Lecture Notes

ENVIRONMENTAL IMPACT ASSESSMENT

SANNA UNIVERSITY - YEMEN

TABLE OF CONTENTS

List of Tables

List of figures

List of Boxes

List of Acronyms

CBA	: Cost Benefit Analysis
CBNRM	: Community Based Natural Resource Management
EA	: Environmental Auditing
EIA	: Environment Impact Assessment
EIS	: Environmental Impact Statement
EMEMP	: Environmental Monitoring, Evaluation, and Mitigation Plan (or Program)
EMP	: Environmental Management Plan
EMP	: Environmental Monitoring Plan
EMS	: Environmental Management Strategy
EMS	: Environmental Management System
EPA	: Environmental Protection Agency
GEF	: Global Environment Facility
GIS	: Geographical Information system
HIA	: Health Impact Assessment
IAIA	: Internal Association for Impact Assessment
IEE	: Initial Environment Examination
M&E	: Monitoring and Evaluation
M&M	: Mitigation and Monitoring
MoU	: Memorandum of Understanding
MSP	: Multiple Stakeholder Platforms
NEAP	: National Environmental Action Plan
NEPA	: National Environmental Policy Act
NGOs	: Non- Governmental organizations
PEA	: Programmatic Environmental Assessment
PLA	: Participatory Learning and Action
PRA	: Participatory Rural Appraisal
SEA	: Strategic Environmental Assessment
ToR	: Terms of Reference
UNCED	: United Nation Conference on Environment and Development
UNDP	: United Nation Development Program
UNEP	: United Nation Environment Program
USAID	: United states Agency for international Development
WB	: World Bank
WCS	: World Conservation Strategy

1. Environmental Impact Assessment

Based on: Dougherty T.C and Hall A.W (1995), Environmental impact assessment of irrigation and drainage projects, FAO, Rome, Italy and UNESCAP Virtual Conference: United Nations; c1998 – 2008 [updated October 30, 2004] available from http://www.unescap.org/drpad/vc/orientation/M8_first.htm

1.1. EIA Introduction

Economic, social and environmental change is inherent to development. Whilst development aims to bring about positive change it can lead to conflicts. In the past, the promotion of economic growth as the motor for increased well-being was the main development thrust with little sensitivity to adverse social or environmental impacts. The need to avoid adverse impacts and to ensure long term benefits led to the concept of sustainability. This has become accepted as an essential feature of development if the aim of increased well-being and greater equity in fulfilling basic needs is to be met for this and future generations.

An EIA may be defined as: a formal process to predict the environmental consequences of human development activities and to plan appropriate measures to eliminate or reduce adverse effects and to augment positive effects.

EIA thus has three main functions:

- to predict problems,
- to find ways to avoid them, and
- To enhance positive effects.

The third function is of particular importance. The EIA provides a unique opportunity to demonstrate ways in which the environment may be improved as part of the development process. The EIA also predicts the conflicts and constraints between the proposed project, programme or sectoral plan and its environment. It provides an opportunity for mitigation measures to be incorporated to minimize problems. It enables monitoring programmes to be established to assess future impacts and provide data on which managers can take informed decisions to avoid environmental damage.

EIA is a management tool for planners and decision makers and complements other project studies on engineering and economics. Environmental assessment is now accepted as an essential part of development planning and management. It should become as familiar and important as economic analysis in project evaluation.

The aim of any EIA should be to facilitate sustainable development. Beneficial environmental effects are maximized while adverse effects are ameliorated or avoided to the greatest extent possible. EIA will help select and design projects, programmes or plans with long term viability and therefore improve cost effectiveness.

It is important that an EIA is not just considered as part of the approval process. Volumes of reports produced for such a purpose, which are neither read nor acted upon, will devalue the process. A key output of the EIA should be an action plan to be followed during implementation and after implementation during the monitoring phase. To enable the action plan to be effective the EIA may also recommend changes to laws and institutional structures.

Initially EIA was seen by some project promoters as a constraint to development but this view is gradually disappearing. It can, however, be a useful constraint to unsustainable development. It is now well understood that environment and development are complementary and interdependent and EIA is a technique for ensuring that the two are mutually reinforcing. A study carried out by the Environmental Protection Agency (USA) in 1980 showed that there were significant changes to projects during the EIA process, marked improvements in environmental protection measures and net financial benefits. The costs of EIA preparation and any delays were more than covered by savings accruing from modifications, (Wathern, 1988).

Water resource development project (i.e. Irrigated agriculture) is crucial to the economy, health and welfare of a very large part of the developing world. Water resources development projects thus have major impacts on the environment. It is necessary to determine the acceptable level and to compensate for the environmental impact. The impacts may be both to the natural, physical environment and to the human environment. All major donors consider water resources development projects to be environmentally sensitive.

Clearly an EIA will not resolve all problems. There will be trade-offs between economic development and environmental protection as in all development activities. However, without an objective EIA, informed decision making would be impossible.

Environment: In U.S environment is interpreted comprehensively to include natural and physical environment and the relationship of people with that environment. In Netherlands it includes physical environment: water, soil, air, man, animals, plants and inanimate objects. And in Canada environment means: air, land or water, plant and animal life including man the social, economic and cultural conditions that influence the life of man or a **c**ommunity any building, structure, machine or other device or thing made by man any solid, liquid, gas, odour, heat, sound, vibration or radiation resulting directly or indirectly from the activities of man any part of or combination of the foregoing and the interrelationships between any two or more of them

Advantage of applying EIA:

- Systematic approach
- Information to the public
- Information to the decision maker
- Consistency of approach
- Improved design
- Provides systematic methods of impact assessment
- Estimates the cost/benefit trade-off of alternative actions
- Provides an effective mechanism for coordination, environmental integration and negotiation
- Achieve a balance between the impact of developmental and environmental concern
- feed back
- Early discussion
- Long term outlook
- Avoid surprises
- Avoid retrofit

Disadvantage of applying EIA:

- Adds to complexity
- Adds to delay
- Costly
- Requires multidisciplinary team
- Requires understanding of environmental systems and processes
- Forecasting of cost/schedule
- Limited proponent options

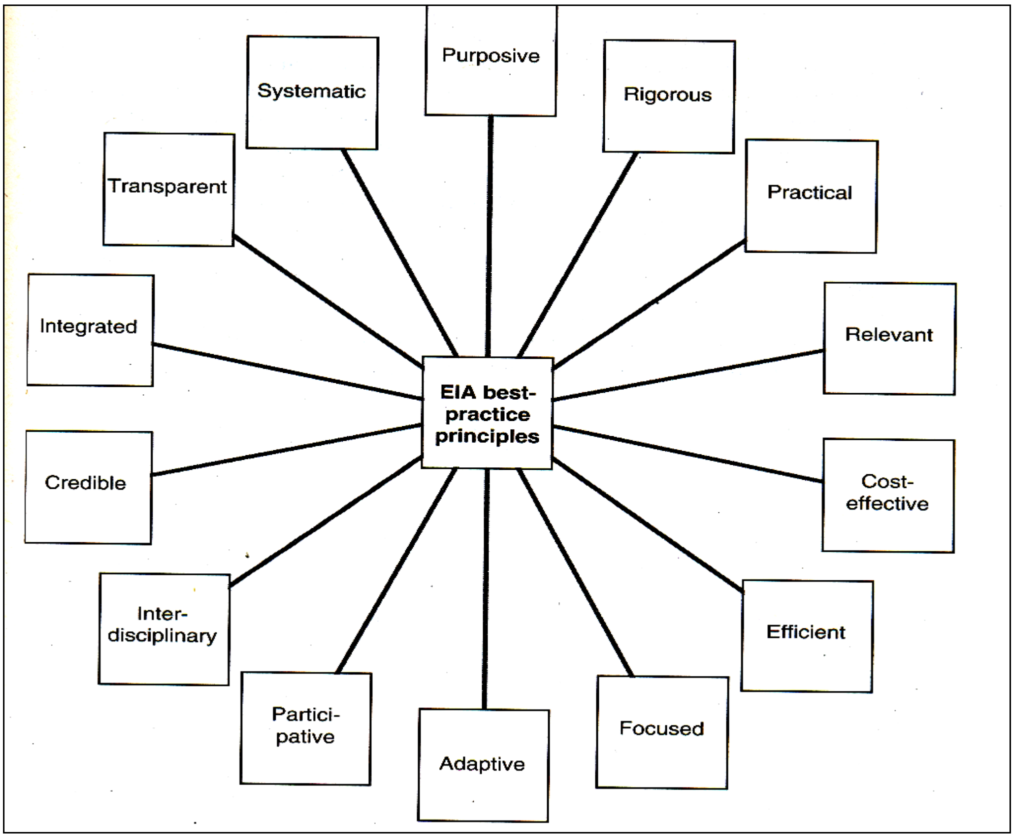

Figure 1.1: Basic Principles of EIA best practice

1.2. EIA origins and Development

EIA originate in North American and West Europe due to a sudden growth in awareness of the relationship between an expanding industrial economy and local environmental change in 1960s.

In order to predict environmental impacts of any development activity and to provide an opportunity to mitigate against negative impacts and enhance positive impacts, the environmental impact assessment (EIA) procedure was developed in the 1970s.

Initial development during the early 1970s immediately following the implementation of NEPA, EIA was only within the local project area. Wider projects impacts and potential impact relationship was ignored. By the mid 1970s and up to early 1980s, EIA efforts become much more highly organized and technically oriented.

The early 1980s to the mid 1990s witnessed rapid growth in EIA. International events such as the 1987 world commission on Environment and Development and the 1992 and 1997 Earth summits. During this period, Environment was defined to inclusive of not only the biophysical environment, but also components of the social and economic environments. In 1987, WHO introduced "environmental Health impact assessment".

1.3. Dimensions of Environment in EIA:

EIA in 1990s is emerged as a multi dimensional approach and involved application of both qualitative and quantitative models.

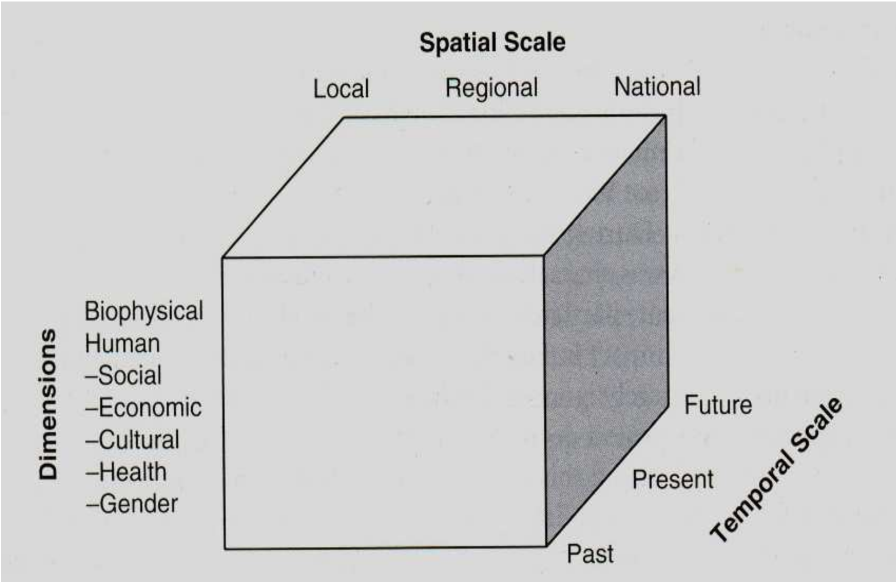

Figure 1.2: Dimension of Environment in EIA

Sustainability initiatives. There is now a growing recognition that EIA should serve as an integral planning tool for decision-making, characterized by integrating cumulative and global environmental effects, empowering the public, recognizing uncertainties, favoring a precautionary and adaptive **approach** and making a positive contribution towards sustainability.

Advancing the sustainability initiative will require increasing the application of EIA principles beyond the project level to address environmental issues at the strategic levels of policy, planning and program decision-making. This can be accomplished through **strategic environmental assessment** (SEA)**. SEA is** the application of environmental assessment principles to policies, plans and programs.

International status of EIA:

Most of countries operate on an ad hoc basis in response to the requirements **of international donor agencies such as World Bank. T**he World **Bank** first introduced EIA requirements in 1989 for evaluating projects it was financing**. T**he Asian Development Bank introduced EIA in 1993**.** Canadian internation**al Development agency (CIDA)** also started after 1993**.**

1.4. EIA in Project cycle

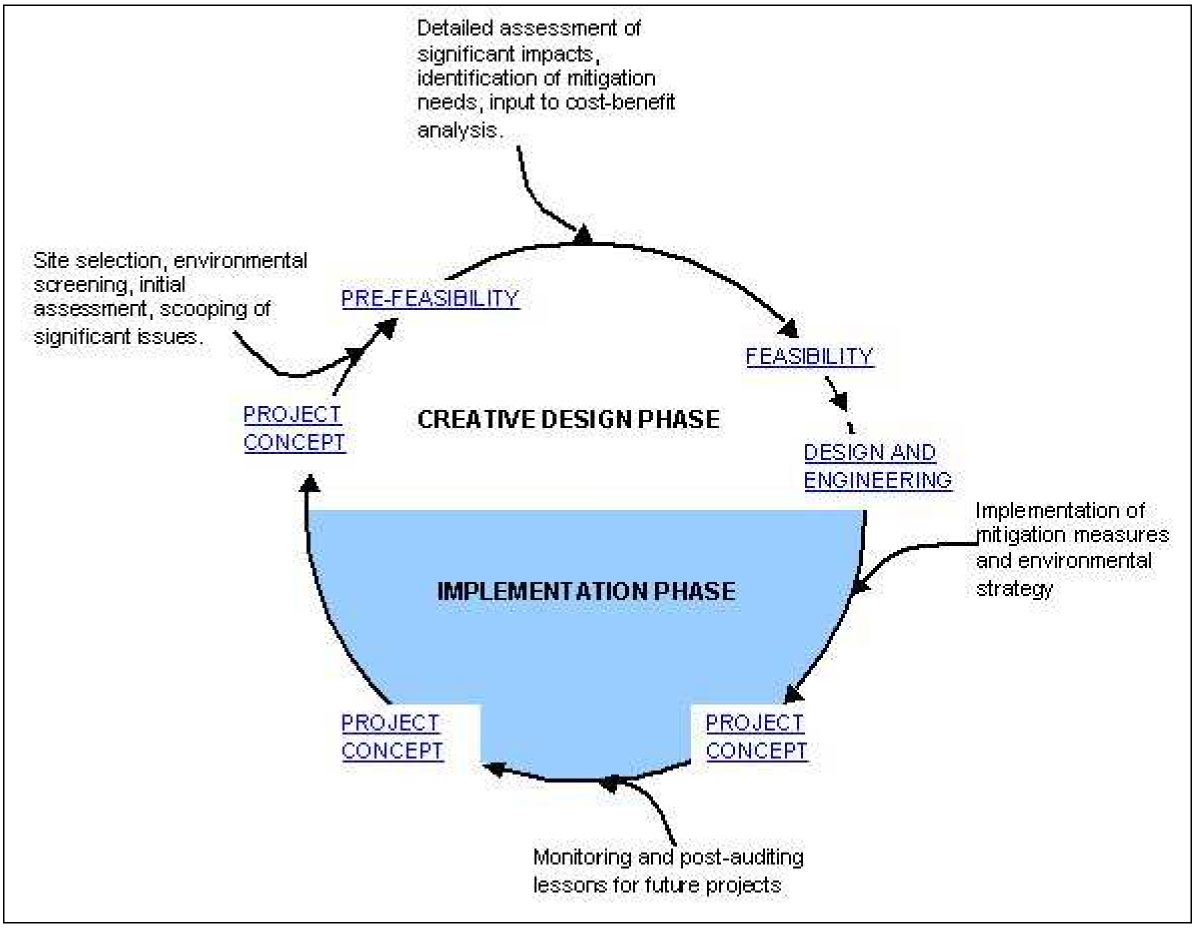

Figure 1.3: EIA in Project Cycle

Source: http://www.unescap.org/drpad/vc/orientation/M8_2.htm

The relevant EIA activities for each stage in the project cycle are

- Project Concept / Identification: At the initial stage of the project, quick environmental overview or preliminary EIA can indicate the environmental implications of any proposed alternatives.
- Pre-feasibility Stage: This stage identifies issues and impacts for investigation, which is equivalent to *'Scoping'*
- Feasibility Stage: EIA study is carried out during this stage.
- Project Appraisal and Decision: A decision on whether a project is feasible or not will be made at this stage.
- Implementation of the project: If the project is feasible, it will be implemented. EIA report will be used as guideline during this phase.
- Management of EIA Study: Conducting an EIA report that can be understood by all the related stakeholders.

