Jaipur Engineering College & Research Centre, Jaipur

ENVIRONMENTAL IMPACT ASSESSMENT

VISION AND MISSION OF INSTITUTE

• VISION

To become renowned centre of outcome based learning and work towards academic, professional, cultural and social enrichments of the lives of individual and communities"

• MISSION

1. Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

2. Identify areas of focus and provide platform to gain knowledge and solutions based on informed perception of Indian, regional and global needs.

3. Offer opportunities for interaction between academia and industry.

4. Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

Vision of the Department

"The vision of our institute is to provide the professional and active learners to the IT challenging world. By providing the technical surroundings and scientific excellence environment, we serve as a valuable resource for industry and society."

Mission of the Department

- To generate the adequate knowledge by promoting the extracurricular activities and technical education.
- To provide the graduates best technology services to fulfill its commitment of technical and education of the highest quality.
- To anticipate and meet the information technology needs of alumni, graduates, faculty and staff as they pursue their educational and professional goals.

ENVIRONMENTAL IMPACT ASSESSMENT SYLLABUS:-

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course	1
2	**Introduction & Concepts of EIA**: effect of human activity on environment, concept of ecosystem imbalances, definition of E.I.A, E.I.S, E.M.P, industrial policy of the Govt. of India.	4
3	**International Protocols, Treaties and Conventions**: Stockholm and Basal convention, Copenhagen conference, Rio-Earth summit, **Indian Scenario:** Guidelines of MoEF and CPCB	4
4	**Methodologies for EIA**: preliminary assessment, quantification, comparison of alternatives and comprehensive E.I.As using Ad hoc, Overlays, Checklist, Matrix and Network methods	7
5	**Prediction and assessment of impacts** on air, water, biota, noise, land, cultural and socio-economic environment.	4
6	**Water quality impact:** Water quality criteria, standards and indices, Impacts on water quality of development projects. **Air quality impact:** Air quality criteria, standards and indices, air quality impact of industry transport systems	8
7	**Noise:** Effects of noise on people, noise scales and rating methods, Noise barriers, estimating transportation noise impacts. **Land Pollution** due to construction activities. **Biota:** Impact on fauna and flora, mitigation measures, alternatives.	4
8	**Cultural and socio economic impacts:** effect of developmental projects on cultural and social settings and economic profile of the community. **Energy impact:** EIA of hydro, thermal and nuclear power plants Public Participation in environmental decision making, Some Case Studies of EIA	8
	Total	40

LECTURE PLAN

Unit No./ Total Lecture Reqd.	Topics	Lect. Reqd.
Session 1 (1)	1.Introduction	1
Session 2 (4)	1. Effect of human activity on environment	1
	2. Concept of ecosystem imbalances	1
	3. Definition of E.I.A, E.I.S, E.M.P	1
	4. Industrial policy of the Govt. of India.	1
Session 3 (4)	1. International Protocols, Treaties and Conventions: Stockholm and Basal convention	1
	2.Copenhagen conference	1
	3. Rio-Earth summit	1
	4. Indian Scenario: Guidelines of MoEF and CPCB	1
Session 4 (7)	1. Methodologies for EIA	1
	2. Preliminary assessment, quantification	2
	3. Comparison of alternatives and comprehensive E.I.As using Ad hoc	2
	4. Overlays, Checklist, Matrix and Network methods	2
Session 5 (4)	1.Prediction and assessment of impacts on air, wate	2
	2. Biota, noise, land, cultural	1
	3. Socio-economic environment.	1
Session 6 (8)	1. Water quality impact: Water quality criteria, standards and indices	2
	2. Impacts on water quality of development projects.	2
	3. Air quality impact: Air quality criteria	1
	4.Standards and indices	1
	5. Air quality impact of industry transport systems	2

Session 7 (4)	1. Noise: Effects of noise on people, noise scales and rating methods, Noise barriers, estimating transportation noise impacts.	2
	2. Land Pollution due to construction activities.	1
	3.Biota: Impact on fauna and flora, mitigation measures, alternatives.	1
Session 8 (8)	1. Cultural and socio economic impacts: effect of developmental projects on cultural	1
	2. Social settings and economic profile of the community.	1
	3. impact: EIA of hydro, thermal and nuclear power plants	1
	4. Public Participation in environmental decision making	1
	5. Some Case Studies of EIA	3

PROGRAM OUTCOMES (ANNEXURE 1)

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life –long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ENVIRONMENTAL IMPACT ASSESSMENT (7CE6-60.1)

[L/T/P - 3/0/0]

Class	:	B. Tech. – 7th semester
External marks	:	120
Internal marks	:	30
Total marks	:	150

Course Outcome (CO's):

On completion of this course, students will be able to:

CO1: Understand and evaluate create the basic concept of Environmental impact assessment, Flow of EIA

CO2: Select methodology and protocol for identification of environmental impacts, environmental indices and indicators

CO3: Apply the skill and knowledge of predicting impact of proposed project on air & water; AQI, AQHI, WQI, WQHI

CO4: To encourage students to develop their own perspectives on Biota, noise pollution and energy impact assessment and to be able to relate this to other subject areas and to their wider understanding.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

H=3, M=2, L=1.

Sem	Subject	Code	L/T/P	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
VII	ENVIRONMENTAL IMPACT ASSESSMENT	7CE6-60.1	L	1. Understand and evaluate create the basic concept of Environmental impact assessment, Flow of EIA	**H**	**M**	-	-	**M**	**M**	**M**	-	-	**M**	-	**L**
			L	2. Select methodology and protocol for identification of environmental impacts, environmental indices and indicators	**H**	**M**	-	-	**M**	**M**	**M**	-	-	**M**	-	**L**
			L	3. Apply the skill and knowledge of predicting impact of proposed project on air & water; AQI, AQHI, WQI, WQHI	**H**	**M**	**M**	**M**	**M**	-	-	-	-	**L**	-	**L**
			L	4. To encourage students to develop their own perspectives on Biota, noise pollution and energy impact assessment and to be able to relate this to other subject areas and to their wider understanding.	**H**	**M**	**M**	**M**	**M**	-	-	-	-	**L**	-	**L**

Department of Information Technology

Weak students Assignment of Environmental Impact Assessment

COURSE: B.Tech **SEMESTER:** VII **SECTION:** (A & B)
SUBJECT & CODE: ENVIRONMENTAL IMPACT ASSESSMENT (7CE6-60.1)

CO1: Understand and evaluate create the basic concept of Environmental impact assessment, Flow of EIA

Question 1- How Does Human Affect the Environment?
Question 2- What are the key elements of EIA?
Question 3- Outline the EIA aspects of a large-scale highway construction project.
Question 4- Relationship between ecological parameter and project activity.

CO2: Select methodology and protocol for identification of environmental impacts, environmental indices and indicators

Question 1- Briefly explain the various types of Socio-economic impacts.
Question 2- Define EIA, EIS and discuss on FONSI. Establish the relation between them.
Question 3- Write a brief note on contents of EIA on required by CEQ.
Question 4- What are the types of environmental impacts?

CO3: Apply the skill and knowledge of predicting impact of proposed project on air & water; AQI, AQHI, WQI, WQHI

Question 1- Discuss about water quality criteria and standards.
Question 2- Explain air quality impact of industry transport system.
Question 3- Explain impacts on water quality of development projects.
Question 4- Why is AQI important? Objectives of Air Quality Index (AQI)

CO4: To encourage students to develop their own perspectives on Biota, noise pollution and energy impact assessment and to be able to relate this to other subject areas and to their wider understanding.

