential environmental and social impacts, and assigns the project to one of three environmental categories (Box 10.2). Most screening processes in eastern and southern Africa are similar in having three categories of projects. The main difference is that in some countries, the order is reversed (category A does not require an EIA, while category

[3] See module 8 for more detailed information on multi-criteria analysis.

C does)[5]. The reason for initial screening is simple; not all projects have significant environmental impacts and thus do not warrant a full-blown and expensive EIA.

b) Scoping

A scoping process is undertaken to identify key issues and develop the Terms of Reference (TOR) for the EIA once a project is categorised. It is essential to identify more precisely the likely environmental impacts and to define the project's area of influence at this stage. As part of this process, information about the project and its likely environmental effects is disseminated to local affected communities and NGOs, followed by consultations with representatives of the same groups. The main purpose of these consultations is to focus the EIA on issues of concern at the local level.

Box 10.2: Classifying EIAs by World Bank Category

Category A: A full EIA is required. These projects are expected to have adverse impacts that may be severe, irreversible and diverse, with attributes such as direct pollutant discharges large enough to cause degradation of air, water or soil; large-scale physical disturbances of the site and/or surroundings; extraction, consumption or conversion of substantial amounts of forest and other natural resources; measurable modification of hydrological cycles; hazardous material in more than incidental quantities; and involuntary displacement of people and other significant social disturbances.

Category B: Although a full EIA is not required, some environmental analysis is necessary. Category B projects have impacts which are less significant, and not as sensitive, numerous, major or diverse. Few, if any of these impacts are irreversible, and remedial measures can be more easily designed. Typical Category B projects entail rehabilitation, maintenance or upgrading rather than new construction.

Category C: No EA or other environmental analysis is required. Category C projects have negligible or minimal direct disturbance on the physical setting. Typical Category C projects focus on education, family planning, health and human resource development. Projects with multiple components are classified according to the component with the most significant adverse impact if there is a Category A component, the full project is classified as A.

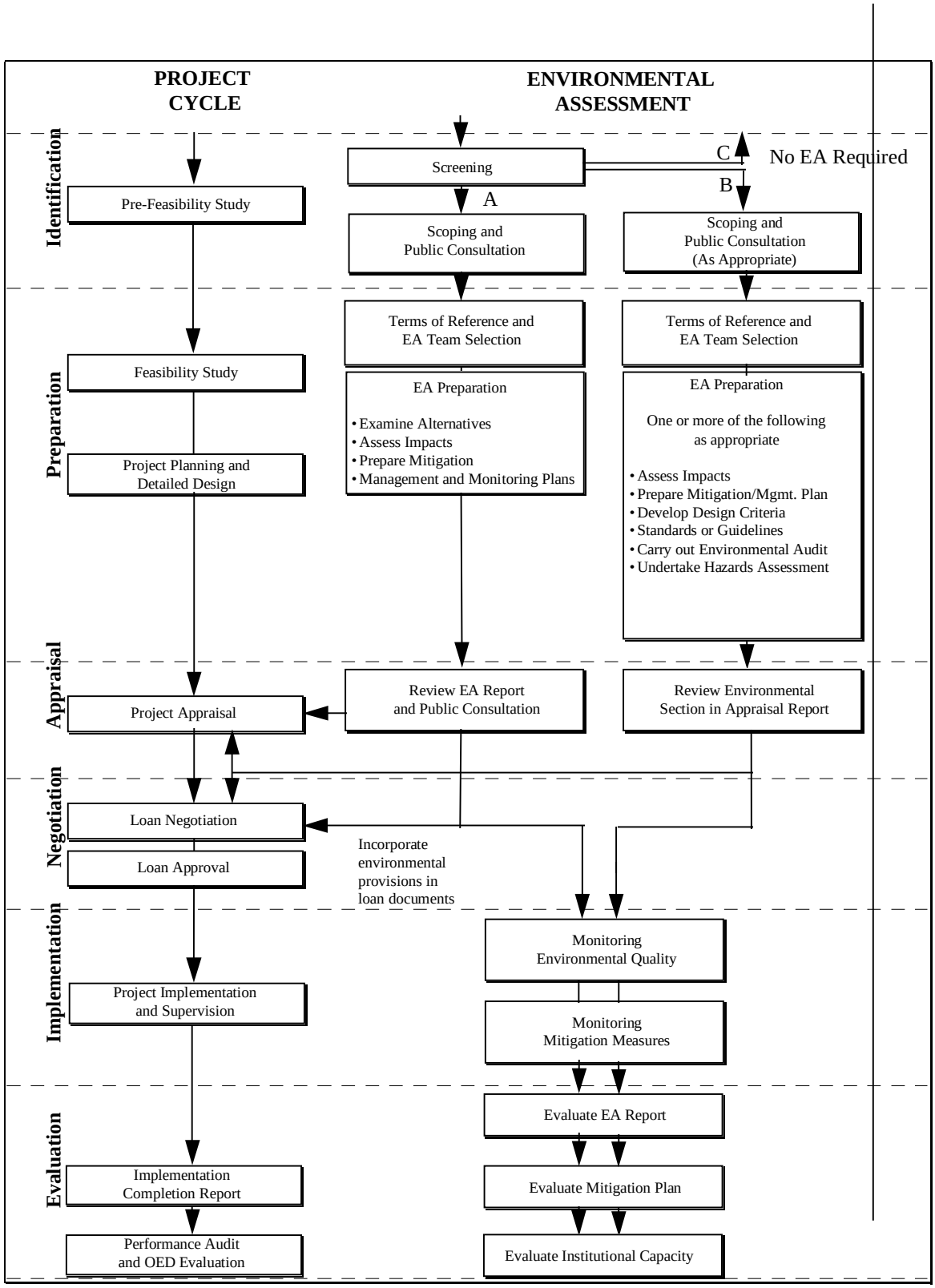
[4] Refer to module 8 for a detailed discussion of various appraisal techniques.
[5] Refer to Annexure 3 for European Union EIA screening categories.