Project Concept/Identification

At the initial stage of the project planning, information on the detailed project designs will not be available, but the basic nature of the project will be known (for example, whether it is to be a coal, oil or nuclear power station; a highway or a dam/reservoir) power output, and an area of land which is likely to be inundated and the site or sites where the project is being proposed to be implemented. At this stage, the project may be subject to "screening" to decide whether a full and comprehensive EIA report must be prepared.

If screening recommends that an EIA report is required, then the initial study will begin. At this early stage quick environmental overview/reconnaissance or preliminary EIA can indicate whether any of the alternatives proposed are environmental "disastrous". These can be eliminated from further consideration, and new alternatives can be identified. Major benefits of a "quick and dirty" overview are as follows:

- identification of "viable" alternatives (from an environmental viewpoint), and
- Provision of an early indication of likely significant impacts for further EIA work.

Pre-feasibility Stage

The main EIA activities, at this stage, are identification of issues/impacts for investigation and, formulation of the Terms of Reference (TOR) for the EIA. The term used for this activity is "scoping"

Feasibility Stage

EIA study should be carried out:

- during feasibility stage in conjunction with economic, technical and design work,
- preliminary EIA works such as scoping and preperation of TOR should be carried out during project pre-feasibility stage,
- If EIA is carried out late in project cycle as an "add on", the process of EIA becomes cumbersome, time consuming and expensive to incorporate the EIA recommendations in the project construction.

Project Appraisal and Decision

During the project appraisal, a decision is made by the proponent or by the government, and in some case by the lending agencies, as to whether the project is viable. At this stage, EIA results will be put into consideration with feasibility study. An application for authorisation(s) has to be made by the project proponent to a local/central government agency. This decision is the final and determines whether a project is to be implemented. The EIA report also plays an important role in this decision making process.

Implementation of the Project

At this stage, in the project cycle, the EIA report will act as a "reference" guide to the implementation and use of mitigation strategies and monitoring schemes. Thus, the usefulness of an EIA report does not end with the "official" authorisation to proceed. It may form a basis for management plan to assist project implementation and management practice. For example, EIA report recommendations can form a part of contract tender documents.

Lastly, after the project is completed, an "audit" can be made to determine how close the EIA's predictions were to the actual impacts of the project. This forms a valuable records for others conducting EIAs on similar projects in the future.

Management of EIA Study

EIA differs from other types of project related studies in the scope and breadth of the work and usually include a diversity of topics ranging from archaeological investigations to noise/vibration assessments. EIA is a multi-disciplinary activity and this factor provides one of its major challenges in terms of project management.

EIA report, unlike other project related reports, has many audiences. The readers/users of engineering and economic financial feasibility studies are the project proponents and the financial backers or supporters with relatively restricted readership. The situation is quite different with EIA reports. Such reports are read/used by the project proponents, financial backers, experts, authorising agencies and other organisations who deserve a rights to comment on an EIA report and submit their views on the desirability of a project and, of course, the members of the public. Thus, there is a challenge of facilitating open communications and understanding of the main issues.

2. The EIA Process

Based on: Dougherty T.C and Hall A.W (1995), Environmental impact assessment of irrigation and drainage projects, FAO, Rome, Italy and UNESCAP Virtual Conference : United Nations; c1998 – 2008 [updated October 30, 2004] available from http://www.unescap.org/drpad/vc/orientation/M8_first.htm

2.1. Introduction to the EIA Process

The EIA process makes sure that environmental issues are raised when a project or plan is first discussed and that all concerns are addressed as a project gains momentum through to implementation. Recommendations made by the EIA may necessitate the redesign of some project components, require further studies, and suggest changes which alter the economic viability of the project or cause a delay in project implementation. To be of most benefit it is essential that an environmental assessment is carried out to determine significant impacts early in the project cycle so that recommendations can be built into the design and cost-benefit analysis without causing major delays or increased design costs. To be effective once implementation has commenced, the EIA should lead to a mechanism whereby adequate monitoring is undertaken to realize environmental management. An important output from the EIA process should be the delineation of enabling mechanisms for such effective management.

The way in which an EIA is carried out is not rigid: it is a process comprising a series of steps. These steps are outlined below. The main steps in the EIA process are:

- screening
- Scoping
- prediction and mitigation
- management and monitoring
- audit

Figure 2.2 shows a general flow diagram of the EIA process, how it fits in with parallel technical and economic studies and the role of public participation. In some cases, such as small scale projects, the transition from identification through to detailed design may be rapid and some steps in the EIA procedure may be omitted.

Screening often results in a categorization of the project and from this a decision is made on whether or not a full EIA is to be carried out.

Scoping is the process of determining which are the most critical issues to study and will involve community participation to some degree. It is at this early stage that EIA can most strongly influence the outline proposal.

Detailed **prediction and mitigation** studies follow scoping and are carried out in parallel with feasibility studies.

The main output report is called an *Environmental Impact Statement (EIS)*, and contains a detailed plan for **managing and monitoring** environmental impacts both during and after implementation.

Finally, an **audit** of the EIA process is carried out sometime after implementation. The audit serves a useful feedback and learning function.

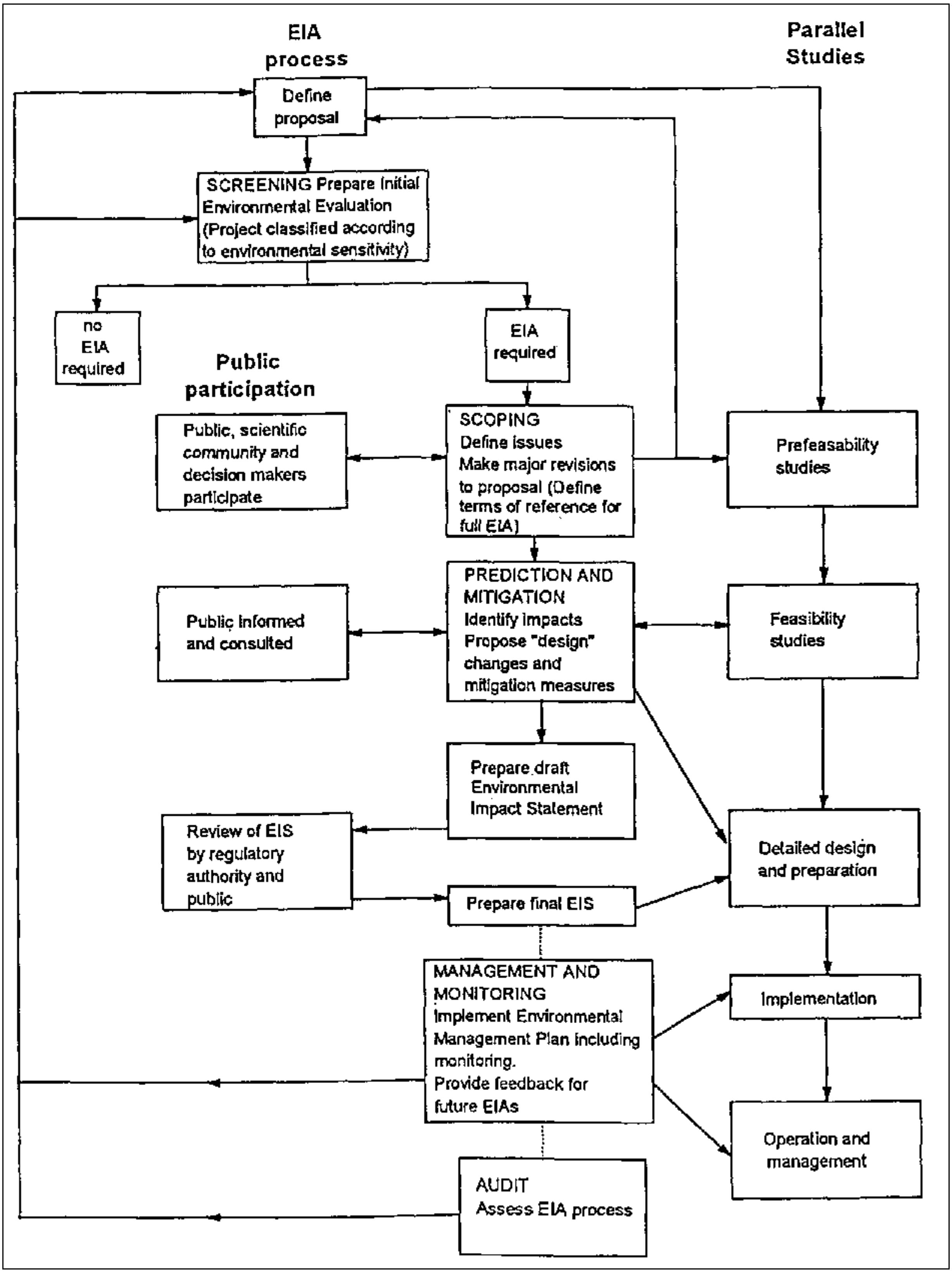

Figure 2.1: Flow diagram of EIA process and parallel studies

2.2. Screening

Screening is the process of deciding on whether an EIA is required. This may be determined by size (e.g. greater than a predetermined surface area of irrigated land that would be affected, more than a certain percentage or flow to be diverted or more than a certain capital expenditure). Alternatively it may be based on site-specific information. For example, the repair of a recently destroyed diversion structure is unlikely to require an EIA whilst a major new headwork structure may. Guidelines for whether or not an EIA is required will be country specific depending on the laws or norms in operation. Legislation often specifies the criteria for screening and full EIA. All major donors screen projects presented for financing to decide whether an EIA is required.

The output from the screening process is often a document called an **Initial Environmental Examination or Evaluation** (IEE). The main conclusion will be a classification of the project according to its likely environmental sensitivity. This will determine whether an EIA is needed and if so to what detail

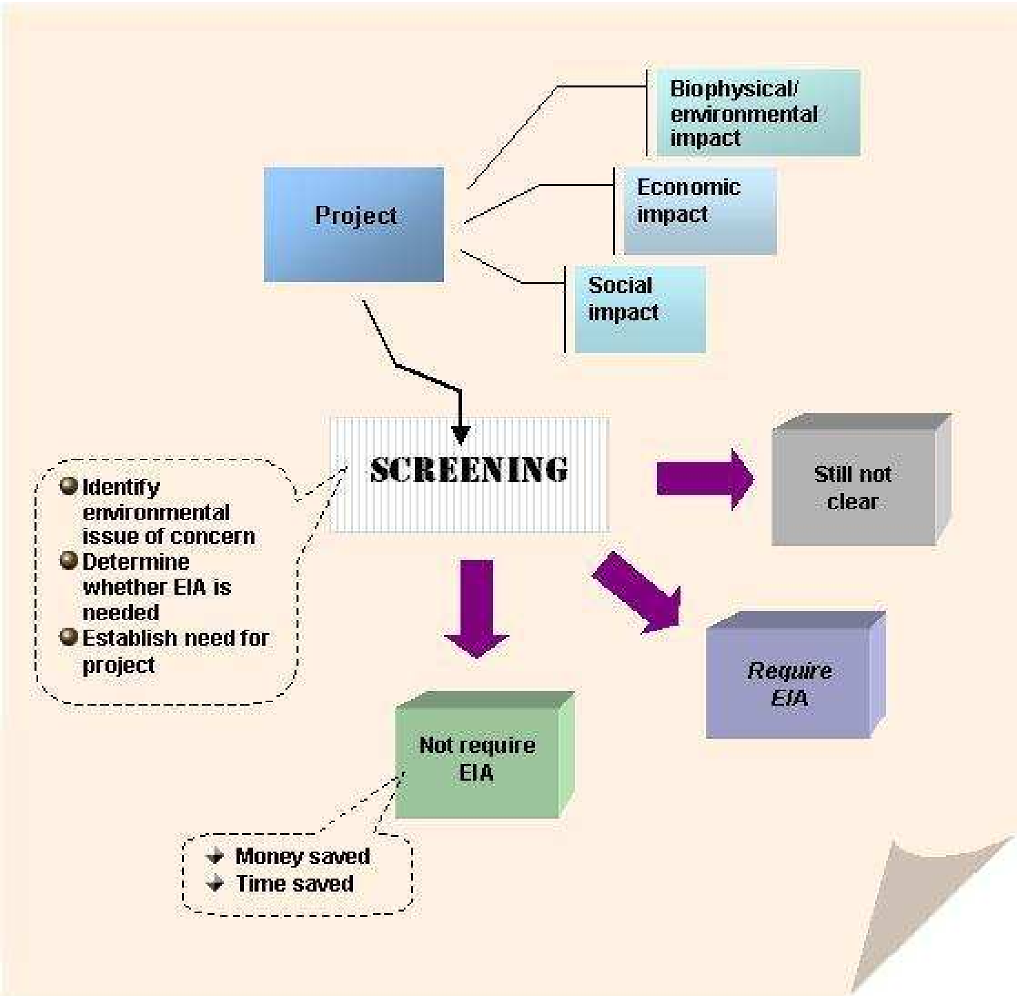

Figure 2.2: The Project screening process

Source: http://www.unescap.org/drpad/vc/orientation/M8_14.htm

Box 2.1: Exercises IEE forms developing

Aim: To orient students to be able to develop IEE forms for different projects Organisation: Student can work in groups Reference materials / supporting literature • Appendix V and VI • USAID (2002) USAID Environmental Procedures training manual for USAID Environmental officers and USAID Mission partners, Washington DC, USA

2.3. Scoping

Scoping occurs early in the project cycle at the same time as outline planning and pre-feasibility studies. Scoping is the process of identifying the key environmental issues and is perhaps the most important step in an EIA. Several groups, particularly decision makers, the local population and the scientific community, have an interest in helping to deliberate the issues which should be considered, and scoping is designed to canvass their views, (Wathern 1988).

Scoping is important for two reasons. First, so that problems can be pinpointed early allowing mitigating design changes to be made before expensive detailed work is carried out. Second, to ensure that detailed prediction work is only carried out for important issues. It is not the purpose of an EIA to carry out exhaustive studies on all environmental impacts for all projects. If key issues are identified and a full scale EIA considered necessary then the scoping should include terms of reference for these further studies.

At this stage the option exists for cancelling or drastically revising the project should major environmental problems be identified. Equally it may be the end of the EIA process should the impacts be found to be insignificant. Once this stage has passed, the opportunity for major changes to the project is restricted.

Before the scoping exercise can be fully started, the remit of the study needs to be defined and agreed by the relevant parties. These will vary depending on the institutional structure. At a minimum, those who should contribute to determining the remit will include those who decide whether a policy or project is implemented, those carrying out the EIA (or responsible for having it carried out by others) and those carrying out parallel engineering and economic studies relating to the proposal. A critical issue to determine is the breadth of the study. For example, if a proposed project is to increase the area of irrigated agriculture in a region by 10%, is the remit of the EIA to study the proposal only or also to consider options that would have the same effect on production?

A major activity of scoping is to identify key interest groups, both governmental and non-governmental, and to establish good lines of communication. People who are affected by the project need to hear about it as soon as possible. Their knowledge and perspectives may have a major bearing on the focus of the EIA. Rapid rural appraisal techniques provide a means of assessing the needs and views of the affected population.

Methods of Scoping

Scoping method includes:

- Making a plan for public involvement
- Assembling relevant existing information
- Distribution of Information to affected persons
- Identifying major Issues of public concern
- Evaluating the significance of Issues on the basis of available Information
- Establishing priorities for environmental assessment
- Developing a strategy for addressing priority issues

These steps are described in details below:

Making a plan for public Involvement

A public involvement or communication plan is one of the most important internal planning tools for those conducting a scoping exercise. The major purpose of scoping at an early stage of project planning is to clearly define all the communities and agencies which should be allowed to influence decisions relating to the proposal. The plan should identify whom to talk to, as well as when and how to undertake the communication exercise. Consent must be obtained from the authorities and government agencies concerned. The project proponent, relevant experts, local people affected, as well as special interest groups should be considered for inclusion in the list of persons to be covered by the communication plan. Methods for involving affected interests and for collecting information include:

- securing written submissions from relevant government agencies and the public,
- holding community meetings and public hearings,
- conducting preliminary field study/observation of sites, and
- Conducting workshops/seminars and establishing an inter-sectoral task force.

Assembling relevant existing Information

At this stage, information should be collected on the nature of the project, including preparation of a preliminary list of potential environmental impacts and practical alternatives, accompanied by maps, drawings and other aids for a fuller understanding of the project proposal. This key information will help in formulating appropriate mitigation measures and will form the basis of further discussion.