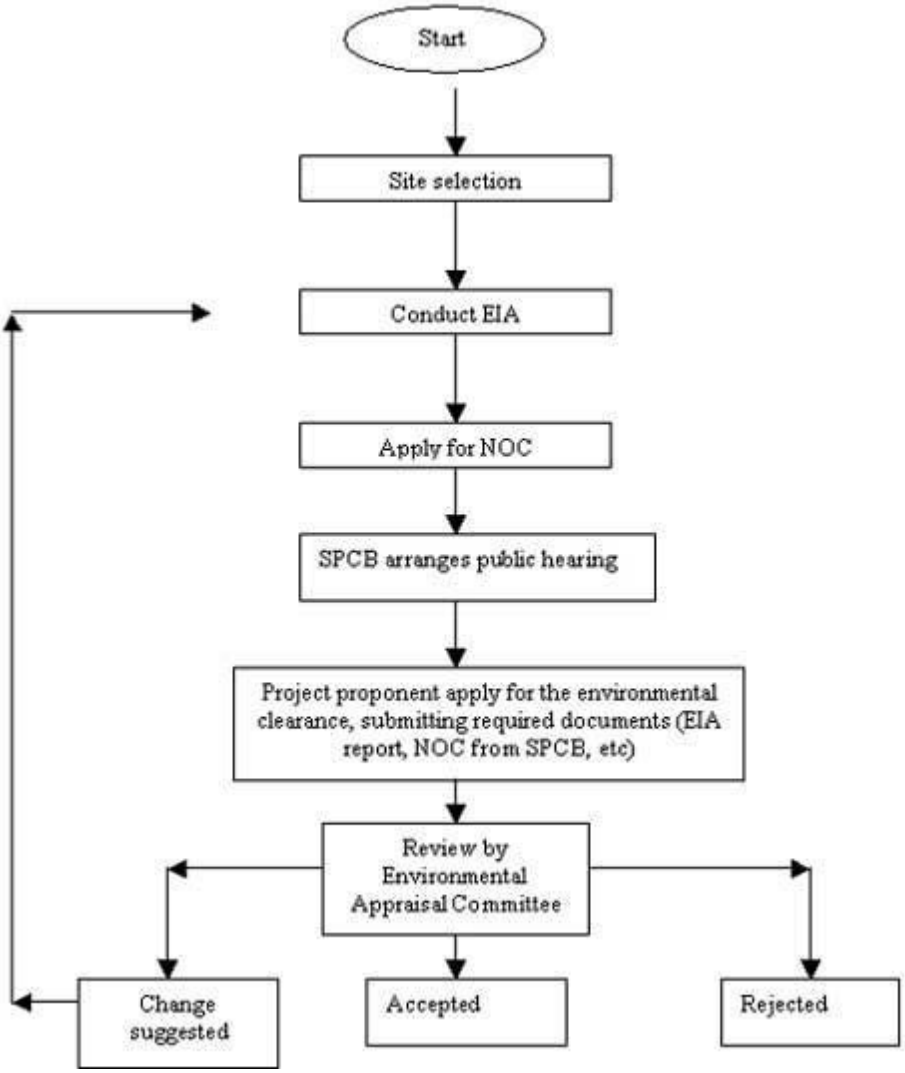
Question 1- Explain effects of noise on people and noise scales.
Question 2- What is land pollution and what activities cause land pollution.
Question 3- Explain how developmental project effect cultural, social and economic profile of community.
Question 4- Explain case study of hydropower project.

UNIT 1

Environmental assessment (EIA) is the term used for the assessment of the environmental consequences (positive and negative) of a plan, policy, program, or project prior to the decision to move forward with the proposed action. In this context, the term 'environmental impact assessment' (EIA) is usually used when applied to concrete projects and the term 'strategic environmental assessment' applies to policies, plans and programmers. Environmental assessments may be governed by rules of administrative procedure regarding public participation and documentation of decision making, and may be subject to judicial review.

The purpose of the assessment is to ensure that decision makers consider the environmental impacts when deciding whether or not to proceed with a project. The International Association for Impact Assessment (IAIA) defines an environmental impact assessment as "the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made. EIAs are unique in that they do not require adherence to a predetermined environmental outcome, but rather they require decision makers to account for environmental values in their decisions and to justify those decisions in light of detailed environmental studies and public comments on the potential environmental impacts.

Engineering and consulting companies work hand in hand as contractors for mining, energy, oil & gas companies executing EIAs. These contractors are the ones not only in charge of preparing an EIA study but most importantly getting these studies approved by each country government offices prior to the execution of a project. Each country will also have its own local contractors offering the same kind of service hence breaking out monopolies by increasing the supply of EIAs execution consultants.



COMPREHENSIVE ENVIRONMENTAL IMPACT ASSESSMENT

The objective of a comprehensive environmental impact assessment is to prevent or at least to considerably reduce activities that may have important harmful effects or consequences on the environment and protected areas, thus realizing the principles of sustainable development, integrity and prevention.

The procedure for a comprehensive environmental impact assessment is defined in the Environmental Protection Act and is carried out for plans provided that:

- They define or envisage an activity affecting the environment for which an environmental impact assessment needs to be carried out;

- Assessment of the acceptability of impacts on the protected areas according to the regulations governing nature conservation is required;
- The responsible ministry estimates that their implementation could have an important effect on the environment.

In the procedure for comprehensive environmental impact assessment, the effects of the plan are evaluated on the basis of the environmental report. The procedure is conducted by the ministry responsible for the environment. It also includes cooperation between all national authorities within their ministries and organizations, as well as public information and participation. The participation of the public is governed by the Environmental Protection Act, which lays down a 30-day public presentation of the environmental report.

National authorities and local communities must, prior to the preparation of the plan and in the specified manner, inform the ministry responsible for the environment thereof. Non-compliance with legal obligations may result in invalidity of plans.

PLANS

Plans shall mean all plans, programmes, spatial or other acts and their amendments that are adopted pursuant to these acts by competent national bodies or municipalities in the area of spatial planning, water management, forest management, hunting, agriculture, energy, industry, transport, waste and waste-water management, drinking-water supply, telecommunications and tourism if the plans define or envisage an activity affecting the environment for which an environmental impact assessment must be carried out or if they include part of a protected area or if the execution of the plan could have an effect in itself or in connection with other plans.

Determination of whether plans could have a significant impact on the environment is governed, in particular, by the provisions of the Decree on categories of projects for which an environmental impact assessment is mandatory.

Protected areas for which the effects of the plans are to be assessed are protected areas according to regulations related to nature conservation, including protection in national, regional and landscape parks, strict nature reserves, nature reserves and natural monuments along with all acts designating natural sites of special interest still in force.

In accordance with the third paragraph of Article 40 of the Environmental Protection Act, comprehensive environmental protection assessment is carried out for plans that do not include activities affecting the environment for which environmental

protection assessment is needed or do not include protected areas defined in regulations related to nature conservation if the responsible ministry estimates that their implementation might have a significant impact on the environment.

ENVIRONMENTAL IMPACT STATEMENT (EIS)

An **environmental impact statement** (**EIS**), under United States environmental law, is a document required by the National Environmental Policy Act (NEPA) for certain actions significantly affecting the quality of the human environment. An EIS is a tool for decision making. It describes the positive and negative environmental effects of a proposed action, and it usually also lists one or more alternative actions that may be chosen instead of the action described in the EIS. Several U.S. state governments require that a document similar to an EIS be submitted to the state for certain actions.

STEPS

Scoping: The first meetings are held to discuss existing laws, the available information, and the research needed. The tasks are divided up and a lead group is selected. Decision makers and all those involved with the project can attend the meetings.

Notice: The public is notified that the agency is preparing an EIS. The agency also provides the public with information regarding how they can become involved in the process. The agency announces its project proposal with a notice in the Federal Register, notices in local media, and letters to citizens and groups that it knows are likely to be interested. Citizens and groups are welcome to send in comments helping the agency identify the issues it must address in the EIS (or EA).

Draft EIS (DEIS): Based on both agency expertise and issues raised by the public, the agency prepares a Draft EIS with a full description of the affected environment, a reasonable range of alternatives, and an analysis of the impacts of each alternative.

Comment: Affected individuals then have the opportunity to provide feedback through written and public hearing statements.

Final EIS (FEIS) and Proposed Action: Based on the comments on the Draft EIS, the agency writes a Final EIS, and announces its Proposed Action. The public is not invited to comment on this, but if they are still unhappy, or feel that the agency has missed a major issue, they may protest the EIS to the Director of the agency. The Director may either ask the agency to revise the EIS, or explain to the protester why their complaints are not actually taken care of.

