Lecture 4

EIA Documentation and Processes

STRUCTURE

OVERVIEW

In Unit 3, we discussed environmental impact assessment (EIA) as a preventive environmental management and decision-making tool. We also touched upon EIA report, known as environmental impact statement (EIS). In that context, we said that EIS is an outcome of a EIA study and documents the environmental consequences of a specific development proposal. We also said that its purpose is to facilitate a full accounting of environmental

effects, along with economic and social factors, in decisions as to whether a project should proceed, be modified to ameliorate consequences or be abandoned. We will discuss these in detail in the present Unit, i.e., Unit 4.

In this Unit, we will discuss the processes involved in the preparation and review of EIS. We will begin the Unit by discussing the processes involved in EIA documentation. We will then explain how EIS should facilitate impact predictions, evaluation, and mitigation.

We will then discuss the impact the report can have on decision-making. We will also touch upon the importance of involving the problems in EIA reporting in order that it forms acceptability and EIA monitoring and auditing.

LEARNING OBJECTIVES

After completing this Unit, you should be able to:

- discuss EIA process management and EIA stages;
- explain environmental impact predictions, evaluation and mitigation;
- discuss how EIA reports or EIS contribute to decision-making;
- review, monitor and audit EIA reports for decision-making.

4.1 PRELIMINARY STAGES OF EIA

Before we discuss the stages of EIA, let us spend a few minutes on EIA process management.

Environmental impact assessments often deal with major (and sometimes poorly defined) projects, with many wide-ranging and often controversial impacts. They can also involve many participants with very different perspectives on the relative merits and impacts of projects. It is important that the EIA is well managed, and, essentially, the EIA process is a management-intensive process (Glasson, et al., 1994).

The EIA process invariably involves an interdisciplinary team approach, and such an approach reflects the normal scope of EIA studies which range from the biophysical to the socio-economic. The team producing the EIS may be one, or a combination, of the proponents in-house, lead external consultants, external sub-consultants and individual specialists.

The team project manager has a pivotal role to play. In addition to personnel and team management skills, the manager should have a broad appreciation of the project type under consideration, knowledge of the relevant processes and impacts subject to EIA, the ability to identify important issues and preferably a substantial expertise in the area of work. The role of a project manager, in the main, consists of:

- selecting an appropriate project team;
- managing specialist inputs;
- liasing with the people involved in the process;
- managing the change in the internal and external environment of the project;
- Co-ordinating the contributions of the team in the various documentary outputs.

The management team has to co-ordinate the resources, i.e., information, people and equipment, to achieve a EIA study of quality, on time and within its budget.

LEARNING ACTIVITY 4.1

Explain in no more than 50 words, what will happen if the project proponent prepares the EIA report.

Note:
a) Write your answer in the space given below.
b) Check your answer with the one given at the end of this Unit.

In Subsection 3.1.2 (Unit 3), we listed the steps in the EIA process. In what follows in the present Section, we will discuss some of these steps in detail.

The preliminary stages of an EIA consist of the following steps:

- Project screening.

- Scoping.
- Consideration of alternatives.
- Establishment of environmental baseline.
- Impact identification.

In Subsections 4.1.1 to 4.1.5 we will discuss each of these steps.

4.1.1 Project screening

The number of projects that could be subjected to EIA is potentially very large. Yet, many projects have no substantial or significant environmental impacts. A screening mechanism seeks to focus on those projects with potentially significant adverse environmental impacts or where the impacts are not fully known. Those with little or no impacts are screened out and are allowed to proceed to the normal planning permission/administrative processes without any additional assessment and without additional loss of time and expense.

Screening can be partly determined by the EIA regulations operating in a country at the time of the assessment. In countries like the UK, there are some projects that will always be screened out for full assessment, by virtue of their scale and potential environmental impacts (e.g., a crude oil refinery, a sizeable thermal power station, a special road, etc.). There are many other projects where the screening decision is less clear. In this scenario, two examples of the project may be screened in different ways (one ‘in’, one ‘out’ for full assessment) based on a combination of criteria, including project scale, sensitivity of proposed location and expectation of adverse environmental impacts.

Some EIA procedures include an initial EIA study to check on the likely environmental impacts and their significance. An initial study, which is usually a simple checklist against which environmental impacts must be ticked as 'yes', 'maybe' or 'no' must substantiate the declaration. If the responses are primarily 'no', most of the 'yes' and 'maybe' can be mitigated, then the project may be screened out from a full EIA (Glasson, et al., 1994).

LEARNING ACTIVITY 4.2

List 3 aspects that need to be considered in the screening of projects for EIA.

Note:
a) Write your answer in the space given below.
b) Check your answer with the one given at the end of this Unit.

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4.1.2 Scoping

The scope of the EIA depends on the impacts and issues that it addresses. The process of scoping is to determine the key impacts of the project. An initial scoping of possible impacts may help distinguish the key impacts from those thought to be non-significant and unclear. Further studies should examine the impacts in the various categories. In the process, those identified as non-significant are eliminated and those in the uncertain

category, but maybe potentially significant, are added to the initial category of other potentially significant impacts. This refining of focus onto the most significant impacts continues throughout the EIA process.

Scoping is carried out generally in discussions among the developer, the competent authority, other relevant agencies and ideally the public. It is often the first stage of negotiations and consultation between a developer and other interested parties. It is an important step in EIA because it enables the limited resources of the team preparing a EIA to be allocated to the best effect, and prevents misunderstanding among the parties concerned about the information required in the report. Scoping can also identify issues that should later be monitored.

Scoping should begin with the identification of individuals, communities, local authorities and statutory consultees likely to be affected by the project.

A good practice is to bring them together in a working group and/or meetings with the developer. Other key issues could include particularly valued environmental attributes; those impacts perceived to be of particular concern to the affected parties; and social, economic, political and environmental issues related to the specific locality. Reference should be made to relevant structure plans, local plans, subject plans and government policies and guidelines. The end result of this process of information collection and negotiation should be the identification of key issues and impacts, an explanation of why other issues are not considered significant and, for each key impact, a defined temporal and spatial boundary within which the impact will be measured (Glasson, et al., 1994).

LEARNING ACTIVITY 4.3

What are the advantages of scoping in the EIA process?

Note:
a) Write your answer in the space given below.
b) Check your answer with the one given at the end of this Unit.

4.1.3 Consideration of alternatives

The question of options is particularly important to decide whether or not the selected option is really justified. In other words, by considering alternatives, the worth of the option is determined with other credible alternatives, in environmental, functional, economic and social terms. The rigorous comparison of viable alternatives:

- strengthens decision-making;
- strengthens public credibility;

- Improves the methodology of the EIA and the integration of the techniques used for relative comparisons.

To help decision-makers, a EIA report must present clear choices on the planning and implementation of the project, and it should make clear the likely results of each option. For instance, to mitigate adverse impacts, the EIA could propose:

- pollution control technology or design features;
- reduction, treatment or disposal of wastes;
- compensation or concessions to affected groups.

It should be obvious that options must be comparable. In other words, they must be developed to an equal level of detail, a level that must permit measurement of impacts, again at an equivalent level.