Distribution of Information to affected persons

The information collected in the previous step (Assembling relevant existing information) should be processed and assembled into an information package and distributed to appropriate individuals and organizations for comment. Government departments and concerned local and regional officials should be contacted. For major projects, it is always advisable to issue a general public notice inviting public comment and to hold public meetings at the project site as well as at the central level to facilitate consultation and interaction.

The project proponents should be responsible for obtaining and making information available to the parties concerned. In cases, where the individuals affected by the proposed project should be identified, information should be sent directly to local community groups.

For larger projects, however, where the number of affected persons is not known, the information should be disseminated through the media or by sending the information package to the location within the area, where interested individuals may visit. The village communities concerned should be actively involved and made responsible for the collection of all written or verbal reactions to the project proposal from the local people.

Identifying major Issues of public concern

All the concerns and issues raised by affected interests groups should be compiled into a comprehensive list. Each contribution should be categorised and no issue or concern should be ignored or rejected in the compilation of the list.

Evaluating the significance of Issues on the basis of available Information

Once the issues have been identified and grouped, their scientific validity needs to be carefully evaluated. If certain questions of a technical nature remain unresolved, a discussion panel or workshop can be organised at an appropriate venue to resolve the problem.

Establishing priorities for environmental assessment

Although grouping of the issues is undertaken in the previous step, a more detailed exercise should be conducted at this stage. Issues to which immediate solutions can be provided or issues which have no relevance to the proposed project should be dropped. The key issues remaining should be arranged in order of priority.

Developing a strategy for addressing priority issues

Issues to which immediate solutions can be provided -- such as suggesting feasible alternatives or mitigation measures that can be implemented at an early stage -- should be removed from the list. For those issues which need further information in order to be resolved, terms of reference (TOR) should be prepared in order to define guidelines for further study. The extent of information required for a detailed EIA depends upon the type, level, and magnitude of the project concerned.

The main EIA techniques used in scoping are *baseline studies, checklists, matrices* and *network diagrams*. These techniques collect and present knowledge and information in a straightforward way so that logical decisions can be made about which impacts are most significant.

See case study on scoping

2.4. Prediction and mitigation

Once the scoping exercise is complete and the major impacts to be studied have been identified, prediction work can start. This stage forms the central part of an EIA. Several major options are likely to have been proposed either at the scoping stage or before and each option may require separate prediction studies. Realistic and affordable mitigating measures cannot be proposed without first estimating the scope of the impacts, which should be in monetary terms wherever possible. It then becomes important to quantify the impact of the suggested improvements by further prediction work. Clearly, options need to be discarded as soon as their unsuitability can be proved or alternatives shown to be superior in environmental or economic terms, or both. It is also important to test the "without project" scenario.

An important outcome of this stage will be recommendations for mitigating measures. This would be contained in the Environmental Impact Statement. Clearly the aim will be to introduce measures which minimize any identified adverse impacts and enhance positive impacts. Formal and informal communication links need to be established with teams carrying out feasibility studies so that their work can take proposals into account. Similarly, feasibility studies may indicate that some options are technically or economically unacceptable and thus environmental prediction work for these options will not be required.

Many mitigating measures do not define physical changes but require management or institutional changes or additional investment, such as for health services. Mitigating measures may also be procedural changes, for example, the introduction of, or increase in, irrigation service fees to promote efficiency and water conservation.

By the time prediction and mitigation are undertaken, the project preparation will be advanced and a decision will most likely have been made to proceed with the project. Considerable expenditure may have already been made and budgets allocated for the implementation of the project. Major changes could be disruptive to project processing and only accepted if prediction shows that impacts will be considerably worse than originally identified at the scoping stage. For example, an acceptable measure might be to alter the mode of operation of a reservoir to protect downstream fisheries, but a measure proposing an alternative to dam construction could be highly contentious at this stage. To avoid conflict it is important that the EIA process commences early in the project cycle.

This phase of an EIA will require good management of a wide range of technical specialists with particular emphasis on:

- prediction methods
- interpretation of predictions, with and without mitigating measures
- Assessment of comparisons.

It is important to assess the required level of accuracy of predictions. *Mathematical modeling* is a valuable technique, but care must be taken to choose models that suit the available data. Because of the level of available knowledge and the complexity of the systems, physical systems are modeled more successfully than ecological systems which in turn are more successfully modeled than social systems. Social studies (including institutional capacity studies) will probably produce output in non-numerical terms. *Expert advice*, particularly from experts familiar with the locality, can provide quantification of impacts that cannot be modeled. Various techniques are available to remove the bias of individual opinion.

Checklists, matrices, networks diagrams, graphical comparisons and *overlays*, are all techniques developed to help carry out an EIA and present the results of an EIA in a format useful for comparing options. The main quantifiable methods of comparing options are by applying *weightings*, to environmental impacts or using economic cost-benefit analysis or a combination of the two. Numerical values, or weightings, can be applied to different environmental impacts to (subjectively) define their relative importance. Assigning economic values to all environmental impacts is not recommended as the issues are obscured by the single, final answer. However, *economic techniques* can provide insight into comparative importance where different environmental impacts are to be compared, such as either losing more wetlands or resettling a greater number of people.

When comparing a range of proposals or a variety of mitigation or enhancement activities, a number of characteristics of different impacts need to be highlighted. The relative importance of impacts needs agreeing, usually following a method of reaching a consensus but including economic considerations. The uncertainty in predicting the impact should be clearly noted. Finally, the time frame in which the impact will occur should be indicated, including whether or not the impact is irreversible

Box 2.2: Exercise on description and prediction of Environmental Impact

Exercise: description and prediction of impact

2.5. Management and monitoring

The part of the EIS covering monitoring and management is often referred to as the **Environmental Action Plan** or **Environmental Management Plan**. This section not only sets out the mitigation measures needed for environmental management, both in the short and long term, but also the institutional requirements for implementation. The term 'institutional' is used here in its broadest context to encompass relationships:

- established by law between individuals and government;
- between individuals and groups involved in economic transactions;
- developed to articulate legal, financial and administrative links among public agencies;
- Motivated by socio-psychological stimuli among groups and individuals (Craine, 1971).

The above list highlights the breadth of options available for environmental management, namely: changes in law; changes in prices; changes in governmental institutions; and, changes in culture which may be influenced by education and information dissemination. All the management proposals need to be clearly defined and costed. One of the more straightforward and effective changes is to set-up a monitoring programme with clear definition as to which agencies are responsible for data collection, collation, interpretation and implementation of management measures.

The purpose of monitoring is to compare predicted and actual impacts, particularly if the impacts are either very important or the scale of the impact cannot be very accurately predicted. The results of monitoring can be used to manage the environment, particularly to highlight problems early so that action can be taken. The range of parameters requiring monitoring may be broad or narrow and will be dictated by the 'prediction and mitigation' stage of the EIA. Typical areas of concern where monitoring is weak are: water quality, both inflow and outflow; stress in sensitive ecosystems; soil fertility, particularly salinization problems; water related health hazards; equity of water distributions; groundwater levels.

The use of satellite imagery to monitor changes in land use and the 'health' of the land and sea is becoming more common and can prove a cost-effective tool, particularly in areas with poor access. Remotely sensed data have the advantage of not being constrained by political and administrative boundaries. They can be used as one particular overlay in a GIS. However, authorization is needed for their use, which may be linked to national security issues, and may thus be hampered by reluctant governments.

Monitoring should not be seen as an open-ended commitment to collect data. If the need for monitoring ceases, data collection should cease. Conversely, monitoring may reveal the need for more intensive study and the institutional infrastructure must be sufficiently flexible to adapt to changing demands. The information obtained from monitoring and management can be extremely useful for future EIAs, making them both more accurate and more efficient.

The Environmental Management Plan needs to not only include clear recommendations for action and the procedures for their implementation but must also define a programme and costs. It must be quite clear exactly how management and mitigation methods are phased with project implementation and when costs will be incurred. Mitigation and management measures will not be adopted unless they can be shown to be practicable and good value for money. The plan should also stipulate that if, during project implementation, major changes are introduced, or if the project is aborted, the EIA procedures will be re-started to evaluate the effect of such actions.

2.6. Auditing

In order to capitalise on the experience and knowledge gained, the last stage of an EIA is to carry out an **Environmental Audit** some time after completion of the project or implementation of a programme. It will therefore usually be done by a separate team of specialists to that working on the bulk of the EIA. The audit should include an analysis of the technical, procedural and decision-making aspects of the EIA. Technical aspects include: the adequacy of the baseline studies, the accuracy of predictions and the suitability of mitigation measures. Procedural aspects include: the efficiency of the procedure, the fairness of the public involvement measures and the degree of coordination of roles and responsibilities. Decision-making aspects include: the utility of the process for decision making and the implications for development, (adapted from Sadler in Wathern, 1988). The audit will determine whether recommendations and requirements made by the earlier EIA steps were incorporated successfully into project implementation. Lessons learnt and formally described in an audit can greatly assist in future EIAs and build up the expertise and efficiency of the concerned institutions

2.7. EIA Study techniques

2.7.1. Baseline studies

Baseline studies using available data and local knowledge will be required for scoping. Once key issues have been identified, the need for further in-depth studies can be clearly identified and any additional data collection initiated. *The ICID Check-list* will be found useful to define both coarse information required for scoping and further baseline studies required for prediction and monitoring. Specialists, preferably with local knowledge, will be needed in each key area identified. They will need to define further data collection, to ensure that it is efficient and targeted to answer specific questions, and to quantify impacts. A full year of baseline data is desirable to capture seasonal effects of many environmental phenomena. However, to avoid delay in decision making, short-term data monitoring should be undertaken in parallel with long-term collection to provide conservative estimates of environmental impacts.

2.7.2. The ICID Check-list

A comprehensive and user-friendly checklist is an invaluable aid for several activities of an EIA, particularly scoping and defining baseline studies. *"The ICID Environmental Check-List to Identify Environmental Effects of Irrigation, Drainage and Flood Control Projects" (Mock and Bolton, 1993) is recommended for use in any irrigation and drainage EIA. The Check-list has been prepared for non-specialists and enables much time-consuming work to be carried out in advance of expert input.* It includes extensive data collection sheets. The collected data can then be used to answer a series of questions to identify major impacts and to identify shortages of data. A matrix indicates which data are linked to which questions.

The very simple layout of the sheet enables an overview of impacts to be presented clearly which is of enormous value for the scoping process. Similarly, data shortages can be readily seen. The process of using the ICID Check-list may be repeated at different stages of an EIA with varying levels of detail. Once scoping has been completed, the results sheet may be modified to omit minor topics and to change the horizontal classification to provide further information about the impacts being assessed. At this point the output from the Check-list can be useful as an input to *matrices*. The ICID Check-list is also available as a WINDOWS based software package. This enables the rapid production of a report directly from the field study.

2.7.3. Matrices

The major use of matrices is to indicate cause and effect by listing activities along the horizontal axis and environmental parameters along the vertical axis. In this way the impacts of both individual components of projects as well as major alternatives can be compared. The simplest matrices use a single mark to show whether an impact is predicted or not. However it is easy to increase the information level by changing the size of the mark to indicate scale, or by using a variety of symbols to indicate different attributes of the impact.

ICOLD has prepared a large and comprehensive matrix for use in EIAs for dams. The system of symbols for each box shows: whether the impact is beneficial or detrimental; the scale of the impact; the probability of occurrence; the time-scale of occurrence; and, whether the design has taken the impact into account, (ICOLD, 1980). This comprehensive approach, however, makes the final output rather difficult to use and a maximum of three criteria is recommended per impact to maintain clarity. Ahmad and Sammy (1985) suggest that the most important criteria are: magnitude, or degree of change; geographical extent; significance; and, special sensitivity. "Significance" could be further sub-divided to indicate why an impact is significant. For example, it may be because of irreversibility, economic vulnerability; a threat to rare species etc. "Special sensitivity" refers to locally important issues. A series of matrices at all stages of the EIA process can be a particularly effective way of presenting information. Each matrix may be used to compare options rated against a few criteria at a time.

The greatest drawbacks of matrices are that they can only effectively illustrate primary impacts. *Network diagrams*, described below, are a useful and complementary form of illustration to matrices as their main purpose is to illustrate higher order impacts and to indicate how impacts are inter-related.

Matrices help to choose between alternatives by consensus. One method is to make pair-wise comparisons. It provides a simple way for a group of people to compare a large number of options and reduce them to a few choices. First a matrix is drawn with all options listed both horizontally and vertically. Each option is then compared with every other one and a score of 1 assigned to the preferred option or 0.5 to both options if no preference is agreed.

2.7.4. Network diagrams

A network diagram is a technique for illustrating how impacts are related and what the consequences of impacts are. For example, it may be possible to fairly accurately predict the impact of increased diversions or higher irrigation efficiencies on the low flow regime of a river. However, there may be many and far reaching secondary or tertiary consequences of a change in low flow. These consequences can be illustrated using network diagrams. For example, reduced low flows are likely to reduce the production of fish which may or may not be of importance depending on the value (either ecological or economic) of the fish. If fish are an important component of diet or income, the reduction may lead to a local reduction in the health status, impoverishment and possibly migration. Also, reduced low flow coupled with increased pollution, perhaps as a result of increased agricultural industry, may further damage the fish population as well as reduce access to safe water.

2.7.5. Overlays

Overlays provide a technique for illustrating the geographical extent of different environmental impacts. Each overlay is a map of a single impact. For example, saline affected areas, deforested areas, limit of a groundwater pollution plume etc can be analysed and clearly demonstrated to non experts. The original technique used transparencies which is somewhat cumbersome. However, the development of Geographic Information Systems (GIS) can make this technique particularly suitable for comparing options, pinpointing sensitive zones and proposing different areas or methods of land management.

2.7.6. Mathematical modelling

Mathematical modeling is one of the most useful tools for prediction work. It is the natural tool to assess both flow quantities and qualities (e.g. salt/water balances, pollution transport, changing flood patterns). However, it is essential to use methods with an accuracy which reflects the quality of the input data, which may be quite coarse. It should also be appreciated that model output is not necessarily an end in itself but may be an input for assessing the impact of changes in economic, social and ecological terms. Mathematical modeling was used very effectively to study the Hadejia-Jama' are region in Nigeria. In this case the modeling demonstrated the most effective method of operating upstream reservoirs in order to conserve economically and socially valuable and ecologically important downstream wetlands. Optimal operation was found to be considerably different from the traditional method originally proposed. Under the revised regime the economic returns were also found to be higher.

2.7.7. Expert advice

Expert advice should be sought for predictions which are inherently non-numeric and is particularly suitable for estimating social and cultural impacts. It should preferably take the form of a consensus of expert opinion. Local experience will provide invaluable insight. Expert opinions are also likely to be needed to assess the implications of any modeling predictions. For example, a model could be developed to calculate the area of wetlands no longer annually flooded due to upstream abstractions. However, the impact on wetland species or the reduction in wetland productivity resulting from the reduced flooding may not be so precisely quantifiable but require a prediction based on expert opinion.

2.7.8. Economic techniques

Economic techniques have been developed to try to value the environment and research work is continuing in environmental economics. This is a specialist subject and only a brief introduction is included here. For more detailed information the reader is advised to read Winpenny (1991) and other standard texts. It is important to stress that environmentally sound development brings long term economic benefits. Unfortunately, short term gains are often given priority.

The most commonly used methods of project appraisal are cost-benefit and cost-effectiveness analysis. It has not been found easy to incorporate environmental impacts into traditional cost-benefit analysis, principally because of the difficulty in quantifying and valuing environmental effects. An EIA can provide information on the expected effects and quantify, to some extent, their importance. This information can be used by economists in the preparation of cost-benefit calculations. Cost effectiveness analysis can also be used to determine what is the most efficient, least-cost method of meeting a given environmental objective; with costs including forgone environmental benefits. However, defining the objective may not be straightforward.

Valuing the environment raises complex and controversial issues. The environment is of value to the actual users (such as fishermen), to potential users (future generations or migrants), and to those who do not use it but consider its existence to have an intrinsic value (perhaps to their "quality of life"). Clearly it is difficult to quantify such values. Nevertheless, attempts have been made and the two most useful methods for irrigation projects in developing countries are "Effect on Production" (EOP) and "Preventive Expenditure and Replacement Costs" (PE/RC). The EOP method attempts to represent the value of change in output that results from the environmental impact of the development. This method is relatively easy to carry out and easily understood. An example would be the assessment of the reduced value of fish catches due to water pollution or hydrological changes. The PE/RC method makes an assessment of the value that people place on preserving their environment by estimating what they are prepared to pay to prevent its degradation (preventive expenditure) or to restore its original state after it has been damaged (replacement cost). Both methods have weaknesses and must be used judiciously.