The structure of the EIA is important. When a project is classified as Category A, a full-scale EIA is undertaken, and presented in an EIA report. Category B projects are subject to a more limited EIA, the nature and scope of which is determined on a case-by-case basis. The main components of a full EIA report are explained in Box 10.3. What is important for the economist is that the baseline without the project and the projected environmental impacts with the project are clearly reported. The information should be easily translatable in an input-output schedule for an economic analysis. Alternatively some clear indicators per project alternatives should be provided. This information will form the backbone of the cash flow analysis and the comparison of project alternatives.

Once the draft EIA report is complete, the borrower submits it to the Bank for review by environmental specialists. If found satisfactory, the Bank project team is authorised to proceed to appraisal of the project. On the appraisal mission, Bank staff review the EIAs procedural and substantive elements with the borrower, resolve any outstanding issues, and assess the adequacy of the institutions responsible for environmental management in light of the findings. They also ensure that the mitigation plan is adequately budgeted, and determine if the EIA recommendations are properly addressed in project design and economic analysis.

The borrower is responsible for implementing the project according to agreements derived from the EIA process. The Bank supervises the implementation of environmental aspects as part of overall project supervision, using environmental specialists as necessary. An ex-post evaluation of the project and its EIA is carried out after the project ends. This information will allow the improvement of the EA process and project effectiveness of similar projects in the future

Figure 10.3: World Bank EIA process



10.4.4 Project-Level EIA Tools

Different techniques apply to the different steps of an EA especially, Identification - Prediction and Project options comparison. Ideally, significance once the environmental impacts have been identified, the difference with and without the project on the environment is calculated using engineering or biophysical information (production function - dose-response function) and an economic analysis is made based on that information. If this scenario is not possible, different presentation type tools can be used in particular for impact identification: Check list, overlays, matrices, networks, and simulation models. The differences between these tools lie in the explanatory power linking cause and effects.

Checklists present a specific list of environmental parameters to be investigated for possible impacts or a list of activities known to have caused environmental concern. They are useful for categories of projects but do not establish cause-effect link. An example used by the European Union (EU) for the EA screening process is provided in Figure 10.4. The EU checklists for all sectors are provided in Annexure 4.

Matrix related project activities or stressors with possible receptors and their interaction can be indicated as important or not in the corresponding cells. An example of a Leopold matrix is provided in Figure 10.5 for a phosphate-mining lease. The matrix could have different units in the boxes, a “yes-no”, a check-mark signifying a linkage, a simple score out of five or ten points, or a multiple score as shown where the lower unit represents weight and the upper number a score.

Networks provide a logical display of impact initiating activities with a number of phases moving left to right identifying impacts. They indicate the impact causes and effects between stressors and receptors as pictured in Figure 10.6.

Computer-aided methods are developing fast. Geographic Information Systems are helpful to organise overlays. Mathematical models develop stressor-receptors and dose-response functions. These methodologies use a combination of tools to identify activities with potential impact, and to propose mitigation. They use models establishing cause-effect relationships and form the basis of Environmental Information Systems. Ecozone is an example of such system to help organise environmental impacts of Agriculture projects.