In reality, this condition can be met only if the project under examination has evolved by examining options. For example, a common failing lies with site selection. The purchase of sites in the effort to force on them a project that is unsuited to the planning environment, or to the physical and foundation conditions, has been a frequent mistake that would have emerged clearly had the siting options been evaluated.

If you are presented with a project in which site selection has not been the result of a credible options study, or in which the industrial process chosen suffers a similar deficiency, you have a problem that can be solved only by persuading the project sponsor to carry out option studies at a later stage. It is probable that different personnel from those associated with the original project development would have to be employed. While comparisons should as far as possible be quantitative, this is not

feasible in all cases. For example, a comparison of the social, cultural or visual impacts of project options must be inevitably the outcome of subjective judgements.

At the simplest level of quantitative comparison, there is the quantified volume of earthwork for two optional road routes, or the measured area of forest eliminated, or the number of stream crossings involved. These all will give some primary guidance as to the extent of the impact that will perhaps be sufficient for a preliminary assessment. Each of the impacts would have to be followed further in a formal EIA. For example, while earthwork quantity may give a first order assessment of possible damage, the effect on water table may be related to depth of cutting. The options may have different visual significance, and therefore, the location and effects of soil dumps may also have to be considered. The area of forest removed does not (but should) take into account forest composition effects, or the presence or absence of rare plants.

Note that this step, i.e., consideration of alternatives, is not a requirement in some countries. This is, in other words, more of a voluntary action than of a mandatory requirement in these countries.

LEARNING ACTIVITY 4.4

Do you feel that the procedure for EIA can be defined as a procedure for designing engineering systems? Justify your answer in no more than 50 words.

Note:
a) Write your answer in the space given below.
b) Check your answer with the one given at the end of this Unit.

4.1.4 Establishing the environmental baseline

The establishment of environmental baseline includes both the present and likely future state of the environment, assuming that the project is not undertaken, taking into account changes resulting from natural events and from other human activities (Glasson et al., 1994). For example, the population of a species of fish in a lake may already be declining even before the potential introduction of an industrial project on the lakeshore.

Initial baseline studies may be wide ranging, but comprehensive overviews can be a waste of resources. The studies should focus as quickly as possible on those aspects of the environment that may be significantly affected by the project, either directly or indirectly. The rationale for the choice of focus should be explained with reference to the nature of the project and to initial scoping and consultation exercises. Although the studies would normally take the various environmental elements separately, it is also important to understand the interaction between them and the functional relationship involved – flora, for example, will be affected by air and water quality and fauna will be affected by flora. This will facilitate prediction.

Baseline studies can be presented in the EIS in a variety of ways. These often involve either a brief overview of both the physical and socio-economic environments of the area of study, following the project description, with the detailed focus studies in subsequent impact chapters (e.g., air quality, geology, employment). Alternatively, a more comprehensive set of detailed studies is presented at an early stage, providing a point of reference for future and often briefer impact chapters. A framework for analysing each baseline sub-element is given in Table 4.1.

Table 4.1
Framework for Analysing Each Baseline Sub-Element

Sub-Element	Objectives	Required Information/ Specialist(s)	Methodology	Findings/ Measurements
Water quality	Protection of human and aquatic life	Existing water quality; possible sources of pollution: runoff, leakage from waste treatment system, surface seepage of pollutants, intrusion of saline or polluted water; capacity of treatment system. Water quality analyst; aquatic biologist; water pollution control engineer; sanitary and civil engineers	Laboratory analyses or field measurement of water quality; pollution indices	Potential for degradation of water quality; safety of potable water.
Surface Water	Protection of plant and animal life; water supply for domestic and industrial needs; natural water purification systems; groundwater recharge and discharge; and recreation and	Location of surface waters-streams, rivers, ponds, lakes, etc.; surface water volume, flow rates, frequency and duration of seasonal variations; 7 day, 10 year low flow; water uses; ecological characteristics; recreation and aesthetic 'uses'. Hydrologist/ ecologist.	Measure proximity of site to surface waters; field measurement of volume, rate and direction of water movement; categories of water usage; ecological assessment.	Potential modification of volume, rate and direction of water movement; impact on ecological character; degree and type of water usage.

Sub-Element	Objectives	Required Information/ Specialist(s)	Methodology	Findings/ Measurements
	aesthetic values.			

The final step, i.e., impact identification is the most important and explains the various methodologies used in EIA. Before we discuss this step, let us do Learning Activity 4.5.

LEARNING ACTIVITY 4.5

List the months that are important for baseline data collection for establishing ambient air quality, surface water quality and ground water quality.

Note:
a) Write your answer in the space given below.
b) Check your answer with the one given at the end of this Unit.

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4.1.5 Impact identification

Impact identification brings together project characteristics and baseline environmental characteristics with the aim of ensuring that all potentially significant environmental impacts (adverse or favourable) are identified and taken into account in the EIA process. A wide range of methods has been developed for the purpose.

Many of the methods were developed in response to the NEPA and have since been expanded and refined. The simplest involves the use of lists of impacts to ensure that none has been left out.

The most complex include the use of interactive computer programmes, networks showing energy flows and schemes to allocate significance weightings to various impacts.

In choosing a method, however, the analyst needs to:

- ensure compliance with regulations;
- provide a comprehensive coverage of a full range of impacts including social, economic and physical;
- distinguish between positive and negative, large and small, long-term and short-term, reversible and irreversible impacts;
- identify secondary, indirect and cumulative impacts as well as direct impacts;
- distinguish between significant and insignificant impacts;
- allow comparison of alternative developmental proposals;
- consider impacts within the constraints of an area's carrying capacity;
- incorporate qualitative as well as quantitative information;
- be easy and economical to use;
- be unbiased and to give consistent results;
- be of use in summarising and presenting impacts in the EIS.

Environmental impact assessment methodologies

There is no single "best" methodology for environmental impact assessment. Characteristics of a methodology such as the type of impacts or projects covered and the resources required may be virtues in one, but vices in another. Only the user can determine which tools may best fit a specific task. In selecting the most appropriate tools, the following key considerations may be useful:

(i) **Use:** Is the analysis primarily a decision or an information document? (A decision document is vital to determine the best course of action, while an information document is intended primarily to reveal the implications of a single, clearly best choice.) A decision document analysis will generally require a more comprehensive analysis concentrating on interpreting the significance of a broader spectrum of possible impacts.

(ii) **Alternatives:** Are alternatives fundamentally or incrementally different? If differences are fundamental, such as preventing flood damage by levee construction as opposed to flood plain zoning, for example, then impact significance can better be measured against some absolute standard than by direct comparison of alternatives, since impacts will differ in kind as well as size. Fundamentally and incrementally different alternative sets require different levels of analysis to discriminate between alternatives and also require greater degree of quantification.

(iii) **Public involvement:** Does the anticipated role of the public in the analysis involve substantive preparation, token review, or vital review? The first two roles allow the use of more complex techniques such as computer or statistical analysis that might be difficult to explain to a previously uninvolved but highly concerned public. A substantive preparation role will also allow a greater degree of quantification or weighting of impact significance through the direct incorporation of public values.