Environmental health effects present similar problems, cost-effectiveness analysis is a useful tool in the selection of mitigating or control measures, but for *ex-ante* project appraisal the incompatibility of human health and monetary values has forced economists to develop other techniques and indicators. A recent publication by Phillips *et al*. (1993) deals with the principles and methods of cost-effectiveness analysis and its application to decisions about the control of vector-borne diseases, particularly the control of disease vectors. In its World Development Report of 1993 (Investing in Health) the World Bank proposes the cost-utility analysis which expresses health status in DALYs (Disability Adjusted Life Years).

2.8. Final report - Environmental impact statement

The final report of an EIA is often referred to as an Environmental Impact Statement (EIS). In addition to summarizing the impacts of the alternatives under study this report must include a section on follow up action required to enable implementation of proposals and to monitor long-term impacts. The purpose of an EIA is not to reach a decision but to present the consequences of different choices of actions and to make recommendations to a decision maker. Recommendations are a crucial part of the Environmental Impact Statement. The format of the report should preferably follow a standard as recommended by the appropriate institution or required by legislation. The executive summary of the EIS should only be 2 to 5 pages long and the main report, excluding appendices should be preferably about 50 pages long and no more than 100. An exceptionally complex study might require 150 pages.

Experts preparing an EIA must appreciate that the final report will be read by a wide range of people and the subject matter may be technically complex. Senior administrators and planners may not understand the importance of technical arguments unless they are presented carefully and clearly. The quality of the executive summary is particularly important as some decision-makers may only read this part of the report. The executive summary must include the most important impacts (particularly those that are unavoidable and irreversible), the key mitigating measures, proposed monitoring and supervision requirements, and the recommendations of the report.

The main text should maximize the use of visual aids such as maps, drawings, photographs, tables and diagrams. Matrices, network diagrams, overlays and graphical comparisons should all be included. The main text should cover the following points (adapted from EBRD (1992) and World Bank (1991)):

- A description of the programme, plan or project including the physical, social and ecological context as well as the time-scale of the proposals under study. Any major revisions made as a result of the scoping process should be identified here.
- A summary of the EIA methodology, including the limits of the study and the reasons for them.
- The policy, legal and administrative framework within which the project is situated.
- A summary of the baseline data providing an overall picture of present conditions and physical, biological and ecological trends. The consequences of the "no-action" option should be described together with a brief description of other developments taking place and their relationship to the study proposal.
- A description of the governmental and non-governmental participation during the EIA.
- Environmental impacts. The most significant beneficial and adverse environmental impacts associated with the options studied need to be clearly stated. Impacts need to be quantified wherever possible and uncertainties in the results need to highlighted, whether due to a lack of knowledge, lack of data or to critical but indeterminate assumptions such as future policy. The results of economic analyses need to be presented in the same section. Mitigation and enhancement measures that are proposed may either be presented together with information on the environmental impacts or as a separate section. Impacts with no effective mitigation need to be clearly identified as such.

- The Environmental Action Plan needs to be presented in two sections. The first part covers the implementation of proposed mitigation measures, including both costs and training, and institutional enhancements required to implement them. The second part should cover monitoring requirements to measure predicted impacts and to determine the success of mitigation measures. Again, costs and institutional requirements need to be included for each major proposal. A clear programme of implementation should be given.
- Recommendations and guidance to the decision maker.
- A statement of provision for auditing, who should carry it out and when.

The appendixes should include:

- a glossary of technical terms and units
- a list of the team who prepared the EIA
- records of public meetings and consultations
- a catalogue of information, both data and written material, and their source
- Technical information too detailed for the main text.

2.9. Public participation

Projects or programmes have significant impacts on the local population. Whilst the aim is to improve the well being of the population, a lack of understanding of the people and their society may result in development that has considerable negative consequences. More significantly, there may be divergence between national economic interests and those of the local population. For example, the need to increase local rice production to satisfy increasing consumption in the urban area may differ from the needs as perceived by the local farmers. To allow for this, public participation in the planning process is essential. The EIA provides an ideal forum for checking that the affected publics have been adequately consulted and their views taken into account in project preparation.

The level of consultation will vary depending on the type of plan or project. New projects involving resettlement or displacement will require the most extensive public participation. As stated before, the purpose of an EIA is to improve projects and this, to some extent, can only be achieved by involving those people directly or indirectly affected. The value of environmental amenities is not absolute and consensus is one way of establishing values. Public consultation will reveal new information, improve understanding and enable better choices to be made. Without consultation, legitimate issues may not be heard, leading to conflict and unsustainability.

The community should not only be consulted they should be actively involved in environmental matters. The International Union for the Conservation of Nature, IUCN promotes the concept of Primary Environmental Care whereby farmers, for example, with assistance from extension services, are directly involved in environmental management. The earlier the public are involved, the better. Ideally this will be before a development proposal is fully defined. It is an essential feature of successful scoping, at which stage feedback will have the maximum influence. Openness about uncertainty should be a significant feature of this process. As the EIA progresses, public consultation is likely to be decreased though it is important to disseminate information. The publication of the draft *Environmental Impact Statement* (EIS), will normally be accompanied by some sort of public hearing that needs to be chaired by a person with good communication skills. He/she may not be a member of the EIA team.

There are no clear rules about how to involve the public and it is important that the process remains innovative and flexible. In practice, the views of people affected by the plan are likely to be heard through some form of representation rather than directly. It is therefore important to understand how decisions are made locally and what are the methods of communication, including available government extension services. The ranges of groups outside the formal structure with relevant information are likely to include: technical and scientific societies; Water User Groups; NGOs; experts on local culture; and religious groups. However, it is important to find out which groups are under-represented and which ones are responsible for access to natural resources, namely: grazing, water, fishing and forest products. The views of racial minorities, women, religious minorities, political minorities and lower cast groups are commonly overlooked, (World Bank, 1991).

There has been an enormous increase in the number of environmental NGOs and "Green" pressure groups throughout the world. Such organizations often bring environmental issues to the attention of the local press. However, this should not deter consultation with such organizations as the approach to EIA should be open and positive with the aim of making improvements. Relevant NGOs should be identified and their experience and technical capacity put to good use.

In some countries, open public meetings are the most common technique to enable public participation. However, the sort of open debate engendered at such meetings is often both culturally alien and unacceptable. Alternative techniques must be used. Surveys, workshops, small group meetings and interviews with key groups and individuals are all techniques that may be useful. Tools such as maps, models and posters can help to illustrate points and improve communication. Where resettlement is proposed, extensive public participation must be allowed which will, at a minimum, involve an experienced anthropologist or sociologist who speaks the local language. He/she can expect to spend months, rather than weeks, in the field.

Information dissemination can be achieved using a number of mechanisms including the broadcasting media, in particular newspapers and radio. Posters and leaflets are also useful and need to be distributed widely to such locations as schools, clinics, post offices, community centres, religious buildings, bus stops, shops etc. The EIA process must be seen to be fair.

The public participation/consultation and information dissemination activities need to be planned and budgeted. The social scientist team member should define how and when activities take place and also the strategy: extensive field work is expensive. It is important to note that public participation activities are often reported as a separate section of the final EIA. Where experience of managing community involvement is limited, training is highly recommended. Further reading on public participation can be obtained from: Ahmed L and G K Sammy (1988) and on Rapid Rural Appraisal from Chambers R (1981). Rapid Rural Appraisal techniques may be an appropriate and cost effective method of assessment

See case study on public participation in EIA

3. The Context of Environmental Analysis

Based on: Dougherty T.C and Hall A.W (1995), Environmental impact assessment of irrigation and drainage projects, FAO, Rome, Italy

3.1. Policy framework

Increasingly, at the national level, new environmental policies are being introduced, perhaps including a National Environmental Action Plan or National Plan for Sustainable Development. Such policies are often supported by legislation. Government policies in areas such as water, land distribution and food production, especially if supported by legislation, are likely to be highly significant for irrigation and drainage projects.

An EIA should outline the policy environment relevant to the study in question. Results are also likely to be most easily understood if they are interpreted in the light of prevailing policies.

Policies and regulations are sometimes conflicting and can contribute to degradation. It is within the scope of an EIA to highlight such conflicts and detail their consequences in relation to the irrigation and drainage proposal under study. An example of conflicting policies would be an agricultural policy to subsidize agro-chemicals to increase production and an environmental policy to limit the availability of persistent chemicals. A totally laissez-faire policy will result in unsustainable development, for example through uncontrolled pollution and distortions in wealth. This creates problems which future generations have to resolve. On the other hand, excessive government control of market forces may also have negative environmental impacts. For example, free irrigation water leads to the inefficient use of this scarce and expensive resource, inequities between head and tail users and water logging and salinity problems.

Legal and policy issues have far-reaching consequences for the environment and are included here to illustrate the complex nature of environmental issues. The FAO Legislative Study 38, "The environmental impact of economic incentives for agricultural production: a comparative law study", is a useful reference. A forthcoming FAO/World Bank/UNDP publication, "Water Sector Policy Review and Strategy Formulation: A General Framework", will address the need for environmental issues to be integrated into water policy. If a regional, sector or basin-wide EIA is needed, such issues will form an important part.

3.2. Social context

A project or programme and its environmental impacts exist within a social framework. The context in which an EIA is carried out will be unique and stereotype solutions to environmental assessments are therefore not possible. Cultural practices, institutional structures and legal arrangements, which form the basis of social structure, vary from country to country and sometimes, within a country, from one region to another. It is a fundamental requirement to understand the social structure of the area under study as it will have a direct impact on the project and the EIA.

Local, regional and national regulations, laws and organizations are interlinked. The way in which they are interlinked needs to be explicitly understood as part of the EIA. An understanding of the institutional and legal framework concerning the environment and irrigation and drainage development is critical to the success of any project or programme. Indeed, it is likely that recommendations arising from the EIA will include restructuring or strengthening institutions, particularly at a local level, for example, ensuring adequate maintenance or effective monitoring of drain water quality. Recommendations for new legal controls or limits may also form part of the EIA output; for example, stipulating a particular flow regime in order to maintain a wetland.

At a local or regional level there may be particular regulations and customary practices which will influence environmental aspects of any project and these must be understood. The participation of local groups and the direct beneficiaries, mainly farmers, is essential to successful EIA. This may best be achieved by involving district councils. At the district level there is more interaction between sectors. Consultation with local interest groups, including non-governmental organizations (NGOs), will enable local views to be taken into account and their concerns addressed. An awareness of social and cultural problems may enable solutions to be found and conflicts to be averted before project implementation commences. Ignorance of a problem will prevent a satisfactory solution being found.

If land acquisition, economic rehabilitation (providing an alternative source of income) or resettlements of displaced people are factors in any proposed development, special care will be needed in carrying out the EIA. In most countries such issues are socially and politically sensitive and legally complex and must be identified early, during screening. They should be highlighted so that they are adequately studied by experts early in project preparation.

Poor people often find themselves in a vicious circle. They are forced by their poverty to exploit natural resources in an unsustainable manner and suffer from increasing poverty because of environmental degradation. They often inhabit fragile, marginal eco-zones in rural and, increasingly, semi-urban areas. High population growth is linked to poverty and further contributes to the dynamics of the vicious circle as ever increasing demands are made on finite natural resources. Therefore, the needs of the poor, their influence on the project and the project's impact on vulnerable groups all require particular attention in an EIA.

3.3. Institutional framework and EIA

Environmental, water and land issues involve many disciplines and many government bodies. Data will therefore have to be collected and collated from a wide range of technical ministries, other government authorities and parastatals. The interests of some bodies may not initially appear to be relevant to irrigation and drainage. However, they may hold important information about the project and surrounding area on such topics as land tenure, health, ecology and demography.

The link between different ministries and departments within ministries are often complex and the hierarchy for decision making unclear. There is a tendency for each ministry to guard "its project" and not consult or seek information from other government bodies unless forced to. This is directly contrary to the needs of an EIA. Even if formal structures exist there may be a lack of coordination between different organizations. Informal links may have been established in practice in order to overcome awkward bureaucratic structures. These issues must be understood and not oversimplified.

There may be conflict between government organizations, particularly between the institution promoting the development and that given the mandate for environmental protection. In countries where some planning processes are undertaken at the regional or district level, the regional or district councils make it easier for affected communities to put forward their views, which may differ from those of the central authorities. They will have different agendas and approaches. The EIA process must be interactive and be sympathetic to the differing views; not biased towards a particular organization.

One of the main conflicts arising from irrigation and drainage projects is between those responsible for agriculture and those for water. In some countries, there are several key ministries with differing responsibility, such as agriculture, public works and irrigation, plus several parastatal organizations and special authorities or commissions, some perhaps directly under the Office of the President. The institutional aspects are complex; for example in Thailand, over 15 institutions have responsibility for various aspects of soil conservation work.

Increasingly, at the national level, new institutions are being created, or existing institutions reorganized, to address environmental issues. Often a Ministry of the Environment will be created with a mandate to prepare legislation, set standards and provide a "policing" role. In addition, an Environmental Protection Agency may also be created to coordinate environmental assessment activities and to monitor follow up actions. As well as specific environmental agencies, new units or departments concerned with environmental issues are being created in technical ministries. Such units may have narrow duties related to the responsibilities of the institution. For example, several units could be concerned with various aspects of monitoring water pollution levels and setting acceptable quality standards. The responsibility of all the relevant institutions needs to be clearly understood.

Institutional weakness is one of the major reasons for environmentally unsound development. The multiplicity of institutions may also mitigate against effective enforcement of environmental control measures. The EIA must cover such issues in depth and highlight contradictions, weak or impractical legislation and institutional conflicts. To overcome such problems an EIA should propose appropriate solutions. This should include institutional strengthening.

3.4. Legal framework for EIA

Environmental policy without appropriate legislation will be ineffective as, in turn, will be legislation without enforcement. Economic and financial pressures will tend to dominate other concerns. In many developing countries legislation on environmental issues has been in existence for many years. For example, laws exist in most countries for the prevention of water pollution, the protection of cultural heritage and for minimum compensation flows. Much of the existing legislation or regulations have not been considered "environmental". Recently, much specific new environmental legislation has been enacted. This may be as a response to major disasters, or may result from government policy, public pressure or the general increased international awareness of the environmental dangers that now exist in the world. Relevant water and land law as well as environmental protection legislation needs stating, understanding and analysing as part of an EIA.

New legislation may include a statutory requirement for an EIA to be done in a prescribed manner for specific development activities. When carrying out an EIA it is thus essential to be fully aware of the statutory requirements and the legal responsibilities of the concerned institutions. These are best given as an annex to the terms of reference. The legal requirements of the country must be satisfied. New laws can impose an enormous burden on the responsible agencies. The statutory requirement to carry out an EIA for specific projects will, for example, require expert staff to carry out the study, as well as officials to review the EIA and approve the project.

Laws designating what projects require EIA should, ideally, limit the statutory requirements to prevent EIA merely becoming a hurdle in the approval process. This will prevent large volumes of work being carried out for little purpose. Most legislation lists projects for which EIA is a discretionary requirement. The discretionary authority is usually the same body that approves an EIA. This arrangement allows limited resources to be allocated most effectively. However, it is essential that the discretionary authority is publicly accountable.

When external financial support is required it will also be necessary to satisfy the obligations of the donor organization. Most major donors now require an EIA for projects relating to irrigation and drainage. Chapter 6 gives details of publications outlining the requirements of the main donors.

The function of environmental legislation can vary. It is not easy to give a precise definition of when an EIA is needed. Therefore the statutory requirement for an EIA is not particularly well suited to law. On the other hand many of the most important environmental hazards are easily addressed by law. For example, it is straightforward to set legal limits for pollution, flow levels, compensation etc: here the problem is one of enforcement. It is normal for an EIA to assess the acceptability or severity of impacts in relation to legal limits and standards. However, it is important to highlight cases where existing standards are insufficiently stringent to prevent adverse impacts and to recommend acceptable standards. Enforcement problems can be partially addressed by changing institutional structures.

Laws relating to irrigated lands are complex and according to an FAO study of five African countries they are not generally applied (FAO, 1992). There are conflicts between modern and customary laws: the former tend to be given prominence although the latter are usually strong locally. Traditional and customary rights have often developed in very different historical and political contexts and can vary greatly over a short distance. They may also be mainly oral and imprecise. Local participation in the preparation of the EIA will help to understand important customary rights and highlight possible weaknesses in any proposed development

3.5. Context of Yemen Environmental Analysis

- EIA laws, guidelines and regulations in Yemen
- EIA guidelines and regulations abroad
- National (Yemen) Environment Action Plans (NEAPs

4. EIA Project evaluation and decision making

Based on: Dougherty T.C and Hall A.W (1995), Environmental impact assessment of irrigation and drainage projects, FAO, Rome, Italy

4.1. Environmental Management Plan

An Environmental Management Plan (EMP) describes the processes that an organization will follow to maximize its compliance and minimize harm to the environment. This plan also helps an organization map its progress toward achieving continual improvements.

