UTTARAKHAND OPEN UNIVERSITY
Teenpani Bypass Road, Transport Nagar, Haldwani - 263 139
Phone No. : (05946) - 286002, 286022, 286001, 286000
Toll Free No. : 1800 180 4025
Fax No. : (05946) - 264232, email : <info@uou.ac.in>
http://www.uou.ac.in

EVS 603

Environmental Impact Assessment (EIA) and Environmental Auditing (EA)

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Department of Forestry and Environmental Science
School of Earth and Environmental Science

Uttarakhand Open University
Haldwani, Nainital (U.K.)

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Phone No. : (05946) - 286002, 286022, 286001, 286000

Toll Free No. : 1800 180 4025, Fax No. : (05946) - 264232,

e-mail: info@uou.ac.in, Website: http://www.uou.ac.in

Board of Studies

Programme Coordinator

Dr. H.C. Joshi
Department of Forestry and Environmental Science,
SoEES, Haldwani, Nainital (U.K.)

Editors

Dr. H.C. Joshi, Department of Forestry and Environmental Science, Uttarakhand Open University, Haldwani.
Dr. Beena Tewari Fulara, Department of Forestry and Environmental Science, Uttarakhand Open University, Haldwani.
Dr. Krishna Kumar Tamta, Department of Forestry and Environmental Science, Uttarakhand Open University, Haldwani.

Units Written by	Unit No.
Adapted from e-PG Pathshala, Paper No: 12 Environmental Management, Module : Introduction to EIA, **Module Id: EVS/EM-XIX/06** Unit writer : **Dr. Sunil Mitta**l Central University of Punjab, Bathinda	**1**
Dr. Beena Tewari, Fulara, Assistant Professor (AC), Department of Forestry and Environmental Science, SOEES, Uttarakhand Open University, Haldwani.	**2**
Dr. Beena Tewari, Fulara, Assistant Professor (AC), Department of Forestry and Environmental Science, SOEES, Uttarakhand Open University, Haldwani.	**3**
Dr. Krishna Kumar Tamta, Assistant Professor (AC), Department of Forestry and Environmental Science, SOEES, Uttarakhand Open University, Haldwani.	**4**
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Dr. Krishna Kumar Tamta, Assistant Professor (AC), Department of Forestry and Environmental Science, SOEES, Uttarakhand Open University, Haldwani	**11**
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Unit 1: Basic Concepts

Unit Structure

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1.1. Introduction
1.2. Origin and development of EIA
1.3. Definition of EIA
1.4. Purpose and aims of EIA
1.5. Methods to carry out EIA
1.6 Hierarchy in EIA
1.6.1 Site selection studies
1.6.2 Rapid or comprehensive studies
1.6.3 Regional studies
1.6.4 Carrying capacity studies
1.7. Types of EIA
1.7.1 Strategic environmental assessment
1.7.2 Regional EIA
1.7.3 Sectoral EIA
1.7.4 Project Level EIA
1.8. Dimensions / Steps in EIA

1.0. Learning Objectives

After studying this unit students will be able to learn:

- To learn about EIA
- Origin and development of EIA
- Methods of EIA
- Hierarchy and types of EIA

1.1. Introduction

The 20th century has been regarded as the century of revolutions and overall growth. The 20th century has witnessed highest population, industrial, agriculture growth etc. The increase in population at very rapid rates necessitated the

requirements of more resources especially basic requirements of food, cloth and housing. In order to sustain the fast increasing population, the major focus of all the governments throughout the world was to increase agriculture production, setting up of industries, construction of houses and other infrastructure facilities. During the initial phases of overall growth, no importance was given to the ecological imbalance and environmental destruction. This overall growth does not come solely as blessing but took many challenges for the future generations. The major challenges for the world population are health, environment, and safety. The increased pollution due to anthropogenic activities tend to increase the human concerns about the environment and sustainable living. The matter in the mid of 20th century was of major concern for most of the developed countries. Efforts were made by various International organizations like United Nations Environment Program (UNEP), United Nations Industrial Development Organization (UNIDO) through decelerations to make some policies to decease the load of infrastructure activities on the environment and emphasized on sustainable development. The developed countries made various policies in this regard and started the process of conducting Environment Impact Assessment studies. In consistent to developing nations, India also took various steps by various acts, notifications and policies. The process of evolution of EIA in various counties is enlisted chronologically in table-1.

1.2. Origin and development of EIA

EIA is a formal policy innovation for environmental conservation in many countries. The process of EIA first started in USA in the early 1970s with the implementation of the National Environment Policy Act (NEPA) 1969. The other developed or high-income countries like Australia, Canada, and New Zealand also followed the footsteps of US and formally started the EIA. This was followed by other countries as well, which started EIA relatively early - Columbia (1974), Philippines (1978).

This was further strengthened by the efforts of the World Bank which adopted EIA in 1989. The World Bank made it necessary to undertake an EIA under the Bank's supervision for all major development projects funded by them. The main strength came from the Rio Earth Summit (1992). After this the consolidation and international dissemination of environmental impact assessment was officially recognized as decision-making tool for sustainable development. The three documents of Rio viz. Principle 17, Article 14, and Agenda 21 played very important role for the consolidation of EIA.

The Principle 17 of the Rio Declaration on Environment and Development states that "Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority".

The Article 14 (titled Impact Assessment and Minimizing Adverse Impacts) of the Convention on Biological Diversity states that "Each Contracting Party, as far as possible and as appropriate, shall: (a) Introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures; (b) Introduce appropriate arrangements to ensure that the environmental consequences of its programs and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account". Fresh water resources" discusses about application of integrated approaches to the development, management and use of water resources though it started in late 20th century still it has been managed to be practiced in more than 100 countries. Briefly the evolution and history of EIA is discussed in table 1.

Table 1: Evolution and history of EIA

	Development of EIA
*Pre-1970	Project review based on the technical/engineering andeconomic analysis Limited consideration given to environmental consequences
*Early/mid – 1970s	EIA introduced by NEPA in 1970 in US Basic principle: Guidelines, procedures including public participation requirement instituted Standard methodologies for impact analysis developed (e.g. matrix, checklist and network). Canada, Australia and New Zealand became the first countries to follow NEPA in 1973-1974. Unlike Australia, which legislated EIA, Canada and New Zealand established administrative procedures Major public inquires help shape the process's development
1970	Introduced in China
*Late 1970 and early 1980s	More formalized guidance Other industrial and developing countries introduced formal EIA requirements (France, 1976; Philippines, 1977), began to use the process informally or experimentally (Netherlands, 1978) or adopted elements, such as impact statements or reports, as part of development applications for planning permission (German states [lander], Ireland) Use of EA by developing countries (Brazil, Philippines, China, Indonesia) Strategic Environment Assessment (SEA), risk analysis included in EA processes Greater emphasis on ecological modeling, prediction and evaluation methods Provision for public involvement. Coordination of EA with land use planning processes
1974	In Malaysia, Environmental Quality Act
*Mid 1980s to end of decade	In Europe, EC Directive on EIA establishes basic principle and procedural requirements for all member states Increasing efforts to address cumulative effects. World Bank and other leading international aid agencies establish EA requirements Spread of EIA process in Asia
*1990s	Requirement to consider trans-boundary effects under Espoo convention Increased use of GIS and other information technologies Sustainability principal and global issues receive increased attention, India also adopted the EIA formally Formulation of EA legislation by many developing countries Rapid growth in EA training
1994	In India, Union Ministry of Environment and Forests (MoEF), formulated EIA notification under EPA Act 1986
1997	Environment Protection Act in Nepal
1997	Environmental Impact Assessment Ordinance in Hong Cong
1998	In Sri Lanka, The National Environmental Act
2004	In Russia, state authority responsible for conducting the State EIA in Russia
2006	In India, Ministry of Environment and Forests (MoEF) occurred major amendments in 1994 Rules
2012	Canadian Environmental Assessment Act
2015	Introduced the Federal Permitting Improvement Act for improvement of NEPA

*Source: International Study of the Effectiveness of Environmental Assessment, final report, Environmental assessment in a changing world, prepared by Barry Sadler, June1996

1.3. Definition of EIA

The International Association for Impact Assessment (IAIA) has defined 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"

Environmental Impact Assessment is a stepwise process of identification, evaluation, monitoring and management of the potential impacts of proposed projects on the environment of the local area. By doing so it provides opportunities to minimize proposed environmental The main purpose of EIA is to provide information regarding the impacts of project on environmental, ecological, cultural, social and economic components of project area to the decision makers for decision making and policy transformation. It works on the principle of sustainable development i.e. to ensure that no or minimum environmental degradation is caused due to proposed project. It also takes into account the short term, midterm and long term effects on the demography, ecology and environment of the area. In simple words, EIA is a planning tool for decision making regarding the starting or denying of proposed project based on the measurable environmental and social impact of the proposed activity.

1.4. Purpose and aims of EIA

The basic objectives of EIA are to

- Consider environmental factors in the decision-making process of any project
- Identify potential environmental, social and economic impacts of proposed activities
- Take steps at initial stages to minimize adverse environmental impacts
- Promote sustainable development through environmental management plan by either alternatives or mitigation measures.

- Public participation in the decision making of the establishment of proposed activity

1.5. Methods to carry out EIA

The methods available to carry out EIAs can be divided into General and industry specific assessment methods as described below:

a) Industrial products- To identify and measure the impact of industrial products on the environment, the method used is Product environmental life cycle analysis (LCA). The method assesses the environmental impacts associated with all the stages of a product's life from raw material extraction to its final disposal or recycling. The impact assessment objectives of LCAs take into consideration of environmental concerns by:

- Making an inventory of inputs in terms of raw materials, natural resources and energy and release of pollutants in environment
- Evaluate the environmental impacts associated with identified inputs and releases
- Interpreting the results to help make decision

Types of LCA

Cradle to Gate: considers raw materials to finished goods but does not consider its use or end life

Cradle to Grave: Considers from harvesting of materials to final disposal of finished goods

b) Genetically modified plants - The development of genetically modified plants (GMP) require strict assessment of safety and potential impact on the crops on the environment, human or animal health, in comparison to its parental or reference crop. GMP-RAM and INOVA are some specific methods for EIA of genetically modified organisms. The "GMP-RAM" is an electronic tool (software) for the evaluation of safety and potential risks related to the use of genetically modified plants. The use of this software provides atransparent process for risk assessment.

Similarly, INOVA-tec System is used for Impact Assessment of Technological Innovation.

(C) Fuzzy Logic: There are many environmental impacts which cannot be quantified and in order to measure data to estimate values of such impact indicators information from similar EIAs, community sentiment and expert judgment are used. The approximate reasoning methods used are called fuzzy logic. For example landscape quality, lifestyle quality, social acceptance etc.

1.6 Hierarchy in EIA

The EIA studies are mainly categorized as:

1.6.1 Site selection studies

These studies focuses on the selection of alternative sites keeping in view of the environmental benefits and project attributes such as infrastructure facilities, markets, availability of raw materials, etc. The objective of such studies is the ranking of site alternatives for decision-making.

1.6.2 Rapid or comprehensive studies

When the assessment period for the baseline data is one season monitoring (i.e. 3- month period), it is called Rapid EIA. Rapid EIA is conducted when a fair amount of knowledge is available about the proposed site or the impacts of the proposed development. The rapid EIA also makes a base for the comprehensive EIA. However, When the assessment of baseline data is based on 3 seasons monitoring (i.e. 9- month period), it is called comprehensive EIA.

1.6.3 Regional studies

As the name indicates, these relate to a particular region. The studies are based on seasonal data collection and analysis of air, water and land components of the environment.

1.6.4 Carrying capacity studies

The natural resources are not infinite and are depleted at a fast pace to support the infrastructure and development activities. To achieve the objective of sustainable development, optimization of natural resources use is must. This can be achieved by considering environmental policies in the development process. Hence, carrying capacity studies are conducted to analyze the resource availability/ utilization, infrastructure/congestion, supply/demand ratio and assimilative capacity/residuals. It has often been observed that one or more natural resource(s) becomes a limiting resource in a given region thereby restrict the development activity. In the last few decades, governments of various countries have realized that EIA has to be an integral part of the project life cycle: from project conceptualization to post implementation corrective action. The Ministry of Environment, Forests and Climate change, Govt. of India, has also sponsored Carrying Capacity Studies for different regions. The studies involve:

- Inventorisation of the natural resources available
- Preparation of the existing environmental settings
- Perspective plans and their impact on natural resources through creation of "Business As Usual Scenario"
- Identification of "Hot Spots" requiring immediate remedial action to overcome air, water or land pollution
- Formulation of alternative development scenarios including a Preferred Scenarios

1.7. Types of EIA

Environmental assessment has been classified into four types:

1.7.1 Strategic environmental assessment

Strategic Environmental Assessment (SEA) is the analysis of environmental effects of developmental policies, plans and programmes. The purpose of SEA is to assist in sound environmental decision making by improvement over the

Environmental Impact Assessment (EIA). SEA represents a proactive approach for integrating socioeconomic values with the environmentally viable development for higher levels of decision-making. Currently there are no government guidelines for SEA in India as it is not legally recognized here. However, due to rapid increase in infrastructure and developmental activities, there is great pressure on natural resources and environment. Hence, thus there is a need for evolving SEA in India.

1.7.2 Regional EIA

EIA in this context is focused on regional planning. It integrates the environmental and economic concerns of particular region due to its development planning. This approach is also referred as economic-cum-environmental (EcE) development planning. This approach allows economic management of renewable natural resources without compromising the environment.

1.7.3 Sectoral EIA

It refers to EIA in specific sectors like mining, airports, townships, nuclear power plants, thermal power etc. It helps in addressing specific environmental problems encountered in planning and implementing sectoral development projects. The benefit of sectoral EIA is that all the environmental, social and economic impacts of same type of sector are nearly similar and hence can play important role in better planning and decision making.

In India, the Ministry of Environment & Forests has prepared 37 EIA Manuals on major sectors of developmental projects which are listed in the Schedule to the Environmental Impact Assessment (EIA) Notification 2006. These Manuals have been prepared to serve as

Technical Guidance Manuals (TGMs) to various stakeholders involved in the environmental clearance (EC) process. The Manual for each sector includes a Model Term of Reference, technological options, processes for cleaner production, waste minimization, monitoring of environmental quality, and related regulations and procedure of obtaining EC. The Ministry assigned the work of

preparation of Sectoral Manuals to two institutions, namely ASCI (prepared 10) and IL& FSS Ecosmart Ltd (prepared 27).

1.7.4 Project Level EIA

It refers to the environmental impacts of developmental activity in isolation. It specifically targets only one developmental activity and does not effectively integrate the cumulative effects of development in the region.

1.8. Dimensions / Steps in EIA

The EIA process involves a number of steps, some of which are listed below:

i. Screening: The projects are 1st screened to know whether the project requires EIA. If yes, then under what category it falls as per norms of the respective regulatory agencies.

ii. Scoping: Identification of the key issues to be addressed in an EIA. This step involves the identification of major and significant environmental issues among the possible impacts of the project and available alternatives to minimize the environmental impacts.

iii. Alternative Considerations: The purpose is to ensure that the project proponent has explored other feasibilities and alternatives. These may be location of project, layouts, operating condition, techniques etc.

iv. Project development Plan: This step involves the description of project like its rationale, stages of development, location, processes, techniques to be used, project cost, development timeline etc.

v. Environmental baseline data collection: This involves the present state of the environment (air, water, soil, biodiversity, energy etc.) before implementation of the project. The objective of baseline data collection are to (i) understand the current environmental conditions of the area and how the project can be implemented under these conditions (ii) it helps in the prediction and

assessment of possible environmental changes that could occur during or after project implementation.

Baseline data includes-

a. Physical- Geographical and geological characteristics, topography etc.

b. Quality of air, water, noise, soil etc.

c. Biodiversity of the area, types of flora and fauna, ecosystem types

d. Socioeconomic- social structure, economic conditions, demography, migration of locals, etc.

e. Cultural- culture, tradition, religion, customs of locals

vi. Identification and prediction of key impacts: Based on the baseline data and scoping, the potentially significant impacts (adverse and beneficial) on environment of the area are identified for project during the development phase and after completion. The magnitude of the identified impacts is predicted by comparing the environmental conditions of base line data with the expected conditions after project implementation.

vii. Mitigation and Management of Environmental impacts: This involves the proposal of different measures to be taken to reduce, manage, remediate or compensate for adverse impacts.

viii. Public hearing/consultation: Public hearing is also part of EIA in some type of projects. The purpose of public participation is to inform the public about the proposed project and its impacts on the local area. The public views or objections are integral part of the decision making process.

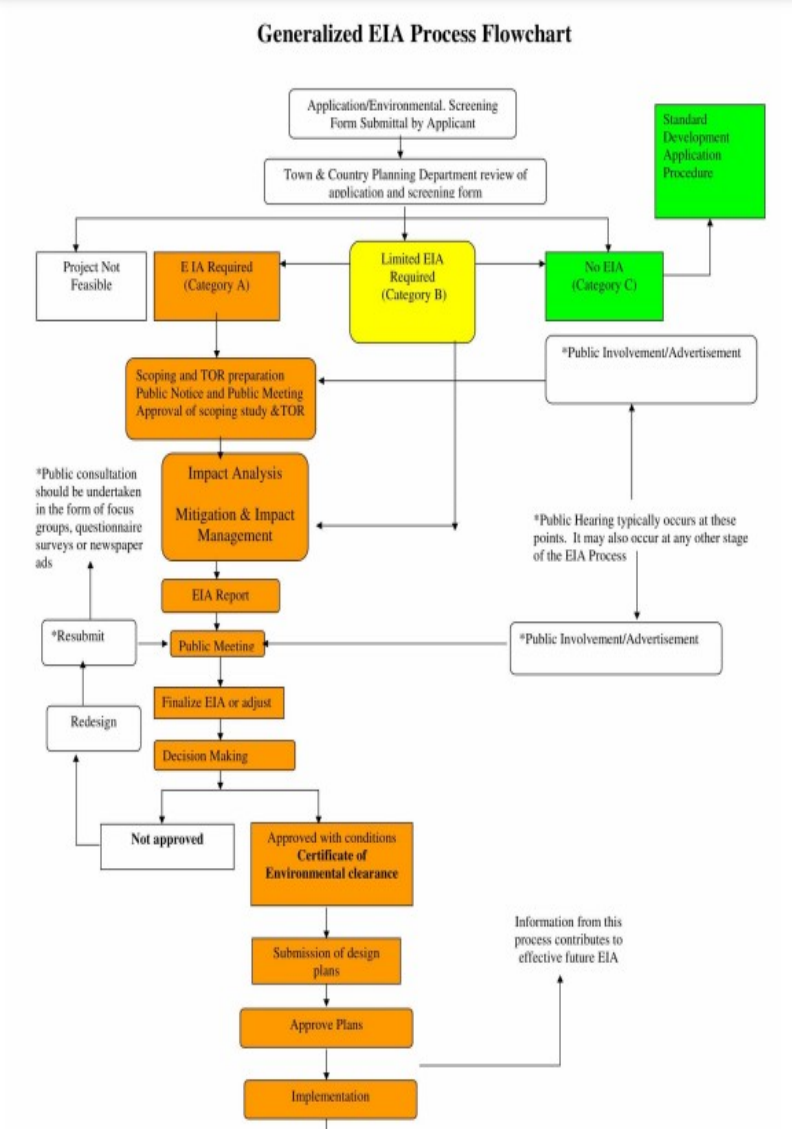
ix. EIA presentation and Decision-making: The report submitted by the Environment consultant on behalf of the project proponent is scrutinized for various documents as per EIA manuals/ laws. Any document deficiency is completed before submitting the report to regulatory/designated authorities for the purpose. The facts of the project starting from the screening to public hearing are presented before the experts. The experts may suggest additional measures to

minimize the impacts. At this stage decisions are made by the relevant authority to whether to accept, defer or reject the project.

x. Post-decision monitoring: This comes into picture after completion of the project. The outcomes of projects after completion are recorded. These represent the actual impacts of the project.

xi. Auditing: This involves comparing actual outcomes with predicted outcomes. This can be used to assess the quality of predictions and the effectiveness of mitigation.

Figure 1: Generalized EIA Process Flowchart



1.9. Advantages of EIA

The main advantages and benefits of EIA are:

- Improved project design
- Reduced cost and time of project implementation
- More informed decision-making
- Increased project acceptance
- More environmentally sensitive decisions
- Improved project performance and reduction in treatment/clean up costs.
- Increased accountability and transparency during the development process
- Improved integration of projects into their environmental and social setting
- Healthier local environment (forests, water sources, agricultural potential, recreational potential, aesthetic values, and clean living in urban areas)
- Reduced environmental damage
- More effective projects in terms of meeting their financial and/or socio-economic objectives.

1.10. EIA in India

- The foundation of EIA in India was first laid in 1976-77. The Planning Commission instructed the Department of Science and Technology (DST) to examine the river- valley projects from an environmental angle. However, this was informal and inactive.
- The first consolidated step for EIA was EIA notification 1994 by Union Ministry of Environment and Forests (MoEF), Government of India, under EPA Act 1986.
- The notification made the Environmental Clearance (EC) mandatory for any modernization activity or setting up new projects. Further, depending on the need and to strengthen the EIA process, EIA notification 1994 was amended almost 13 times in 11 years. The major amendments came in the year 1997, 2000, 2002, 2003 and 2005 (discussed in detail in latter chapters).
- The EIA notification has been amended several times and latest notification was published in 2006. The EIA notification 2006 has been again amended several times.

Unit 2: Components of EIA Process

Unit Structure

2.0. Learning Objectives
2.1. Introduction
2.2. Components of an Environmental Impact Assessment (EIA)
- **2.1.1. Air Environment**
- **2.1.2. Noise Environment**
- **2.1.3. Water Environment**
- **2.1.4. Biological Environment**
- **2.1.5. Land Environment**
- **2.1.6. Socio-economic and Health Environment**
- **2.1.7. EIA Risk Assessment**

2.2. Fundamental components of EIA
2.3. Potential impacts of a project
- **2.3.1. Impact Identification**
- **2.3.2. Impact Prediction**
- **2.3.3. Impact Evaluation**

2.4. Prediction and Mitigation
2.5. Management and monitoring
2.6. Auditing
2.7. Public participation
2.9. Managing uncertainty
2.10. Environment Management Plan
2.11. Importance of EIA
2.12. Conclusion

2.0. Learning Objectives

After studying this unit, you are able to understand about:

- Basic Components of Environmental Impact assessment
- Fundamental Components of Environmental Impact assessment
- Importance of EIA

2.1. Introduction

The overall purpose of an EIA is to identify any potential negative impacts on the environment, community, or health that may result from a proposed development. By doing this, individuals responsible for planning and executing the project can

be better informed and held more accountable for their actions. It should be a transparent and informed decision-making process that avoids, reduces, and mitigates potential negative consequences while also considering alternative methods and solutions.

2.2. Components of an Environmental Impact Assessment (EIA)

2.1.1. Air Environment

- Locating the effect zone (using a screening model) and setting up a monitoring system
- Monitoring the existing level of ambient air quality within the vicinity of the proposed project site (7-10 km from the periphery).
- Monitoring site-specific meteorological information such wind direction and speed, humidity, temperature, and environmental lapse rate.
- The planned project's air emissions, including fugitive emissions, are quantified.
- Identifying, analyzing, and quantifying any additional pollutants that may be present in the impact zone, such as emissions from transportation, as well as calculating the total amount of emissions and affects.
- Predict variations in ambient air quality brought on by emissions from point, line, and area sources using the relevant air quality models.
- Evaluation of the proposed pollution control devices' ability to adhere to criteria for gaseous emissions and air quality.

2.1.2. Noise Environment

- Monitoring current noise levels in the impact zone, as well as forecasting future noise levels as a result of the proposed project and related activities, such as increased automobile traffic.
- Determination of the environmental effects of any predicted increase in noise levels.
- Recommendations for noise pollution mitigating measures.

2.1.3. Water Environment

- Quantitative and qualitative assessment of current ground and surface water resources within the proposed project's effect zone.
- Prediction of water resource impacts as a result of the project's proposed water use/pumping
- Quantification and classification of wastewater from the proposed activity, including harmful organic waste.
- An assessment of the proposed pollution prevention and wastewater treatment system, as well as suggestions for changes if necessary.
- Using appropriate mathematical/simulation models, predict the effects of effluent discharge on the quality of the receiving water body.
- Assessment of the viability of water recycling and reuse, as well as the development of a thorough plan.

2.1.4. Biological Environment

- Survey of flora and fauna clearly outlining season and duration.
- An assessment of the flora and fauna found within the project's effect zone.
- Assessment of potential harm to terrestrial and aquatic flora and fauna as a result of the project's effluent discharge and gaseous emissions.
- Assessment of damage to terrestrial flora and fauna caused by air pollution, as well as changes in land use and landscape.

2.1.5. Land Environment

- Within the impact zone, studies on soil properties, existing land use and topography, landscape, and drainage patterns are being conducted.
- Assessment of the project's impacts on land use, landscape, topography, drainage, and hydrology.
- Determining the significant potential of treated effluent for land application and the consequences.

- Estimation and characterization of solid wastes, as well as the identification of management alternatives for waste minimization and environmentally friendly disposal.

2.1.6. Socio-economic and Health Environment

- Data on demographics and relevant socioeconomic factors are gathered.
- Epidemiological data collection, including research on endemic diseases (e.g., fluorosis, malaria, filaria, malnutrition) and morbidity rates among the population inside the impact zone.
- Projection of expected changes in socioeconomic and health outcomes as a result of the project and related activities, such as traffic congestion, and identification of mitigation strategies.
- Evaluation of the impact on important historical, cultural, and archaeological sites and locations in the area.
- Evaluation of the project's economic benefits.
- Evaluation of rehabilitation needs, with a focus on any planned areas, if any.

2.1.7. EIA Risk Assessment

- Using hazard indices, inventory analysis, dam break probability, Natural Hazard Probability, and other methods, identify hazards.
- An examination of the Maximum Credible Accident (MCA) to identify potentially dangerous circumstances
- Consequence analysis of failures and incidents that result in fires, explosions, hazardous discharges, and dam breaks, among other things.
- HAZOP (Hazard and Operability) studies.
- Risk assessment based on the preceding evaluations
- Planning an onsite and offsite event (project affected area) Strategy for Disaster Management.

2.2. Fundamental components of EIA

- **Screening** is the process of figuring out whether developments or initiatives demand either a complete or partial impact assessment study.
- **Scoping** is the process of determining which potential impacts are pertinent to evaluate (based on statutory requirements, international conventions, expert knowledge, and public involvement), identifying alternative solutions that avoid, mitigate, or make up for negative impacts on biodiversity, and ultimately determining the terms of reference for the impact assessment;
- **To forecast and identify the likely environmental effects of a planned project or development**, including the thorough formulation of alternatives, assessment and evaluation of impacts and development of alternative options are utilized.
- **Publishing an environmental management plan (EMP)** and a non-technical summary for a general audience in the environmental impact statement (EIS) or EIA report.
- **A review of the Environmental Impact Statement (EIS),** depending on the scope of the project and input from the general public and authorities.
- Determining whether to approve the project and under what circumstances;
- **Environmental audits, compliance, enforcement, and monitoring.** As stated in the EMP, keep an eye on whether the anticipated effects and suggested mitigation actions materialize. Verify the proponent's adherence to the EMP to make sure that unexpected effects or unsuccessful mitigation measures are discovered and dealt with right away.

2.3. Potential impacts of a project

To identify the potential impacts of a project, impact identification, Impact predictions and evaluation are main factors.