(iv) **Resources:** How much time, skill, money, data and computer facilities are available? Generally, more quantitative analysis requires more of everything.

(v) **Familiarity:** How familiar is the analyst with both the type of action contemplated and the physical site? Generally, familiarity will improve the validity of a more subjective analysis of impact significance.

(vi) **Issue significance:** How big is the issue in terms of controversy and scope? All other things being equal, the bigger the issue the greater the need for explicitness, quantification, and identification of key issues and the less appropriate is the arbitrary significance weights or specific formulas for trading-off one type of impact (e.g., environmental) against another type (e.g., economic).

(vii) **Administrative constraints:** Are choices limited by the agency procedural or format requirements? Specific agency policy or guidelines may rule out some tools by specifying the range of impacts to be addressed, the need for analysing trade-offs, or the time frame of analysis.

Categorising methodologies

The various methodologies examined can be divided into the following five types based on the way impacts are identified:

(i) **Ad hoc:** These methodologies provide minimal guidance to impact assessment beyond suggesting broad areas of possible impacts (e.g., impacts on flora and fauna, impacts on lakes, forests, etc.), rather than defining specific parameters to be investigated.

(ii) **Overlays:** These methodologies rely on a set of maps of environmental characteristics (physical, social, economic, aesthetic, etc.) for a project area. These maps are overlaid to produce a composite characterisation of the regional environment. Noting the impacted environmental

characteristics lying within the project boundaries identifies impacts.

(iii) **Checklists:** These methodologies present a specific list of environmental parameters to be investigated for possible impacts but do not require the establishment of direct cause-effect links to project activities. They may or may not have guidelines on how parameter data are to be measured and interpreted. The basic categories of checklists are:

- simple checklists (these consist of lists of environmental, economic and social factors, which may be affected by specific project actions) and
- Questionnaire checklists (these present a series of questions relating to the impacts of a project. Note that a sample questionnaire checklist is given below). Note that this questionnaire checklist was developed by the US Agency for International Development (1980). The method was designed for the assessment of rural development projects in developing countries. The questions are listed under generic categories such as terrestrial ecosystems and disease vectors. Those assessing projects must attempt to answer all the questions and three answers are possible, depending upon how much is known about a particular impact.

(iv) **Matrices:** These methodologies incorporate a list of project activities in addition to a checklist of potentially impacted environmental characteristics. These two lists are related in a matrix, which identifies cause-effect relationships between specific activities. Matrix methodologies may specify the actions and the corresponding impact on environmental characteristics or may simply list the range of possible

actions and characteristics in an open matrix to be completed by the analyst.

(v) **Networks:** These methodologies work from a list of project activities to establish cause-condition-effect-networks. They are an attempt to recognise that a series of impacts may be triggered by a project action. These approaches, generally, define a set of possible networks and allow the user to identify impacts by selecting and tracing out the appropriate project actions.

A sample questionnaire checklist

In what follows, we present a section of a questionnaire checklist dealing with terrestrial ecosystems.

a.	Are there any terrestrial ecosystems of the types listed below which, by nature of their size, abundance or type, could be classified as significant or unique?				
		Forest? Savanna? Grassland? Desert?	Yes Yes Yes Yes	No No No No	Unknown Unknown Unknown Unknown
b.	Are these ecosystems				
		Pristine? Moderately Degraded? Severely Degraded?	Yes Yes Yes	No No No	Unknown Unknown Unknown
c.	Are there present trends towards alteration of these ecosystems through cutting, burning, etc. to produce agricultural, industrial, or urban land?		Yes	No	Unknown
d.	Does the local population use these ecosystems to obtain				

	non-domesticated:				
		Food plants? Medicinal plants? Wood products? Fiber? Fur? Food animals?	Yes Yes Yes Yes Yes Yes	No No No No No No	Unknown Unknown Unknown Unknown Unknown Unknown
e.	Will the project require clearing or alteration of: Small areas of land in these ecosystems? Moderate areas of land in these ecosystems? Large areas of land in these ecosystems?		 Yes Yes Yes	 No No No	 Unknown Unknown Unknown
f.	Does the project rely on any raw materials (wood, fibre) from these ecosystems?		Yes	No	Unknown
g.	Will the project decrease use of products from these ecosystems by producing or providing substitute materials?		Yes	No	Unknown
h.	Will the project cause increased population growth in the area, bringing about increased stress on these ecosystems?		Yes	No	Unknown
Estimated Impact on Terrestrial Ecosystems... ND..HA..MA..LA..O..LB..MB..HB					

Legend

ND	-	Not determinable	HA	-	High adverse
MA	-	Medium adverse	LA	-	Low adverse
O	-	Low or insignificant	LB	-	Low benefit
MB	-	Medium benefit	HB	-	High benefit

Note that the EIA process is set within an institutional context and the context will vary from country to country. The various steps in the process can be taken in different sequences, and some may even be missing in certain countries.

LEARNING ACTIVITY 4.6

Can you name a project where preliminary EIA should be carried out? Justify your answer in no more than 50 words.

Note:
a) Write your answer in the space given below.
b) Check your answer with the one given at the end of this Unit.

4.2 IMPACT PREDICTION, EVALUATION AND MITIGATION

EIA is all about prediction and is needed at the earliest stages when the project, including alternatives, is being planned and designed, and this continues through to mitigation, monitoring and auditing. Evaluation follows from prediction and involves an assessment of the relative significance of the impacts. The methods of evaluation range from intuitive to the analytical, from qualitative to quantitative, and from formal to informal. Cost benefit analysis, monetary valuation techniques, and multi-criteria/multi-attribute methods, with their scoring and weighting systems, provide a number of ways for the evaluation issues. Mitigation of significant adverse effects involves the measures to avoid, reduce,

remedy or compensate for the various impacts associated with projects. We will discuss these in Subsections 4.2.1 to 4.2.3, respectively.

4.2.1 Prediction

Environmental impact is any alteration of environmental conditions or creation of a new set of environmental conditions – adverse or beneficial – caused or induced by the project under consideration. The impact depends on the nature, scale and location of the proposed activity, and it includes the effect on the natural resource base (i.e., the quality of air, water, noise, biological) and socio-economic components of the environment which determine the cost of environmental management.

The impacts can be classified as primary, which can be attributed directly to the project, and secondary, which are indirect changes and typically include the changed patterns of socio-economic activities likely to be stimulated or induced by the proposed activity.

A EIA, partly answers the question: What will happen as a result of the project? But, if a preliminary assessment is carried out, it will broadly review the project's effects. Also, scoping helps the decision-makers identify the most important issues. Taking these findings into account and after collecting the baseline environmental data, the full EIA study formally identifies such of the impacts as are to be assessed in detail. The methods used at the identification phase of the study include the following:

(i) Compile a candidate list of key impacts such as changes in air quality, noise levels, wildlife habitats, species diversity, landscape views, social and cultural systems, settlement

patterns and employment levels. This data is drawn from as many EIA studies carried out on similar projects as possible.