Re-evaluation: Prepared following an approved FEIS or ROD when unforeseen changes to the proposed action or its impacts occurs, or when a substantial period of time has passed between approval of an action and the planned start of said action. Based on the significance of the changes, three outcomes may result from a re-evaluation report: (1) the action may proceed with no substantive changes to the FEIS, (2) significant impacts are expected with the change that can be adequately addressed in a Supplemental EIS (SEIS), or (3) the circumstances force a complete change in the nature and scope of the proposed action, thereby voiding the pre-existing FEIS (and ROD, if applicable), requiring the lead agency to restart the NEPA process and prepare a new EIS to encompass the changes.

Supplemental EIS (SEIS): Typically prepared after both a Final EIS and Record of Decision has been issued and new environmental impacts that were not considered in the original EIS are discovered, requiring the lead agency to re-evaluate its initial decision and consider new alternatives to avoid or mitigate the new impacts. Supplemental EISs are also prepared when the size and scope of a federal action changes, when a significant period of time has lapsed since the FEIS was completed to account for changes in the surrounding environment during that time, or when all of the proposed alternatives in an EIS are deemed to have unacceptable environmental impacts and new alternatives are proposed.

Record of Decision (ROD): Once all the protests are resolved the agency issues a Record of Decision which is its final action prior to implementation. If members of the public are still dissatisfied with the outcome, they may sue the agency in Federal court.

Often, the agencies responsible for preparing an EA or EIS do not compile the document directly, but outsource this work to private-sector consulting firms with expertise in the proposed action and its anticipated effects on the environment. Because of the intense level of detail required in analyzing the alternatives presented in an EIS or EA, such documents may take years or even decades to compile, and often compose of multiple volumes that can be thousands to tens of thousands of pages in length.

To avoid potential conflicts in securing required permits and approvals after the ROD is issued, the lead agency will often coordinate with stakeholders at all levels, and resolve any conflicts to the greatest extent possible during the EIS process. Proceeding in this fashion helps avoid interagency conflicts and potential lawsuits after the lead agency reaches its decision.

NEPA

The purpose of the NEPA is to promote informed decision-making by federal agencies by making detailed information concerning significant environmental impacts" available to both agency leaders and the public. The NEPA was the first piece of legislation that created a comprehensive method to assess potential and existing environmental risks at once. It also encourages communication and cooperation between all the actors involved in environmental decisions, including government officials, private businesses, and citizens.

In particular, an EIS acts as an enforcement mechanism to ensure that the federal government adheres to the goals and policies outlined in the NEPA. An EIS should be created in a timely manner as soon as the agency is planning development or is presented with a proposal for development. The statement should use an interdisciplinary approach so that it accurately assesses both the physical and social impacts of the proposed development. In many instances an action may be deemed subject to NEPA's EIS requirement even though the action is not specifically sponsored by a federal agency.

Not all federal actions require a full EIS. If the action may or may not cause a significant impact the agency can first prepare a smaller, shorter document called an **Environmental Assessment** (EA). The finding of the EA determines whether an EIS is required. If the EA indicates that no significant impact is likely, then the agency can release a finding of no significant impact (FONSI) and carry on with the proposed action. Otherwise, the agency must then conduct a full-scale EIS. Most EA's result in a FONSI. A limited number of federal actions may avoid the EA and EIS requirements under NEPA if they meet the criteria for a categorical exclusion (CATEX).

Contrary to a widespread misconception, NEPA does not prohibit the federal government or its licensees/permittees from harming the environment, but merely requires that the prospective impacts be understood and disclosed in advance. The intent of NEPA is to help key decision makers and stakeholders balance the need to implement an action with its impacts on the surrounding human and natural environment, and provide opportunities for mitigating those impacts while keeping the cost and schedule for implementing the action under control. However, many activities require various federal permits to comply with other environmental legislation, such as the Clean Air Act, the Clean Water Act, Endangered Species Act and Section 4(f) of the Federal Highway Act to name a few. Similarly, many states and local jurisdictions have enacted environmental laws and ordinances, requiring additional state and local permits before the action can proceed. Obtaining these permits typically requires the lead agency to implement the **Least Environmentally Damaging Practicable Alternative (LEDPA)** to comply with federal, state, and local environmental laws that are ancillary to NEPA. In some instances, the result of NEPA analysis leads to abandonment or cancellation of the proposed action, particularly when the "No Action" alternative ends up being the LEDPA.

NEPA PROCESS

The NEPA process is designed to involve the public and gather the best available information in a single place so that decision makers can be fully informed when they make their choices.

The process has the following steps:

- **Proposal:** In this stage, the needs and objectives of a project have been decided, but the project has not been financed.
- **Categorical Exclusion (CATEX):** The government may exempt an agency from the process. The agency can then proceed with the project and skip the remaining steps.
- **Environmental Assessment (EA):** The proposal is analyzed in addition to the local environment with the aim to reduce the negative impacts of the development on the area.
- **Finding of No Significant Impact (FONSI):** Occurs when no significant impacts are identified in an EA. A FONSI typically allows the lead agency to proceed without having to complete an EIS.

FINDING OF NO SIGNIFICANT IMPACT(FONSI)

FONSI is a decision document supporting a determination that an action will not result in significant impacts. A FONSI is a document which is concisely presents the reasons why an action not otherwise excluded will not have a significant effect, on the human environment and for which an EIS will not be prepared. If a significant effect or effects are anticipated the an EIS is to be prepared. If no significant effects are anticipated or if they can be mitigated then an FONSI is to be prepared. The FONSI was initially referred to as a Negative declaration. A mitigated FONSI refers to a proposed action which has incorporated mitigation measures to reduce any significant negative effects to insignificant ones.

Negative declarations or FONSI can be prepared on the following types of highway improvement actions, since they are not likely to have significant impacts.

- Signing, marking, signalization and rail-road protective devices
- Acquisition of scenic ease
- Modernization of an existing highway by resurfacing, less than lane width widening
- Correcting substandard curves
- Reconstruction of existing stream crossings, where stream channels are not affected

NEED FOR ENVIRONMENTAL IMPACT ASSESSMENT STUDIES

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.

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.

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
- 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.

Irrigated agriculture is crucial to the economy, health and welfare of a very large part of the developing world. It is too important to be marginalized as it is vital for world food security. However, irrigated agriculture often radically changes land use and is a major consumer of freshwater. Irrigation development thus has a major impact on the environment. All new irrigation and drainage development results in some form of degradation. It is necessary to determine the acceptable level and to compensate for the degradation. This degradation may extend both upstream and downstream of the irrigated area. The impacts may be both to the natural, physical environment and to the human environment. All major donors consider large irrigation and drainage developments to be environmentally sensitive.

An EIA is concerned both with impacts of irrigation and drainage on the environment and with the sustainability of irrigation and drainage itself. 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.

UNIT 2

STEP BY STEP PROCEDURE FOR CONDUCTING EIA

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, 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 and the techniques more commonly used in EIA are described below. The main steps in the EIA process are:

- Screening
- Scoping
- Prediction and mitigation
- Management and monitoring
- Audit