Impact *identification:* The process of impact identification aims to identify and account for all potentially important consequences during the EIA process.

Impact *prediction:* Impact prediction is a method used to gauge probable effects' size and serves as the foundation for determining their significance.

Impact *evaluation:* The process of impact evaluation aids in determining the relative importance of impacts.

2.3.1. Impact Identification

A number of 'tools' are available to assist in impact identification. The simplest, and most frequently used, are *checklists* of impacts, although *matrices*, *network diagrams* and *map overlays* are also commonly used. More complex tools, such as mathematical modeling and the use of GIS systems, may also be used in certain circumstances.

Checklists

Simple checklists - the simplest types of checklists provide lists of potential impacts. These are designed to help practitioners to avoid overlooking potential impacts.

Box 4.1 Part of a Simple Checklist

Effects on human beings, buildings and man-made features

- Population changes arising from the development, and consequential environment effects;
- Visual effects of the development on the surrounding area and landscape;
- Levels and effects of emissions from the development during normal operations;
- Levels and effects of noise from the development;
- Effects on the development on local roads and transport;
- Effects of the development on architectural and historic heritage and archaeological features.

Effects on flora, fauna and geology

- Loss of, and damage to, habitats and plant and animal species
- Loss of, and damage to geological, palaeontological and physiographic features.
- Other ecological consequences

Effects on land

- Physical effects of the development
- Effects of chemical emissions and deposits on soil of site and surrounding land

Adapted from DoE 1989

Descriptive Checklists - these provide guidance on how to assess impacts. They can include information on predictive techniques, data collection and locating information sources. Anexample of a descriptive checklist is given in Box 4.2.

Box 4.2 Part of a Descriptive Checklist

Data Required	*Information Source, Predictive Techniques*
Nuisance	
• Change in occurrence of odour, smoke, haze, *etc.*, and number of people affected.	• Expected industrial processes and traffic volumes, citizen surveys.
Water quality	
• For each body of water, changes in water use, and number of people affected.	• Current water quality, current and expected effluent.
Noise	
• Change in noise levels, frequency of occurrence, and number of people bothered.	• Current noise levels, change in traffic or other noise sources, changes in noise mitigation measures, noise propagation model, citizen surveys.

Adapted from Schaenman, 1976, cited by Glasson et al., 1995.

Questionnaire checklists - these are based on a set of questions, some of which might explore indirect impacts and possible mitigation measures. Box 4.3 is an example of part of aquestionnaire checklist.

Box 4.3 Example of a Questionnaire Checklist

Disease vectors

- Are there known disease problems in the project area transmitted through vector species such as mosquitoes, flies, snails, etc.? (yes, no, or not known)
- Are these vector species associated with:
  - ◊ aquatic habitat? (yes, no, not known)
  - ◊ forest habitats? (yes, no, not known)
  - ◊ agricultural habitats? (yes, no, not known)
- Will the project provide opportunities for vector control through improved standards of living? (yes, no, not known).

Adapted from Glasson et al., 1995.

Matrices

Matrices are another commonly used tool for impact identification. They show environmental components (e.g. species diversity, water quality) on one axis and development actions (e.g. clearing land, construction, and operation) on the other. The entries in the cell of the matrix can either be qualitative or quantitative estimates of impact.

Matrices are useful for the following reasons:

- They visually describe the relationship between two sets of factors;
- They can be expanded or contracted to meet the needs of the proposal being assessed;
- They can help to identify the impacts of different phases of a project, such as duringconstruction, operation and after abandonment; and
- They can help separate site-specific impacts from impacts affecting the region as a whole; however, it is generally advisable to describe different aspects of a proposal using separate matrices.An example of a simple matrix is shown in Box 4.4.

Box 4.4 Simple matrix showing project activities with identified impact on the Pangani Falls Re-development Project

Activity	*Impacts*
• Land clearance, bulldozing	• visual intrusion, acceleration of run-off, dust, noise, diesel fumes, soil erosion, soil compaction, exposure of sub-soil, silt to river, destruction of vegetation.
• Stone crushing	• dust, noise, soil erosion, silt and stones to river, lethal hazard to workers
• Traffic	• oily waste run-off, noise, hazard to pedestrians and animals, dust to roadside
• Impoundment of the headpoint	• inundation of swamp, loss of wetland vegetation, loss of habitat for wildlife especially passerine birds; desiccation of the riverbed between the headrace and tailrace, alteration of the aquatic and riparian ecology, scoring of riverbed downstream - changing the environment for aquatic life
• Road making, trenching	• noise, visual intrusion, dust, fumes, hard surfacing causing alteration of drainage, acceleration of run-off and reduced infiltration, soil erosion, soil compaction, exposure of sub-soil, silt to river, contamination of groundwater.

Source TANESCO, 1994

Network Diagrams

A network diagram visually describes the linkages between pairs of environmental factors, providing some indication of how an ecosystem functions. These types of methods are referredto in several ways within the EIA practice; for example, as *impact trees, impact chains, cause-effect diagrams, or consequence diagrams.* Networks are useful for showing primary, secondary, and tertiary impact-relationships resulting from particular actions.

Different levels of information can be displayed in a network diagram. Various arrow widths or weights can be used to indicate the relative dependence of one factor on the condition of another. Negative and positive feedback loops can also be identified if the nature of the interrelationship (e.g. directly or inversely proportional) is indicated.

Networks have limitations:

- They may be an oversimplification of reality unless relationships among individualecosystem components are adequately understood;
- Individual ecosystem or social system elements may not be easily recognized or found in the diagram, especially as the level of detail increases;
- Like checklists and matrices, networks cannot describe temporal aspects of ecosystemdynamics;
- They are very time-consuming and difficult to construct, although once in place theyform a fundamental reference guide for future project planning.

An example of a network diagram (UNEP 1996) is shown on the next page.

Map Overlays

Map overlays provide an effective visual aid, and are useful for describing existing physical, social and economic conditions and displaying the potential changes resulting from a proposed development. They are also very easy to use and understand. Overlays are particularly useful when addressing questions of site and

route selection. The method uses maps on transparencies, showing environmental and social characteristics and impacts. These can then be superimposedto provide a clear visual characterization of where impacts are likely to occur. The use of different intensities of shading can be used to depict the significance or magnitude of impacts to add further utility. The development of computer mapping, and in particular GIS, allows more information to be shown and manipulated. There are some limitations to map overlays and theseare shown in Box 4.5.

Box 4.5 Some constraints of map

- maps tend to over-simplify; maps of large scale may be needed to capture some relationship; such detailed maps may not be available;
- specific interrelationships between environmental factors are not readilyobtainable using traditional map overlays;

Geographical Information Systems (GIS)

In the strictest sense, any organized system for the management and manipulation of spatial information may be regarded as constituting a GIS. However, the term GIS is generally used to refer to a computer-based system incorporating the collection, storage, retrieval, transformationand display of spatial data.

GIS applications can bring the following benefits to impact assessment practice:

- they offer the potential for storing and accessing large data sets;
- they can consolidate data from many different sources for use in geographic analysis;
- GIS is efficient at performing multiple map overlays;
- GIS can be used to generate maps for output to hard copy as well as display map information on screen.

Limitations of GIS in EIA:

- Most GISs are expensive and require highly trained personnel for efficient operation ofthe system
- GISs are not specifically structured for EIA
- Digital data is costly and often difficult to acquire

Method	*Advantages*	*Disadvantages*
Simple checklist	• Simple to understand and use	• Do not distinguish between direct and indirect impacts
Matrices	• Link action to impact • Good method for displayingEIA results	• Difficult to distinguish between direct and indirect impacts • Significant potential for double-counting of impacts
Networks	• Link action to impact • Useful in simplified form for checking for second order impacts • Handles direct and indirect impacts	• Can become very complex if used beyond simplified version
Overlays	• Easy to understand • Good display method • Good sitting tool	• Address only direct impacts • Do not address impact duration or probability
GIS	• Excellent for impact identification and analysis • Good for experimenting	• Heavy reliance on knowledge and data • Often complex and expensive

2.3.2. Impact Prediction

The objective of prediction is to estimate the magnitude, extent and duration of the impact in comparison with the situation without that project/action. An environmental impact predictionshould, at minimum, perform the following:

- Determine the initial reference or baseline state.
- Forecast the future state/conditions with and without the project.
- Compare with environmental standards and guidelines where appropriate.

Impact Magnitude

Impact magnitude relates to the severity of the impact, whether the impact is irreversible or reversible, and the potential rate of recovery from the impact. For

instance, the magnitude of the impact is considered high if a major adverse impact is cannot be mitigated. A major adverse impact would affect the potential subsistence/recreational/commercial use of biophysical resources, with the result that the value of resources would be reduced far below the publicly acceptable level. Moderate to minor unmitigated impact of a similar nature will result in resources being still usable but at some inconvenience to the public.

Extent of Impact

It is always important to determine the impact's geographical reach or impact zone. An impact may be local or restricted to the project area, regional or national in scope, or site-specific or restricted to the project area. Local impacts may only occur within the proposed project's watershed.

Impact Duration

An EIA must take into account the time aspect of environmental consequences. Impacts that happen at various stages of the project cycle may need to be taken into account. Short-term impacts are those that typically last for no more than three years after project beginning. A medium-term influence is one that lasts for 10 years or longer but less than 20 years, and a long-term impact is one that lasts for more than 20 years. The affects created during a project's building phase are typically of a temporary nature.

Methods

There are many potential methods to predict impacts, some being more holistic than others. One of the most obvious, useful and effective means of prediction is simply by drawing upon expert knowledge. But for some impacts, more sophisticated tools may be required. Box 4.6 provides some examples (note some of these methods overlap with those used for identifying impacts. Use of highly technical techniques, or those that require large amounts of high quality data, are often unsuitable for impact assessment. In reality, many predictions tend to be

qualitative, based on informed expert judgment and consultation, rather than empirical.

Mathematical Modeling

Mathematical models generally incorporate detailed mathematical representations of key processes and interactions present in the system under study. In most cases, these models are used to describe and/or forecast changes in properties of the system over a period of time. Mathematical modeling is particularly used in predicting impacts related to water and air pollution. For example, in the case of water, the types of mathematical models available include:

- Downstream dispersion of pollutants
- Heated effluents
- Water quality
- Dissolved Oxygen Demand (DOD)
- Biological Oxygen Demand (BOD)
- Reservoir quality

Models cannot be expected to provide good results without high quality inputs. For example, water quality modeling not only requires reliable data on seasonal water flows, but also physical information, model development time and model validation. Once modeling results are available, they must be interpreted to determine their environmental significance.

Criteria for significance include:

- The impact's size, likelihood, and geographic and temporal reach;
- The likelihood of the harmed environment recovering to some extent;
- The environment's worth in the area affected;
- The degree of public interest; and
- The political fallout.

Box 4.6 Some examples of impact prediction techniques

Simple Techniques

- Analogs (case studies of similar actions)
- Inventory of resources in study area (could use GIS)
- Checklists (simple, questionnaire, descriptive)
- Matrices (simple, stepped) or networks (impact trees, cause/effect or consequencediagrams)

Indices and Experimental Methods

- Environmental media indices (air, surface and/or ground water quality orvulnerability, land or soil quality, noise)
- Habitat indices or biological diversity indices
- Other indices (visual, quality of life)
- Experimental methods (laboratory, field, physical models)

Mathematical Models

- Air quality dispersion
- Hydrologic processes
- Surface and ground water quality and quantity
- Expert systems
- Noise propagation

Other approaches

- Biological impact (Habitat Evaluation System (HES), Wetland Evaluation Technique (WET)
- Ecological and health-based risk assessment

Source: Canter and Sadler, 1997

Importance of impact significance

Evaluating the significance of environmental impacts is one of the most critical components ofimpact assessment. The interpretation of significance bears directly on project approvals and condition setting. At an early stage, it also enters into screening and scoping decisions on whatlevel of assessment is required and which impacts and issues will be addressed. Subsequently,impact significance provides the key to selecting alternatives. In sum, the attribution of significance continues throughout the EIA process, from scoping to EIS review, in a graduallynarrowing 'cone of resolution' in which one stage sets up the next.

More than other components, however, the interpretation of significance is a contentious process. Impacts that might be considered significant to one part of the community, may be considered unimportant by another. Moreover, significance varies according to the level at which it is judged. What may be considered significant at the local level may vary between different groups (see example in Box 4.7). Similar differences in perceptions of significance will be found between groups or institutions operating at local, regional, national and international levels.

Box 4.7 Significance to different groups, and at different levels

The loss of a small wetland used for fishing and dry season may be considered highly 'significant' by fisher folk and pastoralists, but may not be viewed as important by localfarmers.

Likewise, whilst the wetland might be considered important at the local level for grazing,watering or fish supply, it may be considered less significant at the national and international level, perhaps because of its small size, or lack of rare biodiversity.

This will be evident, for example, at the screening and scoping stages where value judgments and interpretations are made about whether, and to what extent, a proposal is environmentally significant. During the more detailed phase of impact analysis, determining whether impacts aresignificant and acceptable involves both prediction and estimation of nature, magnitude, timingand duration as well as the attribution of importance or value to these findings.

Considerations in evaluating significance

Like impact prediction, various tools to assist the evaluation of impact significance are available. Some are highly technical and context specific, whilst others are much morequalitative and holistic.

Some good practice principles for determining impact significance are as follows:

- use a systematic approach;
- apply criteria that are rational, defensible and problem-relevant;

- identify the basis on which judgments are made;
- distinguish between the ecological and social importance of impacts;
- describe the confidence levels that underlie the attribution of significance; and
- Provide a straightforward, non-technical explanation of the approach adopted.

Impacts are likely to be significant if they:

- Are extensive over space and time;
- Are intensive in concentration or proportion to assimilative capacity;
- Exceed environmental standards or thresholds (see box below)
- Do not comply with environmental policies, land use plans, sustainability strategy;
- Adversely and seriously affect ecologically sensitive areas;
- Adversely and seriously affect heritage resources, other land uses, communities and/orindigenous peoples, traditions and values.

Using Environmental Standards

One way of evaluating significance is to compare expected impact levels with existing standards. Environmental standards provide guidance to decision-makers and practitioners on the minimum acceptable levels to which a proposed project should adhere. They also provide a quantifiable measure for use in the review process. Many countries do not have their own standards, and compiling them can be a time consuming and extremely costly process. In the meantime, internationally agreed standards such as the World Health Organisation standards (Box 4.8).

2.4. Prediction and Mitigation

Prediction work can begin once the scoping exercise is completed and the major impacts to be studied have been identified. This is the most important stage of an EIA. Several major options are likely to have been proposed during or before the scoping stage, and each option may necessitate separate prediction studies. Realistic and affordable mitigation strategies cannot be recommended without first estimating the scope of the impacts, which should be done in monetary terms

whenever possible. It is then necessary to quantify the impact of the proposed improvements through additional prediction work. Clearly, options must be discarded as soon as their unsuitability is proven or alternatives shown to be superior in environmental, economic, or both terms. It is also critical to test the "without project" scenario.

This stage will produce important recommendations for mitigating measures. The Environmental Impact Statement would include this information. Clearly, the goal will be to implement measures that reduce any identified negative impacts while increasing positive impacts. Formal and informal communication links must be established with teams conducting feasibility studies so that proposals can be considered in their work. Similarly, feasibility studies may show that some options are technically or economically unfeasible, and thus no environmental prediction work is required for these options.

Many mitigating solutions call for management, institutional, or financial modifications instead of physical ones, such as those for health services. Procedure adjustments, such as the introduction or increase of irrigation service costs to encourage efficiency and water conservation, are another type of mitigating action.

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.

The project preparation will be far along by the time prediction and mitigation are started, and it is likely that the decision to move forward with the project will already have been made. It's possible that substantial funds have already been spent and budgeted for the project's execution. Major revisions could impede project progress and should only be permitted if projections indicate that the impacts will be much worse than those first estimated during the scoping stage.

For instance, changing a reservoir's mode of operation to save fisheries downstream would be an appropriate approach, but at this point, advocating an alternative to building a dam might be very divisive. Early project cycle initiation of the EIA process is crucial to preventing dispute.

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.

Although mathematical modelling is a useful method, models must be carefully chosen to match the data that are available. Physical systems are more successfully modelled than ecological systems, which in turn are more successfully modelled than social systems, due to the quantity of knowledge now accessible and the complexity of the systems. Expert counsel, especially from specialists who are conversant with the area, can quantify effects that cannot be modelled. There are numerous methods available to eliminate 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 for comparing options are weightings, environmental impacts, economic cost-benefit analysis, or a combination of the two. Different environmental impacts can be assigned numerical values, or weightings, to (subjectively) define their relative importance. Assigning economic values to all environmental impacts is not recommended because it obscures the issues. However, economic techniques can provide insight into relative

importance when trying to compare various environmental impacts, such as losing more wetlands or relocating a larger number of people.

There are a number of features of various impacts that need to be recognized when comparing a range of proposals or a range of mitigation or enhancement measures. The relative importance of affects must be agreed upon, typically using a consensus-building technique but taking economic factors into consideration. It is important to acknowledge the difficulty in anticipating the impact. Last but not least, the impact's timing should be specified, along with whether or not it's irreversible.

2.5. Management and monitoring

The **Environmental Action Plan or Environmental Management Plan** are common names for the section of the EIS that addresses monitoring and management. In addition to outlining the short- and long-term mitigation strategies for environmental management, this section also outlines the institutional prerequisites for execution. In this context, the word "institutional" is used to refer to all kinds of connections:

• Established by law between individuals and government;

• Between parties to economic transactions, both individuals and groups.

• Created to explain the relationships between public agencies on a legal, financial, and administrative level.

• Driven by sociopsychological cues in interpersonal and group contexts (Craine, 1971).

The aforementioned list exemplifies the range of alternatives available for environmental management, including: changes to laws, to prices, to political institutions, and to culture, which may be impacted via education and information sharing. All management suggestions must be precisely stated and costed. Establishing a monitoring programme with clear definitions of which agencies are in charge of data collection, collation, interpretation, and management measure execution is one of the more simple and successful adjustments.

The goal of monitoring is to compare predicted and actual impacts, especially if the impacts are significant or the scale of the impact cannot be predicted accurately. Monitoring results can be used to manage the environment, particularly to identify problems early so that action can be taken. The range of parameters requiring monitoring may be broad or narrow, as determined by the EIA's 'prediction and mitigation' stage. Water quality, both inflow and outflow; stress in sensitive ecosystems; soil fertility, particularly salinization issues; water-related health hazards; equity of water distributions; groundwater levels are typical areas of concern where monitoring is inadequate.

Satellite imagery is increasingly being used to monitor changes in land use and the "health" of the land and sea, and it can be a cost-effective tool, particularly in areas with limited access. Monitoring should not be viewed as an ongoing commitment to collect data. Monitoring and management data can be extremely useful for future EIAs, making them more accurate and efficient.

The Environmental Management Plan must describe a programme and costs in addition to clear action recommendations and the processes for putting them into practice. When costs will be spent and how management and mitigation strategies will be implemented in phases with the project must be crystal clear. Measures for management and mitigation will not be implemented until they can be demonstrated to be workable and economical.

2.6. Auditing

The final step of an EIA is to conduct an **Environmental Audit** after the project or programme has been finished in order to take use of the experience and information obtained. Therefore, it will typically be carried out by a different group of experts from those handling the majority of the EIA. An examination of the technical, administrative, and decision-making components of the EIA should be included in the audit. Technical considerations include the applicability of mitigation methods, the accuracy of predictions, and the sufficiency of baseline

research. The effectiveness of the method, the fairness of the public involvement measures, and the degree of role and responsibility coordination are all procedural considerations.

Aspects of decision-making include: the effectiveness of the decision-making process and its effects on development (adapted from Sadler in Wathern, 1988). The audit will determine whether the project's implementation of the recommendations and requirements from the earlier EIA phases was successful. Lessons discovered and fully documented in an audit can be very helpful in future EIAs and increase the knowledge and effectiveness of the relevant institutions.

2.7. Public participation

Projects and programmes have a large impact on the local population. While the goal is to improve the population's well-being, a lack of understanding of the people and their society may result in development with significant negative consequences. More importantly, there may be a conflict between national economic interests and local population interests. For example, the need to increase local rice production to meet rising urban consumption may differ from the needs perceived by local farmers. To accomplish this, public participation in the planning process is required. The EIA is an excellent venue for ensuring that the affected public has been adequately consulted and that their opinions have been 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 un-sustainability.

The community should actively participate in environmental issues in addition to being consulted. The International Union for the Conservation of Nature, or IUCN, advocates the idea of Primary Environmental Care, in which farmers, for instance, actively participate in environmental management with the aid of extension agencies. Better results come from including the public earlier. A development proposal should ideally be in this stage before being completely described. It is a crucial component of effective scoping because this is the point where feedback will have the biggest impact. Although it is crucial to spread information, it is likely that public consultation will decline as the EIA moves along. A public meeting that is usually held in conjunction with the release of the draught Environmental Impact Statement (EIS) must be presided over by a skilled communicator. He or she might not be an EIA team member. There are no clear rules about how to involve the public and it is important that the process remains innovative and flexible.

The opinions of those who will be impacted by the plan are more likely to be heard indirectly than directly in practise. It is crucial to comprehend the processes used to make choices locally as well as the available communication channels, including any government extension services. The variety of organisations outside the institutional structure that may have pertinent knowledge includes: technical and scientific societies; water user groups; NGOs; local cultural specialists; and religious organisations. Finding out which groups are underrepresented and who controls access to natural resources, such as grazing, water, fishing, and forest products, is crucial. The opinions of women, religious minorities, political minorities, people of colour, and members of lower castes are frequently disregarded (World Bank, 1991).

2.9. Managing uncertainty

Uncertainty plays a significant role in an EIA because it includes prediction. Environmental impact assessments are characterised by two different categories

of uncertainty: those related to the planning and those related to the outcomes. In Wathern, de Jongh discusses the primary types of uncertainty and methods for minimising them (1988). These are a brief summary of them:

Prediction uncertainty: this is significant during the data gathering phase, and the ultimate certainty won't be known until after implementation has started. Research may help to lessen the uncertainty;

Uncertainty of values: Values are uncertain, which is a reflection of the EIA procedures' approach. Decision-making will ultimately determine the level of assurance. There should be less uncertainty as a result of improved communication and thorough negotiations;

Uncertainty of related decision: this affects the decision making element of the EIA process and final certainty will be determined by post evaluation. Improved coordination will reduce uncertainty.

It is impossible to overstate the value of extensive engagement in lowering the chance of overlooking significant impacts. The importance of impacts is a matter of opinion, but the best way to reach consensus on the necessary value judgments is through public participation and consultation with a large cross-section of the community. The conflict over whether to priorities short-term advantages or long-term issues is a recurrent theme. Prediction accuracy depends on a number of variables, including data or knowledge gaps. It's crucial to avoid concentrating on forecasts that are very simple to make at the expense of outcomes that could be far more significant but are challenging to analyze.

The EIA results should indicate the level of uncertainty using confidence limits and probability analyses whenever possible. If adequate quantifiable data are available, sensitivity analysis similar to that used in economic evaluation could be used. By repeating predictions and adjusting key variables, a variety of outcomes can be discovered. EIA allows uncertainty to be managed and, as a result, aids in better decision making.

2.10. Environment Management Plan

- Identification of mitigating strategies, such as prevention and control, for each environmental component, as well as a restoration and resettlement strategy.
- Establishment of a monitoring system to ensure that the conditions are met.
- Development of an implementation strategy, including timetables and resource allocation.

2.11. Importance of EIA

- For ecologically safe and sustainable development, EIA connects the environment and development.
- EIA is a cost-effective way to eliminate or reduce the negative effects of development initiatives.
- EIA allows decision-makers to assess the impact of development activities on the environment long before the project is executed.
- The adaptation of mitigation methods in the development plan is encouraged by EIA.
- EIA ensures that the development plan is environmentally sound and operates within the ecosystem's capacity for assimilation and regeneration.

2.12. Conclusion

The Ministry of Environment, Forestry, and Climate Change (MoEF&CC) has released the draft Environment Impact Assessment (EIA) Notification 2020, which would modify the present EIA Notification, 2006, issued under the Environment (Protection) Act, 1986. Currently, the EIA notification is limited to the point at which environmental clearance has been granted. To efficiently monitor compliance with clearance conditions, the MOEF should establish more regional offices, each with a narrower area of control. The state agency should implement a comprehensive monitoring mechanism where central projects involving forest clearing are distributed. This monitoring organization should have the authority to address both sets of clearance conditions at the same time, as

well as to take punitive action against the project proponent in the event of non-compliance with any of the conditions.

Terminal questions

Question: Consider the following statements:

1. Environmental Impact Assessment has been introduced in India in the year 1952
2. In September 2006, the Ministry of Environment, Forests, and Climate Change (MoEFCC) announced new EIA regulations.

A. Which of the statement(s) given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2
Answer: (b)

B. Which of the following is/ are not the component(s) of Environmental Impact Assessment?

(a) Air Environment
(b) Noise Environment
(c) Environment Management Plan
(d) None of the above
Answer: (d)

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Unit 3: Preparation and Writing of EIA Report

Unit Structure

3.0. Learning Objectives
3.1. Introduction
3.2. EIA Reporting
3.2.1. EIA Quality
3.2.2. Structure & Elements of EIA Report
3.2.3. Qualities of a Good EIA Report
3.2.4. Structure & elements of EIA report includes following sections:
3.3. EIA Review Process
3.3.1. Purpose of EIA Review Process:
3.4. Procedures for Evaluating EIA Reports
3.5. Summary

3.0. Learning Objectives

After studying this unit the learner will be able to:

• understand reporting and reviewing process

• understand EIA Quality

• describe Structure of EIA Report

• explain EIA documentation process

• explain the role, purposes & parameter of EIA review process

3.1. Introduction

Reporting is a critical stage in the EIA process because it presents the results of the evaluation, suggests mitigation techniques, and provides enough information to enable decision-making. The EIA Report is a collection of project components, including project details, environmental and social impact assessments, mitigation measures, and linked management and monitoring approaches. The information gathered is organized, and the findings of the investigations and consultations are summarized in the EIA report. The addressees of the EIA report are the sanctioning and executing organizations, the project proponent, and the project

affected people. The EIA report must be well-organized and clearly written due to its importance as a communication tool. An ideal EIA report must be complete, easily understandable, impartial, accurate, and written in simple language for non-professionals while also meeting the required technical standards. Though Environmental Impact Statement (EIS) and Environmental Statement (ES) are also used, 'ETA report' is the universal term. The basic goal, methodology, and structure of an EIA report are the same regardless of the title. The proponent is responsible for preparing the EIA report in accordance with the Terms of Reference (ToR) established during the scoping stage of the EIA process. EIA accurately predicts the harmful and unfavourable consequences of proposed actions, as well as their mitigation using well-defined methods.

3.2. EIA Reporting

The information to be included in an EIA report is generally detailed in a country's legislature, process, or guidelines, which may differ from one country to the next. The content of an EIA report is typically prepared in accordance with specific ToR established during the scoping stage. It may include additional issues/concerns and other concerns that have arisen as a result of the EIA study and must be addressed during the decision-making process. An EIA report typically includes the following sections:

A brief summary

• Statement of need and proposal objectives

• Policy, legislative, and regulatory frameworks

• Project implementation process description (construction, operation and decommissioning)

• Compilation of alternatives

• Project area description, including land-use and related policies and plans in the area • Baseline and socioeconomic data, as well as identifying anticipated changes before project execution

• Evaluation of the public consultation/hearing process (opinions and concerns expressed by the stakeholders and the way these have been taken into account)

• Discussion of key positive and negative impacts identified as likely to be impacted by the project, including the degree of occurrence, scheduling, and mitigation measures.