(ii) Name all the project's *sources* of impacts (e.g., smoke emissions, water consumption, construction jobs) using checklists or questionnaires and then list possible *receptors* in the environment (e.g., crops, communities using the same water for drinking, migrant labourers) by surveying the existing environment and consulting with interested parties. Where the sources affect the receptors, a potential impact is suspected.

After identifying the environmental components likely to be impacted by the proposed activities the next logical step is impact prediction, which answers the question: What will be the extent of the changes? Prediction scientifically characterises the impact's causes and effects, and its secondary and synergistic consequences for the environment and the local community. It follows an impact within a single environmental parameter (e.g., a toxic liquid effluent) into its subsequent effects in many disciplines (e.g., reduced water quality, adverse impacts on fisheries, economic effects on fishing villages and resulting socio-cultural changes). Prediction draws on the physical, biological, socio-economic and anthropological data and techniques. In quantifying impacts, it may employ various tools such as mathematical models, photomontages, physical models, socio-cultural models, economic models, experiments, expert judgement, etc.

To prevent unnecessary expenses, the sophistication of the prediction methods used should be kept in proportion to the scope of the EIA. For instance, a complex mathematical model of atmospheric dispersion should not be used, if only a small amount of relatively harmless pollutant is emitted. Simpler models are available and are sufficient for the purpose. Also, it is

unnecessary to undertake expensive analysis, if they are not required by the decision-makers for whom the EIA is being done.

All prediction techniques, by their nature, involve some degree of uncertainty. So, along with each attempt to quantify an impact, the study team should also quantify the prediction's uncertainty in terms of probabilities or margins of error.

One of the criticisms against EIA is that it does not give the prominence the social and cultural impacts deserve in describing the extent of changes expected to result from a major development project. Socio-cultural impacts should be integrated into every discussion of physical/biological change.
Below is the case that highlights the prediction techniques in brief

In order to choose impact predictive techniques consider:
- Appropriateness'
- Production of required results
- Replicability, freedom from analytical bias
- Consistency, allows comparison between studies

Models considered for prediction include
- Extrapolative: where prediction is based on past data, trend analysis.
- Normative: establish desired outcome and work backwards
- Retail impact models using gravity models principles
- 21 models for Phosphorous retention in lakes

Few methods recommended are
- Analogue models
- Mass balances
- Field and lab experiments
- Physical images, computer graphics
- Statistical models
- TOC, Leopold,
- Networks - good on indirect impacts
- Overlays - good for spatial impacts

Advantages of these models
- These encourage definition of assumptions and use of statistical probabilities
- These models are also useful when there are simple calculations, complex links and when impacts are time dependent.

4.2.2 Evaluation

This step evaluates the predicted adverse impacts to determine whether they are significant enough to warrant mitigation. In other words, evaluation attempts to find an answer for the question: Do the changes matter? The judgement of can be based on one or more of the following:

- Comparison with laws, regulations or accepted standards.
- Consultation with the relevant decision-makers.
- Reference to pre-set criteria such as protected sites, features or species.
- Consistency with government policy objectives.
- Acceptability to the local community or the general public.

How to estimate significance of an impact?

Step 1: Assign consequence to each environmental impact

Consequence category	Ranking
Catastrophic	5
Major	4
Moderate	3
Minor	2
Negligible	1
None	0
Positive	+

Step 2: Assign Likelihood

Category	Ranking	Definition
Certain	5	The activity will occur under normal operational conditions.
Very Likely	4	Very likely to occur under normal operating conditions
Likely	3	Likely to occur at some time under normal operating conditions
Unlikely	2	Unlikely to but may occur at some time during normal operating conditions
Very Unlikely	1	Very unlikely to occur under normal operating conditions, but may occur under exceptional circumstances.

Step 3: Predict significance of environmental impact

Criteria for significance

- Magnitude of likelihood of impact
- Spatial and temporal extent
- Likely recovery
- Value of effected environment
- Level of public concern
- Political repercussions

Consequence x Likelihood	Significance
>16	Critical
9-16	High
6-8	Medium
2-5	Low
<2	Negligible

In this way significance can be judged and impact can be evaluated.

The scaling-weighting technique

Scaling of the effects addresses issues of magnitude and is based on a numerical system in which the highest number represents a very good effect and the lowest number represents a very adverse

effect. The mid-point indicates an average effect, or a neutral one. Scaling can be used either alone to determine some composite score for magnitude or with a weighting scheme to incorporate considerations of importance or significance. With weighting, values are assigned to elements of the environment (or of a proposal) based on their relative importance or significance. The end result can be either a total score or a group of scores representing various sectors of the environment.

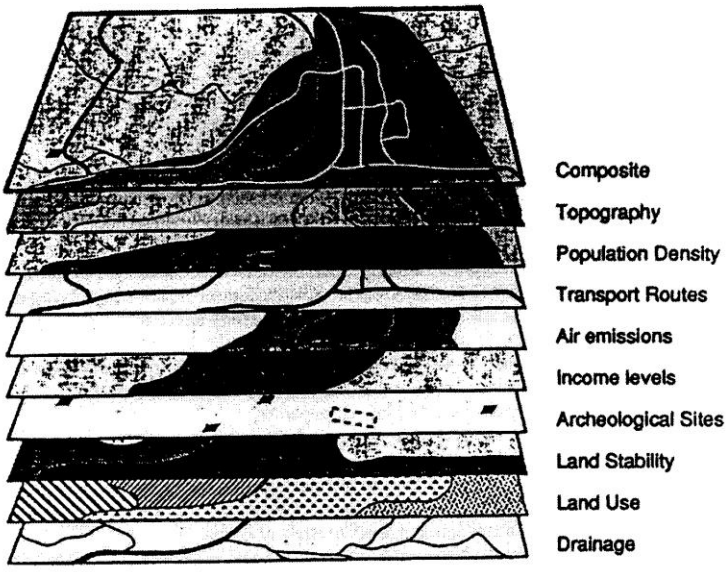
There are several methods that incorporate some means of *scaling* the effects and *weighting* the relative importance of various elements, thus resulting in a mathematical means of combining magnitude and significance for an overall evaluation of the project impact. Technically, these methods fall into the category of checklists, but, in reality, they go far beyond what checklists provide.

A combination of scaling and weighting is particularly useful because it combines measures of magnitude and significance in a highly organised format, and, therefore, is valuable for analysing alternatives. This technique incorporates a large amount of data that may not otherwise be readily comparable. Thus, it provides a means of synthesising a great deal of information while still retaining measures of magnitude and significance.

Judgement is inherent in this approach, particularly when weights or significance are assigned to individual components or elements. However, for objective evaluation, it is necessary to define significance very carefully. In addition, when scaling the effects, it is necessary to be explicit about what the values mean. Scaling works best when the scales relate to real, measurable changes, as in water quality or employment levels. Given appropriately detailed documentation, the scaling and weighting values decided upon by different people should not vary much. An

example of a scaling-weighting technique for site selection is given in Figure 4.1, below:

Figure 4.1
Scaling-Weighting Technique: Example of an Overlay



Source: Dixon and Montz, 1993

Cost-benefit analysis

The scope of approaches such as financial-appraisal, cost-minimisation and cost-effectiveness methods, is limited as they consider only a subsection of the relevant population or only a subsection of the full range of consequences of a plan or project. For example, financial appraisal is limited to a narrow concern, usually of the developer, with the stream of financial costs and returns associated with an investment. Cost effectiveness involves selecting an option that achieves a goal at the least cost. The cost effectiveness approach is more problematic where there are a

number of goals and where some actions achieve certain goals more fully than others.