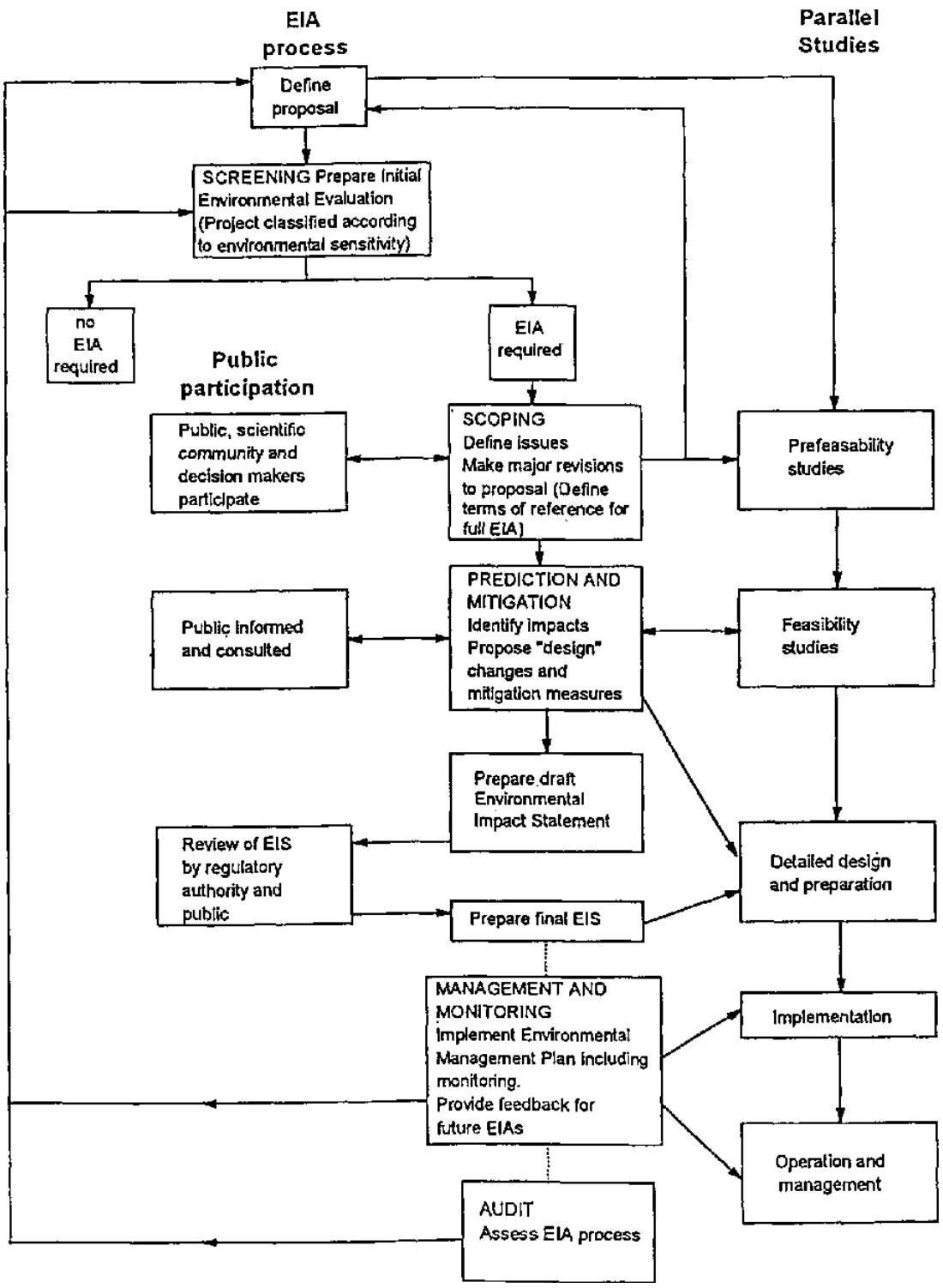
• **Screening** often results in a categorization of the project and from this a decision is made on whether or not a full EIA is to be carried out.

• **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, 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 some time after implementation. The audit serves a useful feedback and learning function.


EIA process
Parallel Studies
Define proposal
SCREENING Prepare Initial Environmental Evaluation (Project classified according to environmental sensitivity)
no EIA required
EIA required
Public participation
Public, scientific community and decision makers participate
SCOPING
Define issues
Make major revisions to proposal (Define terms of reference for full EIA)
Prefeasability studies
PREDICTION AND MITIGATION
Identify impacts
Propose "design" changes and mitigation measures
Public informed and consulted
Feasibility studies
Prepare draft Environmental Impact Statement
Review of EIS by regulatory authority and public
Prepare final EIS
Detailed design and preparation
MANAGEMENT AND MONITORING
Implement Environmental Management Plan including monitoring.
Provide feedback for future EIAs
Implementation
Operation and management
AUDIT
Assess EIA process

RESOURCES

An EIA team for an irrigation and drainage study is likely to be composed of some or all of the following: a team leader; a hydrologist; an irrigation/drainage engineer; a fisheries biologist/ecologist; an agronomist/pesticide expert; a soil conservation expert; a biological/environmental scientist; an economist, a social scientist and a health scientist (preferably a epidemiologist). The final structure of the team will vary depending on the project. Specialists may also be required for fieldwork, laboratory testing, library research, data processing, surveys and modelling. The team leader will require significant management skill to co-ordinate the work of a team with diverse skills and knowledge.

There will be a large number of people involved in EIA apart from the full-time team members. These people will be based in a wide range of organizations, such as the project proposing and authorizing bodies, regulatory authorities and various interest groups. Such personnel would be located in various agencies and also in the private sector; a considerable number will need specific EIA training.

The length of the EIA will obviously depend on the programme, plan or project under review. However, the process usually lasts from between 6 and 18 months from preparation through to review. It will normally be approximately the same length as the feasibility study of which it should form an integral part. It is essential that the EIA team and the team carrying out the feasibility study work together and not in isolation from each other. This often provides the only opportunity for design changes to be made and mitigation measures to be incorporated in the project design.

SCREENING

Screening is the process of deciding on whether an EIA is required. This may be determined by size. 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.

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.

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 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.

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. Risk and uncertainty are discussed further in the section managing uncertainty.

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.

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

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.

AUDITING

In order to capitalize 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. 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.

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 public 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 range 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,

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.

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.

LIMITATIONS OF EIA

EIA is also a way of ensuring that environmental factors are considered in decision-making process along with the traditional economic and technical factors. Importantly EIA requires the scientific (technical) and value issues to be dealt with in a single assessment process. This helps in the proper consideration of all advantages and disadvantages of a proposal. Environmental considerations may, therefore, be set aside in favour of what are felt to be more important considerations. Alternatively, predicted adverse effects on the environment might lead to strict conditions being imposed to avoid these effects or remedy any adverse effects, or perhaps lead to the complete abandonment of a proposal.

However, it is most important to recognise that EIA cannot be regarded as a means of introducing an environmental veto power into administrative decision-making processes. Decisions that are unsatisfactory from an environmental point of view can still

be made, but with full knowledge of the environmental consequences. The final decision about a proposal depends upon the likely severity of the adverse effects, balanced against other expected benefits.

In other words, EIA is an administrative process that identifies the potential environmental effects of undertaking a proposal, and presents these environmental effects alongside the other advantages and disadvantages of the proposal to the decision-makers. In the vast majority of EIA procedures this means that the outcome of the eia process provides advice to the decision-makers it does not provide a final decision. So, by itself, the eia procedures cannot be expected to stop a proposal although this is an outcome that some members of the general community and environment groups may expect.

UNIT 3

AIMS AND OBJECTIVES OF EIA

The aims and objectives of EIA can be divided into two categories. The immediate aim of EIA is to inform the process of decision-making by identifying the potentially significant environmental effects and risks of development proposals. The ultimate (long term) aim of EIA is to promote sustainable development by ensuring that development proposals do not undermine critical resource and ecological functions or the well being, lifestyle and livelihood of the communities and peoples who depend on them.

Immediate objectives of EIA are

- Improve the environmental design of the proposal
- Ensure that resources are used appropriately and efficiently
- Identify appropriate measures for mitigating the potential impacts of the proposal
- Facilitate informed decision making, including setting the environmental terms and conditions for implementing the proposal

Long term objectives of EIA are

- Protect human health and safety
- Avoid irreversible changes and serious damage to the environment
- Safeguard valued resources, natural areas and ecosystem components
- Enhance the social aspects of the proposal

FRAME WORK OF IMPACT ASSESSMENT

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.

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 responsibilities 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.

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.

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.

SCOPE OF EIA

An environmental impact assessment is an activity designed to identify and predict the impact of an action on the biogeophysical environment and on man's health and well-being, and to interpret and communicate information about the impacts.

OPERATIONAL PROCEDURES

- Environmental impact assessments should be an integral part of all planning for major actions, and should be carried out at the same time as engineering, economic, and socio-political assessments.
- In order to provide guidelines for environmental impact assessments, national goals and policies should be established which take environmental considerations into account; these goals and policies should be widely promulgated.
- The institutional arrangements for the process of environmental impact assessment should be determined and made public. Here it is essential that the roles of the various participants (decision-maker, assessor, proponent, reviewer, other expert advisors, the public, and international bodies) be designated. It is also important that timetables for the impact assessment process be established, so that proposed actions are not held up unduly and the assessor and the reviewer are not so pressed that they undertake only superficial analyses.
- An environmental impact assessment should contain the following:

- Environmental impact assessments should include study of all relevant physical, biological, economic, and social factors.
- At a very early stage in the process of environmental impact assessment, inventories should be prepared of relevant sources of data and of technical expertise.
- Environmental impact assessments should include study of alternatives, including that of no action .
- Environmental impact assessments. should include a spatial frame of reference much larger than the area encompassed by the action, e.g., larger than the 'factory fence' in the case of an engineering project.
- Environmental impact assessments should include both mid-term and long-term predictions of impacts. In the case of engineering projects, for example, the following time-frames should be covered:

- Environmental impacts should be assessed as the difference between the future state of the environment if the action took place and the state if no action occurred.
- Estimates of both the *magnitude* and the *importance* of environmental impacts should be obtained. (Some large effects may not be very important to society, and *vice versa*.)
- Methodologies for impact assessment should be selected which are appropriate to the nature of the action, the data base, and the geographic setting. Approaches which are too complicated or too simple should both be avoided.
- The affected parties should be clearly identified, together with the major impacts for each party .