If possible, assess the implications of outstanding impacts for each alternative.

• An Environmental Management Plan (EMP) with mitigation and monitoring recommendations

• Annotations (supportive technical data, data collection and analysis methods, references, etc.)

The best way to prepare an EIA report is to organize the data and interpret it in such a way that it provides justification for the recommended mitigation measures and changes in project execution. Terms of Reference guide the structure and interpretation of the EIA report (ToR). The guiding principles of TORs differ depending on the funding agency and country; for example, the World Bank's ToR discusses the:

• Project description

• Project site

• Project alternatives (site, infrastructure, technologies)

• Prevailing environment and baseline data collection

• Determination of the probable impacts

• Analysis and estimation of risks

• Preparation of Environmental Management Plan

• Mitigation and Monitoring Plan

• Resettlement Action Plan (if relevant)

3.2.1. EIA Quality

An ideal EIA is believed to possess a well-defined structure with a logical sequence, which describes:

• Existing socioeconomic baseline conditions

• Predict the impacts (nature, extent and magnitude)

• Scope for mitigation

• Accepted mitigation measures

• Implication of inevitable impacts for each environmental concern

An ideal EIA must:

Prepare an executive summary.

- At the beginning of the report, include a table of contents.
- Provide a description of consent procedures as well as how EIA supplements them.
- Be succinct but thorough, with clearly defined goals.
- Be written in a balanced manner; • Have a thorough understanding of development proposals; and • Supplement the text with drawings, graphics, and pictures.
- Make use of a glossary and consistent terminology.
- Cites the information/sources used;
  - • Clearly explains complex issues;
  - • Describes the methodology used to achieve each goal;
  - • Consistently covers all aspects of the environment;
  - • Documents the consultation process;
- Have an in-depth discussion of planned alternatives; and
  - • Commit to mitigation and monitoring.

The assessment of EIA quality covers following parameters:

Site/ project description with:

- Photographs
- Layout maps
- Process flow diagrams of the manufacturing processes
- Material balance
- Environmentally sensitive receptors like water bodies
- Wetlands and estuaries
- Forests
- Wildlife sanctuaries national parks and biosphere reserves
- Human habitations, school and hospitals
- Archaeological and historical monuments
- Industrial setups

Consideration of alternative of sites/technology/ processes Methodology for collection of:

1. Primary baseline data for physical environment
2. Secondary data (reference, relevance, authenticity, period, ground validation).
3. Interpretation of data for categorizing environmental impacts and quantification, if required
4. Interpretation of ecological and social baseline conditions and assessment of potential impact and mitigation measures
5. Risks assessment and analysis of effects including an emergency plan
6. Environmental Management Plan and its supervision mechanism
7. Duly signed declaration of experts' clearly indicating their involvement in EIA preparation
8. Compliance to ToR and public hearing

3.2.2. Structure & Elements of EIA Report

This Final Environmental Impact Assessment Report describes the Environmental Impact Assessment process that was undertaken for a proposed project. It contains information regarding the Project, the likely significant effect of the Project, the

Baseline scenario, the proposed Alternatives, the features and Measures to mitigate adverse significant effects as well as a Non-Technical Summary and any additional information.

The EIA report is a keystone document. It assembles the information that assists:

- the proponent in managing the impacts of the proposal;
- the responsible authority in decision-making and condition setting; and
- the public in understanding the likely impacts of the proposal.

3.2.3. Qualities of a Good EIA Report

The main aim of an EIA Report is to provide prudent information for two types of audiences – decision-makers and people potentially affected by a Project. The Report, therefore, must communicate effectively with these audiences. The quality should reflect the following:

- A clear structure with a logical sequence that describes, for example, existing Baseline conditions, predicted impacts (nature, extent, and magnitude), the scope for mitigation, proposed Mitigation/Compensation Measures, the significance of unavoidable/residual impacts for each environmental factor;
- A table of contents at the beginning of the document;
- A description of the Development Consent procedure and how EIA fits within it;
- Reads as a single document with appropriate cross-referencing; Is concise, comprehensive and objective;
- Is written in an impartial manner without bias;
- Includes a full description and comparison of the Alternatives studied;
- Makes effective use of diagrams, illustrations, photographs, and other graphics to support the text;
- Uses consistent terminology with a glossary;
- References all information sources used;

- Has a clear explanation of complex issues;
- Contains a good description of the methods used for the studies of each environmental factor;
- Covers each environmental factor in a way which is proportionate to its importance;
- Provides evidence of effective consultations (if some consultations have already taken place)
- Provides a basis for effective consultations to come;
- Makes a commitment to mitigation (with a program) and to monitoring;
- Contains a Non-Technical Summary which does not contain technical jargon;
- Contains, where relevant, a reference list detailing the sources used for the description and assessments included in the report.

3.2.4. Structure & elements of EIA report includes following sections:

Section I (Introductory): The title of the report, list of contents, organization(s) accountable for the study, preferably with a list of key investigator(s)/consultant(s) and their institutional affiliation are all included in this section of EIA reports.

Section II (Executive Summary): Section II (Executive Summary): The executive summary is a concise account of key findings and recommendations. The emphasis must be on the critical information that can aid in decision making. The executive summary is brief, no more than 7 to 8 pages. Typically, the executive summary is the only part of the report that most people and decision makers read. The language of the executive summary is simple because it is intended to be distributed as an information brochure among stakeholders and project affected individuals; thus, an executive summary includes:

- Project planning blueprint;
- EIA Terms of Reference;
- The outcome of the public hearing;

- Alternatives have been considered;
- The project's key impacts and their significance;
- A summary of the proposed mitigation measures;
- An executive summary of the Environmental Management Plan; and
- Any other critical issues that may support in the decision-making process.

Section III (Need and Goal of the Proposal):

The EIA is a well-defined and distinct statement that explains the need and goals of the proposal. Typically, the project's need is supported by a reference to relevant policies and plans. The proposal outlines the anticipated benefits of the project's activities.

Section IV (Legal and Policy Foundation):

This section of the EIA briefly describes the proposal's legal and policy framework. Other requirements or concerns are mentioned in conjunction with related aspects of the EIA procedure. This section summarizes the EIA's Terms of Reference, elaborating on the reasons for any deviations from them. This section of the report may include a copy of the TOR.

Section V (Project Explanation and Alternates):

This section of the EIA describes the elements and main activities that will take place during the project's construction, operation, and decommissioning phases. This section highlights the key differences between the alternatives, including the no-action alternative, as well as information on:

• The project's location (on-site and off-site topographies)

• Access to roads, power, and water

• Pattern of resource utilization, raw material inputs, and emission and waste releases;

• Operational characteristics, processes, and products;

• The relationship between the proposal's technical, socioeconomic, and environmental aspects;

• Evaluation of alternatives and options for size, location, technology to be used, design, energy sources, and raw material source.

This data is useful for assessing the impact and forecasting mitigation measures. This information is supplemented with appropriate maps, flow charts, and visual illustrations.

Section VI (Description of the Affected Environment):

In this section of the report, you will find brief information about:

• Field research and laboratory systems (biophysical and socioeconomic settings)

• Baseline data (socioeconomic background) with anticipated changes prior to the project

• Pre-existing land-use pattern

• Current policies and plans

• The main trends and the expected future situation

• Eco-sensitive areas and abundant resources

Section VI (Description of affected environment): This section of report contains brief information of:

• Field investigations and laboratory systems (biophysical and socioeconomic settings)

• Baseline information (socioeconomic background) with anticipated modifications before the project

• Existing land utilization pattern

• Prevailing policies and plans

• Main tendencies and expected future situation

• Eco-sensitive areas and resource wealth

Field investigations and laboratory systems: Implementation of the methodologies developed are assessed with respect to:

a. Physical Environment

- Participation of ECs/FAEs in sampling protocols
- Data quality assurance while collecting, storing, and transporting samples
- Interpretation of data
- Baseline data specifics (name, address of laboratory, analysts, type of sample; duration/dates of analysis, analytical method used; number of samples analysed)

b. Ecological Environment

- Participation of concerned ECs/FAEs in field investigation; use of field equipment; observations recorded in field log book for primary data collection and confirmation of secondary data
- Data quality assurance for seasonality, timing, and duration, as well as species identification
- Laboratory testing of field samples (data interpretation in terms of impact on biological receptors (rare/threatened/endangered/endemic species and their habitat).

b. Socioeconomic Environment

- The procedure used to collect primary data on socioeconomic aspects, including the type of data collected
- Involvement of relevant FAEs in scope planning for field-based socioeconomic surveys, design of questionnaire/interview schedules, and field log book maintenance
- Quality control (standardization of the methodology, sampling, etc.)

Section VII (Public Hearing and comments):

One of the most important components of an EIA report is a brief but comprehensive statement of the nature, scope, and outcome of the public hearing process. This section of the report includes the following points:

- Identification of key stakeholders and individuals who are likely to be impacted;
- Methodology chosen for conducting stakeholder analysis;

- Evaluation of communicated opinions and concerns
- Procedure for dealing with expressed opinions and concerns; and
- Unresolved concerns and unresolved issues Section

VIII (Assessment of Environmental Impacts):

This section of the EIA report evaluates the likely positive and negative impacts of both the proposal and its alternates for each environmental component identified in the ToR. Impact is defined in terms of degree, severity, frequency, duration, and so on. The residual effects that cannot be mitigated are also clearly specified. This section contains the following information:

- Projection of major impact, its characteristics, and likely consequences;
- Discussion of their agreement with environmental standards and policy objectives.
- Methods for escaping, reducing, and mitigating the impact;
- determining the magnitude of residual effects; and
- Limitations associated with impact estimation and assessment, as specified by assumptions made, gaps in information, and doubts encountered.

The section describes the methodological framework used to collect the data, the predictive methods, and the standards used to evaluate the outcome. This data is typically tabulated for the benefit of the reader and stakeholders.

Section IX (Comparative evaluation of alternatives):

In this section, the proposal is thoroughly compared to the alternatives, and the methods for scrutinizing are also specified. The eco-friendly preferred options are identified and quantified, as well as the purpose for using them. A comparative analysis is carried out with regard to:

- Both negative and positive effects;
- The efficacy of relief methods;
- A cost-benefit analysis

- Any other potential opportunities for community and environmental development.

Section X (Environmental Management Plan):

This section of the EIA report is 'action oriented,' summarizing the recommended mitigation measures. It also defines the mechanism for implementing the measures. An EMP is all about the activities that are planned to be undertaken to monitor and manage the impacts of a project during its implementation and operation. The strategy entails:

- Suggestions for mitigating measures;
- Liabilities for EMP execution;
- The assumed activities' timetable;
- Keeping track of the schedule in relation to the goals;
- An Impact Management Plan to address anticipated changes;
- Emergency preparedness plans (if necessary); and
- Details of reporting, appraisal, and review processes The EMP plan includes mandatory local institution reinforcement, capacity building, and training requirements for EMP implementation.

Section XI (Appendices):

This section contains information that technical professionals will need for reference or review. Appendices are typically used to include baseline data, technical information, and procedure accounts. These are necessary for a professional to understand the basis of an EIA report but may be unnecessary in the main text. The appendices may include:

The appendices may include:

• Abbreviation list;

• Data and information sources

• A list of references used in the text

• A list of EIA team members and other contributors

Although an ideal report must be comprehensive, easily understandable, impartial, accurate, and consistent, it is extremely difficult to achieve due to certain constraints.

3.3. EIA Review Process

A review is the last quality check that an EIA report must pass in order to be approved. Once the EIA report is submitted, the designated authorities carefully review it, taking into account the methods used, data analyses, suggested measures, and conclusions drawn to assess the impacts of the proposed project. The review determines whether or not the project effectively addresses the major impacts and threats, as well as whether or not to grant project approval to the project proponent or to refer back for modifications/amendments (if any). In general, the review process suggests additional clarification on potential impacts, mitigation measures, or other phases, which not only improves the report's quality but also makes decision making more effective and transparent.

3.3.1. Purpose of EIA Review Process:

One of the most significant determining factors in the Environmental Clearance process is the calibre of the EIA report. There are a number of flaws in the EIA process, the most significant of which is the applicability, where there is misunderstanding regarding the exemption of projects with significant environmental impacts or the non-listing of certain activities in Schedule I of notification. Sometimes the committees formed to conduct EIA studies lack expertise, which can have an impact on the quality of the EIA report. In many cases, public opinion is not taken into account at an early stage, which frequently leads to conflict during clearance. Many projects with significant environmental and social implications are exempted from the mandatory public hearing process, which afterward becomes a source of contention.

It is critical that experts conducting EIA consider community traditional wisdom when suggesting mitigation measures, because this wisdom can be useful in achieving problem mitigation at the local level. Occasionally, due to a lack of authenticity, the consultants would either submit a fake EIA report or present cooked data that neither relates to the existing social and environmental conditions nor meets the criteria of an ideal report. The goal of the review is to validate the quality of the data and methods used in the EIA, as well as to ensure that the EIA report addresses all important mitigation measures. The main objectives of EIA review are to:

- Identify any issues that need to be fixed before the final submission of the report.
- Determine whether the data is sufficient for decision making.
- Ensure that the public's input has been considered.
- Assess the suitability and quality of the EIA report

3.4. Procedures for Evaluating EIA Reports

As far as the review of EIA report is concerned, each nation has its own review process; however, the process may be internal or external. The internal review process is undertaken without formal guidelines by related government agency and thus lacks transparency. External review is undertaken by an independent body/ government agencies, with a formal, transparent procedure confirming high quality outcome.

The role of expertise is determined by environmental concerns and technical aspects of the proposal. Understanding public opinion is an important aspect of the review process. According to studies and experiences, public feedback is very important, which the review committee can gather by organizing a public consultation or inviting written comments from various stakeholders. This process not only ensures transparency, but it also validates the relevance of earlier public consultations held as part of the EIA process and contributes to the evaluation of impacts. The outcomes of the public consultation process/written comments

provide an overview of the issues discussed previously as well as sensitive concerns raised by the public during the consultation process. Thus, review is a double-checked procedure. However, the EIA report does not always meet the required standards, the most important of which are satisfactory, partially satisfactory, and unsatisfactory. The EIA, which identifies and mitigates the effects of development while also taking into account public participation and social implications, is thought to be of acceptable quality. The data and methodological approach used determine the report's quality. The EIA process that follows standard protocols and/or acceptable relevant standards usually meets the challenges of acceptability. The report's presentation is also a deciding factor in whether or not the report is acceptable. Sometimes the review committee/authority suggests some additions or deletions that, when incorporated into the final report, can make the report suitable. The EIA report, with a significant number of additions or deletions and an absence of proper redressal of public opinion and mitigation measures, is frequently only partially satisfactory. Such EIA reports require significant modifications, and the reviewing authority frequently enlists the necessary modifications, which, once incorporated, can make the report acceptable. The third category is the unsatisfactory report, which lacks proper data, is inadequately evaluated and presented, and is biased. Such reports are deemed unfit for consideration. Depending on the nature of the project, the review process is usually undertaken by a responsible authority, a government agency or committee, or an independent body.

The steps involved in the review process are:

The EIA is evaluated by an agency-formed multidisciplinary team/committee based on the nature of the project under consideration. Following the defined procedure, the team identifies flaws in the EIA report while keeping in mind the ToR, applicable rules/norms, criteria, and mechanism chosen for information gathering (based on standard protocols notified by national agencies/relevant authorities).

The MoEFCC in India developed a proper Accreditation Scheme to identify consultants capable of delivering a quality EIA report in order to improve the quality of EIA reports. As a result, in August 2007, the National Accreditation Board for Education and Training (NABET), a board of the Quality Council of India (QCI), launched a scheme. Later, in 2009, the MoEFCC issued an Office Memorandum for the preparation of EIA reports by Accredited Consultant Organizations (ACOs), and the Accreditation Scheme was made mandatory through a Gazette Notification dated March 3, 2016. NABET's 'Scheme for Accreditation of EIA Consultant Organizations' recognises the following basic requirements for EIA Consultant Organization:

• Qualification and technical knowhow of EIA Coordinators

• Prerequisites for field investigations and laboratory arrangement to confirm the quality of baseline data

• Adoption of quality management systems

• Provision of office facilities and other qualifying factors

The assessment of ACOs is conducted based on the parameters listed in the table 3.1.

Human Resource: Preparation of an EIA report requires specialists having knowledge about:

• Environment

✓ Land use

✓ Air quality monitoring and modeling

✓ Water quality monitoring

✓ Monitoring of noise and vibration

✓ Assessment of ecology and biodiversity

• Evaluation of socioeconomic aspects

• Risks and hazard management

Table 3.1: Parameters for Assessment of Accredited Consultant Organizations

Human Resource	Defines the qualification and roles of: • EIA Coordinator • Associate EIA Coordinator • Functional Area Experts
Field surveys and laboratory systems	Laboratories engaged must be NABL accredited, recognized by MoEFCC and certified by Good Laboratory Practice (GLP)
Quality Management System (QMS)	Applicant organization must have a Quality Management Systems (QMS) based on ISO 9001 standards
Quality of EIA reports	Quality EIA report having proper: • Explanation of site • Baseline data analysis • Identification of potential impacts and • Mitigation measures
Organizational Commitment	Identification of credible EIA consultant organizations who can contribute towards refining the quality of EIA reports
Compliance to conditions of accreditation/ improvements achieved	It includes the appropriate data, employing approved experts for preparing EIAs; provides statement endorsed by ECs and FAEs involved in preparation of EIA in prescribed format

The key persons involved in EIA reporting are:

• **EIA Coordinator:** EIA Coordinator (EC) must be well-conversant about the project and probable environmental, ecological and social impacts including the construction, operation and closure/ decommissioning stages which ensure the quality of EIA report.

• **Associate EIA Coordinator**: The EIA Coordinator is assisted by Associate EIA Coordinator and Functional Area Experts (FAEs).

• **Functional Area Experts**: The FAEs are expected to recognize and evaluate in their own areas of expertise the probable impacts of development activity and provide valuable feedback to the EC.

Re-accreditation (RA): Following the principle of 'continual improvement', in Re-accreditation the stress is laid on the improvement recognized during the accreditation. The accreditation includes three steps:

• Application assessment process (for IA, SA, RA)

• Office assessment process

• Decision making process

The important outcomes of accreditation process are:

a. Accredited (when the applicant clears the assessment and accreditation processes successfully) b. Not approved (when the AO/ACO fails to obtain 40 percent marks in assessment or does not fulfill any requirements of the scheme)

c. Cancellation (when an ACO does not justify the terms of certification or does not submit complete application)

d. Incomplete applications (when an AO submits an incomplete application and required details are not provided or these details do not meet the requirements of the scheme)

3.5. Summary

One of the most important stages of the EIA process is reporting, which presents the results of the evaluation, proposes mitigation measures, and provides information for decision making. The EIA Report is a compilation of key project constituents, including an account of the project, an assessment of its ecological and social impacts, mitigation measures, and linked management and monitoring strategies. A perfect EIA report must be complete, easily understandable, unbiased, precise, and written in simple language for non-professionals while also meeting the required technical standards. The information to be included in an EIA report is typically detailed in a country's legislature, processes, or procedures,

which may differ from other countries. The best way to prepare an EIA report is to organize and interpret the gathered data in such a way that it provides logical meaning for the recommended mitigation measures and project amendments. The main objectives of EIA review are to:

• Determine any shortcomings that must be taken care of before final submission of report

• Check, if the data is sufficient for a decision making

• Confirm that the public views have been taken into account

• Assess the suitability and quality of EIA report

References and Suggested Further Readings

- EPA2006: Scientific Applications International Corporation (SAIC): Life Cycle
- Assessment: Principles and Practice. U.S. EPA, SystemsAnalysis Branch, National
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- Green Chemistry Metrics: Measuring and Monitoring Sustainable Process- edited byAlexei Lapkin,Centre for Sustainable Chemical Technologies, University of
- Bath,UK & Glaxosmithkline,USA,Wlieypublication 2008
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Unit 4: Decision Making

Unit Structure

4.0 Objectives
4.1 Introduction
4.2 Decision-maker responsibilities throughout the EIA process
4.3 Considerations and problems apply to EIA decision-making.
4.4 Comparison of EIA with other inputs
4.5 Other inputs
4.6 Information required by a decision-maker for final decision
4.7 Decision-Making Processes With Checks And Balances
4.8 The Significance of Condition for the Final Approval
Summary

4.0 Objectives

This unit aims at the following outcomes:

- To describe the role and contribution of EIA in the decision-making process, particularly the final approval of the proposal.
- To understand the broad trade-offs that must be made among environmental, economic and social factors in decision-making and condition setting.
- Focuses on the relationship of EIA and decision-making.
- Introduce the concept of decision-making and its importance in the EIA process.

4.1 Introduction

The EIA procedure was developed for order to explicitly include environmental factors in decision-making on significant initiatives. Understanding how decisions are made as well as the specific contribution that EIA makes is necessary for everyone involved in the process. The decisions making involves selecting one action from several possible ones. Political issues are at the core of this process. A range of factors must be deal off while assessing the advantages and disadvantages. Decisions are frequently

reached after extensive negotiation, bartering, and compromise, with the opinions of all parties directly represented. It is possible to develop the data required for sound decision-making for large initiatives using a variety of formal instruments. EIA is a procedure for gathering data that is used in this context to aid in making ecologically sound decisions.

The outcome of this process is a final determination about whether or not and under what circumstances a proposal is accepted. When the phrase "decision-making" is used in relation to an EIA, it is typically understood to refer to the ultimate approval of a plan. Nevertheless, a number of "interim" judgments are made about the proposal over the course of the EIA process; such include choosing a preferred option and making changes to the initial proposal's planning and design.

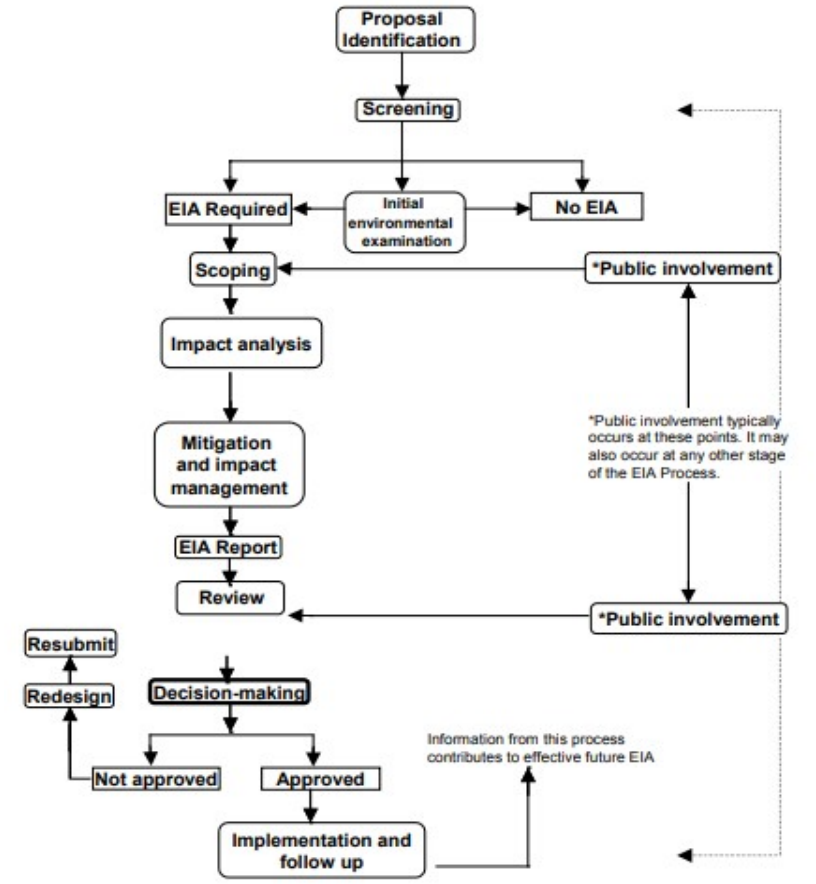

Figure 1. Decision-making in the EIA process (https://www.iaia.org)

These interim judgments could be issued by different parties depending on the EIA protocols that are in place. The relevant authority, for instance, often decides how to handle the proposal throughout the screening and drafting phases. The proponent frequently alters the plan during the EIA process and make it much more environmentally and sociologically acceptable. The final decision to approve the large proposal is typically a political one, frequently made by the central government, the planning authority, or another such entity. In certain EIA systems, obtaining the approval is a prerequisite to obtaining other relevant authorizations, such as licences and permits, which are provided by regulatory authorities.

4.2 Decision-maker responsibilities throughout the EIA process

All decision-makers are now aware of their obligations in terms of the environment. These obligations are generally stated in the Rio Environment and Development Declaration and Agenda 21, the objectives and action plan that all nations that participated in the Earth Summit are formally committed to. Environmental impact assessments (EIAs) are recognised as a crucial tool for incorporating environmental and social factors into development decision-making. When combined with other important decision-making principles agreed in Rio, such as the precautionary principle, its implementation is strengthened. EIA is still seen negatively by a disproportionate number of decision-makers, who see it as a burden or even a barrier rather than as a chance to improve development proposals and protect vital resources and environmental services.

While this is going on, the UNEP, the World Bank, and other international agencies have issued warnings that the effect of environmental changes may be approaching a tipping point and that there are growing demands on land and freshwater resources in many regions of the world. These problems frequently have the greatest impact on the poor and underprivileged, diminishing their ability to rely on natural resources and lowering their chances of having stable and long-lasting livelihoods.

The implementation of the EIA process and the use of its findings to better manage a proposal's environmental risks and impacts are responsibilities that decision-makers must be aware of. Decision-makers must at the very least comprehend:

- The fundamental idea and objective of an EIA (and SEA).
- Applicable EIA requirements, values, and principles.
- The results of their application and how they affect decision-making.
- Information and guidance in an EIA report might need to be subject to restrictions.
- How the EIA methodology and procedures compare to those in existence in comparable nations and those that are internationally acknowledged.
- The difficulties involved in involving the public in decision-making, such as third-party and legal objections to the approval of initiatives subject to EIA.

Decision-makers now have more responsibilities as a result of the sustainability agenda. Decision-makers must have the necessary data and resources to best utilize EIA as a sustainability instrument in order to fulfill these objectives and decision-makers should be pushed to:

- Put into action the Rio pacts on sustainability.
- Enlarge their understanding of the environment and its principles.
- Improved information and justification for decisions.
- When considering how development projects would affect the environment, use the precautionary principle.
- Investigate more effective means of balancing environmental, socioeconomic, and social considerations.
- Adopt more transparent and inclusive decision-making processes.
- Utilize strategic tools to assist in decision-making, such as environmental accounting and SEA for suggested policies and strategies to get a more accurate sense of macroeconomic progress.

The discussion needs to go over the series of decisions that led to the proposal's ultimately approval, including:

- **Screening:** determining whether and how far an EIA must be implemented.

- **Scoping:** the process of determining the essential concerns and creating the scope.
- **Impact analysis:** concentrating attention on the evaluation and selection of options.
- **Mitigation:** to prevent, reduce, or make up for consequences is known as mitigation.
- **Review:** to evaluate the EIA report's suitability and quality as a foundation for the proposal's approval.

A determination of whether or not the plan is appropriate and can be validated environmentally will be made at each level, either implicitly or explicitly. Unless a proposal does have a "fatal defect" or proves to be extremely contentious and undesirable to a significant portion of the population, this is always positive in practice. The choices to be taken at each stage of this iterative decision-making process are constrained by the conclusions drawn at each one. The difference EIA information really makes to intermediate decision-making and finalization of plans raises a number of questions.