Each organization is unique and, as a result, so is Environmental Management Plans. The level of detail and length of an EMP will vary depending on the type of organization, the complexity of its processes and the maturity of the organization in understanding its environmental responsibilities. Some plans may end up being only a few pages long, while others could become extensive documents. Regardless of the organization's situation, all environmental plans may include the following elements:

- Policy
- Planning
- Implementation and Operation
- Checking and Corrective Action
- Management Review and Commitment to Improvement

Details on each of these elements follow.

Policy

Policy statements are important to an organization because they help anchor the organization on a core set of beliefs. These environmental guiding principles keep all members of an organization pointed toward the same objective. They provide an opportunity for outside interests to understand the focus of the organization and what it stands for. These policy statements do not need to be long. In fact, it is often more preferable to keep the policy concise and focused so it is easy to read and becomes an effective tool in understanding the organization's commitment. When properly developed, an environmental policy should commit the organization to:

- Compliance with legal requirements and voluntary commitments.
- Minimizing waste and preventing pollution.

- Continual improvement in environmental performance, including areas not subject to regulations.
- Sharing information on environmental performance with the community.

Planning

The planning portion of the EMP is intended to help an organization define its environmental footprint and then set environmental goals. Goals and objectives should focus on maximizing the organization's positive impact on the environment. When evaluating this portion of the submitted EMPs, the department will be looking for the following elements:

- Does the organization identify how it impacts the environment through its activities, products and services?
- Does the organization understand its legal requirements associated with protecting the environment?
- Does the organization set meaningful and focused environmental objectives and targets?

Implementation and Operation

A key portion of the EMP is how it defines the activities the organization will perform to meet its environmental objectives and targets. This section should identify specific tasks each person is responsible for, ensure task completion and set targets and deadlines for each of the identified activities. In addition, this area should specify the employee training, communication and outreach activities that are necessary to ensure successful implementation of the plan.

Checking and Corrective Action

The EMP should describe the process that will be followed to verify that the plan is being properly implemented and describe how implementation problems will be corrected in a timely manner. Routine evaluation and continual improvement to the process is necessary to make sure that the plan successfully leads the organization toward completion of environmental objectives and targets.

Management Review and Commitment to Improvement

Routine management review and support is a necessary and meaningful tool for the organization. This section should identify the routine management evaluations that will be conducted to ensure that the plan is appropriate and effectively implemented and helps the organization meet its environmental objectives.

- Integrating EMP with project cycles

4.2. Strategic environmental assessment (SEA)

There are many definitions of strategic environmental assessment (SEA). Sadler and Verheem (1996) call it:

"a systematic process for evaluating the environmental consequences of proposed policy, plan or programme initiatives in order to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision making on par with economic and social considerations."

Therivel et al. (1992) define it as:

"the formalised, systematic and comprehensive process of evaluating the environmental effects of a policy, plan or programme and its alternatives, including the preparation of a written report on the findings of that evaluation, and using the findings in publicly accountable decision-making."

Perhaps the simplest definition of SEA is that it is the environmental impact assessment process applied to policies, plans and programmes, keeping in mind that the process of evaluating environmental impacts at a strategic level is not necessarily the same as evaluating them at a project level.

SEA is meant to be a continuous source of environmental information throughout all the stages of decision-making, as shown below. Note that the stages do not necessarily follows one another: for instance, the identification of alternatives may show that other aspects of the environmental baseline need to be analysed.

Table 4.1: SEA in Decision making

SEA in decision-making		
Plan-making stage	SEA stage	Purpose of SEA stage
Early in the plan-making process	Decide whether SEA is needed: screening	
	Context setting Describe the environmental and policy context that affects the plan: Identify other relevant plans, programmes and environmental protection objectives; Collect baseline information; and Identify environmental problem.	Establish how the plan is affected by outside factors; provide an evidence base for impact prediction and monitoring; help focus the SEA and streamlining subsequent stages; suggest ideas for how any constraints can be addressed; and help to develop the SEA framework
	Develop an SEA framework of objectives and/or indicators	Provide a means by which the environmental performance of the plan and alternatives can be assessed
	Early consultation about the scope of the SEA	Ensure that the SEA covers the likely significant environmental effects of the plan.
As the plan evolves	Assessment and mitigation Plan objectives: Test the plan objectives against the SEA framework; suggest mitigation	Identify potential synergies or inconsistencies between the plan objectives and SEA objectives; and help in developing plan alternatives.
	Plan alternatives: Inform the development of plan alternatives, and test the plan alternatives against the SEA framework; suggest mitigation	Develop and refine plan alternatives; predict the significant environmental effects of the plan alternatives; and help in choosing the preferred option
	Draft plan: Test the draft plan (preferred option) against the SEA framework; suggest mitigation	Predict the significant environmental effects of the draft plan; and help to fine-tune the plan.
	Consultation Preparing the SEA report, including proposing monitoring measures;	Present the predicted environmental effects of the plan, including alternatives
	Consult the public, consultation bodies and others on the draft plan and SEA report	Give the public and others an opportunity to express their opinions on the findings of the SEA Report and use it as a reference point in commenting on the plan; and Gather more information through the opinions and concerns of the public and others

	Assess any significant changes made to the plan as a result of plan examination	Ensure that the environmental implications of any significant changes to the draft plan are assessed and taken into account
After plan adoption	Documentation and monitoring Provide information on decisions	Provide information on how the SEA Report and consultees opinions were taken into account in deciding the final form of the plan
	Develop aims and methods for monitoring	Track the environmental effects of the plan to show whether they are as predicted; and help to identify adverse effects

Adapted from ODPM (2005) A Practical Guide to the Strategic Environmental Assessment Directive, London

As a very minimum, the SEA process involves:

- predicting the environmental impacts of a strategic action; and
- Using those predictions in decision-making.

If those two basic criteria are not fulfilled, it is not an SEA.

Several other terms are also used to refer to environmental assessment at the strategic level, including:

- policy environmental assessment;
- policy impact assessment;
- sectoral environmental assessment; and
- Programmatic environmental impact statement.

The term SEA report refers to a report that describes the methods and findings of the SEA process. Preparation of an SEA report is part of most SEA processes.

The main aim of SEA is to incorporate environmental/sustainability issues in strategic decision-making. Secondary aims of SEA are to:

- improve the strategic action by making it clearer, more internally consistent etc;
- involve the public or its representatives in the decision-making process; and
- educate decision-makers about the environmental impacts of their decisions

- Gender analysis consideration in conducting EIA

- Waste treatment EIA
    - Field visit to waste water treatment plant

5. Post Project EIA activities

Based on: UNESCAP Virtual Conference: United Nations; c1998 – 2008 [updated October 30, 2004] available from http://www.unescap.org/drpad/vc/orientation/M8_first.htm

5.1. EIA Monitoring

Environmental monitoring is defined as "an activity undertaken to provide specific information on the characteristics and functions of environmental and social variables in space and time

A serious shortcoming of most environmental impact assessment process is the absence of baseline data and impact monitoring during the construction, and operation of large development projects. Without such data, it is impossible to test impact predictions and the success of mitigative measures. Furthermore, the lack of appropriate ecological monitoring, impedes the scientific progress, in impact prediction and assessment, makes it difficult to learn from experiences.

Environmental monitoring is therefore one of the most important components of an EIA which is essential for:

- Ensuring that impacts do not exceed the legal standards,
- Checking the implementation of mitigation measures in the manner described in the EIA report, and
- Providing early warning of potential environmental damages.

Principles of monitoring

Certain principles of EIA monitoring should not be overlooked. If the EIA monitoring process is to generate meaningful information and improve implementation of mitigation measures, it must accomplish the following:

- Determine the indicators to be used in monitoring activities,
- Collection of meaningful and relevant information,
- Application of measurable criteria in relation to chosen indicators,
- Reviewing objective judgments on the information collected,
- Draw tangible conclusions based on the processing of information,
- Making rational decision based on the conclusion drawn, and
- Recommendation of improved mitigation measures to be undertaken.

Types of Monitoring

Various types of monitoring activity are currently in practice, and each has some degree of relevance to an EIA study. The main types are briefly described below:

Table 5.1: Types of Monitoring

Baseline Monitoring	a survey should be conducted on basic environmental parameters in the area surrounding the proposed project before construction begins (pre-audit study). Subsequent monitoring can assess the changes in those parameters over time against the baseline.
Impact Monitoring	the biophysical and socio-economical (including public health) parameters within the project area, must be measured during the project construction and operational phases in order to detect environmental changes, which may have occurred as a result of project implementation
Compliance Monitoring	this form of monitoring employs a periodic sampling method, or continuous recording of specific environmental quality indicators or pollution levels to ensure project compliance with recommended environmental protection standards

Monitoring should be regular and performed over a long period of duration. Interruptions in monitoring may result in generating insufficient data to draw accurate conclusion concerning project impact.

The main aim of EIA monitoring is to provide the information required to ensure that project implementation has the least possible negative environmental impacts on the people and ecology.

Example:

Nepal: Environmental Monitoring Plan (Example from Hydropower Project from Nepal)

The monitoring plan includes the description of types of monitoring, the parameters to be monitored, methods to be used and schedules for operating monitoring activities. The following examples taken from EIA of hydropower project implemented in Nepal would illustrate the formulation of monitoring plan and schedules which can be expanded and elaborated based upon the types and scales of the projects to be considered.

Table 5.2: Example of Nepal Hydropower Project Monitoring Project

Type	Parameters	Method	Schedule
Baseline Monitoring	Flow rate of River and its tributaries	Gauging station	Continuous
	Glacier lakes in the basin: lake geometry and volume; possibility of GLOF; and possibility of mitigation measures such as artificial draining	Glaciological hazard mapping in aerial photographs, satellite imagery, ground photographs, and site observation	During the design stage
	Stability of slopes	Site observation	At least three times a year: before, during and after the monsoon

			season.
	Forest management	Discussions with user groups, local people and the District Forest Office	At least twice a year
	Fish population, spawning and migration	Fish sampling and discussions with local fishermen	Twice a year during the wet and dry seasons
	Growth of settlements in the project area	discussions with local people, and checking records of local government	Once a year
Compliance monitoring	Incorporating of EIA recommendations into project documents	Review of detailed design, project specification and tender documents	Following completion of tender documents
	Incorporation of environmental considerations mentioned in the tender documents in the contractors' proposed work plans	Review of proposed work plans, submitted by contractor	During contract negotiations
	Contractors' arrangements regarding labour camps materials storage and construction activities	Site observation	Beginning of the construction period
	Land/property acquisition procedures	Discussions with the local people and the project management	At the time of land acquisition
	Implementation of all environmental conditions mentioned in the tender documents, including arrangements for slope protection; pollution prevention; protection of vegetation, fish and wildlife; use of local labours; safe construction; public health and public relations	Site observation and discussion with project management and local people using a checklist	Continuous during the construction period
	Clean-up and reinstatement of the	Site observation	At the end of the construction period

	project area		
Impact Monitoring	Disturbance of slopes	Site observation	Continuously during construction
	Levels of air, water and land pollution	Site observation and water and air sampling	Continuous observation and sampling during construction
	Fish population, spawning and migration	Fish sampling and discussion with local fishermen	Twice a year during the wet and dry seasons
	Conditions of local forests	Site observation and discussions with forest user groups and local people	Twice a year during construction
	Water supply and sanitation in the project area	Site observation and water testing	Continuously during construction
	Public health	Discussions with the local people and the doctors at the local health post	Monthly during construction
	Crime and socially undesirable activities	Discussions with the local people and the local police	Monthly during construction
	Social and economic conditions of the displaced people	Discussions with the displaced people	Regularly for at least three years following land acquisition

Source:

Institutional Aspect

Institutional factors determining the effectiveness of monitoring should not be underestimated. There needs to be a firm institutional commitment by the agencies responsible for the monitoring process, particularly in regard to the following:

- willingness on the part of the institutions involved and organizational personnel to support the monitoring process with the necessary level of resources and authority,
- maintaining continuity in the monitoring programme,
- technical capabilities of the personnel involved must be developed,
- integrity or honesty of the process must be maintained,
- decisions must be taken based on a thorough review of results,
- monitoring information must be made available to all agencies concerned, and
- Necessary institutional reforms need to be made within the planning and implementation agencies.

EIA monitoring responsibility should be given to monitoring section within the planning divisions of concerned ministries.

The costs involved in EIA monitoring should be borned by the project proponent.

The reporting structure for EIA monitoring depends upon the nature of the project and the analysis undertaken by the agencies concerned. The information should be organized in a well developed format and presented in regular reports, allowing for easy presentation at decision making and review meetings. The agencies concerned have to oversee enforcement of the decisions taken in the review meeting. If decisions are not implemented by the agencies responsible, legal measures should be initiated to guarantee implementation.

5.2. Environmental Auditing

Auditing refers to the examination and assessment of a certain type of performance. In the case of an EIA, an audit assess the actual environmental impact, the accuracy of prediction, the effectiveness of environmental impact mitigation and enhancement measures, and the functioning of monitoring mechanisms. The audit should be undertaken upon a project run in operation, for some time, and is usually performed once or twice in the entire project cycle.

The following types of audit that are recommended to be implemented in different phases of the EIA process:

Types of Audit

Table 5.3: Types of Audit

Decision Point Audit	examines the effectiveness of EIA as a decision-making tool
Implementation Audit	ensures that approved conditions have been met
Performance Audit	examines the responses of agencies concerned with project management
Project Impact Audit	examines environmental changes arising from project implementation
Predictive Technique Audit	examines the accuracy and utility of predictive techniques by comparing actual against predicted environmental effects
EIA Procedures Audit	critically examines the methods and approach adopted during the EIA study

Not all the audit types mentioned above are required to be implemented in EIA process. However, at the project approval stage, both project proponent and authorizing agency should considered whether an application of a particular audit technique is likely to result in new information or an improvement in management practices. Particular attention should be given to the project cost-effectiveness of any proposed audit and to technical difficulties likely to be encountered.

Since the EIA concept is a relatively recent, the use of environmental audits will play a significant role in evolving a systematic approach of the application of EIA.

Environmental auditing should compare monitoring results with information generated during the pre-project period. Comparisons can be made with similar projects or against standard norms. Relating actual impacts with predicted impacts, help in evaluating the accuracy and adequacy of EIA predictions.

Environmental Auditing Plan

Environmental Audit should be carried out upon the completion of project construction and after 2 years of project operation in order to obtain information on:

- the condition of natural/social/economical resources prior to project implementation after the project construction is completed,
- whether or not, all the mitigation measures implemented are effective to control adverse impact, or enhance beneficial impacts,
- whether or not mitigation measures implemented are effective to control adverse impact, or enhance beneficial impact,
- whether or not all degraded landscape due to project implementation have been restored into original condition,
- what are the impacts of boom-bust scenario among the workforce involved in project implementation and the local economy, and
- The effect on the local economy of project implementation.

Information from monitoring output should also be utilized for carrying out environmental audit:

Table 5.4: Comparison of Audit Procedures

Informal Audit (Practical)	**Scientific Audit (Ideal)**
Start with observation of project effects	Start with EIA Predictions stated as null hypothesis
Studies only actual or likely impacts	Studies all predicted impacts or predetermined subsets of those impact
Studies are made on readily made observation	Studies requires base line data and setting up experimental protocols in anticipation of impacts
Reference sites used if available	Control sites (unaffected by the project) are important to scientific rigor of the of method
Statistical technique seldom used	Statistical techniques are at the heart of method
Focus on identification of Errors in EIA prediction	Focus on of improving understanding of cause effect relationship

EIA program benefits because EIA practitioners learn from past mistakes	EIA program benefits because the science of environmental prediction is improved
Can be thought as "Impact - backward" because it looks at actual reported impacts before looking back at EIA prediction	Structured as "prediction - forward" in the manner of a scientific experiment that designs monitoring to test hypotheses

Source: Wilson L (1998) A practical method for environmental impact assessment audits *Environmental Impact Assessment Review,* 18 (1), pp. 59-71.