In contrast, a cost-benefit analysis is more comprehensive in scope. It takes a long view of projects (farther as well as nearer future) and a wide view (in the sense of allowing for side effects). It is based in welfare economics, and seeks to include all the relevant costs and benefits to evaluate the net social benefit of a project.

A cost-benefit analysis consists of several stages such as project definition, identification and enumeration of costs and benefits, evaluation of costs and benefits, discounting and presentation of results, etc. Note that, some of these stages are similar to those in EIA. The basic evaluation principle is to measure in monetary terms – as money is the common measure of value and monetary values are best understood by the community and decision-makers – and then to reduce all costs and benefits to the same capital on annual basis. Future annual flow of costs and benefits are usually discounted to a net present value. A range of interest rates may also be used to show the sensitivity of the analysis to changes. If the net social benefit minus cost is positive, then there may be a presumption in favour of a project. However, the final outcome may not be always clear. The presentation of results should distinguish between tangible and intangible costs and benefits, as relevant, allowing the decision-maker to consider the trade-offs involved in the choice of one option or another.

4.2.3 Mitigation

If the answer to the evaluative question (i.e., Do the changes matter?) is in the affirmative, i.e., the changes do matter, then the EIA proceeds to find an answer to the question: What can be done about them? In this phase, the study team formally analyses

mitigation and a wide range of measures are advanced to prevent, reduce, remedy or compensate for each of the adverse impacts evaluated as significant. Since all mitigation measures cost, it must be quantified.

The possible mitigation measures include:

- Changing project sites, routes, processes, raw materials, operating methods, disposal routes or locations, timing, or engineering designs.
- Introducing pollution controls, waste treatment, monitoring, phased implementation, landscaping, personnel training, special social services or public education.
- Offering (as compensation) restoration of damaged resources, money to affected persons, concessions on other issues, or off-site programmes to enhance some other aspect of the environment or quality of life for the community.

Once these measures are compared, and trade-offs between them weighed, the EIA study team proposes one or more action plans, usually combining a number of measures. The action plan may include technical control measures, an integrated management scheme (for a major project), monitoring, contingency plans, operating practices, project scheduling, or even joint-management (with affected groups). The study team should explicitly analyse the implications of adopting different alternatives to help make the choices clearer for decision-makers. Several analytical techniques including the following are available for this purpose:

- Cost/benefit analysis, in which all quantifiable factors are converted to monetary values and actions are assessed for their effect on project costs and benefits. (Note, however, that

the unquantifiable and qualitative aspects can be equally important, and often need to be taken into account in the decision-making process.)

- Explaining what course of action would follow from various broad value judgements (e.g., that social impacts are more important than resources).
- A simple matrix of environmental parameters versus mitigation measures, containing brief descriptions of the effects of each measure.
- Pair-wise comparisons, whereby the effects of an action are briefly compared with the effects of each of the alternative actions, one pair at a time.

The mitigation plan should be supplemented with an environmental management plan (EMP) to guide the proponent towards environmental improvements. The EMP is a crucial input to monitoring the clearance conditions and, therefore, the details of monitoring should be included in the EMP.

Having discussed impact prediction, evaluation and mitigation, we will next explain another important stage of EIA, i.e., impact on decisions.

4.3 IMPACT ON DECISIONS

The primary purpose of EIA studies, as mentioned earlier, is to aid decision-making and serve as an instrument for sustainable development. Decisions can be made at various levels. A national department of energy may take decisions on the direction of energy policy (e.g., the mix of coal-fired versus gas-fired electricity generation) and on the resultant sector programmes (e.g., a 10-

year programme to develop a combined cycle gas turbine (CCGT) plant). Various combinations of stakeholders (e.g., private sector, public sector) can also take decisions at various stages in the planning and development process.

Figure 4.2 represents a sound integrated decision-making process:

Figure 4.2
Environmental Considerations in Decision-Making

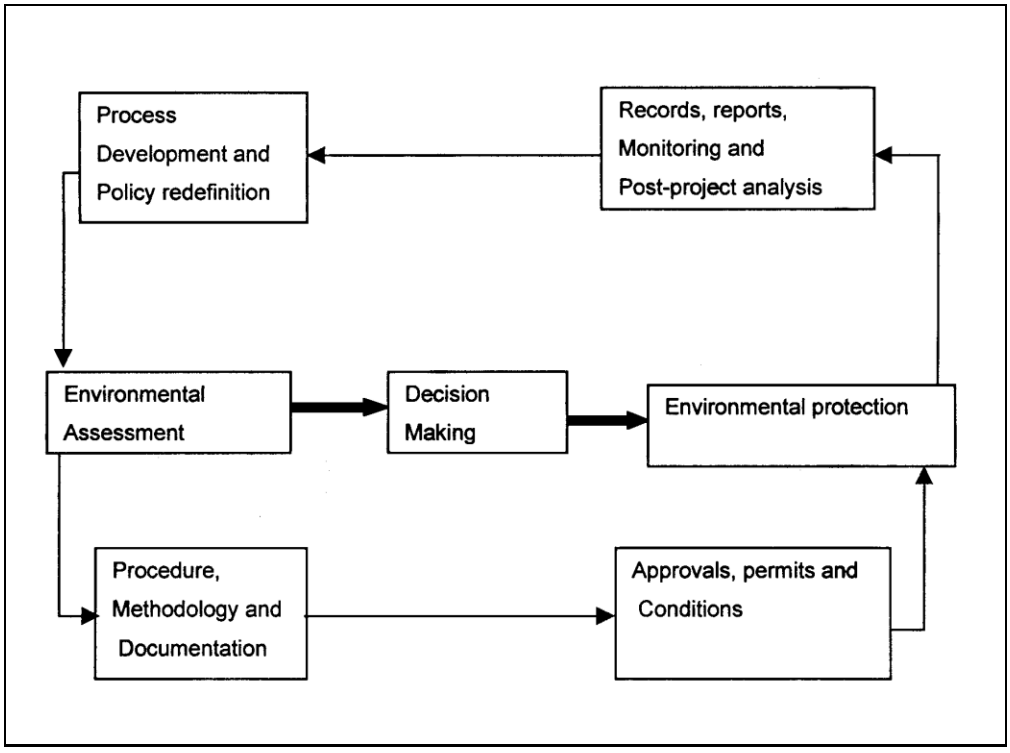


Table 4.2 illustrates both socio-economic and bio-physical environmental categories with examples of negotiable and non-negotiable impacts.