4.3 Considerations and problems apply to EIA decision-making.

For example,consider:

- What kind of example is each step of decision-making setting for the following one?
- How are the possibilities and factors trimmed down?
- How much does the likelihood of approval increase as the decision-making process goes on?
- What elements and situations can prevent a proposal from being accepted?
- During the implementation stage, are the terms specified by the authorization and approval of a plan enforced?

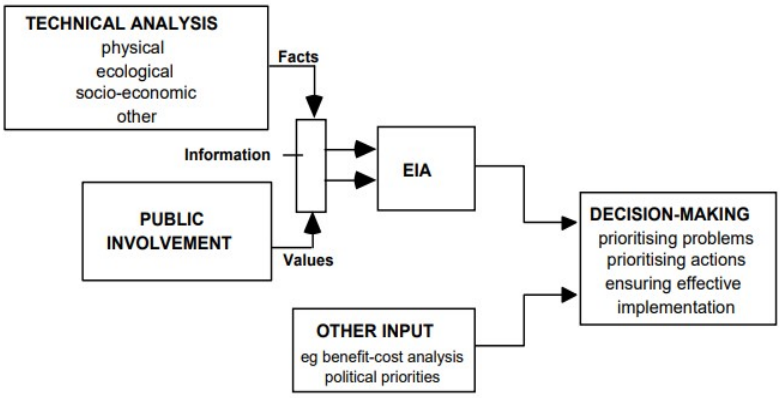

Figure 2. Decision-Making Process (https://www.iaia.org)

EIA is a step in a decision-making process that includes approving significant proposals. The figure above illustrates this process. A political choice is made as a result, one that entails a great deal of trade-offs and is based on data from a variety of sources. Benefits and costs need to be balanced, their environmental, economic, and social implications need to be considered, and there are still questions and disagreements about the importance of risks and repercussions that need to be resolved. When deciding whether to approve a proposal, the following criteria will be taken into account:

- The EIA study includes discoveries with substantial implications.
- A contribution from social and economic assessments.
- Other influences on decision-making or additional external demands.

Technical analysis and input from the public are the foundation of the information given by EIA. A synthesis of "facts" and "values" is used. The EIA report's potential to aid in decision-making can be significantly influenced by how these elements are balanced and described in the document. The application of best practices at earlier phases of the EIA process will also affect how useful the EIA report is for decision-making.

In order to give final clearance and set conditions, decision-makers must at the very least consider the data from the EIA process. With very few circumstances, an EIA procedure does not result in the rejection of a plan, even when there are indications of potentially substantial impacts (although maintaining this choice is essential for the legitimacy of the procedure). However, determining the conditions and guidelines for implementation of the project typically heavily depends on the outcomes of the EIA

process. Those in charge of making choices infrequently have the time to study the EIA report beyond an executive summary.

They typically rely on the counsel of their authorities, whose opinions are probably molded by their mandates and obligations in terms of policy. Decision-makers' general openness to an EIA report's findings will be a reflection of their trust in the method and how others seem to see it. The public's long-established faith in the Environmental Impact Assessment could be very important in this context.

4.4 Comparison of EIA with other inputs

EIA is carried out alongside economic evaluation, engineering feasibility, and other investigations. The choice taken might not be the most environmentally friendly one as a result of these additional inputs. It is necessary to weigh the proposal's environmental effects against economic, social, and other factors. The key decision-making criteria are these trade-offs, and when approving development projects, economic concerns often outweigh environmental ones.

In this sense, a crucial topic is whether EIA should be a wholly objective process or an advocacy process that promotes the case again for environment. Opinions on this issue vary. Most people believe that an EIA practitioner's job is to:

- Clearly and objectively describe the environmental effects and how they were mitigated.
- Bring the viable alternatives, the ecologically favoured option, and, more importantly, the arguments, to the attention of the decision-makers.
- Give contested advice on whether the idea is environmentally acceptable**,** (for example, if it is appropriate given the circumstances).

4.5 Other inputs

A larger representation of opinions and interests frequently results in external inputs to the ultimate decision on a proposal. These demands differ from one nation to another and from one enterprise to another. Numerous expansive plans are contentious and include a wide range of subjects where opinion might be fiercely split. They might come to represent a need for development, harm to the environment, or social injustice. This decision-making principle is best shown by the discussion surrounding the 'big dams'. The Three Gorges (China) and Sardar Sarovar (India) schemes, which

are the largest and most contentious projects, have sparked debate on a global scale about whether it was wise to build them and if the EIA procedure used to do so was enough. Below is a summary of the problems with the Sardar Sarovar scheme that can be read to see if there are any areas where local initiatives can be compared.4.6 Sardar Sarovar scheme, India (Berger, 1994)

A region that is prone to drought is home to the irrigation system known as Sardar Sarovar. It entails constructing a high reservoir on the Narmada River, a 37,000 hectare reservoir spread across three states, a 75,000 km irrigation network, and additional 80,000 hectares of land. A quarter of a million inhabitants will be relocated, many of them tribal members. Thousands more people who live below the dam downstream will also suffer negative effects.

Due to the magnitude of these effects, Sardar Sarovar came to represent both the benefits and drawbacks of extensive development in India and around the world. Some believe the project will have a significant positive economic impact on millions of people, while others believe it will have negative social and environmental effects. The resettlement of tribal members, who lacked legal title to their property, also generated more general questions of human rights. The EIA and SIA processes, which are now in their final phases, were criticized harshly for not adequately considering the full spectrum of implications.

The World Bank's loan agreement with the concerned nations caused an independent review of the scheme to be conducted in 1992. The study revealed that the programme was plagued by several issues, including incomplete data, a lack of consultation with the impacted parties, an insufficient EIA, and a lack of acceptable mitigation.

4.6 Information required by a decision-maker for final decision

It outlines the main elements of EIA reports that decision-makers should consider when giving final clearances and establishing requirements for project implementation. To determine the elements that are crucial, it is advisable to check this basic listing. According to OECD/DAC (1994), the following information is crucial for decision-makers:

Background

- Background information about the project and the key environmental problems at stake

Policy Context

- Basic development problem or concern (such as flooding, a water scarcity, etc.) and how it relates to environmental plans and regulations.

Alternatives

- Alternatives to the idea, including BPEOs or other designations with a similar environmental impact.

Public Participation

- Main popular opinions.
- Affected communities' worries
- Agreement and disagreement in certain areas.

Impact evaluation

- Benefits and costs.
- Losses and gains are distributed.

Monitoring and Mitigation

- Suitability of the proposed measures.

Final thoughts and Suggestions

- Principal financial gains, important environmental impacts, and suggested mitigating actions.
- The degree to which the idea complies with sustainable development concepts.
- Changes to the project's operations and design will increase its environmental acceptability.

Depending on the jurisdiction, decision-makers may be required to take into account the conclusions and suggestions of an EIA report. Normally, the decision-power maker's to reject or accept a proposal is subject to a few restrictions. The decision-maker could need to do the following, based on the arrangements in place:

- Don’t need to meet any more conditions.
- Remember to take into account the EIA report's information.
- Justifications for the choice should be in writing.

- Unless specifically overridden, follow an EIA review body's recommendations.

Decision-making can result in a variety of various consequences, including:

- The proposal may be accepted.
- The proposal may be accepted under some restrictions.
- The project may be put on hold while more research is conducted.
- The proposal may be sent back for editing and resubmitting.
- The proposal may be completely rejected.

4.7 Decision-Making Processes With Checks And Balances

To help promote accountability and openness, the EIA process includes a number of balances and checks. The quality management of the data in an EIA report depends on the procedural controls. The decision-maker might not be in a situation to make an informed decision if these are not in place. Leading EIA systems also have set norms and guidelines for decision-making, which adds another layer of accountability control. It is essential that the decision's written justification be provided.

Leading EIA systems have embraced some or all of the following guidelines and standards for making decisions (adapted from Wood, 1995):

(i) Prior to receiving and taking into account the EIA report, no decision will be made.

(ii) The conclusions of the EIA report and evaluation play a significant role in defining approval criteria.

(iii) The EIA report's public feedback is taken into consideration when making decisions.

(iv) At the final decision step, approvals might be granted or denied, subject to conditions, or modified.

(v) An authority besides the proponent makes the choice.

(vi) The decision's justifications and any conditions are made public.

(vii) The public has the option to appeal the ruling (where policies have been implemented inappropriately or without following them).

4.8 The Significance of Condition for the Final Approval

Normally, as a part of the final approval, all proposals that really are subjected to EIA will have constraints attached to their execution. The terms may be similar to the

impact management and mitigation strategies suggested in the EIA report or different, for instance by imposing more onerous criteria. In all scenarios, condition setting is dependent on impact estimations, which vary in their accuracy. To the greatest extent practicable, the confidence level or range of uncertainties associated with the data should be stated so that decision-makers are aware of the constraints on condition setting.

The methods for putting the authorized conditions into effect are covered in other areas of the manual. These consist of:

- Establishing performance benchmarks for fulfilling the requirements, ideally as a part of a formal agreement with the proponent.
- Requiring the proponents to create (or amend) a plan for environmental management (EMP) that takes these criteria into account and turns the conditions that have been accepted into a timeline of actions.
- EMP integration of systems for environmental management compliant with ISO 14000 standards.
- Enforcing performance criteria and approval requirements, with consequences for willful violations.

Summary

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Unit 5: Project Implementation

Unit Structure

5.0 Objectives
5.1 Introduction
5.2 Requirements of prior Environmental Clearance (EC)
5.3 State Level Environment Impact Assessment Authority
5.4 Categorization of projects and activities
5.5 Screening, Scoping and Appraisal Committees
5.6 General Condition (GC)
5.7 Specific Condition (SC)
5.7 Composition of the Sector/Project Specific (EAC) and (SEACS).
Summary

5.0 Objectives

After reading this unit you will be able to :

- Discuss about the general introduction about the project implementation
- Understand the requirements of prior Environmental Clearance (EC) for project implementation
- About the State Level Environment Impact Assessment Authority
- About the categorization of projects and activities
- Understanding about the Composition of the Sector/Project Specific (EAC) and (SEACS).

5.1 Introduction

According to Notification Ministry of Environment And Forests, New Delhi 14th September, 2006 (Published in the Gazette of India, Extraordinary, Part-II, and Section 3, Sub-section (ii)

S.O. 1533 Whereas, a draft notification under sub-rule (3) of Rule 5 of the Environment (Protection) Rules, 1986 for imposing certain restrictions and prohibitions on new projects or activities, or on the expansion or

modernization of existing projects or activities based on their potential environmental impacts as indicated in the Schedule to the notification, being undertaken in any part of India, unless prior environmental clearance has been accorded in accordance with the objectives of National Environment Policy as approved by the Union Cabinet on 18th May, 2006 and the procedure specified in the notification, by the Central Government or the State or Union territory Level Environment Impact Assessment Authority (SEIAA), to be constituted by the Central Government in consultation with the State Government or the Union territory Administration concerned under sub-section (3) of section 3 of the Environment (Protection) Act, 1986 for the purpose of this notification, was published in the Gazette of India ,Extraordinary, Part II, section 3, sub-section (ii) vide number S.O. 1324 (E) dated the 15th September ,2005 inviting objections and suggestions from all persons likely to be affected thereby within a period of sixty days from the date on which copies of Gazette containing the said notification were made available to the public; And whereas, copies of the said notification were made available to the public on 15th September, 2005; And whereas, all objections and suggestions received in response to the abovementioned draft notification have been duly considered by the Central Government;

Now, therefore, in exercise of the powers conferred by sub-section (1) and clause (v) of sub-section (2) of section 3 of the Environment (Protection) Act, 1986, read with clause (d) of sub-rule (3) of rule 5 of the Environment (Protection) Rules, 1986 and in supersession of the notification number S.O. 60 (E) dated the 27th January, 1994, except in respect of things done or omitted to be done before such supersession, the Central Government hereby directs that on and from the date of its publication the required construction of new projects or activities or the expansion or modernization of existing projects or activities listed in the Schedule to this notification entailing capacity addition with change in process and ortechnology shall be undertaken in any part of India only after the prior environmental clearance from the Central Government or as the case may be, by the State Level Environment Impact Assessment Authority, duly constituted by the Central Government

under sub-section (3) of section 3 of the said Act, in accordance with the procedure specified hereinafter in this notification.

5.2 Requirements of prior Environmental Clearance (EC)

The following projects or activities shall require prior environmental clearance from the concerned regulatory authority, which shall hereinafter referred to be as the Central Government in the Ministry of Environment and Forests for matters falling under Category A‟ in the Schedule and at State level the State Environment Impact Assessment Authority (SEIAA) for mattersfalling under Category B‟ in the said Schedule, before any construction work, or preparation of land by the project management except for securing the land, is started on the project or activity:

(i) All new projects or activities listed in the Schedule to this notification;

(ii) Expansion and modernization of existing projects or activities listed in the Schedule to this notification with addition of capacity beyond the limits specified for the concerned sector, that is, projects or activities which cross the threshold limits given in the Schedule, after expansion or modernization;

(iii) Any change in product - mix in an existing manufacturing unit included in Schedule beyond the specified range.

5.3 State Level Environment Impact Assessment Authority

(i) A State Level Environment Impact Assessment Authority hereinafter referred to as the SEIAA shall be constituted by the Central Government under sub-section (3) of section 3 of the Environment (Protection) Act, 1986 comprising of three Members including a Chairman and a Member – Secretary to be nominated by the State Government or the Union territory Administration concerned.

(ii) The Member-Secretary shall be a serving officer of the concerned State Government or Union territory administration familiar with environmental laws.

(iii) The other two Members shall be either a professional or expert fulfilling the eligibility criteria given in Appendix VI to this notification.

(iv) One of the specified Members in sub-paragraph (3) above who is an expert in the Environmental Impact Assessment process shall be the Chairman of the SEIAA.

(v) The State Government or Union territory Administration shall forward the names of the Members and the Chairman referred in sub-paragraph 3 to 4 above to the Central Government and the Central Government shall constitute the SEIAA as an authority for the purposes of this notification within thirty days of the date of receipt of the names.

(vi) The non-official Member and the Chairman shall have a fixed term of three years (from the date of the publication of the notification by the Central Government constituting the authority).

(vii) All decisions of the SEIAA shall be unanimous and taken in a meeting.

5.4 Categorization of projects and activities

(i) All projects and activities are broadly categorized in to two categories - Category A and Category B, based on the spatial extent of potential impacts and potential impacts on human health and natural and man-made resources.

(ii) All projects or activities included as Category "A" in the Schedule, including expansion and modernization of existing projects or activities and change in product mix, shall require prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC) to be constituted by the Central Government for the purposes of this notification;

(iii) All projects or activities included as Category "B" in the Schedule, including expansion and modernization of existing projects or activities as specified in sub paragraph (ii) of paragraph 2, or change in product mix as specified in sub paragraph (iii) of paragraph 2, but excluding those which fulfill the General Conditions (GC) stipulated in the Schedule, *will* require prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC) as to be constituted for in this notification. In the absence of a duly constituted SEIAA or SEAC, a Category „B" project shall be treated as a Category „A" project;

5.5 Screening, Scoping and Appraisal Committees

The same Expert Appraisal Committees (EACs) at the Central Government and SEACs (hereinafter referred to as the (EAC) and (SEAC) at the State or the Union territory level shall screen, scope and appraise projects or activities in Category "A" and Category "B"respectively. EAC and SEAC"s shall meet at least once every month.

a) The composition of the EAC shall be as given in Appendix VI. The SEAC at the State or the Union territory level shall be constituted by the Central Government in consultation with the concerned State Government or the Union territory Administration with identical composition;

b) The Central Government may, with the prior concurrence of the concerned State Governments or the Union territory Administrations, constitutes one SEAC for more than one State or Union territory for reasons of administrative convenience and cost;

c) The EAC and SEAC shall be reconstituted after every three years;

d) The authorized members of the EAC and SEAC, concerned, may inspect any site(s) connected with the project or activity in respect of which the prior environmental clearance is sought, for the purposes of screening or

scoping or appraisal, with prior notice of at least seven days to the applicant, who shall provide necessary facilities for the inspection;

e) The EAC and SEACs shall function on the principle of collective responsibility. The Chairperson shall endeavor to reach a consensus in each case, and if consensus cannot be reached, the view of the majority shall prevail.

Table 1. List of Projects or Activities Requiring Prior Environmental Clearance

Project or Activity		Category with threshold limit		Conditions if any
		A	B	
1		Mining, extraction of natural resources and power generation (for a specified production capacity)		
(1)	(2)	(3)	(4)	(5)
1(a)	Mining of minerals	≥ 50 ha. of mining lease area Asbestos mining irrespective of mining area	<50 ha ≥ 5 ha .of mining lease area.	General Condition shall apply Note: Mineral prospecting (not involving drilling) are exempted provided the concession areas have got previous clearance for physical survey
1(b)	Offshore and onshore oil and gas exploration, development & production	All projects		Note: Exploration Surveys (not involving drilling) are exempted provided the concession areas have got previous clearance for physical survey
1(c)	River Valley projects	≥ 50 MW hydroelectric power generation; ≥ 10,000 ha. of culturable command area	< 50 MW ≥ 25MW hydroelectric power generation; < 10,000 ha. of culturable command area	General Condition shall apply
1(d)	Thermal Power Plants	≥ 500 MW (coal/lignite/naphta & gas based); ≥ 50 MW (Pet coke diesel and all other fuels)	< 500 MW (coal lignite/ naptha & gas based); <50 MW ≥ 5MW (Pet coke, diesel and all other fuels)	General Condition shall apply

1(e)	Nuclear power projects and processing of nuclear fuel	All projects	-	-
2		Primary Processing		
2(a)	Coal washeries	≥ 1 million ton/annum throughput of coal	<1millionton/annum throughput of coal	General Condition shall apply (If located within mining area the proposal shall be appraised together with the mining proposal)
2 (b)	Mineral beneficiation	≥ 0.1million ton/annum mineral throughput	< 0.1million ton/annum mineral throughput	General Condition shall apply (Mining proposal with Mineral beneficiation shall be appraised together for grant of clearance)
3		Materials Production		
(1)	(2)	(3)	(4)	(5)
3(a)	Metallurgical industries (ferrous & nonferrous)	a)Primary metallurgical industry All projects b)Sponge iron manufacturing ≥ 200TPD c)Secondary metallurgical processing industry All toxic and heavy metal producing units ≥ 20,000 tonnes /annum	Sponge iron manufacturing <200TPD Secondary metallurgical processing industry i.)All toxic and heavy metal producing units <20,000 tonnes /annum ii.)All other non – toxic second industries >5000 tonnes/ annum	General Condition shall apply for Sponge iron manufacturing
3 (b)	Cement plants	≥ 1.0 million tonnes/ annum production capacity	<1.0 million tonnes/annum production capacity. All Stand alone grinding units	General Condition shall apply
4		Materials Processing		
(1)	(2)	(3)	(4)	(5)
4(a)	Petroleum refining industry	All projects	-	-
4(b)	Coke oven plants	≥2,50,00 0 tonnes/a	<2,50,000 & ≥25,000	-

			tonnes/annum	
4(c)	Asbestos milling and asbestos based products	All projects	-	-
4(d)	Chlor-alkali industry	≥300 TPD production capacity or a unit located outside the notified industrial area/ estate	<300 TPD production capacity and located within a notified industrial area/ estate	Specific Condition shall apply No new Mercury Cell based plants will be permitted and existing units converting to membrane cell technology are exempted from this Notification
4(e)	Soda ash Industry	All projects	-	-
4(f)	Leather/skin/hide processing industry	New projects outside the industrial area or expansion of existing units	All new or expansion of projects located within a notified industrial area/ estate	Specificcondition shall apply
5		Manufacturing/Fabrication		
5(a)	Chemical fertilizers	All projects	-	-
5(b)	Pesticides industry andpesticide specific intermediates (excluding formulations)	Allunits producing technical grade pesticides	-	-
5(c)	Petro-chemical complexes (industries based on processing of petroleum fractions & natural gas and/or reforming to aromatics)	All projects -	-	-
5(d)	Manmade fibers manufacturing	Rayon	Others	General Condition shall apply
5(e)	Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes)	Located outside the notified industrial area/ estate -	Located in a notified industrial area/ estate	SpecificCondition shall apply

5(f)	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basicorganic chemicals, other synthetic organic chemicals and chemical intermediates)	Located outside the notified industrial area/estate	Located in a notified industrial area/ estate	SpecificCondition shall apply
5(g)	Distilleries	(i) All Molasses based distilleries (ii) All Cane juice/ non-molasses based distilleries ≥30 KLD	AllCane juice/non-molasses based distilleries – <30 KLD	General Condition shall apply
5(h)	Integrated paint industry	-	All projects	General Condition shall apply
5(i)	Pulp & paper industry excluding manufacturing of paper from waste paper and Manufacture of paper from ready pulp without bleaching	Pulp manufacturing And Pulp & Paper manufacturing industry -	Paper manufacturing industry without pulp manufacturing	General condition shall apply
5(j)	Sugar Industry	-	≥ 5000 tcd cane crushing capacity	General condition shall apply
5(k)	Induction/arc furnaces/cupola furnaces 5TPH or more	-	All projects	General condition shall apply
6		Service Sectors		

6(a)	Oil & gas transportationpipe line (crude and refinery/ petrochemical products), passing through national parks/sanctuaries/c oral reefs /ecologically sensitive areas includingLNG Terminal	All projects -		-
6(b)	Isolated storage & handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of schedule 2 & 3 of MSIHC Rules1989 amended 2000)	-	All projects	General Condition shall apply
7		Physical Infrastructure including Environmental Services		
7(a)	Air ports	All projects	-	-
7(b)	All ship breaking yards including ship breaking units	All projects	-	-
7(c)	Industrial estates/ parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes.	If at least one industry in the proposed industrial estate falls under the Category A, entire industrial area shall be treated as Category A, irrespective of the area. Industrial estates with area greater than 500 ha. and housing at least one Category B industry.	Industrial estates housing at least one Category B industry and area <500 ha. Industrial estates of area> 500 ha. and not housing any industry belonging to Category A or B.	Special condition shall apply Note: Industrial Estate of area below 500 ha. and not housing any industry of category A or B does not require clearance.
7(d)	Common hazardous waste treatment, storage and disposal facilities (TSDFs)	All integrated facilities having incineration &landfill or incineration alone	All facilities having land fill only	General Condition shall apply
7(e)	Ports, Harbours	≥ 5 million TPA of cargo handling capacity (excluding fishing harbours)	< 5 million TPA of cargo handling capacity and/or ports/ harbours ≥10,000	General Condition shall apply

			TPA of fish handling capacity	
7(f)	Highways	i) New National High ways; and ii) Expansion of National High ways greater than 30 KM, involving additional right of way greater than 20m involving land acquisition and passing through more than one State.	i) New State High ways; and ii) Expansion of National / State Highways greater than 30 km involving additional right of way greater than 20m involving land acquisition.	General Condition shall apply
7(g)	Aerial ropeways		All projects	General Condition shall apply
7(h)	Common Effluent Treatment Plants (CETPs)		All projects	General Condition shall apply
7(i)	Common Municipal Solid Waste Management Facility (CMSWMF)		All projects	General Condition shall apply
8		Building /Construction projects/Area Development projects and Townships		
8(a)	Building and Construction projects		≥20000 sq.mtrs and <1,50,000sq.mtrs.of built-up area#	(built up area for covered construction; in the case of facilities open to the sky, it will be the activity area)
8(b)	Townships and Area Development projects.		Covering an area ≥ 50 ha and or Built up area ≥1,50,000 sq .mtrs ++	All projects under Item 8(b) shall be appraised as Category B1

5.6 General Condition (GC)

Any project or activity specified in Category B will be treated as Category A, if located in whole or in part within 10 km from the boundary of: (i) Protected Areas notified under the Wild Life (Protection) Act, 1972, (ii) Critically Polluted areas as notified by the Central Pollution Control Board from time to time, (iii) Notified Eco- sensitive areas, (iv) inter-State boundaries and international boundaries.

5.7 Specific Condition (SC)

If any Industrial Estate/Complex / Export processing Zones /Special Economic Zones/Biotech Parks / Leather Complex with homogeneous type of industries such as Items 4(d), 4(f), 5(e), 5(f), or those Industrial estates with pre –defined set of activities (not necessarily homogeneous, obtains prior environmental clearance, individual industries including proposed industrial housing within such estates /complexes will not be required to take prior environmental clearance, so long as the Terms and Conditions for the industrial estate/complex are complied with (Such estates/complexes must have a clearly identified management with the legal responsibility of ensuring adherence to the Terms and Conditions of priorenvironmental clearance, who may be held responsible for violation of the same throughout the life of the complex/estate).

5.7 Composition of the Sector/Project Specific (EAC) and (SEACS).

The Composition of the Sector/Project Specific Expert Appraisal Committees (EAC(s) for category-A and the State/UT Level Expert Appraisal Committees (SEACs) for category-B Projects shall consist of only professionals and experts fulfilling the following eligibility criteria:

- **Professional:** The person should have at least (i) 5 years of formal University training in the concerned discipline leading to a MA/MSc Degree, or (ii) in case of Engineering/Technology/Architecture disciplines, 4 years formal training in a professional training course together with prescribed practical training in the field leading to a B.Tech/B.E./B.Arch. Degree, or (iii) Other professional degree (e.g. Law) involving a total of 5 years of formal University training and prescribed practical training, or (iv) Prescribed apprenticeship/article ship and pass examinations conducted by the concerned professional association (e.g. Chartered Accountancy),or (v) a University degree , followed by 2 years of formal training in a University or Service Academy (e.g.

MBA/IAS/IFS). In selecting the individual professionals, experience gained by them in their respective fields will be taken note of.

- **Expert:** A professional fulfilling the above eligibility criteria with at least 15 years of relevant experience in the field, or with an advanced degree (e.g. Ph.D.) in a concerned field and at least 10 years of relevant experience.
- **Age:** Below 70 years. However, in the event of the non-availability of /paucity of experts in a given field, the maximum age of a member of the Expert Appraisal Committee may be allowed up to 75 years.
- The Members of the EAC shall be Experts with the requisite expertise and experience in the following fields /disciplines. In the event that persons fulfilling the criteria of "Experts" are not available, Professionals in the same field with sufficient experience may be considered:
  - **Environment Quality Experts**: Experts in measurement/monitoring, analysis and interpretation of data in relation to environmental quality
  - **Sectoral Experts in Project Management**: Experts in Project Management or Management of Process/Operations/Facilities in the relevant sectors.
  - **Environmental Impact Assessment Process Experts**: Experts in conducting and carrying out Environmental Impact Assessments (EIAs) and preparation of Environmental Management Plans (EMPs) and other Management plans and who have wide expertise and knowledge of predictive techniques and tools used in the EIA process.
- **Risk Assessment Experts**
- **Life Science Experts in floral and faunal management**
- **Forest and Wild Life experts**
- **Environmental Economics Expert with experience in project appraisal**

(i) The Membership of the EAC shall not exceed 15 (fifteen) regular Members. However the Chairperson may co-opt an expert as a Member in a relevant field for a particular meeting of the Committee.

(ii) The Chairperson shall be an outstanding and experienced environmental policy expert or expert in management or public administration with wide experience in the relevant development sector

(iii) The Chairperson shall nominate one of the Members as the Vice Chairperson who shall preside over the EAC in the absence of the Chairman /Chairperson.

(iv) A representative of the Ministry of Environment and Forests shall assist the Committee as its Secretary.