RESEARCH

Research should be encouraged in the following areas:

1. Post-audit reviews of environmental impact assessments for accuracy and completeness in order that knowledge of assessment methods may be improved. (No systematic post-audit programme has as yet been initiated in any country with experience in impact assessment.)
2. Study of methods suitable for assessing the environmental effects of social and institutional programmes, and of other activities of the non construction type.
3. Study of criteria for environmental quality
4. Study of quantifying value judgements on the relative worth of various components of environmental quality .
5. Development of modelling techniques for impact assessments, with special emphasis on combined physical, biological, socio-economic systems.
6. Study of sociological effects and impacts.
7. Study of methods for communicating the results of highly technical assessments to the non-specialist.

TECHNIQUES OF EIA

Baseline studies
The ICID Check-list
Matrices
Network diagrams
Overlays
Mathematical modelling
Expert advice
Economic techniques

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.

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" 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.

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.

The greatest drawback 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.

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.

Example of network analysis showing the impact of a policy to utilize groundwater by subsidizing tubewells

Primary impacts	**Secondary impacts**	**Tertiary impacts**	**Quaternary impacts**	**Mitigation**
Lowering of groundwater in dry season	Loss of income & water from domestic hand pumps	Use of poorer quality water	Increased health risks	1. Ensure that the new DTW either hold domestic water locally or feed into distributary system Note Effected group are poorer people
		Income diverted to buy water	Decreased income & time	
		Travel to distant source	Reduced quality of life	
	Loss of income & water from shallow tubewells for irrigation	Income diverted to buy water	Decreased income & time leading to possible food shortage	1. Deepen STW
		Crop failure	Reduced quality of life	2. Ensure new DTWs supply STWs in dry season
			Abandonment of land & migration	3. Provide compensation from DTW taxation
	Drawdown of surface water	Decreased fish capture/fish	Loss of protein intake	1. Artificially stock water bodies

	bodies	mortality	Loss of income for fishermen	2. Recharge water bodies from DTW Note: Fishermen are already poorer than farmers in general
		Loss of wetland	Loss of wetland flora/fauna migratory birds, fish spawning areas	
			Loss of wetland products	1. Restrict DTW development in vulnerable areas Note Landless & Rural poor are greatest users of wetlands
		Reduced navigation possibilities	Increased transport costs	1. Increase navigation depth by dredging
Agricultural intensification	Increased fertilizer	Groundwater contamination by nitrate	Polluted drinking water by nitrate causes various illness, particularly in babies	1. Control fertilizer use 2. Educate users of groundwater as well as fertilizer users babies
		Eutrophication of surface water due to runoff	Increased weeds in channels & surface water bodies, algal blooms	1. Remove and control weeds
				2. Educate about dangers of algal blooms
	Increased pesticide use	Groundwater contamination	More expensive alternative for drinking water must be found	1. Regulate pesticide use
		Poisoning of fish & shrimp	Reduction in fish catches & protein availability	2. Encourage rainwater storage
			Reduced income for fishermen	3 Encourage integrated pest management
			Bioaccumulation of pesticide in man	4 Subsidize non-persistent

				pesticides
				5. Tax undesirable pesticides
				6. Educate pesticide users & fish eaters
	Increased level of pest & diseases vectors due to loss of fallow period	Increased pesticide use	Bioaccumulation of pesticide in man	1. Vaccinate to prevent epidemics
		Increase in animal & human disease due to vector	Loss of quality of life	2. Encourage alternative cropping patterns
				3. Educate about disease vectors
	Reduced fallow land & grassland for grazing	Fewer livestock or poor quality livestock	Reduced protein intake & income for landless groups	1. Develop alternative grazing
	Reduced scrubland for fuel wood	Alternative sources sought for fuel	Income & time spent collecting fuel	1. Develop fuelwood supplies
			Destruction of trees	2. Introduce more efficient cookers

MATHEMATICAL MODELLING

Mathematical modelling is one of the most useful tools for prediction work. It is the natural tool to assess both flow quantities and qualities (eg 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 modelling was used very effectively to study the Hadejia-Jama' are region in Nigeria. In this case the modelling 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.

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 modelling 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.

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. 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.

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.

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.

• 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.

Unit 4

EIA GUIDELINES FOR DEVELOPMENT PROJECTS

The MoEF has prepared Environmental Guidelines, to help the project proponents to work out an EIA. Guidelines have been prepared to bring out specific information on the environment required for environmental clearance. The agencies, which are primarily responsible for the respective sectors are closely involved in preparing the guidelines. River valley projects, thermal power projects, mining projects and industries, ports and harbors, development of beaches, highway/ railroad projects are the sectors for which guidelines have already been prepared. These guidelines basically consist of aspects regarding planning and implementation of development projects. The majority of projects in India, which require EIA's, are large developmental projects like nuclear power, river valley, thermal power plants etc, where government plays an important role.