Table 4.2
Judging Environmental Acceptability

	Non-negotiable impacts	Negotiable impacts
Ecological (physical and biological components)	Degrades essential life support systems. Degrades conservation. Estate. Adversely affects ecological integrity. Loss of biodiversity.	No degradation beyond carrying capacity. No degradation of productive systems. Wise use of natural resources.
Social (humans as individuals or in social groupings)	Loss of human life. Reduces public health and safety unacceptably. Unreasonably degrades quality of life where people live.	Community benefits and costs and where they are borne. Reasonable apportionment of costs and benefits. Reasonable apportionment of intergenerational equity. Compatibility with defined environmental policy goals.

Source: Sippe, 1994

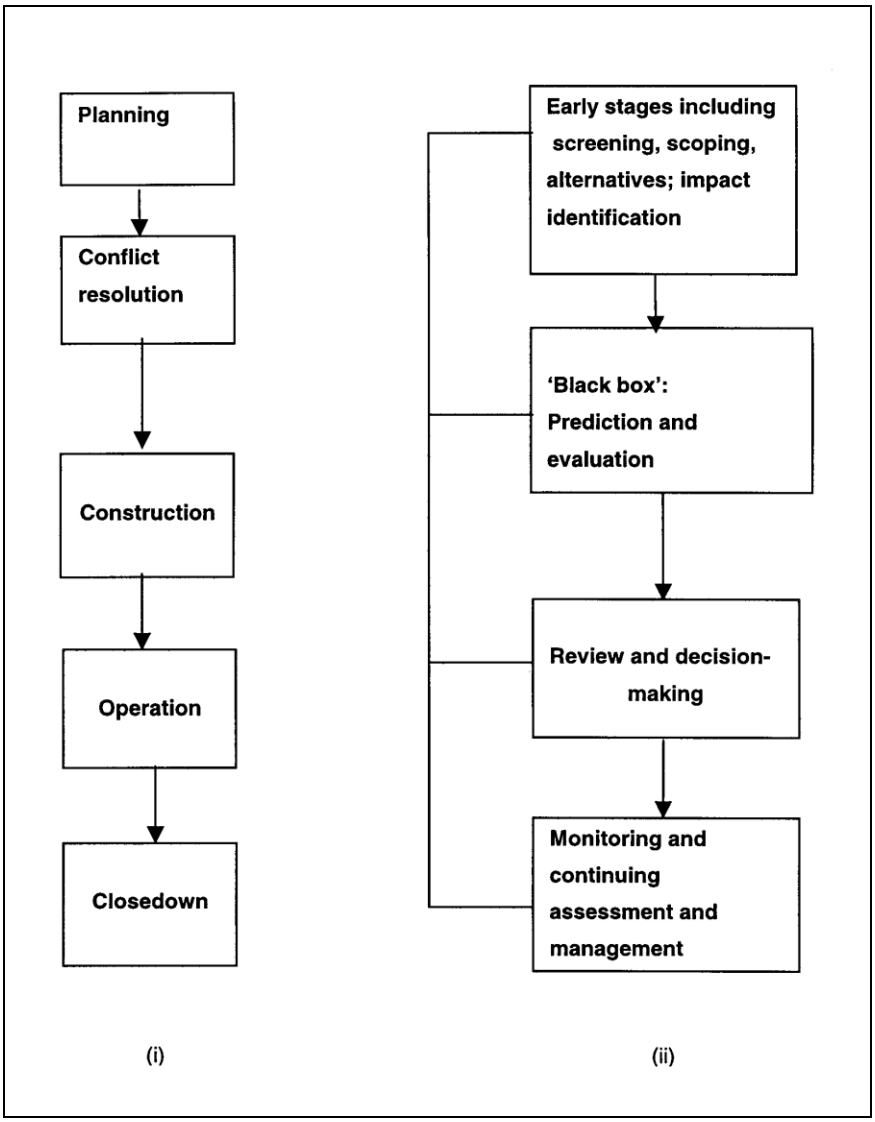
Decisions, planning and development process

Major projects have a life-cycle, including a number of key stages from initial planning to project closedown. For some projects, this life may be quite short (e.g., 5 – 10 years for a medium-size/fast-track opencast coal project); for others, it may be very long (e.g., 50 years plus for a reservoir or a nuclear power station). EIA is a systematic process for assessing impacts of such major projects as an aid to improved decision-making and environmental outcomes. EIA processes are normally located within EIA systems. Some may be relatively ad hoc, while some others may operate under formal institutional procedures that include laws

and regulations. Such procedures normally relate to a planning and consents/licensing framework. The level of integration between the EIA system and the planning framework varies.

The EIS may have an impact on a planning official's report, on a planning committee's decision, and on pre- and post-submission project modifications. Decisions are rarely a simple 'yes' or 'no', and are more likely to be conditional. For example, project support is pledged subject to certain modifications and/or associated measures. Whilst this is important, and EIA can have a key role to play at this stage, decision-making occurs at many other stages and is undertaken by various parties. Decisions, for example, are to be made on whether EIA is needed at all (the screening stage); the scope of the EIA; the alternatives under considerations; project design and redesign; the range of mitigation measures and implementation and monitoring during the 'post-key-decision' stages of the project life-cycle. Figure 4.3 gives the key stages in the planning and development life-cycle for major projects and the environmental assessment process:

Figure 4.3
Key Decision-Making Stages



Criteria for assessing the impact of environmental impact assessment on decisions

Synthesising the various criteria, the following are identified as particularly important in assessing the impacts of EIA on decisions (Handbook of Environmental Impact Assessment Vol. 2):

(i) Centrality in decision-making (i.e., to what extent does EIA make a difference?).

(ii) Integration in the project cycle and approval process (i.e., to what extent is EIA easily bypassed?).

(iii) Consistency in application to development proposals.

(iv) Fairness in application, providing opportunities for participation and influence in the process by all relevant stakeholders.

(v) Flexibility in terms of application to various stages in the EIA process (e.g., from consideration of alternatives to implementation of project modifications).

(vi) Scope in terms of considering a range of environmental factors both biophysical and socio-economic.

4.4 PARTICIPATION, REQUISITES AND REVIEW

The aim of the EIA process is to provide information about a proposal's likely environmental impacts to the developer, public and decision-makers so that an informed decision is made. As such, how the information is presented, how the various interested parties use that information, and how the final decision incorporates the results of the EIA and the views of the various parties, are essential components in the EIA process.

Past experience shows that the overall benefits of openness can exceed its cost, despite the expenditure and delays associated with full-scale public participation in the project planning process.

4.4.1 Public participation

It is being realised increasingly that those whose environment will be affected by development proposals have a right to participate in decision-making that may affect that environment. Annex 1 to *Our Common Future* recommends that "States shall inform in a timely manner all persons likely to be significantly affected by a planned activity and to grant them equal access in administrative and judicial proceedings". Principle 10 of the *Rio Declaration* insists that environmental issues are best handled with the participation of all concerned citizens, at the relevant level.

Despite the positive trends towards greater public participation in the EIA process and improved communication of EIA findings, both are still underdeveloped in many parts of the world. Few developers make a real effort to gain a sense of the views of the public before presenting their planning applications and EISs to local authorities, while few local authorities have the time or resources to gauge public opinion adequately before making their decisions.