(v) The maximum tenure of a Member, including Chairperson, shall be for 2 (two) terms of 3 (three) years each.

The Chairman/Members may not be removed prior to expiry of the tenure without cause and proper enquiry

Summary

References

EPG Pathshala, Subject: Environmental Science, Paper No: 12 Environmental Management Module: 09 EIA Notification 2006 –I.

Unit 6: EIA Notification in India

Unit Structure

6.0 Learning objectives
6.1 Introduction
6.2 Prescribing qualifications/ eligibility criteria with respect to Chairman and Member EAC
6.3 Post Environmental Clearance Monitoring
6.4 Amendments in procedure for Scoping
6.5 Introduction of new category B2 in Schedule and formation of DEIA and DEAC
6.6 Scheme of accreditation of EIA consultants
6.7 Product Mix Pet Coke in existing projects
6.8 Integration of Environmental Conditions with Building Permissions:
6.9 Amendments in Schedule
Summary

6.0 Learning objectives

After studying this unit you will be able to:

- Understand about the EIA Notification
- Understand the depth knowledge EIA Notification 2006 and its amendments

6.1 Introduction

In suppression to EIA Notification 1994, a new notification 2006 was published in the Gazette of India on 14 September 2006 and implemented prospectively. A time line of 24 month was given for clearance of projects which were already at various stages and submitted pre EIA Notification 2006. The new notification was totally a reform to the previous notification. The notification included 12 main paragraphs and subparagraphs under each paragraph. The notification included a Schedule having list of projects or activities requiring prior environmental clearance. The various projects were divided into category "A" and "B". Depending on the type of project/activity, the schedule contains 8 major types of projects/activities and each project

type/activity type is subdivided into many activities. The notification also included appendix from Ito VI.

However, during the last 11 years (December 2017), the notification has come a long way with many numbers of amendments, substitutions, deletions, additions etc. During the last 11 years, 26 amendments as listed following have been made changingnearly all structure of the notification.

i. The principal notification was published in the Gazette of India, Extraordinary,Part II, Section 3, Sub-section(ii)
ii. vide number S.O. 1533(E), dated the 14th September, 2006
iii. S.O.1737(E) dated the 11th October, 2007,
iv. S.O. 3067(E), dated the 1st December, 2009,
v. S.O.695(E), dated the 4th April, 2011,
vi. S.O.2896(E), dated the 13th December, 2012,
vii. S.O.674(E), dated the 13th March, 2013,
viii. S.O.2559(E), dated the 22nd August, 2013,
ix. S.O.2731(E), dated the 9th September, 2013,
x. S.O. 562(E), dated the 26th February, 2014,
xi. S.O.637(E), dated the 28th February, 2014,
xii. S.O.1599(E), dated the 25th June, 2014,
xiii. S.O. 2601 (E), dated 7th October, 2014,
xiv. S.O. 2600(E) dated 9th October, 2014,
xv. S.O. 3252(E) dated 22nd December, 2014,
xvi. S.O. 382 (E), dated 3rd February, 2015, and S.O. 811(E), dated 23rd March, 2015,
xvii. S.O. 996 (E) dated 10th April, 2015,
xviii. 18. S.O. 1142 (E) dated 17th April, 2015,
xix. 19. S.O. 1141 (E) dated 29th April, 2015,
xx. S.O. 1834(E) dated 6th July, 2015 and S.O. 2572(E) dated 14th September, 2015,

xxi. S.O. 141(E) dated 15th January, 2016,

xxii. S.O. 190(E) dated 20th January, 2016,

xxiii. S.O. 648(E) dated 3rd March, 2016 and S.O. 2269(E) dated 1st July, 2016.

xxiv. S.O. 2944 (E) dated 14th September 2016

xxv. S.O. 3518 (E) dated 23rd November 2016

xxvi. S.O. 3999 (E) dated 9th December 2016

xxvii. S.O. 804(E) dated 14th March, 2017

Some of these amendments were very minor and included in only minor insertions, substitutions deletions etc. But some of the amendments were very major and added new dimensions to the notification. The number of paragraphs in main EIA Notification has increased from 12 to 14. New subparagraphs have also been added in many main paragraphs.

The list of projects/activities in the schedule has also been amended with new additions and deletions. In Schedule another category of "B2" has been added up for mining of minor minerals. New appendix has also been added increasing the appendix I-VI to I-XVI. The following new appendix has been added.

APPENDIX VII: Qualifications and terms for the Experts in DEIAA and DEAC

APPENDIX VIII: FORM 1 M - Application for mining of minor minerals undercategory 'B2' for less than and equal to five hectare.

APPENDIX – IX: Exemption of certain cases from requirement of environmentalclearance

APPENDIX – X: Procedure for preparation of district survey report

APPENDIX – XI: Procedure for environmental clearance for mining of minorminerals including cluster

APPENDIX – XII: Procedure for monitoring of sand mining or river bed mining

APPENDIX –XIII: Process for obtaining "No Increase in Pollution Load" certificate/permission from the State Pollution Control Board.

APPENDIX-XIV: Environmental conditions for buildings and constructions (Category 1: 5000 to <20,000 Square meters)

APPENDIX –XV: Accreditation of Environmental auditors (Qualified BuildingAuditors)

APPENDIX –XVI: Environmental cell at the level of local authority

Keeping in view of the large number of amendments it is not possible to discuss allbut some of the important amendments are discussed follow.

6.2 Prescribing qualifications/ eligibility criteria with respect to Chairman and Member EAC

The 1st amendment No. S.O.1737(E) dated the 11th October, 2007 mainly substituted the eligibility criteria given in APPENDIX VI for chairman EAC and other member. As per the amendment the Chairman and other member shall be an expert in one of the specified fields as described below, with sufficient experience in environmental policy or management.

- **Environment Quality:** Experts in measurement, monitoring, analysis and interpretation of data in relation to environmental quality.
- **Sectoral Project Management:** Experts in Project Management or Management of Process or Operations or Facilities in the relevant sectors.
- **Environmental Impact Assessment Process:** Experts in conducting and carrying out Environmental Impact Assessments (EIAs) and preparation of Environmental Management Plans (EMPs) and other Management Plans and who have wide expertise and knowledge of predictive techniques and tools used in the EIA process.
  - Risk Assessment
  - Life Science (Floral and Faunal Management)
  - Forestry and Wildlife

- Environmental Economics with experience in project appraisal
- Public Administration or Management

6.3 Post Environmental Clearance Monitoring

The 1st major amendment in **Post Environmental Clearance Monitoring** came in S.O. 3067(E), dated the 1st December, 2009 when in respect of Category 'A' projects, it was made mandatory for the project proponent to make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the district or State where the project is located and in addition, this shall also be displayed in the project proponent's website permanently. Further, in respect of Category 'B' projects, irrespective of its clearance by MoEF / SEIAA, the project proponent shall prominently advertise in the newspapers indicating that the project has been accorded environment clearance and the details of MoEF website where it is displayed. The Ministry of Environment and Forests and the State / Union Territory Level Environmental Impact Assessment Authorities (SEIAAs), as the case may be, shall also be place the environmental clearance in the public domain on Government portal. The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.

6.4 Amendments in procedure for Scoping

The amendments in respect of scoping werepublished vide S.O.2896(E), dated the 13th December, 2012.

"Scoping" refers to the process to determine detailed and comprehensive Terms of Reference (TOR) addressing all relevant environmental concerns for the preparation of an Environment Impact Assessment (EIA) Report in respect of the project or activity for which prior environmental clearance is sought. Standard TOR developed by the Ministry in consultation with the sector specific Expert Appraisal Committees shall be the deemed approved

TOR for the projects or activities. The standard Terms of Reference are displayed on the website of the Ministry of Environment, Forest and Climate Change:

Provided that the Expert Appraisal Committee (EAC) or State Expert Appraisal Committee (SEAC) may finalize amendment, if found necessary for a project within thirty days of the acceptance of application in specified application Form I or Form IA. These standards TOR shall enable the Project Proponent to commence preparation of an Environment Impact Assessment Report after successful online submission and registration of the application:

Provided further that, the Expert Appraisal Committee (EAC) or State Expert Appraisal Committee (SEAC) may stipulate additional Terms of Reference, if found necessary, within thirty days of the acceptance of the application in the specified application Form I or Form IA and the Project Proponent shall carry out the EIA studybased on the standard TORs as well as the additional TOR, if any, stipulated by EAC/SEAC:

Provided also that the following shall not require Scoping−

i. all projects and activities listed under Category 'B', against Item 8(a) of theSchedule;
ii. All national high way and new state highways
iii. all Highway expansion projects involving expansion of national highways greater than 30 KM, involving additional right of way greater than 20 m involving land acquisition and passing through more than one state and expansion of national / State highways greater than 30 KM, involving additional right of way greater than 20 m involving land acquisition Provided also that –
    A. the project and activities referred to in clause (i) shall be appraised on the basis of Form I or Form IA and the conceptual plan;
    B. the projects referred to in clause (ii) shall prepare EIA and EMP report on the basis of standard TOR specified by the Ministry of Environment, Forest andClimate Change.

6.5 Introduction of new category B2 in Schedule and formation of DEIA and DEAC

The most major amendment in the original notification came in S.O. 141(E) dated15th January, 2016. A new category of 'B2' was inserted in the schedule. This category related to the mining of minor minerals in the said schedule. The amendment put the mining of minor minerals up to 5 ha of mining lease area (B2 category) under the preview of new committees District Level Environment Impact Assessment Authority (DEIAA) and District Level Expert Appraisal Committee at district level. The important points of the amendments are as follow.

(i) Inserting Category 'B2' for mining of minor minerals in the said Schedule

(ii) Formation of District Environment Impact Assessment Authority (DEIAA) for matters falling under Category 'B2' comprising of four members including a Chairperson and a Member Secretary.

(iii) Formation of District Level Expert Appraisal Committee (DEAC) comprising of eleven members, including a Chairman and a Member-Secretary.

(iv) The senior most Executive Engineer, Irrigation Department in the district of respective State Governments or Union territory Administration shall be the Chairperson of the DEAC.

(v) The Assistant Director or Deputy Director of the Department of Mines and Geology or District Mines Officer or Geologist of the district shall be the Member- Secretary of the DEAC in that order.

(vi) The District Magistrate or District Collector shall notify an agency to act as Secretariat for the DEIAA and the DEAC and shall provide all financial and logistic support for their statutory functions.

(vii) Introduction of Appendix VII-The term and qualifications of the expert fulfilling the eligibility for DEIAA and DEAC.

(viii) The 'B2' Category projects pertaining to mining of minor mineral of lease area less than or equal to five hectare shall require prior

environmental clearance from DEIAA. The DEIAA shall base its decision on the recommendations of DEAC, as constituted for this notification.

(ix) Form 1M for mining of minor minerals up to five hectare under Category 'B2' projects, as given in Appendix VIII, before commencing any construction activity, or preparation of land, or mining at the site by the project proponent.

(x) Exemption of cases from prior environmental clearance as specified in Appendix IX . These are:

1) Extraction of ordinary clay or sand, manually, by the Kumhars (Potter) to prepare earthen pots, lamp, toys, etc. as per their customs.

2) Extraction of ordinary clay or sand, manually, by earthen tile makers who prepare earthen tiles.

3) Removal of sand deposits on agricultural field after flood by farmers.

4) Customary extraction of sand and ordinary earth from sources situated in Gram Panchayat for personal use or community work in village.

5) Community works like de-silting of village ponds or tanks, construction of village roads, ponds, and bunds undertaken in Mahatama Gandhi National Rural Employment and Guarantee Schemes, other Government sponsored schemes, and community efforts.

6) Dredging and de-silting of dams, reservoirs, weirs, barrages, river, and canals for the purpose of their maintenance, upkeep and disaster management.

7) Traditional occupational work of sand by Vanjara and Oads in Gujarat vide notification number GU/90(16)/MCR-2189(68)/5-CHH, dated the 14th February, 1990 of the Government of Gujarat.

8) Digging of well for irrigation or drinking water.

9) Digging of foundation for buildings not requiring prior environmental clearance.

10) Excavation of ordinary earth or clay for plugging of any breach caused in canal, nala, drain, water body, etc., to deal with any disaster or flood like situation upon orders of District Collector or District Magistrate.

11) Activities declared by State Government under legislations or rules as non- mining activity with concurrence of the Ministry of Environment, Forest and Climate Change, Government of India.

   a) Prescribed procedure for preparation of District Survey Report for sand mining or river bed mining and mining of other minor minerals is given in Appendix X.

   b) Prescribed procedure for environmental clearance for mining of minor minerals including cluster situation is given in Appendix XI.

   c) Prescribed procedure for sand mining or river bed mining and monitoring is given in Appendix XII.

6.6 Scheme of accreditation of EIA consultants

The EIA amendment through notification No. S.O. 648(E) dated 3rd March, 2016 introduced in new paragraph No.13 for the preparation and presentation of Environment Impact Assessment (EIA) report and Environment Management Plan (EMP). It was made mandatory that the Environmental consultant organizations which are accredited for a particular sector and the category of project for that sector with the Quality Council of India (QCI) or National Accreditation Board for Education and Training (NABET) or any other agency as may be notified by the Ministry of Environment, Forest and Climate Change from time to time shall be allowed to prepare the Environmental Impact Assessment report and Environmental Management Plan of a project in that sector and category and to appear before the concerned Expert Appraisal Committee (EAC) or the State Expert Appraisal Committee (SEAC). The Ministry will also prepare a panel of national level

reputed educational and research institutions to work as Environmental Consultant Organizations. The details in this regard are given in module No. 34 of this paper.

6.7 Product Mix Pet Coke in existing projects

Amendment vide S.O.3SfB (E) dated 23.11.2O16 was issued regarding prior Environmental Clearance (EC) process for Expansion or Modernization or Change of product mix in existing projects: one of the important point of the amendment was exemption from the requirement of prior environmental clearance in case of any change in product-mix, change in quantities within products or number of products in the same category for which environmental clearance has been granted provided that there is no change in the total capacity sanctioned in prior environmental clearance and there is no increase in pollution load. The amendment further provides that the project proponent shall follow the procedure for obtaining **No Increase in Pollution Load certificate** from the concerned State Pollution Control Board as given in Appendix –XIII.

6.8 Integration of Environmental Conditions with Building Permissions:

The Government vide notification S.O. No. 3999 (E) dated 09.12.2016 put in place a new framework and an institutional structure for streamlining the environmental clearance for building and construction sector. This was a step towards decentralization, delegation of powers and enhancing the '**Ease of Doing Responsible Business'.** The amendment mainly focused on integrating standard and objectively monitorable environmental conditions with building permissions for buildings of different sizes:

Category '1': 5000 sq. mtr. to 20,000 sq. mtr

Category '2': 20,000 sq. mtr. to 50,000 sq. mtr

Category '3': 50,000 sq. mtr. to 1,50,000 sq. mtr

The important features of the amendment are:

(i) All building and construction projects covering 20,000 sq. mtr. and above are subject to environmental clearance given by the State Level Environmental Impact Assessment Authority. Under the revised norms, the environmental clearance will now be issued in an integrated manner along with the building permission under building bye laws for all building constructions covering 20,000 to 1,50,000 sq. mtr. of built up area.

(ii) Environmental clearance for built up areas from 1,50,000 to 3,00,000 sq. mtr. will be given by the State Level Authorities subject to EIA while the areas above 3,00,000 sq. mtr. will be approved and cleared by the Union Government. In other words, the Townships and Area Development projects of size ≥ 3,00,000 sq. mtr. of built up area or covering an area ≥ 150 ha area are being included in Category "A" of Schedule and appraised at the central level.

(iii) Area less than 20,000 sq. mtr. will be subject to a self-declaration. However, the buildings of size 5000 sq. mtr. to 20,000 sq. mtr. will also follow environmental norms for construction and maintenance phase.

(iv) For the first time, it has been envisaged that the Qualified Building Environment Auditors as empanelled by the MoEFCC would assess and certify the building projects.

(v) For the first time the provision of self-declaration for compliance and also certification by Qualified Building Environment Auditors have been introduced for building and environmental clearance.

(vi) It is mandatory to constitute an Environmental Cell in the local authorities to support appraisal, compliance and monitoring of building projects and to provide environmental planning in this area.

(vii) The Environmental Cell will also have independent sectoral experts.

(viii) The Environment Cell in the local authority will process the application and present it in the meeting of the Committee headed by the authority competent to give building permission in that local authority. The Committee will appraise the project and stipulate the

environmental conditions to be integrated in the building permission. After recommendations of the Committee, the building permission and environmental clearance will be issued in an integrated format by the local authority.

(ix) The project proponent shall submit Performance Data and Certificate of Continued Compliance of the project for the environmental conditions parameters applicable after completion of construction from Qualified Building Environment Auditors every five years to the Environment Cell with special focus on the following parameters:-

- Energy Use (including all energy sources)
- Energy generated on site from onsite Renewable energy sources
- Water use and waste water generated, treated and reused on site
- Waste Segregated and Treated on site
- Tree plantation and maintenance

(x) After completion of the project, the Cell shall randomly check the projects compliance status including the five years audit report. The State Governments will enact the suitable law for imposing penalties for non- compliances of the environmental conditions and parameters.

(xi) The cases of false declaration or certification shall be reported to the accreditation body and to the local body for blacklisting of Qualified Building Environment Auditors and financial penalty on the owner and Qualified Building Environment Auditors.

(xii) No Consent to Establish and Operate under the Water (Prevention and Control of Pollution) Act, 1974 and the Air (Prevention and Control of Pollution) Act, 1981 will be required from the State Pollution Control Boards for residential buildings of built up area up to 1,50,000 square meters.

6.9 Amendments in Schedule

Apart from these many major amendments have been made in **Schedule** since EIA notification 2006. Instead of discussing each amendment,the amendments have been compiled in single table and are attached with the next module No. 12 of this paper.

Note: The current module is written only for education purpose and not for any legal purpose. The contents of the module have been taken from the Govt. of India websites mainlyministry of Environment, Forest and Climate Change. Only those contents have been taken which author feel are important foreducation/teaching to student's purpose.

Summary

References

EPG Pathshala, Subject Environmental Science, Paper No: 12 Environmental Management, Module: 11 EIA Notification 2006 – Amendments https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000282/M028891/ET/1522925143Paper12_Module_11_PC_etext.pdf

Unit 7: EIA Methodologies-I

Unit Structure

7.0 Objectives
7.1 Introduction
7.2 Steps in EIA
7.3 Advantages of EIA
7.4 Hierarchy in EIA
7.5 Desirable of EIA Methodologies
7.6 Criteria for selection of EIA Methodology
7.7 Choosing a Method
7.8 Objectives of Methodologies:
7.9 Focus of Methodology
7.10 Methodology Requirements
Summary

7.0 Objectives

After studying this unit you will be able to understand:

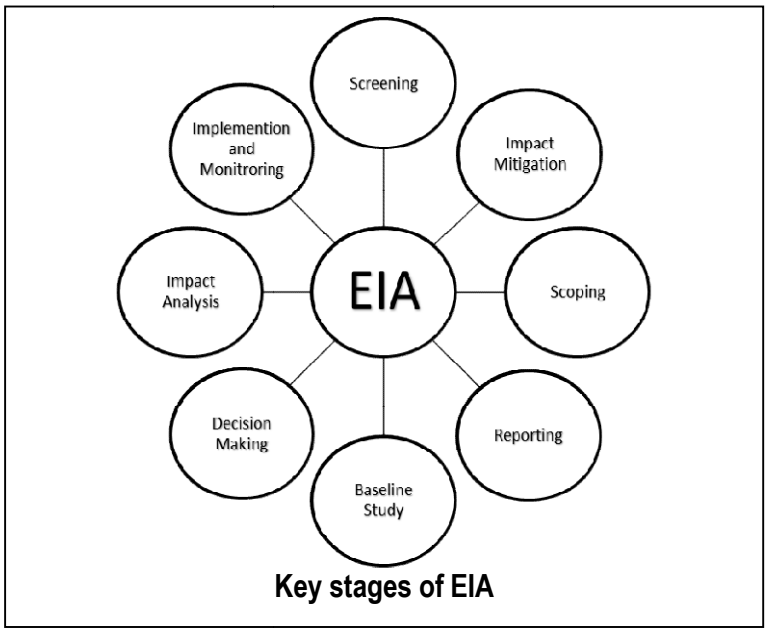
- About general Introduction and Objectives of EIA methodology
- About the various steps involve in EIA
- About the advantages of EIA and Hierarchy in EIA
- About the criteria for selection of EIA Methodology
- About the Methodology Requirements

7.1 Introduction

Environmental Impact Assessment is a stepwise process of identification, evaluation, monitoring and management of the potential impacts of proposed projects on the environment of the local area. By doing so it provides opportunities to minimize proposed environmental damage at initial stages. The main purpose of EIA is to provide information regarding the impacts of project on environmental, ecological, cultural, social and economic components of project

area to the decision makers for decision making and policy transformation. It works on the principle of sustainable development i.e. to ensure that no or minimum environmental degradation is caused due to proposed project. It also takes into account the short term, midterm and long term effects on the demography, ecology and environment of the area. In simple words, EIA is a planning tool for decision making regarding the starting or denying of proposed project based on the measurable environmental and social impact of the proposed activity.

EIA methodology is a structural approach developed to identify, predict and value changes of an action. Changes are reflected to the sequence of activities, steps regarding the environmental issues (physical, chemical, biological, socioeconomic, cultural, landscape values and processes). The methodology uses in process quantify these changes.



Key stages of EIA

7.2 Steps in EIA

The EIA process involves a number of steps, some of which are listed below:

(i) Screening: The projects are 1st screened to know whether the project requires EIA. If yes, then under what category it falls as per norms of the respective regulatory agencies.

(ii) Scoping: Identification of the key issues to be addressed in an EIA. This step involves the identification of major and significant environmental issues among the possible impacts of the project and available alternatives to minimize the environmental impacts.

(iii) Alternative Considerations: The purpose is to ensure that the project proponent has explored other feasibilities and alternatives. These may be location of project, layouts, operating condition, techniques etc.

(iv) Project development Plan: This step involves the description of project like its rationale, stages of development, location, processes, techniques to be used, project cost, development timeline etc.

(v) Environmental baseline data collection: This involves the present state of the environment (air, water, soil, biodiversity, energy etc.) before implementation of the project. The objective of baseline data collection are to:

(a) Understand the current environmental conditions of the area and how the project can be implemented under these conditions

(b) It helps in the prediction and assessment of possible environmental changes that could occur during or after project implementation.

❖ **Baseline data includes-**

- Physical- Geographical and geological characteristics, topography etc.
- Quality of air, water, noise, soil etc.
- Biodiversity of the area, types of flora and fauna, ecosystem types
- Socioeconomic- social structure, economic conditions, demography, migration of locals, etc.
- Cultural- culture, tradition, religion, customs of locals

(vi) **Identification and prediction of key impacts:** Based on the baseline data and scoping, the potentially significant impacts (adverse and beneficial) on environment of the area are identified for project during the development phase and after completion. The magnitude of the identified impacts is predicted by comparing the environmental conditions of base line data with the expected conditions after project implementation.

(vii) **Mitigation and Management of Environmental impacts:** This involves the proposal of different measures to be taken to reduce, manage, remediate or compensate for adverse impacts.

(viii) **Public hearing/consultation:** Public hearing is also part of EIA in some type of projects. The purpose of public participation is to inform the public about the proposed project and its impacts on the local area. The public views or objections are integral part of the decision making process.

(ix) **EIA presentation and Decision-making:** The report submitted by the Environment consultant on behalf of the project proponent is scrutinized for various documents as per EIA manuals/ laws. Any document deficiency is completed before submitting the report to regulatory/designated authorities for the purpose. The facts of the project starting from the screening to public hearing are presented before the experts. The experts may suggest additional measures to minimize the impacts. At this stage decisions are made by the relevant authority to whether to accept, defer or reject the project.

(x) **Post-decision monitoring:** This comes into picture after completion of the project. The outcomes of projects after completion are recorded. These represent the actual impacts of the project.

(xi) **Auditing:** This involves comparing actual outcomes with predicted outcomes. This can be used to assess the quality of predictions and the effectiveness of mitigation.

7.3 Advantages of EIA

The main advantages and benefits of EIA are:

- Improved project design
- Reduced cost and time of project implementation
- More informed decision-making
- Increased project acceptance
- More environmentally sensitive decisions
- Improved project performance and reduction in treatment/clean up costs.
- Increased accountability and transparency during the development process
- Improved integration of projects into their environmental and social setting
- Healthier local environment (forests, water sources, agricultural potential, recreational potential, aesthetic values, and clean living in urban areas)
- Reduced environmental damage
- More effective projects in terms of meeting their financial and/or socio-economic objectives.

7.4 Hierarchy in EIA

The EIA studies are mainly categorized as:

(i) Site selection studies: These studies focuses on the selection of alternative sites keeping in view of the environmental benefits and project attributes such as infrastructure facilities, markets, availability of raw materials, etc. The objective of such studies is the ranking of site alternatives for decision-making.

(ii) Rapid or comprehensive studies: when the assessment period for the baseline data is one season monitoring (i.e. 3- month period), it is called Rapid EIA. Rapid EIA is conducted when a fair amount of knowledge is

available about the proposed site or the impacts of the proposed development. The rapid EIA also makes a base for the comprehensive EIA. However, When the assessment of baseline data is based on 3 seasons monitoring (i.e. 9- month period), it is called comprehensive EIA.

(iii) Regional studies: As the name indicates, these relate to a particular region. The studies are based on seasonal data collection and analysis of air, water and land components of the environment.

(iv) Carrying capacity studies: The natural resources are not infinite and are depleted at a fast pace to support the infrastructure and development activities. To achieve the objective of sustainable development, optimization of natural resources use is must. This can be achieved by considering environmental policies in the development process. Hence, carrying capacity studies are conducted to analyze the resource availability/utilization, infrastructure/congestion, supply/demand ratio and assimilative capacity/residuals. It has often been observed that one or more natural resource(s) becomes a limiting resource in a given region thereby restrict the development activity. In the last few decades, governments of various countries have realized that EIA has to be an integral part of the project life cycle: from project conceptualization to post implementation corrective action. The Ministry of Environment, Forests and Climate change, Govt. of India, has also sponsored Carrying Capacity Studies for differentregions. The studies involve:

- Inventory of the natural resources available
- Preparation of the existing environmental settings
- Perspective plans and their impact on natural resources through creation of "BusinessAs Usual Scenario"
- Identification of "Hot Spots" requiring immediate

remedial action to overcome air,water or land pollution

Formulation of alternative development scenarios including a Preferred Scenarios

7.5 Desirable of EIA Methodologies

EIA Methodology are based on principle of equality, openness, cost-effectiveness andefficiency approaches. Broadly these are 4 types.

(a) Comprehensive: Recognize intricate systems and bound complex inter-relationship.

(b) Selective: Pinpoint critical (significant) impacts and eliminate as early as possible unimportant impacts.

(c) Comparative: Determine environmental changes due to the project activities compared with under existing conditions (Before starting project).

(d) Objective: Provide unbiased measurements free from political and external influences.

7.6 Criteria for selection of EIA Methodology

(a) Simplicity: The methodology should be simple and based on available manpower & background knowledge. It can be adapted without much difficulty.

(b) Budget and Time: The methodology should be applied by small group with under approvebudget and limited time span.

(c) Flexibility: The method should be flexible and allow the modifications and changes duringcourse of study.

7.7 Choosing a Method

The methodology of EIA ranges from simple to complex and requires different kinds of data, several data formats, expertise and technological skill for their

interpretation. Their analyses produce differing levels of precision and certainty. All of these factors should be considered for selecting a suitable methodology.