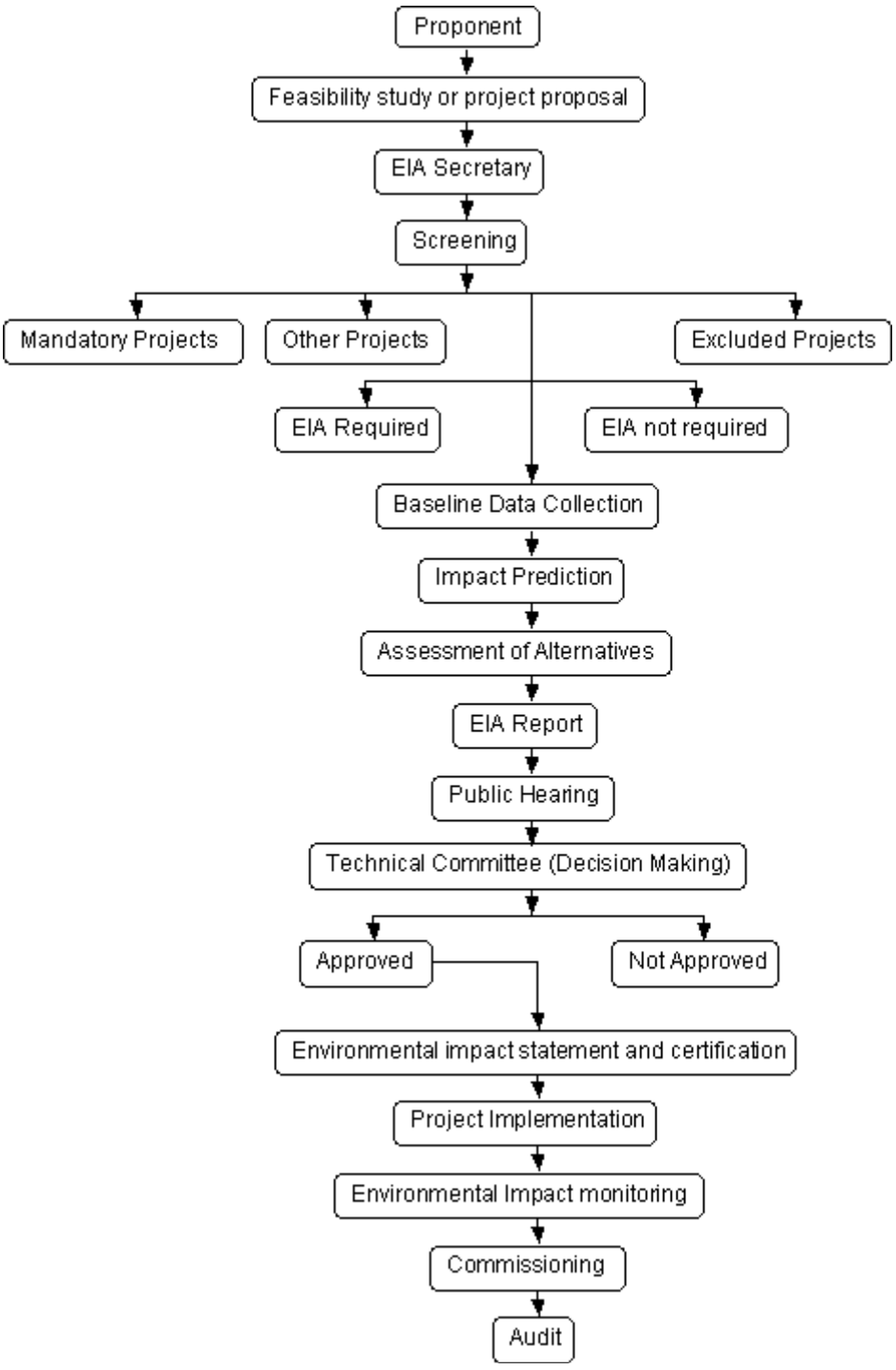

Proponent
Feasibility study or project proposal
EIA Secretary
Screening
Mandatory Projects
Other Projects
Excluded Projects
EIA Required
EIA not required
Baseline Data Collection
Impact Prediction
Assessment of Alternatives
EIA Report
Public Hearing
Technical Committee (Decision Making)
Approved
Not Approved
Environmental impact statement and certification
Project Implementation
Environmental Impact monitoring
Commissioning
Audit

Fig 1

ENVIRONMENTAL GUIDELINES FOR INDUSTRIES

In order to help the concerned authorities and the entrepreneurs, it is necessary to frame certain broad guidelines for siting an industry. It is also necessary to identify the parameters that should be taken into account while setting up an industry. With this in view, the following environmental guidelines are recommended for siting of Industries to ensure optimum use of natural and man-made resources in sustainable manner with minimal depletion, degradation and/or destruction of environment. Those are in addition to those directives that are already in existence under the Industries (Development and Regulation) Act.

AREAS TO BE AVOIDED

In siting industries, care should be taken to minimise the adverse impact of the industries on the immediate neighbourhood as well as distant places. Some of the natural life sustaining systems and some specific land uses are sensitive to industrial impacts because of the nature and extent of fragility. With a view to protecting such an industrial sites shall maintain the following distances from the areas listed

- Ecologically and/or otherwise sensitive areas at least 25 km; depending on the geo-climatic conditions the requisite distance hall have to be increased by the appropriate agency.
- Coastal areas at least 1/2 km from High Tide Line.
- Flood Plain of the Riverine Systems at least 1/2 km from flood plain or modified flood plain affected by dam in the upstream or by flood control systems.
- Transport/Communication System at least 1/2 km from highway and railway.
- Major settlements(3,00,000 population):distance from settlements is difficult to maintain because of urban sprawl. At the time of siting of the industry if any major settlement's notified limit is within 50 km, the spatial direction of growth of the settlement for at least a decade must be assessed and the industry shall be sited at least 25 km from the projected growth boundary of the settlement.

  Pre - requisite: State and Central Governments are required to identify such areas on a priority basis.

- Ecological and/or otherwise sensitive areas include
- Religious and Historic Places
- Archaeological Monuments
- Hill Resorts
- Beach Resorts
- Health Resorts

- Coastal Areas rich in Coral, Mangroves, Breeding Grounds of Specific Species
- Estuaries rich in Mangroves, Breeding Ground of Specific Species
- Gulf Areas
- Biosphere Reserves
- National Parks and Sanctuaries
- Natural Lakes, Swamps
- Seismic Zones
- Tribal Settlements
- Areas of Scientific and Geological interest
- Defence Installations, specially those of security importance and sensitive to pollution
- Border Areas (International) and
- Airports.

SITING CRITERIA

Economic and social factors are recognized and assessed while siting an industry. Environmental factors must be taken into consideration in industrial siting. Proximity of water sources, highway, major settlements, markets for products and raw material resources is desired for economy of production, but all the above listed systems must be away for environmental protection. Industries are, therefore, required to be sited, striking a balance between economic and environmental considerations. In such a selected site, the following factors must be recognized.

- No forest land shall be converted into non-forest activity for the sustenance of the industry.
- No prime agricultural land shall be converted into industrial site.
- Within the acquired site the industry must locate itself at the lowest location to remain obscured from general sight.
- Land acquired shall be sufficiently large to provide space for appropriate treatment of waste water still left for treatment after maximum possible reuse and recycle. Reclaimed(treated) wastewater shall be used to raise green belt and to create water body for aesthetics, recreation and if possible, for aquaculture. The green belt shall be 1/2 km wide around the battery limit of the industry. For industry having odour problem it shall be a kilometer wide.
- The green belt between two adjoining large scale industries shall be one kilometer.
- Enough space should be provided for storage of solid wastes so that these could be available for possible reuse.
- Lay out and form of the industry that may come up in the area must conform to the landscape of the area without affecting the scenic features of that place.

- Associated township of the industry must be created at a space having physiographic barrier between the industry and the township.
- Each industry is required to maintain three ambient air quality measuring stations within 120 degree angle between stations.

Environmental Impact Assessment (EIA)

1. The purpose of Environmental Impact Assessment (EIA) is to identify and evaluate the potential impacts(beneficial and adverse)of development and projects on the environmental system. It is an useful aid for decision making based on understanding of the environment implications including social, cultural and aesthetic concerns which could be integrated with the analysis of the project costs and benefits. This exercise should be undertaken early enough in the planning stage of projects for selection of environmentally compatible sites, process technologies and such other environmental safeguards.
2. While all industrial projects may have some environmental impacts all of them may not be significant enough to warrant elaborate assessment procedures. The need for such exercises will have to be decided after initial evaluation of the possible implications of a particular project and its location. The projects which could be the candidates for detailed Environment Impact Assessment include the following:-
    - Those which can significantly alter the landscape, land use pattern and lead to concentration of working and service population;
    - Those which need upstream development activity like assured mineral and forest products supply or downstream industrial process development;
    - Those involving manufacture, handling and use of hazardous materials;
    - Those which are sited near ecologically sensitive areas, urban centers, hill resorts, places of scientific and religious importance.
    - Industrial Estates with constituent units of various types which could cumulatively cause significant environmental damage.
3. The Environmental Impact Assessment (EIA) should be prepared on the basis of the existing background pollution levels contributions of pollutants from the proposed plant. The EIA should address some of the basic factors listed below:
    - Meteorology and air quality
      Ambient levels of pollutants such as Sulphur Dioxide,oxides of nitrogen, carbonmonoxide, suspended particulate matters, should be determined at the center and at 3 other locations on a radius of 10 km with 120 degrees angle between stations. Additional contribution of pollutants at the locations are required to be predicted after taking into account the

emission rates of the pollutants from the stacks of the proposed plant, under different meteorological conditions prevailing in the area.

- Hydrology and water quality
- Site and its surroundings
- Occupational safety and health
- Details of the treatment and disposal of effluents(liquid,air and solid) and the methods of alternative uses
- Transportation of raw material and details of material handling
- Control equipment and measures proposed to be adopted

4. Preparation of Environmental Management Plan is required for formulation, implementation and monitoring of environmental protection measures during and after commissioning of projects.