Table 5.5: Nine Steps in an EIA Audit

Ref #	Step	Description
1	Select project EIAs to Audit	Focus the study and limit cost by selecting representative projects that has been operating long enough to have caused actual impacts and for which at least some post project information is available
2	Identify likely project impacts	Undertake a literature research and extensive network with agency expert , local government, and citizen groups directly familiar with effects from the selected or similar projects
3	Initial review to determine if EIA has been incorrectly predicted impacts	Review EIA to identify potential errors or mitigation failure: this includes impacts where the EIA itself noted uncertainty, and those impacts predicted using methods that are suspect. This step provides a general sense of issues to be examined in the audit.
4	Prioritize impacts for further investigation	Impacts selected based on: Magnitude of apparent error (especially underestimates of serious impacts); importance impacts to agency program; degree of public controversy and or scientific uncertainty; easy of study
5	Prepare protocol for field investigation	Develop a detailed plan of study to evaluate each prioritized impact.
6	Identify actual project impacts	Use method to identify what actually happened in the area of the project including the identification of cause effect relationships possibly accounting for actual impacts
7	Compare actual impacts and predicted impacts	Assess EIA to determine if an error actually occurred. The null hypothesis is that the EIA is presumed correct unless clearly wrong.

		Step 8 and 9 apply to error identify in step 7
8	Determine causes of error	Explain why prediction was not correct. This typically requires determining why an impact did occur (cause-effect analysis). Errors may result because of limit on the EIA scope, as when a project change after the EIA was completed. Other error sources include poor data prediction method and or poor use of good data and method.
9	Apply lesson learned	Use audit result to modify the EIA process used in future work. Minor errors may be corrected by greater awareness among practitioners; Major errors may require special training, new expertise or new research.

Source: Wilson L (1998) A practical method for environmental impact assessment audits *Environmental Impact Assessment Review,* 18 (1), pp. 59-71.

See Case Study on EIA Auditing.

6. World Bank Project classification

The World Bank has several policies governing environmental assessment (EA) of projects. Operational Directive (OD) 4.01 on Environmental Assessment (currently under revision) is the central document that defines the Bank's environmental assessment requirements. The Environmental Assessment Sourcebook (World Bank 1993) and its updates provide technical guidance

World Bank Policies and Guidance on Environmental Issues

The World Bank has various mandatory EA guidelines in the form of Operational Directives (ODs) or Operational Policies (OPs). In addition to OD 4.01, there are other directives that cover a number of specific environmental issues, including:

- Pesticide Management (OD 4.03)
- Conservation of Natural Habitats (OP 4.04)
- Water Resources Management (OP 4.07)
- Indigenous Peoples (OD 4.20)
- Involuntary Resettlement (OD 4.30)

- Management of Cultural Property (OPN 11.03)
- Forestry Management (OP 4.36)

Particularly useful Sourcebook Updates related to environmental issues include:

- No. 1, The World Bank and Environmental Assessment: An Overview (1993)
- No. 8, Cultural Heritage in Environmental Assessment (1994)
- No. 5, Public Involvement in Environmental Assessment: Requirements, Opportunities and Issues (1993)
- No. 16, Challenges of Managing the EA Process (1996)
- No. 18, Health Aspects of Environmental Assessment (1997)
- No. 20, Biodiversity and Environmental Assessment (1997)

A screening process for all World Bank subprojects classifies them into one of three environmental assessment categories (World Bank, 1993). Subprojects in Category "A" potentially cause significant and possibly irremediable environmental impacts. Category "B" subprojects cause lesser impacts, which are often essentially remediable or mitigable. Category "C" subprojects can be expected to have little or no environmental impact. All social fund subprojects within the World Bank are now classified as Category "B" because they result only in small-scale, largely remediable impacts. A possible new category, FI is currently under consideration; it would be used for financial intermediaries, such as SFs, that finance subprojects with potential environmental impacts but are not involved with their execution.

7. Preparation of EIA Terms of Reference

Based on: Dougherty T.C and Hall A.W (1995), Environmental impact assessment of irrigation and drainage projects, FAO, Rome, Italy

World Bank. 1991. Environmental assessment source book. Vol 1, Policies, procedures and cross-sectoral issues. *Technical paper 139*. World Bank, Washington D.C., USA.

World Bank. 1991. Environmental assessment source book. Vol II. Sectoral guidelines. *Technical paper 140*. World Bank, Washington D.C., USA.

The need for EIAs has become increasingly important and is now a statutory requirement in many developing countries. Similarly, all major donors require some form of environmental analysis for irrigation and drainage projects. If an EIA is required, irrespective of the source of funding, the promoting agency will be required to either prepare it themselves or appoint others to do the study for them.

If the promoter intends to prepare the EIA study using its own staff, reference should be made to the publications prepared by most donors and UN agencies outlining their requirements and procedures. The World Bank Operational Directive 4.01 (1991) is perhaps the most comprehensive and well known manual and is a useful reference text. All international organizations and bilateral agencies frequently update their procedures and it is important to obtain the current version from the organization. Many United Nations agencies publish guidelines on various themes related to environmental assessment of irrigation and drainage which could be of use to developing country staff if they are to carry out an EIA and the most useful are listed in Chapter 6.

Usually government bodies do not employ sufficient staff to carry out EIAs. It is more cost effective to ask specialist consultants (local or foreign), universities or research institutions to carry out environmental assessments. In this case terms of reference (TOR) will have to be prepared by the project executing agency. As for any technical design or feasibility study, the terms of reference for the study will determine its ultimate value. The preparation of terms of reference can cause considerable difficulties for non-experts and brief guides to the major issues that must be addressed in the TOR are given below.

Determining study requirements

There are no universal formats for terms of reference which will be suitable for every study. However, there are general rules which should be observed when preparing TOR for the EIA of irrigation and drainage proposals. The study should ensure that the consultants focus on the major issues and the most serious likely impacts. The opportunities for enhancing any positive benefits from the project should also be highlighted.

The study should identify the relevant natural resources, the eco-system and the population likely to be affected. Direct and indirect impacts must be identified and any particularly vulnerable groups or species highlighted. In some instances views will be subjective and the consultants should give an indication of the degree of risk or confidence and the assumptions on which conclusions have been drawn. In most cases the output required will be a report examining the existing environment, the impacts of the proposed project on the environment and the affects of the environment on the project, both positive and negative, the mitigating measures to be taken and any actions needed. Interim reports, for example of baseline studies, should be phased to be of maximum value to parallel technical and economic studies.

The timing of the study is important. Scoping prior to a full EIA will enable the major issues to be identified. The terms of reference for the full EIA can then be better focused. The study should be carried out early enough in the project cycle to enable recommendations to be incorporated into the project design.

The requirements stated in the TOR will determine the length of time needed for the study, the geographical boundary of the EIA, its cost and the type of expertise required. Baseline data collection, if needed, can be time consuming and will have a major impact on the cost and time needed for the study. If considerable data exists, for example a good record of water quality information and hydrological statistics, the EIA may be possible without further primary data collection. If data are scarce, time must be allowed for field measurement and analysis.

Prior to writing the TOR the following questions should be asked:

- Is the study for an environmental scoping, a full EIA or other type of study? Before preparing the TOR the purpose must be clear.

- Is the study to be for a site specific project or a regional or sectoral programme? The breadth of the study needs to be well defined.
- Will the EIA team be required to collect baseline data or does this already exist? The depth of the study and the type and quality of information already available or needed must be known.
- Who will use the final report? Different end users will often require different information. Readers may not be technical experts and careful thought should be given to the presentation of complex information.
- What output is required from the EIA study? Is an Environmental Action Plan to be prepared? A draft contents page for the final report as an annex to the TOR will give some guidance to the team carrying out the study.
- Is the team responsible for all issues or are other organizations (universities, government departments) responsible for some environmental studies? The TOR should clearly delimit responsibilities and give information on other work being done. If it is a requirement that the team liaise or work with other organizations, including NGOs, then this should be stated. Unabridged versions of the sub-contracted studies should be made available to the appraising authority for reference.
- What types of experts are needed in the team and for how long? An approximate estimate is needed to prepare a budget for the study and to estimate the time period. However, the TOR should not be too rigid on the number and type of expertise to be provided as there should be some flexibility for the team to decide on the most appropriate methodology and additional staffing.

Contents of the TOR

The TOR should commence with a brief description of the programme or project. This should include a plan of the area that will be affected either indirectly or directly. Basic data should be given on existing and proposed irrigation and drainage in the area and the catchment characteristics. The institutions that are involved in the proposal should also be given.

An overview of the local environment should follow the general description. This will include socio-economic information, land use, land tenure, water use in the area and any particular aspect of the flora and fauna. If other studies have been completed a list of available reports should be given.

A brief description should be given of the most important institutions, including those responsible for the EIA, the project executing agency and future managers. This should be presented in the form of an organogram.

A description of the work to be undertaken should give a general set of requirements for determining the potential impacts of, and impacts on, the proposed project. The TOR should require the consultants to cover the following points:

- whether a range of proposals should be considered and if so whether they would be less environmentally damaging;
- the main environmental effects of the proposed project, both in the project area and in the surrounding area and the timescale of the impacts;

- The size and extent of the impacts based as much as possible on quantitative data rather than qualitative assessment. In some cases it may be necessary to highlight certain topics (such as water logging, resettlement etc as discussed in Chapter 4) when a particular issue is known to be of concern. In most cases, however, it may be preferable not to mention any specific topic and make the consultant responsible for a complete review of all topics;
- those groups that will benefit and those disadvantaged by the project;
- the impact on any rare species of plant or animal in the area;
- the impact on human health;
- the control and management aspects of the project to determine if they will be effective;
- the need for further baseline data collection or other specialist studies;
- the present policy, institutional and legislative situation and future needs;
- the mitigating measures needed and how they should be incorporated into the project design;
- The monitoring and evaluation activities that are required to ensure that mitigating measures are implemented and future problems are avoided.

The TOR should give an indication of the team considered necessary for the study. Depending on the scope of the study this may include one or several of the following: an irrigation specialist, drainage specialist, rural sociologist, terrestrial ecologist (of various specializations), aquatic ecologist/fisheries expert, hydrologist, agronomist, soil chemist or physicist, economist and epidemiologist. However, as mentioned earlier the team should not be rigidly imposed on the consultant.

It is important to make provision for technology transfer. Apart from enabling in-country expertise to be built up, this will promote more involvement and understanding of the issues raised by the study. As most EIA studies are of relatively short duration, this is probably best achieved through the attachment of government staff to the consultants during the study or an insistence on the use of local government personnel for some of the tasks.

The expected date of commencement and time limit should be given. An environmental screening can be done quickly as part of the general project identification. In most cases scoping can be done in one to three months using checklists or other techniques assuming adequate data is readily available. Up to 12 months is needed for a full EIA for a medium or large scale project although this could be longer if the project is complex or considerable primary data have to be collected or field measurement undertaken.

The budget limit should be given in the TOR. The type of experts, and whether foreign or local, and the duration of their inputs will usually be the deciding cost factors although a large field survey or measurement programme with laboratory analysis could significantly increase costs.

Any assistance to be provided by the Client should be clearly stated in the TOR. Reporting requirements should be clearly stated. An annex giving a draft table of contents for the final report (the Environmental Impact Statement) is helpful as this will standardize presentation and ensure all aspects are covered by the Consultants.

See appendix VII for examples of TORs

Box 7.1: Exercise on ToRs development

This exercise will involve visiting or studying any project having environmental concerns and the student should develop ToRs for the EIA study. The example can be sought from Appendix VII

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CASE Studies

Environmental Scoping

Environmental Auditing

Source: Wilson L (1998) A practical method for environmental impact assessment audits *Environmental Impact Assessment Review,* 18 (1), pp. 59-71.

1. Introduction to Environmental Impact Assessment Audits

An environmental impact assessment (EIA) audit evaluates the performance of an EIA by comparing actual impacts to what was predicted. There are two common objectives of these audits:

- Scientific—to check the accuracy of predictions and to explain errors, so that *methods* used in future EIAs will be more valid;
- Management—to assess the success of mitigation in reducing impacts, so that *decisions* made about future management actions can be more effective.

In 1993, the U.S. Environmental Protection Agency (EPA) asked my consulting firm to: (1) develop a procedure to audit the agency's well-regarded EIA program in the south-central United States; (2) test the audit procedure on actual EIAs; and (3) use the audit results to advise the EPA on how to improve its future EIA. In this article, I report on three general lessons from our work.

- *Lesson 1.* The audit procedures generally described in the literature are not very practical. A simpler procedure is needed. I developed one such procedure and describe it here.
- *Lesson 2.* The simple audit procedure was applied to a small coal mine EIA, in which the EPA had used a checklist to predict impacts. Minor “errors” in the EIA were caused by insufficient information on the specific project and project site. The recommended solution is to improve the scoping of small project EIAs.
- *Lesson 3.* The audit procedure also was applied to an EIA for a large mine, where the EPA had prepared a detailed impact statement. Again, there were no serious errors. However, mitigation measures were not dealt with systematically. The recommended improvement involves changes in the EIA structure to improve the discussion of mitigation measures, including a protocol for monitoring mitigation success.

These lessons are discussed more fully in the following sections.

2. Lesson: Audit Methods Must Be Practical

2.1. The Literature Ideal: A Scientific Audit

There is an extensive literature on EIA audits. (See references for a list of many key articles; a more complete, annotated bibliography is in LWA 1992a.) Almost without exception, the published methods treat audits as a scientific experiment (for example, Culhane 1987; Davies and Sadler 1990). The first part of Table 1 lists the procedural elements in such a scientific audit.

Most authors have recognized that there will be substantial difficulty in achieving the scientific ideal. Serafin 1989 describes one attempt at a scientific audit and demonstrates just how difficult the approach would be in reality. Buckley 1989 also discusses the numerous obstacles to a successful audit. It is noteworthy that the few completed EIA audits documented in the literature do not use the scientific approach (e.g., EPA 1985).

As part of our work for EPA, I developed a list of reasons why scientific audits are impractical; the main reasons are given in the second part of Table 1. The fact that audits are rare is often attributed to institutional problems: audits are neither required by law nor routinely funded. However, as Table 1 indicates, an additional impediment is that audits using procedures recommended in the literature are an inherently difficult undertaking.

2.2. Principles of a Practical Audit Procedure

To develop a more practical audit procedure for EPA, I relied on my own 25 years of EIA practice and my knowledge of work by other EIA experts. This experience indicates that EIA professionals learn about errors when citizen complaints, scientific studies, or regulatory monitoring disclose an adverse impact that actually occurred but had been underestimated (or not predicted at all). These professionals take care to avoid repeating such mistakes. This informal process of learning about mistakes is a type of EIA audit.

The limitation to this informal audit procedure is that it is not comprehensive or systematic. The procedure described here simply uses the basic concepts of the informal method and makes it more structured. One step in the design of a simple procedure was to list the main elements of the informal process that has worked in the real world, and then compare it to the scientific ideal audit that has not worked. The comparison is provided in Table 2.

From Table 2, I concluded that the key to the informal audit is that it *relies on reports or observations of actual impacts after a project is built*, and checks those impacts against EIA predictions. In contrast, the scientific audit attempts to set up a comprehensive monitoring program before the project is built. Scientific audits can be termed “predictions-forward,” because the entire audit concept is developed at the time the EIA document makes its prediction. Informal audits are “impacts-backward”: they can be initiated any time after the project is actually built, and focus entirely on what is actually observed to occur in the project area. The fact that informal audits deal with selected impacts after-the-fact is what makes them more practical.

The audit procedure I developed consists of nine steps, which are outlined in Table 3. The steps are explained below, in the context of two case studies. See also LWA 1992b.

3. Lesson: Need to Improve Scoping for Small-Project EIAs

In the past 10 years or so, the EPA completed a dozen EIA reports for small coal strip mines in eastern Oklahoma. In each case, EPA used a simple checklist to assess impacts and reached a "Finding of No Significant Impacts." The steps listed in Table 3 were used to audit a representative example of these EIAs (LWA 1993a). This provided a test of whether the audit procedure is useful, and it also provided an audit of one particular EIA.

3.1. Step 1: Select project

The project chosen for audit was a small (500-hectare) mine located in a gently rolling upland characterized by woodlands, grazing land, and small intermittent streams with riparian vegetation. The project was chosen because it was typical of mines assessed in the EIAs, and because it included both active pits—with associated impacts from mine operation—and reclaimed pits—with longer term land-use and habitat impacts.

3.2. Step 2: Identify impacts

Twenty representative impacts of small surface mines were identified based on the EIA checklist, networking with experts, and review of the literature. The impact categories are listed in Table 4. Several of the impacts had the potential to be "significant" in the absence of proper project design, operation, and management. The list of impacts is extensive enough to cover a range of environmental effects, but short enough to make auditing practical. All of the impacts listed in Table are a direct result of project construction and operation. Auditing of secondary and indirect impacts from a project would be very difficult, and is unlikely to be done unless the audit has the explicit purpose of assessing such impacts.