7.8 Objectives of Methodologies:

1. Understand the nature and location of the project and possible alternatives
2. Identify factors of analysis and assessment objectives
3. Preliminary identification of impacts and scoping
4. Baseline studies and evolution in the absence of projects
5. Prediction and assessment of impacts and alternatives comparison
6. Mitigation
7. Monitoring and impacts management

7.9 Focus of Methodology

- Potential impacts and their types of environmental components
- Natural and social systems
- Time and space

7.10 Methodology Requirements

The EIA practitioner faces vast varieties of raw and unorganized information that must be collected and analyzed in preparation of an EIA report. The best methods are able to:

- Organize a large mass of heterogeneous data
- Allow summarization of data
- Aggregate the data into smaller sets with least loss of information

- Display the raw data and the derived information in a direct and relevant fashion
- Target audience should also be considered (example if target audience are not educated then, use of color code, size, cross etc. should be used rather that figures andtables)

Summary

References

EPG Pathshala, Subject: Environmental Science: Paper No: 12 Environmental Management, Module: 06 Introduction to Environmental Impact Assessment (EIA).

EPG Pathshala, Subject: Environmental Science: Paper No: 12 Environmental Management, Module: 13 EIA Methodology.

Unit 8: EIA Methodologies-II: Major Methodologies for EIA

Unit Structure

8.0 Objectives
8.1 Introduction
8.2 Ad Hoc Method
8.3 Checklists
8.4 Matrix
8.5 Networks
8.6 Overlay Method
Summary

8.0 Objectives

After studying this unit you will be able to:

- Understand about the Ad Hoc Method for EIA
- Understand about the Checklists Method for EIA
- Understand about the Matrix Method for EIA
- Understand about the Networks Method for EIA
- Understand about the Overlay Method for EIA

8.1 Introduction

EIA methodology is a structural approach developed to identify, predict and value changes ofan action. Changes are reflected to the sequence of activities, steps regarding the environmental issues (physical, chemical, biological, socioeconomic, cultural, landscape values and processes). The methodology uses in process quantify these changes. The following are the 5 major methodologies of EIA.

(i) Ad Hoc
(ii) Checklists
(iii) Matrices
(iv) Networks
(v) Overlays

8.2 Ad Hoc Method

This is a simple method and based upon broad environmental impacts aspects. This method is very useful whenever time period is limited with lack of require scientific information. In such situation, EIA depends exclusively on background, expertise and experience of experts. This method is not recommended, when more scientific methods are available.

❖ **Types of Ad Hoc Method**

- Opinion polls
- Expert opinion
- Delphi methods etc.

❖ **Advantage:**

- Simple and easily understandable.
- The experts of a respective areas guide EIA.
- Overall environmental components are enlisted.

❖ **Disadvantage:**

- It required expert person.
- The identification and prediction of short & long term impacts are poor because it examined on guess basis.
- It provides minimal guidance for impact analysis, while suggesting subjective area of impacts
- Not good for organizing, reviewing and interpreting data

8.3 Checklists

Checklists are standard lists of the types of environmental potential impacts, which may be associated with respective project. The lists are prepared with highly structured approaches and involve importance with weighing of factors and ensure that no potential impact is overlooked. Checklists are very effective in impact identification and capable to spread awareness & attention for respective people. Checklists should enable identification of impacts on Soil,

Water, Atmosphere, Flora, Fauna, Resources, Recreation and Cultural etc. status.

A typical checklist might contain entries such as:

- Earth: Mineral Resources, Construction Material, Soils, Land form, Force fields andBackground Radiation, Unique physical features
- Water: Surface water like rivers, lakes and reservoirs, estuaries, coastal seas and ocean, Groundwater quality, Snow, Ice
- atmosphere: Quality regarding gases & particles), Climate, Temperature
- Flora: Trees, Shrubs, Grass, Crops, Micro & Macro flora, aquatic plants; endangeredspecies; barriers; corridors
- Fauna: birds; land animals including reptiles; fish and shellfish; benthic organisms;insects; micro fauna; endangered species; barriers; corridors
- Land Use: Wilderness and open space, Wetlands, Forestry; Grazing, Agriculture,Residential, Commercial, Industrial, Mining and Quarrying
- Recreation: Hunting; Fishing; Boating, Swimming, Camping and Hiking, Picnicking Resorts

❖ **Types of Checklists**

(i) Simple Checklist

(ii) Descriptive Checklists

(iii) Scaling Checklist

(iv) Scaling Weighting Checklist

(v) Questionnaire Checklist

(i) Simple Checklist

Simple checklist consist simple list of environmental parameters and no information needed on the magnitude or importance of impacts.

Checklist can recognize resource/environmental component, which affects by particular activities.

The example given below (Table 1) for construction sites, the tick mark confirm that impact is there, where no tick mark or leaving the box means no impact.

Table 1: Example of Simple Checklist

	Potential Impact from Construction Activities				
Resources	**Site Clearance**	**Earth Moving**	**Lay Foundations**	**Import Materials**	**Cumulati veImpacts**
Air Quality	✓	✓		✓	✓
Water Quality	✓	✓			
Landscape	✓	✓	✓	✓	✓
Ecology	✓				
Noise	✓	✓	✓	✓	✓
Traffic	✓	✓	✓	✓	✓

(Source http://ec.europa.eu/environment/archives/eia/eia-studies)

Table 2: Checklist Used for Identifying Impacts of the Turku Central Sewage Treatment Works

	Impacts on environment				**Impacts on built environment**			
	Soils and Geology	**Surface and Ground water**	**Air and climate**	**Flora and fauna**	**Urban structure and planned land use**	**Buildings and structures**	**Landscape and townscape**	**Cultural heritage**
Construction								
Ground preparation work	□	□	□			□		□
Surface structures					□	□	□	□
Operation								
Treatment of waste Water		□	□	□	□			
Intake and removal of air								
Treatment of sludge			□		□			
Transport								
traffic			□		□			
Exceptional circumstances								
disturbances in operation		□	□	□				

(Source http://ec.europa.eu/environment/archives/eia/eia-studies)

□□Mark indicates issues the project and have an impact. The lack of the symbol indicates thatthe impact will not occur or insignificant.)

Simple Checklist can also give idea about type of impacts like short term, long term, reversible, irreversible etc. An example is depicted in Table 2, mentioned checklist used to identify impacts of Turku Central Sewage Treatment Works. Ground preparation work, wastewater treatment, treatment of sludge, traffic and disturbances in operation has impact on air& climate and resulting in a cumulative impact.

(ii) Descriptive checklist

Descriptive checklist is extension of simple checklists and adds background information of each aspect. It also includes guidelines on the measurement of parameters. Simple checklist consist only aspects, whereas descriptive checklist give both aspect and their background information. Descriptive checklists are strong for impact identification of environmental parameters and also incorporate to measurement of impact measurements, interpretation &evaluation ofimpacts as well as in decision making process. It guides mainly how to impacts assess and include data requirements, information sources and predicted techniques as in Table 3.

Table 3. Impacts assess and include data requirements, information sources and predicted techniques

Data Required	Information Sources, Predictive Techniques
Nuisance Change in Occurrence of odour, smoke, hazeetc. and number of people affected	Expected industrial processes and trafficvolume, citizen surveys
Water Quality For Each body of water, changes in wateruses and number of people affected	Current water quality, current & expectedeffluents
Noise Change in noise levels, frequency of occurrence and number of people affected	Current noise levels, changes in traffic orother noise sources, changes in noise mitigation measures, noise propagation model, citizen surveys

(Source: Schaenman 1976, Glasson et al. 2013)

Descriptive checklist delivers more information about the nature and magnitude of the impacts rather than just identification, whether it occurs or not. Table 4 is an example of a descriptive checklist and includes past, present

and future actions. The checklist can also discuss the cumulative impacts due to past activities, project and other nearby sources.

Table 4: Descriptive Checklist Regarding Cumulative Impacts

Resource	Past Activities	Present Impact	Future Activities	Future Impact	Cumulative Impact
Groundwater	Contaminationfrom industrial use	Contaminationfrom surface water percolation	Excavation of site would result in mobilization of contaminants	Contaminationfrom surface water percolation	Contamination exceed standards
Air Quality	No significant impact from emissions	Emissions from existing power station within standards	Addition emissions	Emissions from existing power station within standards	Combined emissions of two power stations resultsresult in significant impact

(Source http://ec.europa.eu/environment/archives/eia/eia-studies)

(iii)Scaling Checklist

Scaling checklists are similar to the descriptive checklist with additional information of subjective scaling of the impacts on the environmental parameters. The meaning of scaling is rating or grading system. Example: The rating of Water Quality, i.e. best is 5 and 1 for worst. In case of school, generally follows A^+, A, B^+, C etc. A representative example is given below for scaling of parameters in Table 5:

Table 5: Representative Table of Scaling Checklist

Factors	Beneficial Impact			Adverse Impact		
	1	2	3	1	2	3
Habitat Quality						
Species						
Size/Abundance						
Duration						
Magnitude						
1=Low, 2=Medium, 3=High						

❖ **Scaling Weighting Checklist**

Scaling Weighting Checklist represent scaling checklists with information provides as to subjective evaluation of each parameter with respect to every other parameter. Scaling weighting checklists employ both magnitude and importance factor.

In this checklist method, give weightage to specific parameter on the scale and evaluate the Parameter Importance Value for the environmental components and parameters. The structured equations are used to weigh of the environmental parameters. Weighting means give importance to some specific parameter, example water quality is prime important in one project in comparison to land area. So with scaling, give weight to water parameter, so it becomes more important in evaluation.

Example: Environment Evaluation Value System such as **Battelle Environment Evaluation System.**

The Environmental Evaluation System (EES) is a methodology, which conducts environmental impact analysis. The EES evaluates environmental impact in four major categories such as ecology, environmental pollution, and esthetics and human interest.

Major features of the EES are:

1. Its hierarchical classification system;
2. Its commensurate unit of measure (EIU)
3. It's flagging of environmentally sensitive areas.

❖ **Battelle Environment Evaluation**

The Battelle Environmental Evaluation System (EES) is a methodology that developed by Battelle Columbus Laboratories for conducting environmental impact analysis (Dee et al., 1972 &1973).It is based on a hierarchical assessment of environmental quality indicators. The system is based on a classification consisting of four levels:

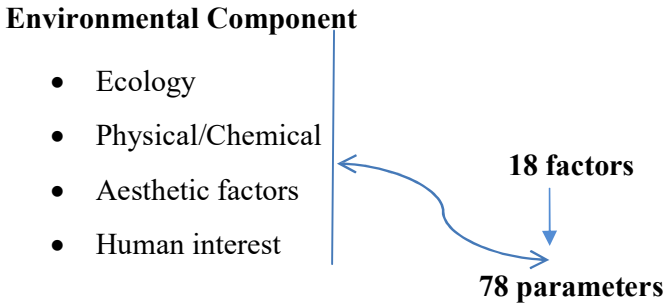
The system is based on classification consisting of four levels. Category (Level 1) is divided into several components (Level II) and each component is divided into several parameters (Level III) and further parameters divide into several measurements (**Table 6**).

Level I: Categories (4)

Level II: Components (18)

Level III: Parameters (78)

Level IV: Measurements



The two EIU scores are produced with and without project activities. The difference between them gives measurement of the environmental impact. Suppose a scale of 10, the score is 8 before starting a project and it became 3 after completion of project, then measurement of impact is 5, means have a lot of impact. If difference will come 2, means less impact.

Table 6 shows the complete list of categories, components, and parameters of the Battelle EES. Column 1 shows the four (4) categories, Column 2 shows the eighteen (18) components and Column 3 shows the seventy-eight (78) parameters.

The EES methodology depends upon the assignment of an importance unit to each parameter and collectively these "importance units" are referred to as "parameter importance units" or PIU's. A total of 1000 PIU's is distributed among the 78 parameters based on value judgments. The individual PIU's are shown in Column 4 of Table 6, the summation component PIU's are shown in Column 5, and the summation category PIU's are shown in Column 6. Effectively, for each parameter i, its $(PIU)_i$ represents a weight w_i.

Table 6. Categories, Components, and Parameters of the Battelle EES (Source: Victor M. Ponce) https://ponce.sdsu.edu/the_battelle_ees.html

(1)	(2)	(3)	(4)	(5)	(6)
			Parameter Importance Unit (PIU)		
Categories	**Components**	**Parameters**	**Parameter**	**Component**	**Category**
Ecology	Species and populations	1. Terrestrial browsers and grazers	14	140	240
		2. Terrestrial crops	14		
		3. Terrestrial natural vegetation	14		
		4. Terrestrial pest species	14		
		5. Terrestrial upland game birds	14		
		6. Aquatic commercial fisheries	14		
		7. Aquatic natural vegetation	14		
		8. Aquatic pest species	14		
		9. Sport fish	14		
		10. Waterfowl	14		
	Habitats and communities	11. Terrestrial food web index	12	100	
		12. Land use	12		
		13. Terrestrial rare and endangered species	12		
		14. Terrestrial species diversity	14		
		15. Aquatic food web index	12		
		16. Aquatic rare and endangered species	12		
		17. River characteristics	12		
		18. Aquatic species diversity	14		
	Ecosystems	Descriptive only	-	-	
Pollution	Water	19. Basin hydrologic loss	20	318	
		20. BOD	25		
		21. Dissolved Oxygen	31		
		22. Fecal coliforms	18		
		23. Inorganic carbon	22		
		24. Inorganic nitrogen	25		
		25. Inorganic phosphate	28		

		26. Pesticides	16		
		27. pH	18		
		28. Stream flow variation	28		
		29. Temperature	28		
		30. TDS	25		
		31. Toxic substances	14		
		32. Turbidity	20		
	Air	33. Carbon monoxide	5	52	
		34. Hydrocarbons	5		
		35. Nitrogen oxides	10		
		36. Particulate matter	12		
		37. Photochemical oxidants	5		
		38. Sulfur dioxide	10		
		39. Other	5		
	Land	40. Land use	14	28	
		41. Soil erosion	14		402
	Noise	42. Noise	4	4	
Aesthetics	Land	43. Geologic surface material	6	32	153
		44. Relief and topographic character	16		
		45. Width and alignment	10		
	Air	46. Odor and visual	3	5	
		47. Sounds	2		
	Water	48. Appearance	10	52	
		49. Land and water interface	16		
		50. Odor and floating materials	6		
		51. Water surface area	10		
		52. Wooded and geologic shoreline	10		
	Biota	53. Animals - domestic	5	24	
		54. Animals - wild	5		
		55. Diversity of vegetation types	9		

		56. Variety within vegetation types	5		
	Manmade objects	57. Manmade objects	10	10	
	Composition	58. Composite effect	15	30	
		59. Unique composition	15		
Human interest	Educational/ scientific packages	60. Archaeological	13	48	205
		61. Ecological	13		
		62. Geological	11		
		63. Hydrological	11		
	Historical packages	64. Architecture and styles	11	55	
		65. Events	11		
		66. Persons	11		
		67. Religions and cultures	11		
		68. Western frontier	11		
	Cultures	69. Indians	14	28	
		70. Other ethnic groups	7		
		71. Religious groups	7		
	Mood/atmosphere	72. Awe-inspiration	11	37	
		73. Isolation/solitude	11		
		74. Mystery	4		
		75. Oneness with nature	11	37	
	Life patterns	76. Employment opportunities	13		
		77. Housing	13		
		78. Social interactions	11		
Sum Total of Parameter Importance Units (PIU)					**1000**

Each PIU_I or w_i requires a specific quantitative measurement and the methodology converts in different measurements i.e. scalar or "value function." A scalar has the specific measurement in the x-axis and a common environmental quality scale or "value" in the y- axis. The latter varies in the range $0 \leq V_i \leq 1$ Where V_i stands Environmental Quality (Source: Victor M. Ponce).

If $V_i = 0$ indicates very poor quality $V_i = 1$ indicates very good quality

Figure 1 shows an example of a typical scalar, that of dissolved oxygen (DO) (Table 1, Column 3, number 21). In this figure, V_i (environmental quality) varies in the range 0-1 as a function of DO concentration (mg/L).

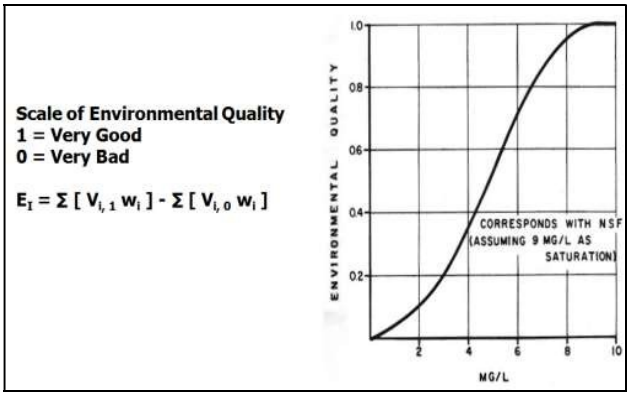


Figure.1: Variation of environmental quality index as a function of DO concentration (mg/L) **Source:** Dee et al. (1973)

Values of $V_i = V_{i,0}$ are obtained for conditions 'without' the projectand

$V_i = V_{i,1}$ for conditions 'with' the project.

The condition 'without' represents the current condition of project activities in case of 'with'represents the predicted future condition of project.

The environmental impact E_I is evaluated as follows:

$$E_I = \sum [V_{i,1} w_i] - \sum [V_{i,0} w_i]$$

For i = 1 to n, where n = number of parameters (78).

For $E_I > 0$, the condition 'with' the project is better than 'without' the project, indicates project has positive environmental benefits. Reversely, $E_I < 0$, the situation 'with' the project is worse than 'without' the project, indicating certain negative impacts& benefits.

The potential problem areas are characterized by those parameters for which the V_i value changes significantly in the adverse direction, as measured by the following relation (in percent):

$$\Delta V_i (\%) = 100 (V_{i,0} - V_{i,1}) / V_{i,0}$$

These parameters are tagged with 'red flags' to indicate potential problems which maywarrant more detailed attention.

For parameters in the ecology category, a minor red flag applies

When $5\% < \Delta V_i < 10\%$; a major red flag, when $\Delta V_i > 10\ \%$

For all other categories, a minor red flag applies

when $\Delta V_i < 30\%$, or $\Delta V_i < 0.1$ (in absolutevalue, per unit);

A major red flag when $\Delta V_i \geq 30\%$, or $\Delta V_i \geq 0.1$ (in absolute value, per unit).

(iv) Questionnaire Checklist

The checklist is prepared on the basis of questions for Public Consultation (Table 7). It gives information about the stakeholder's awareness and responses for their proposed project. The questionnaire is further evaluated in spread sheets to find the scale of impacts and weight of parameters based on public opinion.

Table 7: Example of Questionnaire Checklist (Source: Partidário & Maria, 2003)

Issue	Yes	May be	No observation
Noise. Will the project: Increase existing noise levels?			
Vegetation. Will the project: Change the diversity or productivity of species or thenumber of any species (Including trees, shrubs, aquatic plants. etc.}?			
Energy. Will the project: Use of substantial amounts of energy?			
Transport and Traffic. Will the project: Generate additional traffic? Have effects or increase demand of parking infrastructures?			
Public Service: Will tile projects have effect on or result in, need for new services in or changes in the following areas: Fire services?			
Public Reaction: Is the project: Potentially converse? Conflict with objective in environmental plans locally adapted?			

- **Advantages**

- Simple to understand and use
- Good for site selection and priority setting
- Impacts can see on past, present & future

❖ **Disadvantages**

- Do not distinguish between direct and indirect impacts.
- Do not link action and impact.
- Sometime it is a cumbersome task.

8.4 Matrix

Matrix method provides a framework for interaction between project activities and their environmental impacts. It can evaluate degree of impacts of project activities on environmental resources. It is a grid like table that one axis displayed project activities and other axis displayed environmental characteristics. It can also evaluate the cumulative and indirect impacts as well as interaction with resources.

❖ **Observed as two-dimensional checklist:**

- Axis of actions
- Axis of environmental components
- The intersections are the impacts

❖ **Functions:**

- Preliminary identification of impacts (scoping)
- Comparative analysis of alternatives
- Impact assessment
- Presentation of evaluation results

❖ **Leopold Matrix**

The Leopard Matrix provides a framework for the analysis and numerical weighting of probable impacts. It is a simple way to summarize & rank environmental impacts and to focus on that impact, which is considered to be

greatest. Matrix method is pioneered by Leopold et al (1971), enlisted about 100 project actions and 88 environmental characteristic or parameter. It delivers a total of 8,800 interactions. Each action and their impact potential are considered. The magnitude of the interaction (extensiveness or scale) is described by assigning a value ranging from 1 (for small magnitudes) to 10 (for large magnitudes). The assignment of numerical values is based on an evaluation of available facts and data. Similarly, the scale of importance also ranges from 1 (very low interaction) to 10 (very important interaction). The impact associated with the project action columns and their environmental condition row is described in terms of its magnitude (M) and significance (I) (Figure 2).

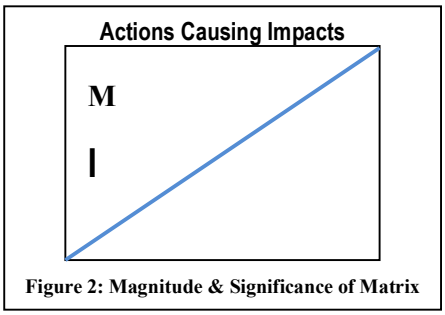


Figure 2: Magnitude & Significance of Matrix

Each impact is described by two factors:

(i) Significance: Indicates the theoretical importance of the impact (eg. The spatial extension) and Varies between -10 and 10.

(ii) Magnitude (size or importance): how much the impact is present in this case? It varies between -10 and 10.

Each individual impact is estimated by the product of significance and magnitude

In Leopard matrix: On horizontal axis - The actions cause environmental impact

On the vertical axis - The existing environmental conditions affected by actions

Table 8 depicted the factors listed in the vertical & horizontal axis of the Leopold matrix. The horizontal axis shows most efficient way to check each significant action (listed on the horizontal axis). As on listed on vertical axis give information about that each checked action (on horizontal axis) is

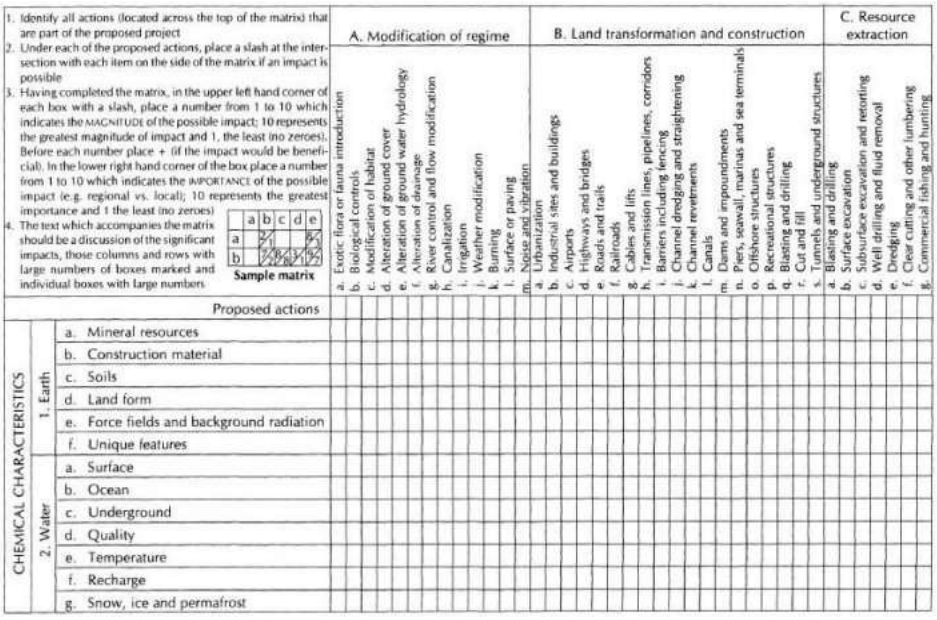
evaluated in terms of magnitude of effect on environmental characteristics and conditions.

❖ **Matrices advantages:**

- Visually describe relationship between two sets of factors,
- Expanded or contracted to meet needs of the proposal being assessed,
- Identify impacts of different phases of project, construction, operation and so on.
- Help separate site-specific impacts from impacts affecting region

However, matrices also have their disadvantages: they do not explicitly represent spatial ortemporal considerations and they do not adequately address synergistic impacts.

Table 8: Leopard matrix (Source: http://www.ilnaturalista.it/la)



8.5 Networks

Network method identifies the pathway of an impact using a series of chains (networks) between a proposed action and the receptor of an impact. It attempt to recognize a series ofimpacts that may be triggered by a project action.

According to Larry et al. "Networks" are those methodologies which integrate impact causes and consequences through identifying interrelationships between casual actions and the impacted environmental factors, including

those representing secondary and tertiary effects (Larry W. Canter, 1996, page 81). The Networks or Systematic Sequential Approach (SSA) of assessment is required, a "scientific thinking through" of the potential impacts on the environment with and without the project. SSA describes how environmental, social, and economic systems are associated with each other, and how it will react to human disturbances. SSA views EIA as a continuing source of information throughout the project cycle.

Network diagrams, flowcharts and impacts trees are the effective major to analysis of the inter-relationship between causes and effects and enable the analysis of indirect and cumulative impacts. A typical figure of flow diagram is depicted as in Figure 4).

❖ **Advantages & Disadvantages of Networks Method**

- **Advantages:**
  - Integrated assessment, instead of discipline by discipline
  - Inter-relations between causes and effects, including indirect impacts
  - Cumulative impact assessment
  - Communication (when simple).
- **Disadvantages:**
  - Complexity (especially visually complex)
  - Difficult to distinguish and quantify magnitudes (and importance) of different impacts

❖ **Cause and Effect Relationship Network Diagram**

The Figure 3 depicted the direct and indirect effect of fertilizer on environment. The application of fertilizer first increases the nitrogen and phosphorus in the soil. The some fraction of fertilizer reaches to run-off and become available to plants, algae and other organisms. Due to this, increase of growth and biomass in water body and resultant reduces dissolve oxygen. Reduce dissolve oxygen decrease fish populations, size and quality.

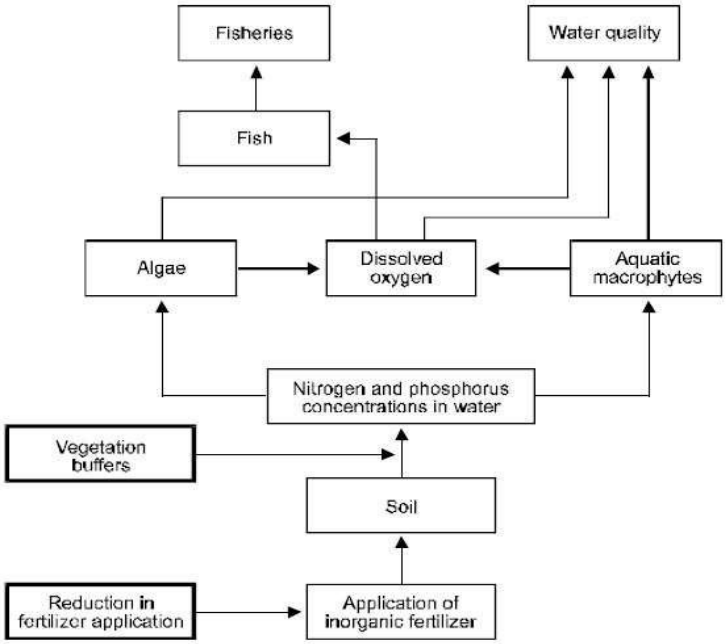


Figure 3: Network diagram of the causal chain that begins with application of inorganicfertilizers. Source: (http://www.doe.ir) December 1997 EIA for Developing Countries)

8.6 Overlay Method

The overlay method is developed by Shopley and Fuggle (1984) and McHarg (1969). It is based upon a set of transparent maps. Each represents the spatial distribution of an environmental characteristic. The set of transparent maps have information about physical, social, ecological, aesthetic characteristics of the project area and after overlapping to produce a composite characterization of the regional environment (Figure 4).