The approach to be taken for public involvement is worthy of a great deal of consideration at the scoping stage, as it could make or break our EIA report. History shows that engineers are not very good at public involvement processes and they tend to be resistant to them. But, it is necessary to remember that:

- Public involvement is not public relations in the sense of "selling" the project. It is consultation with the public, and "consultation" means a genuine attempt to communicate information and to seek advice on the basis that the advice, if relevant, will be acted upon.
- Public involvement is an area of the EIA reporting process that can be politically sensitive. Certain interests, even project

sponsors, may seek to exercise control and influence on the process.

The process you devise, hopefully through wide consultation, will be inevitably project-specific because the sponsors, the people directly affected and the general public interest, will be different for each project. There will not be one public so far as a specific project is concerned. There may, in fact, be several *publics* as under:

- The experts within the community, the scientific organisations, the expert government agencies, university departments and expert professional groups.
- Local authorities, citizen groups and NGOs.
- The stakeholders, i.e., those with a direct interest in, or who are directly affected by, the project.
- Societies, cultural groups and individual citizens interested in, or affected by, the project.
- The general community.

Identifying the publics in relation to your particular project, and perhaps consulting to establish the level of information and involvement they would like to have, will do a lot for your credibility and the ultimate success of your EIA report. As well, it will help ensure that knowledge of the intention to carry out a EIA report is disseminated at a vital time – before it starts. One of the most certain routes to damaged credibility and unnecessary objections is the discovery by affected citizens that their opportunity for intervention has been pre-empted. This can be expressed as the first of the following general rules governing participation:

- make sure that all the identified publics have been advised before the EIA;
- state about the project, its objectives, programmes, the proposed public involvement process, and the anticipated documentation;
- information must be communicated, not just provided;
- language, format, illustration and media vehicle is appropriate to a particular public.

You will find that you have a number of options (and opportunities) for the type of consultation best suited to a particular public or phase of your EIA Report. These include newspaper advertisements, reports of journalists, public meetings, cottage (or small scale) meetings with specific interest or stakeholder groups, TV and radio, newsletters and progress reports.

In summary, the benefits of a quality public involvement programme are immense. The greatest benefit will be trust and confidence. Your conclusions, even if unpalatable, will be more likely to get acceptance if the public develops confidence in your work, methods and your objectivity and professionalism.

4.4.2 Requisites for a good EIS

A EIS should be comprehensive. It must, at the minimum, fulfil the requirements of the relevant EIA legislation concerning contents. A good EIS will also go further than the minimum requirements, if other significant impacts are identified. Most EISs are broadly organised into the following sections:

(i) a non-technical summary;

(ii) a discussion of relevant methods and issues;

(iii) a description of the project and of environmental baseline conditions;

(iv) a discussion of the project's likely environmental impacts (which may include the discussion of baseline environmental and predicted environmental impacts, proposed mitigation measures and residual impacts).

Ideally an EIS should also include the main alternatives that were considered, and proposals for monitoring. It should emphasise key points. These should have been identified during the scoping exercise, but additional issues may arise during the course of the EIA. The EIS should set the context. It should be kept as brief as possible while still presenting the necessary information. The main text should include all relevant discussion of impacts, and appendices should present only additional data and documentation.

EIAs are, indirectly, public relation exercises and can be seen as publicity documents for developers. Good presentation can convey a concern for the environment, a rigorous approach to the impact analysis and a positive attitude to the public. Bad presentation, in turn, suggests a lack of care and perhaps a lack of financial backing. Similarly, good presentation can help to convey information clearly, whereas bad presentation can negatively affect even a well-organised EIS (Glasson, et al., 1994).

4.4.3 Review of EIS

An environmental impact assessment (EIA) report, i.e., EIS, is normally reviewed once it has been completed, before being submitted to the decision-making authority. The main purpose of the review is to verify that the information and conclusions

presented in the EIA report are sufficient for informed decision-making.

A proper review and evaluation of EIS requires a triple-A test of *appropriateness* (i.e., coverage of key issues and impacts), *adequacy* (i.e., impact analysis), and *action ability* (i.e., does the report provide the basis for informed decision making?).

Essentially, a EIA report satisfies the following three criteria:

(i) Completeness and conformance with the TOR (terms of reference) for the EIA.

(ii) Accuracy and veracity as defined by general acceptable scientific criteria (e.g., quality assurance and quality control procedures for analysis of sampling data) and use of acceptable methods for the assessment of environmental impacts.

(iii) Clear description of environmental impacts, recommended mitigation measures, environmental monitoring plan and environmental management plan.

Now, consider the following checklist for reviewing a EIA report:

(i) Executive summary

- An adequate summary of the significant findings of the EIA report.
- A sufficiently detailed description of how significant environmental issues will be resolved.
- A presentation of the study's conclusions.

- Effective, simple, visual presentations of the type and magnitude of the impacts.

(ii) Introduction

- Description of project rationale.
- Consideration and evaluation of project alternatives.
- Methods used to identify, predict and assess impacts.

(iii) Project description

- A listing of project activities that are likely to cause significant impacts to environmental resources.
- A listing of mitigation measures to be incorporated into the project.
- The location, scale and scheduling of activities.
- Potential accident or hazard scenarios covered in the risk assessment are based on the characteristics of the project and the history of accidents at similar types of facilities.
- Information should match the expected operations according to the feasibility study.

(iv) Description of the baseline environment

- A description of the environmental components that may be significantly affected by the project.
- An explanation of the derivation of environmental indicators chosen to represent environmental components.
- Base maps for spatial data.
- Baseline values, or some other appropriate form of quantitative and qualitative information, for environmental

components/resources that may be affected either directly or indirectly by project activities.

(v) Prediction/assessment of impacts

- A description of the major issues.
- Documentation of the cause and effect relationships between planned project activities and the environmental components.
- Identification of secondary or higher order effects with clearly defined pathways of impacts from higher order effects.
- Impact prediction includes a number of stated assumptions that affect the predicted impacts, their probability of occurrence and degree of impact.
- Methods used to predict impacts.
- An assessment of the significance of predicted impacts, methods or approaches to assigning impact significance.
- Justification for the choice of methods used to predict environmental impacts.

(vi) Development of mitigation measures

- A description of all the environmental protection measures considered to mitigate or offset damaging environmental impacts from project activities.
- A description of the costs and benefits for each recommended environmental protection option developed to resolve a significant environmental issue, as well as a comparison of each option to the other options.
- Appropriateness and cost effectiveness of environmental protection measures.

- A description of the technology used in each environmental protection measure, including information regarding its prior effective use, the range of environmental conditions under which it is effective, and the level of skill required to operate or maintain the technology.
- A time schedule for implementation of the environmental protection measures, showing that they will be in use before the project impacts are felt.
- A drawing or table that illustrates how the mitigation measures address the significant environmental issues.