3.3. Step 3: Initial review

For many of the impacts listed in Table 4, the EPA's prediction of "insignificant" was based on the judgment that mitigation measures proposed by the mining company would be effective. Thus, the determination was made to focus the audit on determining the success of mitigation. The step 3 review for this particular project did not indicate, one way or another, if the predictions in the EIA were correct. Therefore, none of the impacts listed in Table 4 were eliminated from further study.

3.4. Step 4: Prioritize impacts

The purpose of prioritization was to focus the limited resources of the audit team. The impacts assigned the highest priority for audits were those related to mine reclamation, the most important factor determining mitigation success. However, in practice it proved possible to assess the EIA with respect to all impacts listed in Table 4.

3.5. Step 5: Prepare field protocols

An important step in the methodology was to select field techniques and sites and develop a detailed field study plan. Methods for impact evaluation are identified in Table 4 and included:

- Observe conditions on and near the mine during a 3-day, four-person field trip;
- Interview regulatory personnel, local officials, and neighbours;
- Analyze the mine operator's self-monitoring data, especially records of surface water quality and ground water levels;
- Review regulatory files and environmental data bases, especially those of the Oklahoma Department of Mines;
- Interpret available air photos for the project area; and
- Take simple field measurements, using a hand-held noise meter, field chemistry kit, and rapid bio assessment apparatus.

In addition, nearby areas of past mining, and areas undisturbed by mining, were used as “controls,” i.e. analogy for impacted and non-impacted areas respectively.

The level-of-effort required for even this relatively simple level of field work was on the order of 500 staff-hours.

3.6. Step 6: Impact documentation

The evaluation of actual impacts from the mine is summarized in Table 5.

3.7. Step 7: Comparison to EIA report

A number of impacts were observed that had not been predicted in the EIA. These included: minor impacts to neighbours from dust, noise, traffic, and blasting (items 1–3 in Table 5); an adverse impact to agricultural productivity and tax assessments (number 19 in Table 5); and the negative, cumulative loss of wildlife habitat, which is the inevitable result of strip mining as it is currently practiced in the area (item 17 in Table 5). In my judgment, the actual impacts of the project were small. Therefore, these minor differences between predictions and actual effects would not change the basic conclusion of the impact analysis. Specifically, there were “No Significant Impacts” from the small Oklahoma coal mine.

3.8. Step 8: Determine causes of error

Three factors contributed to the prediction errors identified by the audit:

- Because the project being evaluated was small, the EPA had not been able to expend a great deal of time and effort on the EIA, and consequently, there had been limited project-specific investigation (as through scoping) to identify impacts that might be associated with the site or mine design;

- Insufficient consideration had been given to cumulative impacts (this is a common problem in EIA); and
- For many impacts, mitigation had been assumed to be more effective than actually proved to be the case.

3.9. Step 9: Apply lessons learned

An important lesson from this audit concerned project scoping. Based on a limited audit of other EIAs for small mine projects, the case study EIA was not the only example where site-specific issues had not been fully characterized. Therefore, our team recommended that the agency expand its scoping process for small projects, to better assure that project-specific conditions are understood.

A second lesson concerned mitigation. It was not appropriate to have a checklist on which impacts were judged insignificant simply because a mitigation measure had been identified. We recommended instead that the checklist denote that at least some impacts (such as habitat change) would be rated as significant, in the absence of evidence to the contrary. A judgment of “insignificant” requires an affirmative basis for concluding that mitigation will be effective. For example, mitigation success can be assumed if the project owner/operator has a good record of achieving adequate mitigation, using similar measures in comparable projects and environments, and if there is a regulatory or other basis for assuring that the mitigation will be implemented. EIA audits represent one tool for building a record as to which mitigation measures can in fact be relied on.

4. Lesson: EIAs Need Improved Consideration of Mitigation

A second audit was conducted for a large coal mine and associated power plant complex in eastern Texas, where EPA had prepared a full-scale environmental impact statement (LWA 1993b). The audit involved all nine steps listed in Table 3, but the discussion here is limited to results that substantially expand on the findings of the first audit discussed above.

4.1. Steps 2–4: Impact identification/prioritization

Because the project was so large, the audit was limited to a single impact—the loss of water-based habitat caused when the mine excavation passed through streams, seeps, and wetlands.

4.2. Step 5: Field protocols

Specific predictions from the EIA regarding water-based habitat impacts were restated as null hypotheses, which characterized the expected mitigation success. For example, an EIA statement to the effect that “land will be reclaimed to premining condition” was restated as “the hypothesis is that mined lands were reclaimed to the following condition"; the condition was stated in relative detail, in terms consistent with the EIA description of the existing environment. Audit methods included: discussions with a network of EIA experts; agency interviews; rapid bio assessments of benthic macro invertebrates at sites where the mining company itself had previously performed a rapid bio assessment; and analysis of the mining company's water quality data, which had been collected in accordance with the wastewater discharge permit issued by the EPA under the Clean Water Act. In addition, the mining company had created an experimental control in the form of paired watersheds and also had gathered time-series water-quality monitoring data at a number of stations within these watersheds and elsewhere. These data were used in the audit, though their value was limited because in many cases the water quality stations were not at the same locations as the company's benthic surveys.

4.3. Steps 6–8: Audit results

Overall, adverse impacts to water quality and aquatic habitat occurred as predicted in the environmental impact statement. However, the audit found that, although mitigation met those requirements set forth in the applicable regulations, it did not fulfil all predictions set forth in the EIA. For example, the hypothesis (prediction) that "stream channels were successfully reclaimed to the pre-mine landforms" was rejected, as the channels that were restored to regulatory standards for conveyance of a certain quantity of flow did not have the geomorphic variability or ecological diversity of the natural channels. As another example, the EIA was possibly in error in characterizing habitat impacts as "short-term." In fact, restoration success (if it occurred fully) would require many decades and is better considered a "long-term" impact.

4.4. Step 9: Lessons learned

The most important lesson from this audit was further appreciation that many EIA predictions assume implementation and success of mitigation measures. A major purpose of EIA audits is to determine the success of mitigation. To this end, EIAs would be improved greatly if they contained an expanded discussion of mitigation to explain the measures in some detail and to document the roles of different agencies in assuring the public that mitigation will actually take place as planned. A *protocol for mitigation tracking* was developed based on information on how various agencies were involved with mitigation at the project site. The protocol includes the following elements.

- The EIA should contain a "commitments list" which summarizes all mitigation proposals and which identifies the organizations responsible for implementing and regulating each proposal. The list should provide details on what mitigation is intended to achieve, why it is predicted to succeed, and the consequences of failure.
- To the extent practical within existing laws, regulations, and policies, the project sponsor should be obliged to report formally on mitigation success (or failure). The reporting could use a standardized format that builds on the extensive requirements that already exist to monitor water discharges and other environmental effects.

- Agencies that share mitigation oversight responsibilities for a particular project should develop a network that will allow them to share information and otherwise to coordinate their mitigation tracking.
- Future EIA audits should focus on the performance of mitigation measures. For at least some impacts and projects, the appropriate oversight agency should periodically review the extent to which mitigation was successful (or not successful) in achieving the benefits predicted in the EIA process.

5. Summary and Conclusions

There is an extensive EIA literature that recommends that audits be constructed as rigorous scientific testing of hypotheses. In this article, I recommend a simpler procedure that involves qualitative judgments about whether EIA documents predicted what in fact has actually occurred. In this procedure, actual impacts are documented through discussions with experts, review of monitoring data, and simple field techniques. The audit aims at learning the underlying causes of apparent errors in impact prediction so that future mistakes can be avoided.

One result of testing the audit method was to find that there is sometimes insufficient scoping of small, “routine” projects and a tendency to assume minimal impacts. Since the audit was completed, the EIAs done by EPA Region 6 have involved a modest increase in the scoping effort; these EIAs have also used the worst-case approach to impact prediction discussed previously, in which certain impacts are judged as significant in the absence of firm evidence to the contrary. In my judgment, these changes improved the EIAs.

Another audit lesson was that, because so many EIA predictions assume mitigation success, EIAs should be better at explaining why mitigation is expected to be effective. The EPA applied this lesson in a recent major EIA by providing a comprehensive inventory of the mitigation commitments on which impact predictions depended, and identifying implementation responsibilities and other bases for expecting the mitigation to be effective. Again, I judge this additional information to represent an improvement in the quality of the EIA.

The simplified audit method worked well in both case studies; the audit methods were practical and produced useful results. The work confirmed that an audit involving field checks requires substantial resources, which means that audits can be done only on a selected basis. However, investing in an audit provides a major tool for improving the effectiveness of future EIA work.

Table 1. Characteristics of Scientific EIA Audits

Table 1 summarizes professional judgments made by the author, based on review of the literature, especially Beanlands and Duinker 1983, Bisset 1984, EPA 1985, Sadler 1985, Munro et al. 1986, Serafin 1989, Davies and Sadler 1990 and ECE 1990.

Elements in a scientific audit • Extensive, quantitative inventory of pre-project conditions (baseline) • Prediction in the form of quantitative null hypothesis, which are phrased in terms of spatial extent, time occurrence, probability, and significance impacts. • Designation of reference sites and/or experimental controls for purposes of ongoing data gathering • Testing of null hypotheses through rigorous statistical comparison of post-project data to baseline data, and of data from the project area(s) to data from the reference area(s)
Problems with Scientific audits: • Projects are usually too complex to be treated effectively as environmental experiments. • Project descriptions at the time of an EIA often are incomplete, and it is rare for projects to be built and operated exactly as planned. • EIA predictions are not done for the purpose of making a precise forecast, but for the purpose of allowing trade off comparisons among alternatives, and as a consequence they seldom are required to be scientifically rigorous or quantitatively precise. • A difference between a predicted and actual impacts may reflect the approach used in the EIA, as when a worse-case assumptions are used to deliberately overstate the expected adverse effects of a project. • In principle, all possible impact predictions must be monitored which is impractical, or in practice only some impact predictions are monitored, which may mean that important prediction are not verified. • Cumulative impacts can't easily be assessed by audit of a single project and are therefore not typically addressed by a scientific audit • For many impacts, limitations in EIA prediction methods constrain our ability to specify rigorous null hypotheses and/or perform statistical testing

Table 2. Comparison of Audit Procedures

Informal Audit (Practical)	**Scientific Audit (Ideal)**
Start with observation of project effects	Start with EIA Predictions stated as null hypothesis
Studies only actual or likely impacts	Studies all predicted impacts or predetermined subsets of those impact
Studies are made on readily made observation	Studies requires base line data and setting up experimental protocols in anticipation of impacts
Reference sites used if available	Control sites (unaffected by the project) are

	important to scientific rigor of the of method
Statistical technique seldom used	Statistical techniques are at the heart of method
Focus on identification of Errors in EIA prediction	Focus on of improving understanding of cause effect relationship
EIA program benefits because EIA practitioners learn from past mistakes	EIA program benefits because the science of environmental prediction is improved
Can be thought as "Impact - backward" because it looks at actual reported impacts before looking back at EIA prediction	Structured as "prediction - forward" in the manner of a scientific experiment that designs monitoring to test hypotheses

Table 3. Nine Steps in an EIA Audit

Ref #	Step	Description
1	Select project EIAs to Audit	Focus the study and limit cost by selecting representative projects that has been operating long enough to have caused actual impacts and for which at least some post project information is available
2	Identify likely project impacts	Undertake a literature research and extensive network with agency expert , local government, and citizen groups directly familiar with effects from the selected or similar projects
3	Initial review to determine if EIA has been incorrectly predicted impacts	Review EIA to identify potential errors or mitigation failure: this includes impacts where the EIA itself noted uncertainty, and those impacts predicted using methods that are suspect. This step provides a general sense of issues to be examined in the audit.
4	Prioritize impacts for further investigation	Impacts selected based on: Magnitude of apparent error (especially underestimates of serious impacts); importance impacts to agency program; degree of public controversy and or scientific uncertainty; easy of study
5	Prepare protocol for field investigation	Develop a detailed plan of study to evaluate each prioritized impact.
6	Identify actual project impacts	Use method to identify what actually happened in the area of the project including the identification of cause effect relationships possibly accounting for actual impacts
7	Compare actual impacts and predicted impacts	Assess EIA to determine if an error actually occurred. The null hypothesis is that the EIA is presumed correct unless clearly wrong. Step 8 and 9 apply to error identify in step 7
8	Determine causes of error	Explain why prediction was not correct. This typically requires determining why an impact did occur (cause-effect analysis). Errors may result because of limit on the EIA scope, as when a project change after the EIA was completed. Other error sources include poor data prediction method and or poor use of good data and method.

9	Apply lesson learned	Use audit result to modify the EIA process used in future work. Minor errors may be corrected by greater awareness among practitioners; Major errors may require special training, new expertise or new research.

Table 4. Impact Categories and Audit Methods, Oklahoma Coal Mine

Methods are listed in a generalized order of priority.

Codes for audit methods: A = analog to another site; E = environmental data bases (agencies); I = interviews with experts, neighbours; M = self-monitoring by project operator; O = general observation at the site; P = photo interpretation; R = records of oversight agency; S = field measurement/sampling/testing.hey

Impact Category	Audit Methods
Impacts involving *off-site* effects of active operations	
1. On-site equipment, causing dust or noise at nearby properties	O,I,R,S,M
2. Blasting, causing annoyance or damage at nearby properties	I,R,M
3. Transportation, causing road noise, dust, congestion, deterioration	O,I
4. Off-site storage (tipples) causing noise, dust, washoff	R,O,I
5. Pits that act as an attractive nuisance for off-site trash, stock, people	O,I,R
6. Dewatering impacts on private wells	M,I,S
Operational impacts on hydrology, water supply, water quality, land	
7. General water quality	M,R,S
8. Discharge of unregulated pollutants	E,S,A
9. Discharge of sediment	M,P,O,I
10. Solvent/lubricant disposal in pits	O,R,M
11. Disturbance of key habitats (riparian, wetland, prairie)	O,P,M
12. Disturbance of key resources (soil horizons, archeological sites)	R,M
Impacts related to *reclamation* success and post-project effects	
13. Restoration of vegetative productivity	M,O,P,S,I
14. Erosion and sedimentation (scarring, alluviation)	O,P
15. Changes to ground water quality	M,A,S
16. Impaired quality of runoff	M,E,S
17. Changes in on-site habitat type and quality	O,P,M,S
18. Downstream changes in stream-related habitats	S,P
19. Changes in land use, property values and/or taxes	I,R
20. Habitat creation in end lakes or sedimentation ponds	O,I,A,S

Table 5. Impacts Identified by Audit of Oklahoma Coal Mine

Impact category (from)	Impact (identified using methods listed in)
1. Dust/noise from equipment	Minor impact observed.
2. Blasting: annoyance/damage	Annoyance occured. Claims of damage could not be substantiated.
3. Transportation dust, etc.	Minor impact observed.
4. Off-site storage impacts	Observed for other mines in area, but not this project
5. Pits act as attractive nuisance	Observed for other mines in area, but not this project.
6. Dewatering of private wells	Minor effects observed, but cause could not be determined.
7. General water quality	Minor effects observed, but could be caused by other mines in watershed.
8. Discharge unregulated pollutants	None observed.
9. Discharge of sediment	Minor impact observed.
10. Waste disposal in pits	As designed, project would have caused this impact; impact did not occur because the proposed disposal practice had bee banned by regulations that were adopted after the EIA was completed.
11. Disturbance of key habitats	Observed.
12. Disturbance of key resources	Soil disturbed by mining.
13. Restoration of productivity	Occurred to level required by regulations, but not to premining condition.
14. Erosion and sedimentation	Minor impacts observed.
15. Changes to ground water quality	No impacts observed.
16. Impaired quality of runoff	No impacts observed.
17. Changes in habitat type	Long-term impact caused by site reclamation to "improved pasture." Reclamation met all requirements of federal regulati but those regulations did not require restoration of upland woodland wildlife habitat, nor of fully functional riparian habi Small areas of both habitats were destroyed by the project. This impact was cumulative to the impacts from numerous oth mines in the area.
18. Changes in stream habitats	Minor effects observed, but could be caused by other mines in watershed.
19. Changes in land use, etc.	Reclaimed land had less potential for agricultural productivity than land that had been cleared but never mined. This resu in a small reduction in the level of local government tax assessment compared with other grazed land.
20. Habitat creation in ponds	This mitigation measure could have been more functional with better planning.