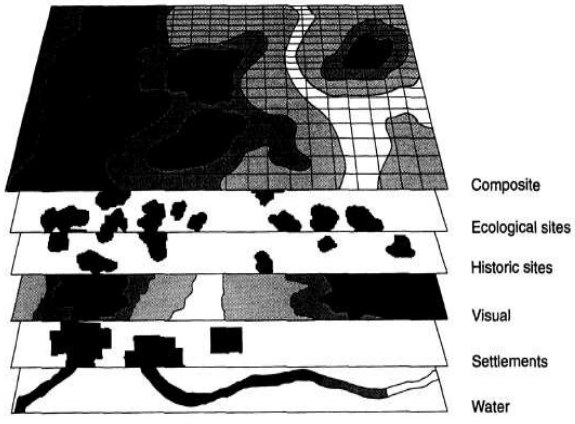


Figure 4: A set of Transparent Maps (Source: Wathern 1988)

- Overlay mapping is a simple technique to display of impact areas
- Intensity of impacts can be presented by color shading
- Effective visual aid
- Useful for documentation of environmental conditions before and after projectimplementation
- May describe both biophysical and social aspects of area under study
- Highly communicative
- Easy to integrate multiple information (Including those of remote sensing)

Summary

References

EPG Pathshala, Subject: Environmental Science: Paper No: 12 Environmental Management, Module: 13 EIA Methodology.

Unit 9: Assessment of Socio-economic Impacts

Unit Structure

9.0 Objectives
9.1 Introduction
9.2 Tools Used in Various Steps of Community Assessment
9.3 Community Profiling
9.4 Community Map
9.5 Decision-Making Analysis
SUMMARY

9.0 Objectives

After reading this unit you will be able to:

- Understand the various community assessment tools used at different steps while working in the community.
- Understand the need for these assessment tools.
- Comprehend the steps and process followed while using these tools.

9.1 Introduction

Community organization is a planned process to enable community actions to use existing social structures and available resources, internal as well as external, to accomplish community goals. These goals are decided primarily by community representatives and consistent with local values. As explained in its introduction in the previous module (*see Module No.24 Overview of community assessment)* community assessment is an essential need at every step of the community organization process—from entry into the community till achievement of objectives—to help the community discover its goals and resources

Assessing the community's strengths and weaknesses is an important first step in planning an effective service project. The community worker collects details about the community while identifying the economic, political, social and environmental needs of his/her project area, and the resources available.

The entire process achieves optimal outcomes when the local people are actively involved. Therefore, most of the techniques used in participatory research appraisal (PRA) are useful for community assessment. We will discuss them here.

9.2 Tools Used in Various Steps of Community Assessment

(i) Transect Walk: Transect walk is a structured walk or a series of walks through a community to explore its various aspects. This walk is best carried out with a group of people who live in the community and know the area well. Local people should act as guides in the walk, pointing various features and discussing them with the community worker. A transect walk should be used at the time of entry in the community and is a useful means for gaining information about the area in which the intervention is being planned. A transect walk should aim for an understanding of the following:

- The site and topography of the area
- The prevailing conditions and problems, availability of critical resources and opportunities in the area
- The location of different sections (particularly the marginalized groups) within the community
- The inter-relationships among various sections of the community

❖ **A transect walk can be of two types:**

- **General:** The purpose of general transect walk is to observe and understand the area being studied in general terms and to get a cross-sectional perspective.
- **Purpose-specific:** Here, the purpose is pre-determined and specific A purpose-specific transcend walk could be undertaken to understand the kind of infrastructure or resources that are available in the community.

❖ **Steps that must be followed in a transect walk**

- Locate a group of local people having knowledge of the area and who are willing to walk with you. A Transect Walk can be carried out by a single facilitator or two.
- Explain the purpose of your walk to the people and involve them in deciding the transect path.
- Observe the surroundings. Make mental notes if you can manage it. However, it is preferable to make detailed notes, using local terms if possible.
- If necessary, stop at some locations to detailed discussions on the emerging points about the community. This will also give you a much-needed pause, which you can use for writing notes.

❖ **Census Map:** Census mapping is a method of community assessment that provides more detailed information about the community with emphasis on individual households. It profiles each household and includes such information as number of family members, the number of males and females in each family, educational status, housing, resources available, etc. The Steps to be followed in census mapping:

(i) Organize the community census mapping team (which must include women). Orient the team on how to conduct the exercise and its importance.

(ii) Based on the list of household heads generated from the social mapping exercise, prepare cards approximately 4" x 6" in size.

(iii) Number the cards and then indicate the names of the households on the cards, one card for every household.

(iv) To facilitate cross-checking, make sure that the card numbers match the numbers assigned to the houses indicated in the social map.

(v) Tape or paste the cards on a large sheet of paper in a consecutive order. The cards can also be laid out on the floor/ground or on any flat surface.

(vi) Discuss the information needed to be obtained. Allow them to design their own legend or symbol for each category of information to be gathered.

(vii) Crayons or stickers of assorted colours and shapes can be used in recording data on the cards. Seeds, stones, and other local materials can be also be used if census mapping is undertaken on the ground, floor, or on any flat surface.

(viii) Proceed with the exercise by asking the village census mapping team to fill out the cards with the needed information.

(ix) After all the cards have been filled out, consolidate the data. Encourage discussions and cross-checking, and have the team analyze the results of the exercise.

(x) Take notes of the processes, particularly the difficulties encountered. Also note any new learning which took place in conducting the census mapping exercise.

9.3 Community Profiling

Community profiling is a method thatcan provide basic information to help both community people and the community worker to know more about the community. It provides information on the bio-physical and socio-economic conditions of the community as well as its cultural and social organizations. Community profiling helps both community people and the worker to learn about the local situation as well as appreciate it. More importantly, it serves as a baseline for planning, implementation of actions, monitoring andevaluation of community development activities (which includes selection of community organizing strategy). A community profile may include information on the following:

- Geographical characteristics of the community
- History of the locality
- Population characteristics
- Employment and income features

- Housing patterns and characteristics
- Major concerns of the community
- Resources available in the community

❖ **Steps that must be followed in preparing a community profile:**

(i) Plan and prepare for the exercise. Addressing the important points: how it is going to be done, where will it be one, and why it is necessary to be undertaken?

(ii) Organize the community profiling team (which must include women). Orient the team on how to conduct the exercise and its importance.

(iii) Review the results of the other methods of PRA used and communityland use map. Based on these, discuss what information is needed to be included in the community profile and the reasons for its inclusion.

(iv) Based on the agreed-upon contents, prepare a community profile. Facilitate the exercise to enhance participation.

(v) Observe how the exercise is taking place. If at the end of the exercise, you find certain items to have been left out, ask the team about these.

(vi) Encourage discussions, cross-checking, and analysis of community profile so that key issues are highlighted.

(vii) Take note of the process. Indicate the names of the team members to give them credit. Record date and place where the community profile was prepared.

9.4 Community Map

It presents a spatial analysis of a wide range of different themes. It is also an effort to facilitate the identification of the key elements important to separate groups of people. In their simplest form, maps are used to identify the comparative location and importance of different resources in the area.

Participatory community mapping involves the spatial drawing of any area, drawn on the ground, paper or other material by the local people, in which

they show and explain their locality and other related areas. It can include a range of items like households, livestock, farm size, water bodies, forest, trees, common property resources, roads, developmental facilities, literacy, disease, socio- economic status, etc., depending on the theme under deliberation. Thus, maps can examine a great breadth of subject matter and allow for a range of several types of maps to be produced for one area or for comparative analysis by different groups within the same area.

❖ **Steps to be followed in preparing a community map**

(i) Find an open space in the community where about 50 persons can be comfortably accommodated. In an urban area, this is often difficult,

(ii) Particularly in larger cities where the clusters are very crowded. Open spaces in these clusters could be the temple or community hall, a small park or water tap area. If space is a constraint, we may make several small maps of the community; say of 200-250 households at a time and then put all information together in one comprehensive map.

(iii) Collect a group of people from the community or from the neighboring households, where smaller maps are being developed. Inform them about the purpose of your exercise. Ensure that different interest groups are represented here.

(iv) You may tell the community that you wish to understand how their community is laid out or to know how to move around the community without their help.

(v) Facilitate the community to draw the map on the ground. This will enablea larger group of the community to participate in the exercise.

(vi) Ask the people to mark out the main roads and small lanes; the different services in the community such as common taps, toilets. They may then draw each and every household in their neighborhood that they may know of. The proportions in the map will invariably be determined by the importance given by the community to these services/areas.

(vii) Facilitate this process by asking questions.

(viii) In each of the households, information about the house can be included such as the number of family members, the children, houses with toilets, houses with working mothers/children, houses where children have dropped out of school, using different symbols.

(ix) The map can later be transferred on to a chart paper preferably by the people themselves. One copy should be given to the community to keep. The community can suggest the name of the individual who will store the map. This will in fact, help to identify key leaders in the community. The map should preferably be kept in a place, which is accessible to all. For example, it can be hung at the anganwadi/balwadi, the community centre,the mahila mandal's office, the NGO centre, etc.

(x) The information collected in the maps must be analysed to locate the problem areas/households.

(xi) The information must be presented back to the community, so that they may make corrections and suggest solutions/alternatives

❖ **For understanding the lives of the people of the community**

Institutional/ Venn/ Chapatti Diagram: This is used to study institutional relationships. The Venn diagram helps in understanding the roles different institutions play in the community, their mutual relationships and their relative importance in people's lives. It provides us with valuable insights into the power structures prevalent in the community. Through a Venn or chapatti diagram we can also analyze the importance of institutions/ certain sections within the social milieu of a given community. Venn diagrams are used for revealing two contexts:

(i) The Institutional Context: Institutional context shows the key institutions, organizations or groups as well as influential individuals in the community and their relationships, as also their role/importance in decision-making.

(ii) Problem Context: Problem Context is used for finding out the problems of people in the communities, how the different problems/people are linked together; and how they affect people

❖ **Steps to be followed in conducting an Institutional/ Venn/ Chapatti diagram:**

(i) First, you may prepare a large circular paper which represents the community. Smaller circles of assorted sizes should also be kept handy. These small circles would represent different institutions.

(ii) The size of the circle represents the importance of an institution to the community. (The bigger the shape, the more important is the institution).

(iii) The proximity to or distance of an institution from the community is denoted by the closeness or distance of the circle representing the institution from the centre of the main circle (which represents the community).

(iv) Institutions placed inside the main circle are institutions the people feel close to.

(v) The circles touching or overlapping each other show a close link between them.

(vi) Similarly, the distance between circles represents absence of links between them.

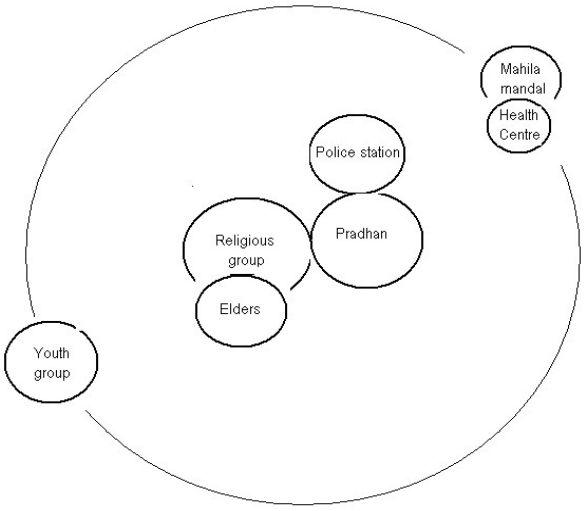


Figure 1: A Venn diagram showing association of various groups

- **Seasonal Chart:** Seasons have their influence on the lives and livelihoods of local communities in many ways. Change in seasons bring changes in climate and rainfall, soil and agricultural conditions, nature and extent of job availability, wages, food patterns, disease incidence, income, expenditure and the like. Hence, it is important to understand the impact of season on the lives of the local people. A Seasonal calendar (or Seasonal diagramming) is a method that determines patterns and trends throughout the year, which are influenced by change in season, in a certain village or community that one needs to study. A seasonal calendar helps the community worker to understand the effect of seasonal changes on the living patterns of the people, occupation/income generation, agricultural production, health issues and others. The purpose of a seasonality diagram or calendar is that it can help in:

  (i) Depicting community activities month by month.

  (ii) Presenting large quantities of diverse information in a common timeframe.

  (iii) Identifying cycles of activity which occur within the life of community on a regular basis, and help determine common periods of excessive environmental problems or opportunities over the course of normal year.

  (iv) Planning the time of intervention of different services

  (v) Prioritizing crisis periods

  (vi) Planning for the crisis periods and forthcoming threats

  (vii) Ensuring people's participation in various activities.

- **Steps to be followed in preparing a seasonal chart:**

  (i) Select time and location where the exercise must be conducted undisturbed or undisrupted.

  (ii) Identify the type of seasonal patterns you wish to learn, and are agreed upon by the local people after mutual discussions. The purpose and objectives of the exercise should be stated before commencement.

(iii) Brief the participants on how to conduct the exercise and discuss the expected outcome and its usage.

(iv) Prepare a two-dimensional matrix by writing the months of the year along one axis and the activities along another axis. Ask the participating members of the community by indicating what months of the year they undertake each activity.

(v) Encourage discussion while the exercise is being conducted to enhance probing and cross-checking of information

(vi) At the end of the exercise, briefly discuss the results and analyze the seasonal calendar variations together with the community members.

(vii) Analyze the information given in the seasonal calendar and record the details of the exercise in a notebook for preparing community action plan and future interventions.

- **Time Line.** A Time Line exercise is used to trace the historical sequences of the community. It tracks the history of the community from the time the community came into existence. A list of key words in the history of the community helps identify past trends, events, problems and achievements in its life. In this exercise, all events considered significant by the community with their approximate year are noted. A time line exercise is done for the following purposes:

(i) To understand how the community began and progressed/grew historically

(ii) To provide communities' viewpoint on changes and their influence on their lives

(iii) To help understand community priorities and plan future interventions with them

(iv) To help build a community data base as well as monitor the impact of programmes and services.

(v) To help communities to recognize and appropriate change so as to create a sense of ownership and community level action

(vi) To help improve social interactions in the community and to empower people

- **Steps followed in a time line exercise:**

(i) Select time and location where the exercise must be conducted undisturbed or undisrupted.

(ii) Identify key informants or elderly persons within the community who are willing and able to participate. Group discussions are preferred to interview of key individuals because they encourage dialogue amongst the community members and help them remember events from the distantpast.

(iii) Brief the participants on how to conduct the exercise and discuss the expected outcome and its usage.

(iv) Going back in time, the discussion may begin with the oldest resident in the community. Events that have affected the community more are recalled by the discussing members.

(v) As people mention the different events, their approximate dates may be worked out and noted. This can be done on the ground or on a chart paperor on a blackboard. Later this may be transferred onto paper.

(vi) Encourage discussions while the exercise is being conducted to enhance probing and cross-checking of information.

(vii) At the end of the exercise, briefly discuss the results and analyze the time line exercise together with the community members.

(viii) Analyze the information given in the time line exercise and record the details of the exercise in a notebook for monitoring and evaluating the impact of different interventions and future interventions.

- **Daily Activity Chart.** A daily routine diagram provides a clear picture of who does what in the community. In a way, it helps to understand a day in the lives of diverse groups of people i.e., women, men, children, young and old, poor and rich, etc. Mostly daily activities in traditional rural societies

and urban communities are managed along gender lines. In some communities' gender role division are still pronounced. In such cases, itis necessary for the community worker to be aware in order not be seen as interfering with the community's cultural norms of gender-specific roles so that new programmes are not introduced to overburden an already overworked group. The purpose of the daily routine diagram is to mainly provide an insight into the lives of the people of the community and the nature of activities/ work undertaken by diverse community groups. The daily activity chart helps the community worker tounderstand:

(i) The different work/activities done by an individual member as representative of the larger group.

(ii) The multiple activities being carried out simultaneously by certain members of a household (cooking, washing clothes and vessels, cleaning the house, etc).

(iii) Gender bias in the distribution of work load among men/women/children. Moreover, this diagram helps in sensitizing men about workloads of women, girls, children at work, bringing about a change in attitudestowards women. It may also enable women to gain a better understandingof the work/role played by men.

(iv) Free or relatively 'less occupied' time slots of diverse groups of people (which can help the PRA team to schedule meetings/trainings, etc. at convenient timings).

(v) Help in the formulation of Community Action Plan i.e., in deciding when to schedule community development activities such as opening a community center, arranging non-formal education classes, vocational training, coaching centers, etc.

❖ **Steps followed in preparing a daily activity chart:**

(i) Select the time and location which is convenient to the community members. The place of preparation and materials needed involve the following considerations:

(ii) Identify persons within the community who are willing and able to explain their daily routine with clarity.

(iii) Brief the participants on the objective of the exercise and discuss the expected outcome and its usage.

(iv) The individual may be asked to recollect a day in his/her routine life. The recollection of the day must not be some day in the very distant past, but some day in the immediate/vivid past.

(v) The individual then needs to put down the recollection on the ground or chart paper using pen or materials locally available like seeds, stones etc.

(vi) At the end, the facilitator and the individual or group analyze the exercise

(vii) The results and details of the exercise are recorded in a notebook for future interventions.

9.5 Decision-Making Analysis

This process helps us to understandthe power structure in the community and see how decision-making powers are vested in various groups or individuals. Decision-making is more natural to certain personalities. People that are less natural decision-makers are often able to make quality assessments, but then need to be more decisive in acting upon their assessments. Problem-solving and decision-making are closely linked, and each requires creativity in identifying and developing options, for which the brainstorming technique is particularly useful. When people from the community themselves come up with decisions, it helps the community worker to understand the situation as well as the dynamics in the community. The steps followed in decision making analysis process are:

- Define and clarify the issue. Does it warrant action? If so, now? Is the matter urgent, important or both?
- Gather all the facts and understand their causes.

- Think about or brainstorm viable options and solutions. Consider and compare the 'pros and cons' of each option—consult others if necessary or useful—and for bigger complex decisions where there are several options, create a template which enables measurements according to different strategic factors.
- Ask them to select the best option, avoiding vagueness and weak compromises in trying to please everyone.
- Explain the decision to those involved and affected, and follow up to ensure proper and effective implementation.
- Reflect on the process to understand the community power structure and think on ideas to work further on it.

SUMMARY

This module explains the various community assessment tools that are commonly used for understanding the community, and the lives of the people residing there. The geographical, spatial and historical profile helps the community worker to understand the community with information about the physical environments, resources, including common pool resources and the landscape in which people conduct their activities. Representation of data is done in the form of community profile, community map, social map, etc. Information about livelihoods, economic structures, and how people procure their basic human needs helps the community worker to understand their lives better. Tools such as seasonal charts, daily activity charts, etc. help the community worker to understand the how the community works help in planning of the community programmes.

References

EPG Pathshala, Subject**:** Social Work Education, Paper Name: Community Organization, Module 25: Community Assessment: Process and Methods – I

Unit 10: Sectoral EIA

Unit Structure

10.0 Objectives
10.1 Introduction
10.2 Land use planning and management: A Solution for Sustainable Development
10.2.1 Lack of overall approach to land use planning and utilization in the country
10.2.2 Competing and conflicting land uses
10.3 Need for policy framework for optimal utilization of land resource
10.4 Core issues to be addressed for land use
10.5 Mining of Minor Minerals
Summary

10.0 Objectives

After studying this unit you will be able to:

- Understand a general introduction about sectoral EIA.
- Discuss about the land use planning and management.
- Understand about the solution for Sustainable Development
- Develop the knowledge Mining of Minor Minerals

10.1 Introduction

The sectoral EIA refers to EIA in specific sectors like mining, airports, townships, nuclear power plants, thermal power etc. It helps in addressing specific environmental problems encountered in planning and implementing sectoral development projects. The benefit of sectoral EIA is that all the environmental, social and economic impacts of same type of sector are nearly similar and hence can play important role in better planning and decision making.

In India, the Ministry of Environment & Forests has prepared 37 EIA Manuals on major sectors of developmental projects which are listed in the Schedule to the Environmental Impact Assessment (EIA) Notification 2006. These Manuals have been prepared to serve as Technical Guidance Manuals (TGMs) to various stakeholders involved in the environmental clearance (EC) process. The Manual for each sector includes a Model Term of Reference, technological options, processes for cleaner

production, waste minimization, monitoring of environmental quality, and related regulations and procedure of obtaining EC. (For more please see unit-5 Project Implementation).

Environmental protection is vital for sustainable development. Most of the nations have implemented environmental protection laws for sustainable development. Effective environmental protection mechanism is needed to strengthen sustainable development. Poor population is the major sufferer from environmental degradation as large part of their livelihood is dependent on environmental resources. Policy decisions should be environmental oriented and well planned so as to ensure that there is no degradation in the natural environment.

Environment (Protection) Act, 1986 has been implemented in India for conservation and protection of environment. Some other pollution control and prevention laws have been enforced at national and states level. Ban on polythene, outdated vehicles etc. in some states as per need are some of the initiatives for preserving environment from degradation. The ultimate aim is to ensure sustainable development for protection of environment from being degraded or polluted. The concept of sustainable development was widely accepted across the globe in1987 after its appearance in The Brundtland Report (also referred as 'Our Common Future'). This report was the result of UN commission set up with a purpose to initialize the concept and practice of global agenda for change. In simple terms 'sustainable development' refers to wise development strategies which meets the needs of present generation without any comprise for its availability to the future generations. Present scenario of change in the environment conditions and resources due to overexploitation has led to urgent need for taking initiatives at global level with co-ordination and co-operation to circumvent the deterioration of the environment and its resources.

10.2 Land use planning and management: A Solution for Sustainable Development

- Proper planning of land resources allows for sensible and sustainable use of land to fulfill various needs including economic, environmental, social, and developmental needs. Proper land use planning based on technical procedures, land utilization strategies and scientific approaches permits people to make decisions on land utilization and allocation.

- There is an urgent need for an integrated land use planning. It includes commerce, housing infrastructure, industry, agriculture, forests, mining, and transportation infrastructure, urban area settlements, etc.
- National Commission on Agriculture (1976) gave special importance on the use of scientific approaches for land use planning so as to achieve self-reliability, food security, and enhanced livelihood security.
- The National Policy for Farmers (2007) recommended the revision and linkage of existing Land Use Boards to district-level land-use Committees. The main aim of the policy was to provide quality and positive advice to farmers on land use.
- The Committee on "State Agrarian Relations and the Unfinished Task in Land Reforms" (2009) also laid emphasis on the need for land use planning in India.
- Sustainable Development strategy Agenda 21, an action plan of the United Nations (UN) was ratified by more than 170 countries at International Earth Summit held in Rio de Janeiro, Brazil, (1992). This plan advocates the achievements of sustainable development through suitable land use planning and management.

10.2.1 Lack of overall approach to land use planning and utilization in the country

- In India, there is lack of complete and integrated land use planning which enables optimal land utilization. The existing land use planning in the country is insufficient and does not cover all the levels including districts, state, regional and national levels. Therefore, the need of the present era is to develop a systematic and scientifically based land use planning.
- The Constitution (74th Amendment) Act, 1992 provides area/land planning for Districts and Metropolitan areas that consolidates plans of both panchayats and municipalities with regard to spatial or land use planning. However, the currently prepared district plans do not cover land.
- Due to the non-existence of land use plans on district level, the development at regional levels as triggered by industrialization or urbanization needs to be

regulated for initiating land use planning of industrial, urban or eco sensitive areas so as to make sure that sustainable development will happen.

- If immediate actions are not taken, then the unplanned development can cause adverse impacts. These negative impacts will include land use conflicts with natural resource areas, agricultural areas, rural areas, and fragile ecosystem. The hazardous impacts will also cause loss of ecosystem services and productive land.

10.2.2 Competing and conflicting land uses

Competing and conflicting land uses are the most important concern. "Competing land uses" are those that fight for the same bundle of land for their location. For example, rural areas competing with agriculture area for cash or food crops; agro-industrial uses; integratedtownships, and mega projects like power plants or ports).

"Conflicting land uses" are in disagreement/conflict with the existing land use. Certain land uses produce effects on nearby land uses. For example, an industrial area can adversely affect the nearby areas due to air pollution. Similarly, an urban expansion can destruct the ecosystem service of natural drainage thereby producing impacts on lakes and water bodies. The basic concern is the harmful impact that such land uses produce on other land uses. Indiscriminate changes in land use affect eco-sensitive zones and hence, affect wildlife habitat, local and global biodiversity. Competing and conflicting land uses are also the cause for conflicts between the local population, and the authorities.

❖ **Impacts from improper land use are to be dealt with:**

- Land degradation mainly due to soil erosion and other degradation processes is a severe problem in many regions of India. Land degradation turns down the soil fertility and also creates the problems of water logging and salinity/ alkalinity/acidity. These degraded soils are frequently used by marginal farmers and tribal population. However, the productivity of these lands is less and a study has estimated the economic loss of Rs. 285,000 million. This loss is 12% of total productivity value of these lands.
- Water resource projects are frequently planned and implemented without considering benefits of the people, environmental sustainability and optimal utilization of water resources. The natural water bodies are being encroached upon

and diverted for other purposes. As a result, the recharge zones of groundwater are repeatedly blocked. Water pollution of water sources is growing due to industrial effluents, and is causing environmental and health hazards. Large stretches of rivers are heavily polluted and are unable to support aquatic ecology, aesthetics, cultural needs and self-purification. Moreover, the features of catchment areas of rivers, streams, and aquifers are changing due to improper land use and land cover changes and thereby, affecting water resource quality and availability.

- Climate change is responsible for an elevation in temperatures, drought and flooding. Land use changes involving the conversion of forest covered areas to agriculture/ industrial is a major factor in increasing CO2 (carbon dioxide) concentration in the atmosphere. CO2 is a dominant greenhouse gas that is contributing to climate change.
- Threats of disasters and pollution are growing day by day due to industrialization, urbanization and use of chemicals/pesticides in agriculture. Hazardous effects arise due to application of chemicals/pesticides, emission of toxic pollutants, and discharge of industrial effluents that are non-biodegradable and toxic. Biodiversity is also facing risk due to loss of several flora and fauna.

10.3 Need for policy framework for optimal utilization of land resource

- A policy framework needs to be formulated at the national level that should incorporate concerns from stakeholders and different sectors. The framing of policy will ensure the optimal exploitation of land resources via proper land use planning and management.
- The framed policy should provide guiding structure for adoption by States and in order to prepare their own policies incorporating State specific concerns. Land use policies should be developed by state authorities in consultation with stakeholders and ensuring suitable legal back up. Additionally, land use plans and strategies should be developed in detail in agreement with these policies in order to achieve sustainable development.