Environmental Management Plan (EMP)

Preparation of environmental management plan is required for formulation, implementation and monitoring of environmental protection measures during and after commissioning of projects. The plans should indicate the details as to how various measures have been or are proposed to be taken including cost components as may be required. Cost of measures for environmental safeguards should be treated as an integral component of the project cost and environmental aspects should be taken into account at various stages of the projects

- Conceptualization: preliminary environmental assessment
- Planning: detailed studies of environmental impacts and design of safeguards
- Execution: implementation of environmental safety measures
- Operation: monitoring of effectiveness of built-in safeguards

The management plans should be necessarily based on considerations of resource conservation and pollution abatement, some of which are:

- Liquid Effluents
- Air Pollution
- Solid Wastes
- Noise and Vibration
- Occupational Safety and Health
- Prevention, maintenance and operation of Environment Control Systems
- House-Keeping

- Human Settlements
- Transport Systems
- Recovery - reuse of waste products
- Vegetal Cover
- Disaster Planning
- Environment Management Cell

1. Liquid Effluents
    - Effluents from the industrial plants should be treated well to the standards as prescribed by the Central/State Water Pollution Control Boards.
    - Soil permeability studies should be made prior to effluents being discharged into holding tanks or impoundments and steps taken to prevent percolation and ground water contamination.
    - Special precautions should be taken regarding flight patterns of birds in the area. Effluents containing toxic compounds, oil and grease have been known to cause extensive death of migratory birds. Location of plants should be prohibited in such type of sensitive areas.
    - Deep well burial of toxic effluents should not be resorted to as it can result in re-surfacing and ground water contamination. Re-surfacing has been known to cause extensive damage to crop and livestocks.
    - In all cases, efforts should be made for re-use of water and its conservation.
2. Air Pollution
    - The emission levels of pollutants from the different stacks, should conform to the pollutin control standards prescribed by Central or State Boards.
    - Adequate control equipment should be installed for minimising the emission of pollutants from the various stacks.
    - In-plant control measures should be taken to contain the fugitive emissions.
    - Infrastructural facilities should be provided for monitoring the stack emissions and measuring the ambient air quality including micro-meteorological data(wherever required) in the area.
    - Proper stack height as prescribed by the Central/State Pollution Control Boards should be provided for better dispersion of pollutants over a wider area to minimise the effect of pollution.
    - Community buildings and townships should be built up-wind of plant with one-half to one kilometer greenbelt in addition to physiographical barrier.
3. Solid Wastes
    - The site for waste disposal should be checked to verify permeability so that no contaminants percolate into the ground water or river/lake.

- Waste disposal areas should be planned down-wind of villages and townships.
- Reactive materials should be disposed of by immobilising the reactive materials with suitable additives.
- The pattern of filling disposal site should be planned to create better landscape and be approved by appropriate agency and the appropriately pretreated solid wastes should be disposed according to the approved plan.
- Intensive programs of tree plantation on disposal areas should be undertaken.

4. Noise and Vibration
   Adequate measures should be taken for control of noise and vibrations in the industry.
5. Occupational Safety and Health
   Proper precautionary measures for adopting occupational safety and health standards should be taken.
6. Prevention, maintenance and operation of Environment Control Systems
   - Adequate safety precautions should be taken during preventive maintenance and shut down of the control systems.
   - A system of inter-locking with the production equipment should be implemented where highly toxic compounds are involved.
7. House - Keeping
   Proper house-keeping and cleanliness should be maintained both inside and outside of the industry.
8. Human Settlements
   - Residential colonies should be located away from the solid and liquid waste dumping areas. Meteorological and environmental conditions should be studied properly before selecting the site for residential areas in order to avoid air pollution problems.
   - Persons who are displaced or have lost agricultural lands as a result of locating the industries in the area, should be properly rehabilitated.
9. Transport Systems
   - Proper parking places should be provided for the trucks and other vehicles by the industries to avoid any congestion or blocking of roads.
   - Siting of industries on the highways should be avoided as it may add to more road accidents because of substantial increase in the movements of heavy vehicles and unauthorised shops and settlements coming up around the industrial complex.
   - Spillage of chemicals/substances on roads inside the plant may lead to accidents. Proper road safety signs both inside and outside the plant should be displayed for avoiding road accidents.

10. Recovery - reuse of waste products
    Efforts should be made to recycle or recover the waste materials to the extent possible. The treated liquid effluents can be conveniently and safely used for irrigation of lands, plants and fields for growing non-edible crops.
11. Vegetal Cover
    Industries should plant trees and ensure vegetal cover in their premises. his is particularly advisable for those industries having more than 10 acres of land.
12. Disaster Planning
    Proper disaster planning should be done to meet any emergency situation arising due to fire, explosion, sudden leakage of gas etc. Firefighting equipment and other safety appliances should be kept ready for use during disaster/emergency situation including natural calamities like earthquake/flood.
13. Environment Management Cell
    Each industry should identify within its setup a Department/Section/Cell with trained personnel to take up the model responsibility of environmental management as required for planning and implementation of the projects.

Rapid Environmental Impact Assessment:

If it is felt that the project is likely to cause some detrimental effects on the environment, it is subjected to Rapid Environmental Assessment which involves

1. Identification of the important impacts of the project on the environment.

2. Evaluation of the impact of the project on the locality or entire region.

3. Conducting cursory cast benefit analyses.

4. Listing of the issues which are unresolved and which need examination in detail.

Comprehensive Environmental Assessment:

Comprehensive Environmental Assessment is usually undertaken after the initial screening and Rapid Impact Assessment has been performed. The earlier work has already generated some information about the project and its likely impact on the environment and it is now a comprehensive study of the critical aspects of project which is taken-up in the Comprehensive Environmental Impact Assessment. It usually involves collection and evaluation of the following set of information.

1. Base-line data about the project, its description in detail along with the description of the existing environment.

2. Impact Identification.

3. Impact Prediction.

4. Evaluation of the impacts.

5. Mitigative measures and monitoring plans.

6. Informing the society and the decision makers.

1. Collection of Baseline Data:

The nature and the description of the project to be undertaken along with the details about the magnitude of activity which shall occur in the locality are the basic information's required for Comprehensive Impact Assessment. The condition of the locality and the description of existing environment in which the project has to come up are also necessary requisites for the impact assessment.

The description of the environment should include all its components such as atmosphere, hydrosphere, lithosphere and the biosphere. Comprehensive Impact Assessment has to conduct socio-economic surveys also among the human settlements located nearby.

Data on population densities, age and sex distribution, ethnic groups, education level, morbidity and mortality rates etc. are very valuable for the assessment of the impact of development activities on human society. So also are the descriptions of the community, life styles, the needs and problems of the people, likely productivity levels, unemployment figures, and means of livelihood etc. which are necessary to assess the socio-economic aspects of the project.

2. Impact Identification:

Impact identification attempts to answer the question, "What will happen when the project enters its operational stage?" A list of important impacts such as changes in ambient air quality, changes in water and soil qualities, noise levels, wild life habitats, species diversity, social and cultural systems, employment levels etc. may be prepared. The important sources of impact like smoke emission, consumption of water, discharge of effluents etc. are identified.

3. Impact Prediction:

Impact prediction examines the extent of changes which occur in the system due to the project activity. As far as possible, impact prediction scientifically quantities the effect and examines its secondary and synergistic consequences for the environment and local community. The impact is closely studied and evaluated for its subsequent effects on the components of the environment.

For example, the discharge of effluents in the local waters causes deterioration in the quality of water, its secondary effect is degeneration of fishereis which is followed by detrimental economic effect on the fishermen of the locality. With means of livelihood gone the fishermen may have to migrate to other localities or seek some other alternative for livelihood. This could cause a rise in the crime graph of the locality.

4. Impact Evaluation:

Impact evaluation attempts to answer the question, "Do the changes really matter?" This step evaluates the predicted adverse impacts to determine whether they are significant enough to warrant mitigation. If the project has to come up on inhospitable land with very little biological significant localities around and no human settlements or very sparsely populated areas a little deterioration of the environment may be permitted.

However, if the development activity is undertaken in biologically significant locality even minor detrimental impacts should be avoided. Either adequate mitigative efforts should be taken up or the project could be shifted to some other locality. The judgement of significance is usually based on

1. Comparison of predicted information with accepted standards.

2. Reference to pre-set criteria such as protected places, features or species.

3. Consultation with relevant decision makers.

5. Mitigative Measures and Monitoring Plans:

If the changes caused by the developmental activities are significant, the process of environmental impact assessment proceeds to examine ways and means to mitigate the adverse effects. A wide range of measures may be proposed to prevent, reduce, remedy or compensate each of the adverse impact evaluated as significant. The measures are critically examined for their effectiveness. The possible mitigative measures may include:

1. Introduction of pollution control measures, waste treatment, strict monitoring etc. to mitigate the adverse effects caused by the developmental activity.