Public Participation in EIA

Appendix

Appendix I: Glossary of terms

Abiotic: Non-living e.g. rocks or minerals.

ameliorative measures: See mitigation.

Alternative: A possible course of action, in place of another that would meet the same purpose and need of the proposal.

Audit: See environmental audit.

Baseline studies: Work done to collect and interpret information on the condition/trends of the existing environment.

Benefit-cost analysis: A method of comparing alternative actions according to the relative costs incurred (technical, environmental and economic) and the relative benefits gained. The analysis can incorporate discounting calculations to take into account the time value of money.

Biodiversity: See biological diversity.

Biological diversity: The variety of life forms, the different plants, animals and microorganisms, the genes they contain and the eco-systems they form. It is usually considered at three levels: genetic diversity, species diversity and ecosystem diversity.

Biophysical: That part of the environment that does not originate with human activities (e.g. biological, physical and chemical processes).

Biota: All the organisms, including animals, plants, fungi and micro-organisms in a given area.

Biotic: living organisms

Carrying capacity: The rate of resource consumption and waste discharge that can be sustained indefinitely in a defined impact region without progressively impairing bio productivity and ecological integrity.

Coherence In EIA: Aiming to achieve the co-ordination of EIA procedures, guidelines, standards and criteria by those involved in funding or approving proposals.

Compensation: Trade-offs between different parties affected by proposals to the mutual satisfaction of all concerned.

Cost-benefit analysis: See benefit-cost analysis.

Cumulative effects assessment: The assessment of the impact on the environment which results from the incremental impact of an action when added to other past, present or reasonably foreseeable actions regardless of what agency or person undertakes such actions. Cumulative impact can result from individually minor but collectively significant actions taking place over a period of time.

Decision-maker: The person(s) entrusted with the responsibility for allocating resources or granting approval to a proposal.

Development proposals: Consists of a wide range of human activities which provide (a) favourable conditions for an increase in the transformation of the natural, biophysical environment to provide the goods and services available to society (e.g.. Structural adjustment programs, 'rolling' development plans) and (b) actions which directly produce the goods and services.

Discretionary process/decision: A process or decision which the decision-maker is able to base on personal preference.

Ecological processes: Processes which play an essential part in maintaining ecosystem integrity. Four fundamental ecological processes are the cycling of water, the cycling of nutrients, the flow of energy and biological diversity (as an expression of evolution).

Ecosystem: A dynamic complex of plant, animal, fungal and microorganism communities and associated non-living environment interacting as an ecological unit.

Endemic: Restricted to a specified region or locality.

Environment: There is no generally agreed definition of environment in EIA. Increasingly, it means the complex web of inter-relationships between abiotic and biotic components which sustain all life on earth, including the social/health aspects of human group existence.

Environmental audit: Process focusing on an existing installation, facility, or activity which involves a systematic, periodic evaluation of environmental management to objectively review the performance of an organisation, management and equipment with the aim of safeguarding the environment.

Environmental assessment: See environmental impact assessment.

Environmental impact assessment (EIA): The systematic, reproducible and interdisciplinary identification, prediction and evaluation, mitigation and management of impacts from a proposed development and its reasonable alternatives. Sometimes known as environmental assessment.

Environmental impact report/statement: Document in which the results of an EIA are presented to decision makers and, usually, the public.

Environmental management: Managing the productive use of natural resources without reducing their productivity and quality.

Environmental management plan: See impact management plan

Environmental management system: A structured approach for determining, implementing and reviewing environmental policy through the use of a system which includes organisational structure, responsibilities, practices, procedures, processes and resources. Often formally carried out to meet the requirements of the ISO 14000 series.

Fauna: All of the animals found in a given area.

Flora: All of the plants found in a given area.

Health impact assessment: Component of EIA which focuses on health impacts of development actions. Most attention is concentrated on morbidity and mortality, but increasingly, the World Health Organization (WHO) definition of health as being a state of 'social, physical and psychological well-being and not just the absence of disease' is being used to guide this type of assessment work.

Impact management plan: A structured management plan that outlines the mitigation, monitoring and management requirements arising from an environmental impact assessment.

Impact monitoring: Monitoring of environmental/social/health variables, which are expected to change after a project has been constructed and is operational, to test whether any observed changes are due to the project alone and not to any other external influences.

Initial environmental evaluation/examination: A report containing a brief, preliminary evaluation of the types of impacts that would result from an action. Often used as a screening process to assess whether or not proposals should undergo full scale EIA.

Interdisciplinary team: A group of people, from a range of disciplinary backgrounds, working together to ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment.

Level of assessment See tiering.

Memoranda of understanding (MoU): A written agreement between two or more levels or areas of government.

Mitigation: The purposeful implementation of decisions or activities that are designed to reduce the undesirable impacts of a proposed action on the affected environment.

Monitoring: Activity involving repeated observation, according to a pre-determined schedule, of one or more elements of the environment to detect their characteristics (status and trends).

'Moving' baseline: Existing state of the environment projected into the future assuming no development proceeds. The projected baseline situation, rather than that existing at the time of EIA work, is theoretically the one to be compared with the state of the environment predicted in the event of a development action proceeding.

Natural resources: Features that have ecological, economic, recreational, educational or aesthetic value.

Natural resource accounting: Transformation of data, on environmental features (components and processes) and renewable/non-renewable resources, into a form that is comparable with data on the economy. Incorporation of the environmental data into the standard set of economic accounts (e.g.. gross national product) used in government policy-making.

NEPA: National Environmental Policy Act 1969 of the United States of America. This Act, which applied to Federal US agencies, was the first policy to require the preparation of a statement of the predicted environmental impact of a proposal. This statement has since become known as the Environmental Impact Statement (EIS).

Precautionary principle: A principle of sustainability that where there are threats of serious or irreversible damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

Proponent: Organisation (private or public sector) or individual intending to implement a development proposal.

Proposal: Any project, policy, program, plan or other activity.

Public consultation: See public involvement.

Public involvement: A range of techniques that can be used to inform, consult or interact with stakeholders affected by a proposal.

Resource: Anything that is used directly by people. A renewable resource can renew itself or be renewed at a constant level. A non-renewable resource is one whose consumption necessarily involves its depletion.

Risk analysts :Technique used to determine the likelihood or chance of hazardous events occurring (such as release of a certain quantity of a toxic gas) and the likely consequences. Originally developed for use in nuclear and chemical industry where certain possible events, of low probability, could have extremely serious results. Attempts are being made to use concepts from probabilistic risk analysis to characterise environmental impacts, whose occurrence and nature are not easy to predict with any degree of accuracy.

Secondary impact: Indirect or induced changes in the environment, population, economic growth and land use and other environmental effects resulting from these changes in land use, population and economic growth. The potential effects of additional changes that are likely to occur later in time or at a different place as a result of the implementation of a particular action.

Scoping: An early and open activity to identify the impacts that are most likely to be significant and require investigation during the EIA work. Can, also, be used to: identify alternative project designs/sites to be assessed; obtain local knowledge of site and surroundings; and prepare a plan for public involvement.

The results of scoping are frequently used to prepare a Terms of Reference for the EIA.

Screening: Preliminary activity undertaken to classify proposals according to the level of assessment that should occur.

Social impact assessment: The component of EIA concerned with changes in the structure and functioning of social orderings. In particular the changes that a development would create in: social relationships; community (population, structure, stability etc); people's quality and way of life; language; ritual; political/economic processes; attitudes/values. Can sometimes include health impacts.

Stakeholders Those who may be potentially affected by a proposal e.g.: local people, the proponent, government agencies, NGOs, donors and others.

State of the Environment reports**:** Reports that provide an assessment of the conditions of the environment, pressures on the environment and the responses of the environment to those pressures.

strategic environmental assessment: An EIA-like appraisal procedure that examines the likely environmental impacts of proposed policies, programmes and plans.

Synergistic: By acting together, separate elements produce a greater effect than would be produced if they acted separately.

Tiering: Addressing issues and impacts at th**e appropriate level of decision** making (e.g. from the policy to project levels).

Terms of Reference (ToR): Written requirements governing EIA implementation, consultations to be held, data to be produced and form/contents of the EIA report. Often produced as an output from scoping.

Trans-boundary impacts: Any impact, not exclusively of a global nature, within an area under the jurisdiction of a Party caused by a proposed activity the physical origin of which is situated wholly or in part within the area under the jurisdiction of another Party.

Value judgement: The use of opinion or belief in analysis or decision-making.

Appendix II: Information requirement for EIA per institution

Component	World Bank	EBRD	IDB	AsDB	AfDB
Executive Summary	Yes	Yes	Yes	Yes	Yes
Policy, Legal, Inst. Framework	Yes	Yes	Yes	Depends	Yes
Project Description	Yes	Yes	Yes	Yes	Yes
Baseline Data	Yes	Yes	Yes	Yes	Yes
Environmental Impact Analysis	Yes	Yes	Yes	Yes	Yes
Cost-Benefit Analysis	No	No	Yes	Yes	No
Analysis of Alternatives	Yes	Yes	Yes	Yes	Yes
Mitigation Plan *	**Yes**	**Yes**	**Yes**	**Yes**	**No**
Institution Building	Yes	Yes	Yes	Yes	No
Environmental Monitoring Plan	Yes	Yes	Yes	Yes	Yes
Consultation	Yes	Yes	Yes	Yes	Yes

Appendix III: Indicative list of environmental factors to be monitored

(Excerpts from "Volume II Sectoral Guidelines" in *World Bank Environmental Assessment Source Book* (Electronic version)[1]

Dams and Water Retention

Factors that may be monitored for dams and water retention facilities include:

Rainfall annual volume of sediment transported into reservoir hydrogen sulfide and methane generation behind dam fisheries assessment surveys (species, populations. etc.) in the river and reservoir vegetation changes (cover, species composition, growth rates, biomass) in the upper watershed, reservoir drawdown zone, and downstream areas impacts on wild lands, species or plant communities of special ecological significance in and out-migration of people to area stored water volume in the reservoir	water quality at dam discharge and at various points along the river (quality should be measured with indicators such as, salinity, pH, temperature, electrical conductivity, turbidity, dissolved oxygen, suspended solids, phosphates, nitrates) limnological sampling of micro flora, micro fauna, aquatic weeds and benthic organisms wildlife (species, distribution, numbers) increases in erosion in the watershed public health and disease vectors changes in economic and social status of resettlement populations and people remaining in the river basin

Fisheries

Factors that may be monitored for fisheries activities include:

CAPTURE FISHERIES	
fish stocks (population size and structure) conformance by fishermen to regulations on equipment use, fishing areas, catch, fishing seasons effects of land use or water management on water quality and fishery resources contamination of fish or shellfish or presence of conditions which could lead to contamination (e.g., red tide, oil spills)	fish landings presence of any discarded materials causing "ghost fishing" condition of nonfish species, especially indicator species (those most susceptible to changes in water quality) condition of coastal zone habitats (mangroves, sea grass beds, coral reefs) water quality (including pollution and oil spills)

CULTURE (FARMED) FISHERIES	
water quality in fish ponds or water bodies containing traps, nets or attachment substrates for nonmotile organisms water quality and quantity of fish pond receiving waters effect of aquaculture on local capture fisheries (population size and structure, health condition) contamination of fish or shellfish	water quality of fish pond effluent hydrologic effects of fish ponds presence of fish diseases or parasites increase in water-borne or water related disease vectors or human disease attributable to fish pond establishment

[1] The following excerpts were derived from a search on the *keyword*: monitoring under the electronic version of the *World Bank Environmental Sourcebook: Volume II Sectoral Guidelines*. 1991.

FISH PROCESSING	
changes in commercial and non-commercial (especially indicator) species down-stream of processing plants	water quality of influent to and effluent from fish processing plants

Floodplain Management

Factors which influence the quantity of water entering and being withdrawn from the river; the land's capacity to absorb floodwater; and the potential damage from floods may be monitored. Factors that may be monitored include:

quantity, intensity, timing and geographical distribution of rainfall soil moisture conditions at various times of the year storage, diversion and regulation of stream flows sediment content of the river water changes in the river course and riverbed rural and urban land uses (controlled and uncontrolled land use change on the floodplain and watersheds of the river) effects of flood control measures on riverine, estuaries or near shore marine fisheries effects of flood control measures on wild lands, wildlife habitats and wildlife populations	storm patterns stream discharge (including records of annual peak discharge) changes in drainage and other factors that affect storm water runoff sedimentation problems in downstream areas demographic changes in the floodplain and watershed areas socioeconomic impacts resulting from the project (including changes to preproject agricultural, pastoral, fishing practices) effects of flood control measures on floodplain vegetation

Irrigation Projects

Factors that may be monitored for irrigation activities include:

Climate (wind, temperature, rainfall, etc.) nutrient content of discharge water water table elevations in project area and downstream quality of groundwater in project area physical and chemical properties of soil in irrigation area cropping intensity erosion/sedimentation rates in project area condition of distribution and drainage canals (siltation, presence of weeds, condition of linings) incidence of disease and presence of disease vectors changes in natural vegetation in the project area and on the floodplain downstream fish population and species	stream discharge above the irrigation project and below at various points flow and water levels at critical points in the irrigation system water quality of project inflows and return flows water salinity levels in coastal wells agricultural acreage in production crop yield per unit of land and water relation between water demand and supply of users (equitability of distribution) upstream watershed management (agricultural extent and practices, industrial activity) health condition of project populations changes in wildlife populations in the project area and on the floodplain downstream

Appendix IV: Waste Treatment Plant trip

Appendix V: Template IEE Outline

Adapted from: USAID (2002) USAID Environmental Procedures training manual for USAID Environmental officers and USAID Mission partners, Washington DC, USA.

Program/Activity Data
Program/Activity No:
Country/Region:
Program/Activity Title:
1. Background and activity description
1.1 Background
1.2 Description of Activities
2. Country and environmental information (baseline information)
2.1 Locations Affected
2.2 National Environmental Policies and Procedures (of host country both for environmental assessment and pertaining to the sector)
3. Evaluation of environmental impact potential
4. Recommended determinations and mitigation actions (includes monitoring and evaluation)
4.1 Recommended IEE Determination
4.2 Mitigation, Monitoring, and Evaluation
4.3 Summary table (and summary conditions)

For Umbrella IEEs, the following might be used:
4.1 Recommended Planning Approach
4.2 Environmental Screening and Review Process
4.3 Promotion of Environmental Review and Capacity Building Procedures
4.4 Environmental Responsibilities
4.5 Mitigation, Monitoring, and Evaluation
4.6 Summary table

Appendix VI: Annotated IEE Outline

Adapted from: USAID (2002) USAID Environmental Procedures training manual for USAID Environmental officers and USAID Mission partners, Washington DC, USA.

Program/activity data:
Program/Activity No:
Country/Region:
Program/Activity Title:

The IEE narrative can be organized around your major activity groups or categories. This works best if the activity categories are distinct, e.g., road construction, agricultural development, and irrigation works. In this case, sections 1, 3, and 4 of the IEE would each have sub-sections corresponding to the major activity groups.

Alternatively, one could write a "mini-IEE" for each activity group. This would result in separate sections 1, 3 and 4 written for each activity.

If you are preparing an "Umbrella" IEE, please refer to Annex G for a suggested outline.

1. Background and activity description

Describe why the activity is desired and appropriate, and outline the key activities proposed for Title II funding. A current activity description should be provided. Indicate whether this is an IEE amendment, or submitted for a new activity. Indicate deferrals.

2. Country and environmental information

This section is critical and should briefly assess the current physical environment that might be affected by the activity. Depending upon the activities proposed, this could include an examination of land use, geology, topography, soil, climate, groundwater resources, surface water resources, terrestrial communities, aquatic communities, environmentally sensitive areas (e.g., wetlands or protected species), agricultural cropping patterns and practices, infrastructure and transport services, air quality, demography (including population trends/projections), cultural resources, and the social and economic characteristics of the target communities.

The information obtained through this process should serve as an environmental baseline for future environmental monitoring and evaluation. Be selective in the country and environmental information you provide, as it should be specific to the activity being proposed and more information is not necessarily better.

Finally, indicate the status and applicability of host country, Mission, and CS policies, programs and procedures in addressing natural resources, the environment, food security, and other related issues.

3. Evaluation of environmental impact potential

This section of the IEE is intended to define all potential environmental impacts of the activity or project, whether they be considered direct, indirect, beneficial, undesired, short-term, long-term, or cumulative.

Appendix VII Sample Terms of Reference (TOR)

An Environmental Assessment of Wastewater Collection, Treatment, Reuse, and Disposal Systems