(vii) Public consultation and participation

- Description of strategy and approach.
- Chronology of individuals and groups consulted.
- Descriptions of methods used to consult with public.
- Summary of information obtained during consultations and how it was used in preparation of the EIA report.
- A sampling programme design (frequency, intensity) sufficient to provide the information necessary to answer questions.
- Analytical system quality assurance and quality controls are effective.
- Information for reporting monitoring results.

(viii) Environmental management plan and institutional arrangements

- Detailed descriptions of the environmental protection measures, the monitoring program, and follow-up activities.
- Monitoring requirements.
- Allocation of responsibilities and tasks.

- Staffing requirements.
- Budgets and schedules.
- Administrative arrangements.
- Administrative mechanisms for enforcement and taking corrective action are in place.

(ix) Summary and conclusions

- Net benefits which justify the project.
- Explanation of how adverse effects have been mitigated.
- Explanation of use or destruction of any irreplaceable components.
- Provisions for follow-up surveillance and monitoring.

Uncertainties can arise in any decision and EIA is no different. Monitoring and auditing in EIA enables the environmental authority to reconsider its original decision and also whether there is a need for some form of additional action. Let us discuss these issues in Section 4.5. But, first, let us work out Learning Activity 4.7.

LEARNING ACTIVITY 4.7

List 3 benefits of public participation in EIA process.

Note:
a) Write your answer in the space given below.
b) Check your answer with the one given at the end of this Unit.

4.5 EIA MONITORING AND AUDITING

The issues in EIA monitoring and auditing appear to shift from purely technical and scientific to management aspects. Key issues in EIA monitoring and auditing, thus, are the accuracy of impact prediction and the quality of the EIS. EISs, are, generally, expected to contain testable hypotheses, and monitoring and auditing focused on compliance. Of late, however, the focus is on

project implementation, mitigation, activity management and communication. Nevertheless, EIA monitoring and auditing are less developed than the pre-decision elements of the EIA process. This does not mean that there is no post-decision monitoring and evaluation – in many jurisdictions, compliance monitoring and enforcement of permits are elements of the environmental permit system.

Table 4.3 below gives the relationship between monitoring and auditing objectives and uncertainties in EIA:

Table 4.3
Relationship Between Monitoring and Auditing Objectives and Uncertainties

Objectives of EIA monitoring and auditing	**Uncertainties about**
Controlling	Correct implementation and operation (permit and general environmental standards). Effects on the environment.
Scientific knowledge	Dose-effect relationships (causal mechanisms). Accuracy of prediction methods.
Acceptance and legitimisation	Public concern/debate about the effects of the activity. Public acceptance with respect to the overall plan of which the project forms part. Public preferences with respect to valuation of impacts.
Integration with other information	None (the objective relates to efficient governance).

4.5.1 Monitoring

A monitoring plan should specify for each indicator the measurement technique, frequency, locations, responsibilities, reporting, data storage method, etc. These choices depend upon

the type of activity, the indicators selected for monitoring, the timescale of impacts and the characteristics of the area, particularly of dispersion media and sensitive targets. Monitoring of environmental pollution by point sources is illustrated in Table 4.4:

Table 4.4
Environmental Impact and Their Monitorable Characteristics

Environmental impact	**Monitorable characteristics**
Contribution to green house effect	Energy use by type
Contribution to stratospheric ozone depletion	Emission of ozone depleting gases
Acidification	Emission of NO_x, SO_2 Impact on ecosystems Impact on buildings, artificial constructions
Ambient air pollution	Emission of toxic gases Ambient air quality
Noise and vibration	Noise emission Ambient air quality
Soil pollution	Emission to the soil Quality of the soil Quality of groundwater near the pollution source Quality of groundwater near water intake
Surface-water pollution	Emissions to surface water or sewage system Quality of surface water

Environmental pressures may be monitored by adopting environmental management and auditing systems, which consist of measures such as procedures for handling of wastes, prevention of spillage, etc., performance checking and maintenance of protection measures and facilities (such as sampling of groundwater beneath secure disposal sites), registration of generated waste and its method of disposal and registration of material flows in order to discover leaks. These systems maybe specified in the permit conditions.

The activity manager might go further and certify his or her environmental management system under the ISO 14000 series. This type of indicator will give information about the mitigation

performance of the operator, and normally emissions will be known to be at an acceptable level. According to the best available technology (BAT) principle, the activity manager should reduce emissions to a minimum, although the latter does not necessarily have to be defined in quantitative terms.

4.5.2 Auditing

Monitoring is only useful if the observations are collated, evaluated and formally reported and if required actions are taken. Auditing implies that the monitoring results are compared with standards or criteria of acceptability and that, subsequently, a value judgement is made in order to decide whether further action is needed.

With reference to the primary aim of control to secure environmental protection, the original consent decision is important in providing the audit reference point. For appraising the monitoring results, information in the EIS may also be relevant (e.g., impacts as predicted and the described reference situation). Other relevant criteria may include legal standards, regulations and policies, new investigation and new insights. Often, the acceptability of monitoring results cannot be defined fully in advance. The audit will be most effective, if the results are made public and if the component authorities have some obligation to report publicly.

On the basis of the audit, the environmental authority can reconsider its original decision and it may also consider whether there is a need for some form of additional action. Remedial actions can be necessary, if the actual impacts exceed the expected or acceptable impacts, or if the original terms and conditions need to be reviewed. Depending on the significance of unacceptable impacts, actions may range from doing nothing,

adjusting the permit granted, taking preventive, mitigation or compensation measures, through to stopping the activity (Handbook of Environmental Impact Assessment, Vol. 1).

SUMMARY

In this Unit, we discussed the processes involved in EIA documentation – screening, scoping, and consideration of alternatives, baseline establishment and impact identification. Following this discussion, we explained the role of EIS in impact prediction, evaluation and mitigation. Being predominantly a decision-making tool, EIA, we said must contribute to informed decision-making, and in that context explained how EIS facilitates decisions. We also discussed the importance of involving the public and cautioned that without which the report would not receive the desired level of acceptability. We then mentioned some of the prerequisites for an effective and useful EIS and provided a checklist to review a EIA report. We closed the Unit by explaining the processes involved in, and the importance of, EIA monitoring and auditing.

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Lecture 4

Model Answers to Learning Activities

LEARNING ACTIVITY 4.1

The project proponent may not have the expertise for understanding environmental impacts associated with the proposed project. Also, he or she may be biased in favour of the project as proposed by him or her.

LEARNING ACTIVITY 4.2

- Size of the project (production capacity/investment).
- Location (ecological sensitivity).
- Pollution load addition.

LEARNING ACTIVITY 4.3

Power transmission line. This will help in the selection of route.

LEARNING ACTIVITY 4.4

No. The process of EIA has to take into consideration the socio-economic environment, topography of the proposed location and the existing environmental quality.

LEARNING ACTIVITY 4 .5

- Air: Winter
- Surface water: Summer
- Groundwater: Post-monsoon

LEARNING ACTIVITY 4 .6

- Optimal utilisation of time.
- Minimisation of cost of study.

LEARNING ACTIVITY 4 .7

- Identifying concerns of local people.
- Ensuring proper rehabilitation of project affected population.
- Ensuring co-operation of local people.