2. Changing project sites, routes, processes, raw materials, operating methods, disposal routes or location or wastes and engineering design.

3. Offering restoration of damaged resources, money to affected people, concessions on other issues, improvement in the quality of life for the community etc.

All mitigation measures cost something. This cost should be estimated and added to the value of the product. If a number of mitigative measures are proposed the cost of each of

these measures should be estimated and compared. Environmental Impact Assessment should explicitly analyse implications of adopting different alternatives so as to make policy decisions easier. A thorough cost benefit analyses should be made to simplify the decision making process.

6. Informing the Society and Decision Makers:

Documentation and communication of the findings of the Environmental Impact Assessment to the relevant people also constitutes an important step of the impact assessment. Many technically sound Impact Assessment studies fail to exert their importance and impress the decision makers simply because of poor documentation.

The assessment can achieve its true purpose only if its findings are well documented and communicated to the policy-makers. For the effective communication one has to identify the target audience and then shape the report accordingly so that it becomes a meaningful document. For the purpose, Impact Assessment report may have to be written as a non-technical document as well, so that its contents are intelligible to non-technical administrators and general public while the technical document is studied by review committee and experts.

UNIT 5

Public participation is a political principle or practice, and may also be recognized as a right (right to public participation). The terms public participation, often called P2 by practitioners, is sometimes used interchangeably with the concept or practice of stakeholder engagement and/or popular participation.

Generally public participation seeks and facilitates the involvement of those potentially affected by or interested in a decision. This can be in relation to individuals, governments, institutions, companies or any other entities that affect public interests. The principle of public participation holds that those who are affected by a decision have a right to be involved in the decision-making process. Public participation implies that the public's contribution will influence the decision.

Public participation may be regarded as a way of empowerment and as vital part of democratic governance.

In the context of knowledge management the establishment of ongoing participatory processes is seen by some in the facilitator of collective intelligence and inclusiveness, shaped by the desire for the participation of the whole community or society.[2]

Public participation is part of “people centred” or "human centric" principles, which have emerged in Western culture over the last thirty years, and has had some bearings of education, business, public policy and international relief and development programs. Public participation is advanced by the humanist movements. Public participation may be advanced as part of a “people first” paradigm shift. In this respect public participation may challenge the concept that "big is better" and the logic of centralized hierarchies, advancing alternative concepts of “more heads are better than one” and arguing that public participation can sustain productive and durable change.

The role of public participation in economic and human development was enshrined in the 1990 African Charter for Popular Participation in Development and Transformation.

In 1990 practitioners desired the established of the International Association for Public Practitioners in order to respond to the increasing interest in the practice, and in turn established the International Association for Public Participation (IAP2). The practice is well established global and the International Association of Public Participation now has affiliate organizations across the globe.

OBJECTIVES OF PUBLIC PARTICIPATION DURING STAGES OF THE EIA PROCESS

Stage of EIA process	Objectives of public involvement
Screening	Identification of significant impacts
Scoping	• Identification of public's interest and values • Identification of priorities for assessment • Encouraging public understanding of the proposed project
Assessment	• The public can contribute local knowledge and values to the prediction, evaluation and mitigation of impacts • Improvement in quality and acceptability of EIA report
EIA Report Review	Public contribute to evaluation of quality and acceptability of report
Decision	Public comment on acceptability of project impacts
Monitoring	Public evaluate impacts that occur and support project environmental management process

PUBLIC POLICY

In some countries public participation has become a central principle of public policy making. In the UK it has been observed that all levels of government have started to build citizen and stakeholder engagement into their policy-making processes. This may involve large-scale consultations, focus group research, online discussion forums, or deliberative citizens' juries. There are many different public participation mechanisms,

although these often share common features (for a list over 100, and a typology of mechanisms.

PARTICIPATORY BUDGET

Participatory budgeting is a process of democratic deliberation and decision-making, in which ordinary city residents decide how to allocate part of a municipal or public budget. Participatory budgeting is usually characterized by several basic design features: identification of spending priorities by community members, election of budget delegates to represent different communities, facilitation and technical assistance by public employees, local and higher level assemblies to deliberate and vote on spending priorities, and the implementation of local direct-impact community projects.

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

In recent years public participation has become to be seen as a vital part of addressing environmental problems and bringing about sustainable development. In this context the limits of solely relying on technocratic bureaucratic monopoly of decision making, and it is argued that public participation allows governments to adopt policies and enact laws that are relevant to communities and take into account their needs. Public participation is recognised as an environmental principle, see Environmental Principles and Policies, and has been enshrined in the Rio Declaration.

PUBLIC PARTICIPATION IN ENVIRONMENTAL GOVERNANCE

With growing complexities of the environmental issues, public participation has come to the fore in academic analysis concerning the contemporary debates about environmental governance.

There have emerged a number of arguments in favour of a more participatory approach, which stress that public participation is a crucial element in environmental governance that contributes to better decision making. It is recognized that environmental problems cannot be solved by government alone. Participation in environmental decision-making effectively links the public to environmental governance. By involving the public, who are at the root of both causes and solutions of environmental problems, in environmental discussions, transparency and accountability are more likely to be achieved, thus secures the democratic legitimacy of decision-making that good environmental governance depends on. Arguably, a strong public participation in environmental governance could increase the commitment among stockholders, which strengthens the compliance and enforcement of environmental laws. GIS can provide a valuable tool for such work (see GIS and environmental governance). In addition, some opponents argue that the right to participate in environmental decision-making is a procedural right that “can be seen as part of the fundamental right to environmental protection”. From this ethical

perspective, environmental governance is expected to operate within a framework coinciding the "constitutional principle of fairness (inclusive of equality)", which inevitably requires the fulfillment of "environmental rights" and ultimately calls for the engagement of public. Further, in the context of considerable scientific uncertainties surrounding environmental issues, public participation helps to counter such uncertainties and bridges the gap between scientifically-defined environmental problems and the experiences and values of stakeholders. Through joint effort of the government and scientists in collaboration with the public, better governance of environment is expected to be achieved by making the most appropriate decision possible.

Although broad agreements exist, the notion of public participation in environmental decision-making has been subject to a sustained critique concerning the real outcome of participatory environmental governance. Critics argue that public participation tends to focus on reaching a consensus between actors who share the same values and seek the same outcomes. However, the uncertain nature of many of the environmental issues would undermine the validity of public participation, given that in many cases the actors come to the table of discussion hold very different perceptions of the problem and solution which are unlikely to be welded into a consensus due to the incommensurability of different positions.This may run the risk of expert bias, which generates further exclusion as those who are antagonistic to the consensus would be marginalised in the environmental decision-making process, which violates the assumed advantage of participatory approach to produce democratic environmental decisions. This raises the further question of whether consensus should be the measure of a successful outcome of participation. As Davies suggests, participative democracy could not guarantee the substantive environmental benefits ‘if there are competing views of what the environment should be like and what it is valuable for’. Consequently, who should be involved at what points in the process of environmental decision-making and what is the goal of this kind of participation become central to the debates on public participation as a key issue in environmental governance.

RIGHT TO PUBLIC PARTICIPATION

In some jurisdictions the right to public participation is enshrined by law. The right to public participation may also be conceived of as human right, or as manifestation of the right to freedom of association and freedom of assembly. As such the Netherlands, Germany, Denmark and Sweden, have public participation and freedom of information provisions in their legal systems since before the Middle Ages. Democracy and public participation are closely connected democratic societies have incorporated public participation rights into their laws for centuries. For example, in the US the right to petition has been part of the first Amendment of the US constitution since 1791. More recently, since the 1970s in New Zealand numerous laws (e.g.: health, local government, environmental management) require government officials to "consult" those

affected by a matter and take their views into consideration when making decisions. Effective public participation depends on the public having accessing to accurate and comprehensive information. Hence laws regarding public participation often deal with the issue of the right to know, access of information and freedom of information.

The right to participation may also be advanced in the context of equality and group rights, meant to ensure equal and full participation of a designated group in society. For example, in the context of disabled people.

RIO DECLARATION ON ENVIRONMENT AND DEVELOPMENT

The states that environmental issues are best handled with participation of all concerned citizens, at the relevant level. The Rio Declaration continues, drawing a close link between access to information and public participation:

At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.