- National Land Use Policy Guideline and Action Points (1988) was prepared by the Government of India (GoI) and Ministry of Agriculture. In case if there was the violation of this policy, then penalties were imposed. First meeting of the said policy was held on 6th February, 1986 and the framed policy along with its guidelines was placed before the National Land Use and Wasteland Development Council (NLUWDC), under the chairmanship of Prime Minister. The Council approved the implementation of policy and circulated the same throughout the country for adoption at State level after appropriate considerations. However, the policy failed to make the desired impact.
- The proposed policy framework is referred as National Land Utilization Policy. The policy regulates land use in an efficient way and takes care of community's needs by preserving natural resources and reducing land use conflicts.
- The details of policy, the challenges, and the guidelines are discussed in detail in the upcoming sections.

10.4 Core issues to be addressed for land use

(a) Unregulated land use shifts: Geographical area of India territory is 328.73 million ha. Several developmental activities require land and during the developmental process, land use changes occur with time. If such changes are not regulated, then they can become detrimental in future for the sustainable development of country. Statistical data during the period 1950- 51 to 2007-08 shows that the net sown areas in India have increased 4.3% and the forest areas have increased by 8.6%. The area under non-agriculture sector including mining, transport network, heritage sites, urban and rural settlements industrial complexes, and water bodies and has increased by 5.2%.

During the same period, the other areas including barren & un-culturable land and uncultivated land have decreased by 18.1%. The mining areas, urban areas and industrial areas represent 0.17%, 2.35% and <1%, respectively of total land of India. However, with advancement in industrialization and urbanization, the associated infrastructure development requires additional land. The demands for additional lands will be fulfilled from agricultural or forests land and it would prove detrimental. Therefore, there is a need to make

strategic land utilization and its management so that the land use changes are not disadvantageous to sustainable development of the country.

(b) Reducing per capita land resource: The per capita availability of land has reduced from 0.89 Ha to 0.27 Ha in 1995 to 2007/08. By the end of 2030, India will be the most populated country on earth and account for 17.9% of total population of world. As a result, the land availability per capita will further decrease. Reduction in per capita land availability will directly affect the land requirements for community development and other developmental purposes. If the land availability per capitais reduced in those areas that are supporting human life, agricultural areas or ecosystems including flora and fauna or natural resources.

(c) Meeting the demands of rural and agriculture sectors: According to the census 2011, 68.84% of Indian population lives in 6, 40,867 villages and rest of the population (31.16%) live in 7,935 urban areas. Agriculture contributes only 14% of the Gross Domestic Product (GDP). However, it provides food security to the nation and serves as main source of livelihood for the rural population. Therefore, fertile land for agriculture purpose and clean water resources must be protected effectively. At present, India is producing approximately 245 million tons of food grains. It has been estimated that the demand for food grains will rise to 307 million tons. The agricultural productivity of our country is almost half in comparison to that of many other countries. Food productivity and security experience great threat due to the increasing use of soil. Since the continuous and increased use can lead to the loss of soil fertility. Hence, the major question is whether these soils will have that much productivity so that the increasing population can sustain higher living standards than those prevailing now. For this purpose, sensible restrictions on acquisition and conversion of agricultural lands should be introduced. National Policy for Farmers, 2007 explains that primary farmland must be preserved for agricultural use only and it should be altered under exceptional circumstances. The demand of the present time is the protection of agricultural areas including double cropped land, irrigation areas and agricultural land, since these are vital for food security and livelihood of tribal and rural populations.

(d) Protecting lands under natural resources and ecosystem services: India is comprised of seven climate regions and nine bio-geographical regions. India is extremely rich in biodiversity and consists of several eco-sensitive zones. India is amongst one of mega-biodiversity countries in the world, and comprises of around 45,500 plant and 91,000 animal species. Out of the 45,500 plant species, 6,500 native plants are used significantly in native healthcare. In addition, India is also recognized as 'Vavilovian Centres of Origin and Diversity of Crop Plants', where more than 300 wild ancestors are present and close relatives of cultivated plants are still evolving under natural conditions. Indian soils are broadly classified into 27 classes. Approximately 56% land area is covered by alluvial soils, red soils and black cotton soils, and these soils are considered appropriate for a variety of crops. Laterite, lateritic and desert soils covering 15% of the land area are not good for agriculture. There are limited water resources in India. Besides, these limited resources show uneven distribution over space and time. The total forest area is 23.57% of total geographic area of India. Of the forest areas, 51.6%, 30.8% and 17.6% are classified as reserved forests, protected forests and un-classed forests, respectively. The Indian Forest Act (1927), National Forest Policy (1988), and other State legislations provide guidelines, procedures and ways by which forests can be utilized and administered. These legislations have profound effect not only on forest lands but also on non-forest lands. India produces 89 minerals, out of which the number of non-metallic, minor minerals, metallic and fuel minerals are 52, 22, 11 and 4, respectively. Natural environment and its resources offer several ecosystem services that include

- Providing food, water, biomass, industrial products, pharmaceuticals, and hydro wind/wave power.
- Supporting air and water purification, nutrient cycling, seed dispersal, crop pollination and disease control.
- Cultural benefits including recreational and spiritual and benefits.
- Genetic and species diversity is conserved for future use.
- Regulation of climate, detoxification, flood retention, carbon sequestration, and waste decomposition.

Natural resource areas including forest areas, biodiversity areas, and ecosystem service areas need to be protected. National Parks, Biosphere Reserves, wildlife sanctuaries are clearly demarcated for protection purpose due to legal provisions. However, the Eco Sensitive Zones around them are not demarcated due to the involvement of different agencies. Therefore, it is necessary to ensure that eco-sensitive areas are clearly demarcated along with the proper planning of land use. Land uses in such sensitive zones should be regulated and controlled to avoid conflicts or negative impacts on environment.

(e) Meeting urbanization demands: Urbanization in India increased from 17% to 31% from 1951 to 2011. World population prospect released by United Nations shows that urban population will represent 55% of Indian population by 2050. If the urbanization will keep on increasing in this pattern, then the 377 million populations according to 2011 census will become 915 million by 2050. The number of towns in India exhibited an increase of 5,161 to 7,935 from 2001 to 2011. Maximum cities are located around coastline, lakes and along the rivers, the agriculturally productive belt and eco-sensitive areas. Urban land accounts for 7.74 million hectares, and this data is only 2.35% of the India's total land area. However, urban areas give rise to several conflicts regarding land use. Most of the domestic and international investments are made in cities and towns since they provide site for the occurrence of commercial activities. As the economic sector grows, towns and cities are also expanding and the contribution made by urban sector to the Indian economy is also increasing. In the upcoming days, the urban sector will structurally transform the Indian economy and will sustain the economic growth. In future, the requirement for non-farm land use will further enhance. Therefore, proper land use planning, and land utilization and management strategy should be developed to fulfill the growing urbanization needs.

(f) Meeting industrialization demands: In addition to urbanization, Industrial development also accounts to the major part of economic growth in India. According to 12th Five Year Plan, the annual economic growth rate of India should reach at least 8% in 2012-17. An increase in economic growth will show a significant increase in the life quality life its citizens, encourage sustainable development and reduce poverty. The 12th Five Year Plan estimates economic growth in manufacturing sector at 9.8-11.5% and the mining and quarrying sector at 8 – 8.5%. This will bring in requirement of additional land and there will be pressure on existing land resources. Therefore, the pressure can be relieved by adopting various land utilization and management strategies and land use planning.

(g) Meeting minor sector demands: Minerals are site specific and non-renewable natural resources. Minerals located in the state boundaries are owned by State Governments and minerals underlying the ocean are owned by Central Government. Mining projects require land for the extraction of minerals. Currently, land utilization by mineral sector is 0.17% of India's total land area. It contributes 2.72% of India's GDP. Mineral extraction has become a priority as it is a contributor to the economic development of India. Mining leads to the degradation of the land and natural resources associated with it. Maximum mining areas are located in forest areas and therefore, there are several environmental and forestry issues linked to mineral extraction. Mining activities also have potential to perturb the ecological balance of adjacent areas. Hence, there is the demand of proper planning and management of mining areas so as to ensure sustainable development.

(h) Meeting transport sector demands: Transport sector is the major user of land in the form of railway stations and tracks, roads, toll plazas, fuel pump stations, airports, workshops,

runways, ports, godowns etc. The total length of road network in India is 4.69 million km. According to the National Highways Act (1956), the Central Government has the authority and power to acquire land for the construction of National Highways. Therefore, considerable amount of land is required for transport networks. Consequently, proper planning of land usage is very important; otherwise the unplanned construction of national highways can trigger land use conflicts between the developing authorities and communities depending on them.

(i) **Development vs. sustainable development:** All the developmental activities require land acquisition and possess full potential to exploit natural resources and displace people residing on that land. These effects create conflicts and negative impacts on environment. Accordingly, different developmental sectors like industrial development, infrastructure development, urban development, mining, and transportation development can be supported in a sustainable manner so as to avoid land use conflicts or harmful environmental impacts

(j) **Protecting social interests:** India has significant amount of helpless populations in the rural, tribal and backward areas. These communities do not have sufficient access to basic facilities and are devoid of good livelihood. They represent the backward communities and economically weaker sections of people. These communities need to be developed socially in order to sort out these issues. Again, land plays significant role in this matter. If social conflicts arise due to possession of land, then the land use should be planned in such a way so as to minimize or to prevent conflicts.

(k) **Protecting heritage**: India is a country enriched with historic and cultural heritage. There are several areas including scenic areas, archaeological and heritage sites, which need to be protected from adverse impacts of land use changes. Proper land use

planning can play a vital role in the management of such negative impacts and securing of the heritage areas.

(l) Inadequate land use planning capacities: Land use planning in India requires detailed knowledge of systematic and up to date spatial data base. However, there is lack of systematic database and therefore, difficulties are being faced while making projections for land uses by different sectors. However, the spatial database can be generated by the use of Geographic Information Systems (GIS) and remote sensing. Indian government is on its way to set up National Spatial Data Infrastructure. Therefore, land use planning (systematic and integrated) at regional, state and national levels is going to be a great challenge**.** Another aspect is the framing of guidelines for consistentland use planning.

10.5 Mining of Minor Minerals

The most major amendment in the original notification came in S.O. 141(E) dated 15th January, 2016. A new category of 'B2' was inserted in the schedule. This category related to the mining of minor minerals in the said schedule. The amendment put the mining of minor minerals up to 5 ha of mining lease area (B2 category) under the preview of new committees District Level Environment Impact Assessment Authority (DEIAA) and District Level Expert Appraisal Committee (DEAC) at district level. The important points of the amendments are as follow.

(i) Inserting Category 'B2' for mining of minor minerals in the said Schedule

(ii) Formation of District Environment Impact Assessment Authority (DEIAA) for matters falling under Category 'B2' comprising of four members including a Chairperson and a Member Secretary.

(iii) Formation of District Level Expert Appraisal Committee (DEAC) comprising of eleven members, including a Chairman and a Member-Secretary.

(iv) The senior most Executive Engineer, Irrigation Department in the district of respective State Governments or Union territory Administration shall be the Chairperson of the DEAC.

(v) The Assistant Director or Deputy Director of the Department of Mines and Geology or District Mines Officer or Geologist of the district shall be the Member-Secretary of the DEAC in that order.

(vi) The District Magistrate or District Collector shall notify an agency to act as Secretariat for the DEIAA and the DEAC and shall provide all financial and logistic support for their statutory functions.

(vii) Introduction of Appendix VII-The term and qualifications of the expert fulfilling the eligibility for DEIAA and DEAC.

(viii) The 'B2' Category projects pertaining to mining of minor mineral of lease area less than or equal to five hectare shall require prior environmental clearance from DEIAA. The DEIAA shall base its decision on the recommendations of DEAC, as constituted for this notification.

(ix) Form 1M for mining of minor minerals up to five hectare under Category 'B2' projects, as given in Appendix VIII, before commencing any construction activity, or preparation of land, or mining at the site by the project proponent.

(x) Exemption of cases from prior environmental clearance as specified in Appendix IX . These are:

(a) Extraction of ordinary clay or sand, manually, by the Kumhars (Potter) toprepare earthen pots, lamp, toys, etc. as per their customs.

(b) Extraction of ordinary clay or sand, manually, by earthen tile makers whoprepare earthen tiles.

(c) Removal of sand deposits on agricultural field after flood by farmers.

(d) Customary extraction of sand and ordinary earth from sources situated in Gram Panchayat for personal use or community work in village.

(e) Community works like de-silting of village ponds or tanks, construction of village roads, ponds, and bunds undertaken in Mahatama Gandhi National Rural Employment and Guarantee Schemes, other Government sponsored schemes, and community efforts.

(f) Dredging and de-silting of dams, reservoirs, weirs, barrages, river, and canals for the purpose of their maintenance, upkeep and disaster management.

(g) Traditional occupational work of sand by Vanjara and Oads in Gujarat vide notification number GU/90(16)/MCR-2189(68)/5-CHH, dated the 14th February, 1990 of the Government of Gujarat.

(h) Digging of well for irrigation or drinking water.

(i) Digging of foundation for buildings not requiring prior environmental clearance.

(j) Excavation of ordinary earth or clay for plugging of any breach caused in canal, nala, drain, water body, etc., to deal with any disaster or flood like situation upon orders of District Collector or District Magistrate.

(k) Activities declared by State Government under legislations or rules as non- mining activity with concurrence of the Ministry of Environment, Forest and Climate Change, Government of India.

Summary

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Unit 11: EIA for Some Typical Development Projects

Unit Structure

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11.1 Introduction
11.2 River Valley Projects' EIA: A Case Study
11.3 EIA of Thermal Power Plants
11.4 Mining Projects
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11.0 Objectives

After reading this unit, you should be able to:

- Describe the many environmental impact assessment of river valleys
- Describe the many environmental impact assessment of thermal power plants
- Describe the many environmental impact assessment of minerals mining plants
- Describe the many environmental impact assessment of oil and petrochemical plants,
- Describe the many environmental impact assessment of cement industries
- Describe the many environmental impact assessment of tourism industries

11.1 Introduction

The environmental effects of a proposed project are taken into account during environmental impact assessment processes. This covers all effects that planned initiatives will have on the environment, society, and the economy. These factors include how the project would affect risks to human health and the environment, as well as how it will affect natural resources, local communities, waterways, endangered species, waste management from the planned projects, and the environment. Before a proposed project is approved and given the go-ahead, EIA procedures ensure that environmental factors

have been taken into account. It might be beneficial to involve local communities more in decision-making. The following list outlines some advantages of involving local communities in decision-making. Participating in environmental evaluations has several advantages for local populations, including:

- Healthy and clean surroundings.
- Sanitation and human health improvement.
- Conserve biodiversity
- Usage of natural resources is decreased.
- Improved knowledge and abilities in the community.

After identifying and projecting potential issues, EIA studies assist in minimizing issues and work on remedies to increase the project's compatibility for its intended environment. Therefore, a crucial part of any project planning is conducting an environmental impact assessment. Learn about some environmental impact assessment case studies right now.

11.2 River Valley Projects' EIA: A Case Study

A dam over the river near Linganamakki was built in 1964 by the Karnataka Power Corporation Limited. One of our nation's oldest hydroelectric power projects, according to reports, is this one. The dam is located at 512 meters above sea level. It has a 152 billion cubic foot capacity. The reservoirs it uses for its water supply are Chakra and Savahaklu, which are interlinked by a canal that flows through Linganamakki.

Large areas were flooded as a result of the Linganamakki dam's construction, and the region's biodiversity also suffered. Additionally threatened were the marine and terrestrial habitats. Consequently, the river environment was impacted by the dam's construction.

Significant environmental destruction is brought on by large dams and river valley development projects. The effects of these projects can be lessened with the aid of comprehensive environmental impact assessment (CEIA). Any project in the river valley must take the following actions in order to be deemed ecologically sensitive:

- Before the planned project is given the go-ahead, a thorough environmental impact study needs to be done.
- Preventative measures should be made for the negative environmental effects after the planned project is deemed practical and desirable in light of the socioeconomic and environmental factors.
- After completion of the project, environmental effects should be observed and preventive steps to mitigate them should be implemented.

11.3 EIA of Thermal Power Plants

The production of electricity is mostly based on thermal power plants. Thermal power plants generate over 60% of the electricity in India. The environment is harmed by these power plants in a number of ways, including the air, water, and soil. In addition, they discharge fly ash and mercury, which devastate the local ecosystem. As a result, before a project is launched, thermal power plants need to conduct a thorough and accurate environmental impact assessment.

❖ **Sompeta Thermal Power Plant**

In 2016, Boddu et al. conducted an environmental impact study of a thermal power plant in Sompeta. The quick impact assessment matrix approach was used to identify and consider the possible environmental negative and positive impacts. Negative effects from fly ash included issues with ground and surface water quality, land use changes usage, soil fertility, a loss of biological diversity, and pollution. Some socio-cultural elements were also observed, including the beautification of local areas, the loss of life from accidents, and aesthetics. Uplifting underdeveloped communities, creating job opportunities, and other positive effects were brought about by the proposed initiative. As a result, the study found that the initiative had both positives and negatives. It was determined that by using mitigation strategies, the detrimental effects might be reduced.

❖ **Thermal power station at Jindal, Dongamahua**

The Centre for Science and Environment, New Delhi, assessed this Rapid Environment Impact Assessment (REIA) study. The EIA was completed by the Min Mec Consultancy Pvt Ltd., New Delhi. The study is focused on Jindal Steel and Power Ltd., a company that planned to build a thermal power plant in Dongamahua, Raigarh, Chattisgarh. The Raigarh-Ambikapur highway is 30 kilometers away from the project location, which is approximately 50 km from Raigarh. The suggested location is 3.5 kilometres from the Kelo Nadi River. There are several Kelo River tributaries, all of which enter the Kelo River. Due to the abundance of coal in the area, numerous coalmines are both open and planned. According to the report's findings, the future project would need 7.46 million cubic meters of groundwater.

The project would need 56 acres of land, according to the land use patterns. Either agricultural land or wasteland has been acquired. The EIA's research area contains 26.5% forestland, and 77% of the forestland is covered by reserved or restricted forests. Within a 10-km radius, there are 94 populated revenue villages. Within a 10 km radius, there are about 85,000 people living. The projects' environmental impact includes:

(i) **Impacts of the project on the consumption of water:** We can project a significant amount of water by using thermal power. The ground water regime will change as a result of groundwater breaching caused by mining operations.

(ii) **Project's implications on air quality:** Air pollution from thermal power plants is severe. Particulate emissions were predicted at 511 tons per annum in the project's environmental impact assessment. A drop in yields, a loss of chlorophyll, and increased leaf fall are all effects of SO2 emissions, which the EIA calculated to be 3120 kg/hr. The annual NOx emissions were estimated in the EIA report at 4,000 tones. The proposed facility will produce 618 kilogram of mercury emissions every year. Carbon dioxide emissions from the plant will total 9.47 lakh tones annually.

(iii) **Impacts on biodiversity:** Among the mammals that call the area home are foxes, monkeys, spotted deer, rhesus macaques, bears, and leopards. Mahua

plantations can be found in abundance in the area close to the plant. For the nearby communities, this has excellent economic importance.

(iv) Solid wastes: The amount of fly ash and bottom ash produced by the plant is assessed. There will be 1.37 million tons of solid trash produced.

The planned project will have an influence on the local groundwater, forests, and wildlife. It can impact forests in addition to communities' way of life. As a result, the environment and the local communities must be protected through the appropriate measures.

11.4 Mining Projects

❖ **EIA analysis by M/s Jayaswals Neco Limited of coal mining project**

The Centre for Science and Environment, New Delhi, assessed this Rapid Environment Impact Assessment (REIA) study. In Raigarh, Chattisgarh, Jayaswals Neco Ltd. planned a coal mining project. The EIA study was carried out by Enviro Techno Consult, based in Nagpur. The region surrounding the potential site is coal-rich. The area surrounding the project location is heavily forested and needs 491 hectares of land. Agriculture is a significant occupation in the studied area, according to the EIA report. The project may have an effect on regional biodiversity, forest ecology, and local communities' means of subsistence. Noise, air pollution, ground vibrations, and blasting will have an impact on the nearby settlements. The project's environmental effects include;

(i) Impacts on the community's groundwater resources: The groundwater table would be breached by open cast coal mining, claims the EIA assessment. The study finds that in order to keep the groundwater in the "safe" category, the rate of groundwater dewatering from the mine pit must not be more than 65% of the rate of groundwater recharge in the mining lease area. Because of ongoing industrial activity, the region's waterways are all contaminated and under stress. The total dissolved solids levels in the water from the pit are greater.

(ii) Effect of the project on the air quality in the area: Air pollution from mining can be rather bad. Estimates of fugitive emissions have been made

in the EIA report for the development site. Estimates have been made of the emission prospective through soil surface removal, digging, explosion, transportation, material handling, as well as from the coal handling facility. It is possible to produce 3,510 tons of dust annually. The Environment Management Plan (EMP) recommends appropriate measures for dust suppression, including water spraying, the attachment of bag filters to drilling machines, and others. Additionally, covered storage spaces and conveyor belts are advice.

(iii)Impact on biodiversity: The site's surroundings are rich in species, which may have an effect on the local biodiversity. According to the EIA assessment, the region belongs to significant populations of bears, monkeys, pea birds, and leopards.

(iv)Noise impacts: The local populace in adjacent villages may suffer from the high impact of noise and vibrations caused by mining.

(v) Disaster management: Accidents and workplace dangers can result from coal mining, especially underground coal mining. Roof collapse, flooding, suffocation from methane, carbon dioxide, and carbon monoxide, among other dangers, are only a few of the risks. Therefore, risk management for underground mining must have been considered in disaster management strategies.

A large-scale project is the one that has been offered as a result. The impact of coal mining is included in the EIA analyses' estimates of the effects. Impacts on the water cycle, air pollution, vibration and noise pollution, influence on trees, and local biodiversity are only a few of the effects. Since the area is ecologically fragile, the woodlands here are vital to the survival of the local population.

11.5 Oil Refineries and Petrochemicals

❖ **EIA of an oil refinery in Iran**

The study was reported for the Tehran oil refinery in Iran by Narimisa and Basri 2011. Petrochemical and oil refinery developments are undoubtedly beneficial for a nation's economic development. However, these initiatives

also have detrimental effects on the environment, including loss of biodiversity, air, water, and land pollution, as well as loss of ecosystem service functions. According to their analysis, the oil refinery's main effects on the environment include its gas emissions, untreated sewage, solid wastes, noise, odour, and aesthetic effects. They found the following impacts to be substantial in their investigation.

(i) **Air pollution:** This is produced, among other things, by activities involving distillation towers, steam boilers, burners, motors, and compressors. Some of the air pollutants include sulphur oxides, nitrogen oxides, carbon monoxide, aldehydes, ammonia, particulates, and hydrocarbons. Nitrogen oxides are created during the combustion process and discharged into the environment through boilers, compressors, and catalytic reducers.

(ii) **Water pollution:** The effluents released pollute both the surface and ground waters. They might also come out of leaking pipelines.

(iii) **Solid wastes:** They are able to generate a lot of solid trash. They can result from procedures including cracking, making coke, producing and treating sludge, using water and oil separators, and using effluent treatment systems.

(iv) **Ecosystem:** Environmental damage is also caused by oil and gas exploration and exploitation on land and in the ocean.

Consequently, EIA studies are useful in understanding how oil refineries affect our ecosystem. Additionally, additional social impact assessments are crucial since they can aid in understanding how the project will affect people and organisations. They came to the conclusion that all the aforementioned factors should be included in future development efforts to ensure a healthy world.

❖ **EIA of an oil refinery in the North Atlantic (Sólnes, 2000)**

The study reveals a case study of an oil refinery in Iceland's Reyoarfjorour, which is located in the North Atlantic. The causes of the pollution are mentioned, and the effects on the environment are described in depth. The

proposed location of the six million tons oil refinery on Iceland's east coast is expected to have a significant economic and social impact on the rural towns there. Agriculture, fisheries, and tourism are the main economic drivers for the population. The following are some of the environmental effects:

(i) **Air pollution:** It will produce significant levels of airborne dust, VOCs, other chemicals, and greenhouse gas emissions. Injurious low atmospheric ozone can be created by the VOCs and nitrogen oxides in this reaction. Storage tanks with floating roofs can be used to lessen this. Scrubbers have the capacity to lower SO2 emissions. The refinery will be a significant contributor to greenhouse gas emissions, with 500,000 tons of emissions annually possible.

(ii) **Toxic Wastes:** Additionally, the refinery will release toxic pollutants that need to be cleaned up. Sewage, unpolluted wastewater, process systems, the SO2 seawater scrubber, and these are the main sources of wastewater produced by refineries. The presence of oil, oil that has been emulsified, phenols, poly-romantic hydrocarbons, ionised sulphides, ammonia, inorganic particle debris, and trace levels of heavy metals that are harmful to marine life are all possible in the waters. All wastewater from refineries should be handled as a result.

(iii) **Solid waste:** They can come from a variety of sources, including crude oil, sludge from surface drainage and water supplies, corrosion particles from process units and the sewage system, solid particles from maintenance and cleaning tasks and water treatment facilities, ash from sludge incinerators, used catalyst, and soils contaminated from oil spills. Solid oil residue and oily sludge produced at the refinery can be incinerated, dumped in landfills, or used as fertilizer for farmland. Three thousand tons of solid trashes per year are anticipated to be produced by the Icelandic refinery. Around 900 tons of these can be deemed dangerous. As a result, the refinery's hazardous waste could be disposed off.

(iv) **Socio-economic impacts:** On the east coast region's population, which depends on agriculture, fishing, tourism, and a few ancillary service sectors, the anticipated industrial expansion would have both advantages

and disadvantages. As a result, it is important to gauge the socioeconomic advantages.

They came to the conclusion that there will undoubtedly be environmental problems if an oil refinery is built in the North Atlantic, such as in Iceland.

11.6 Cement Industries

❖ **EIA of a proposed cement plant at Southwestern Nigeria**

This study by Ilalokhoin et al., (2013) focuses on the environmental impact assessment of a proposed cement mill in southwest Nigeria. Environmental pollution results from Portland cement manufacturing. In quarries, blasting creates dust, fumes, noise, and tremors. Also released is carbon dioxide. According to the study, soil erosion will happen as a result of excavation and bush clearing since the topsoil would become exposed. There will be a loss of vegetation and wildlife, and the ecosystem and biodiversity will be significantly impacted. There will be a loss of vegetation canopy as well as noise, energy, and environmental impact analysis. You can get dust from diffuse or point sources. The workers at the facility and the local residents' health may be impacted by this cement dust. Therefore, it will be necessary to install mitigation techniques like fabric filters and electrostatic precipitators. Phases of operation will produce a lot of noise pollution. Therefore, adequate hearing protection must be offered. Heavy machinery, road traffic, blasting in quarries, and piling in construction are a few potential sources of vibration. Communities may get distressed as a result of this. These were some Primary findings of the study.

11.7 Tourism Industry

❖ **EIA of Tourism Industries**

Tourism is the largest industry in the world. By 2020, it is predicted that there will be 1.6 billion tourists worldwide. Tourism-related development initiatives may harm the environment as well. Therefore, in order to detect potential environmental repercussions, an EIA is necessary prior to the implementation of any tourism development. Islands are delicate regions that face major environmental threats. The island of Mauritius is home to indigenous species,

but the Mauritian ecology is currently under danger, and the numbers of local birds and reptiles are declining.

In addition to destroying habitats, tourists frequently leave behind trash and contaminate the islands. There is also pollution from cruises. These wastes harm marine animals and degrade the quality of the water. The growth of tourists poses a threat to the coral reefs. By boats, they are destroyed. The coastal ecosystem is negatively impacted by the quick growth of the tourism industry nearby and the absence of EIA monitoring. They may have an impact on how sustainably the tourism sector develops. Therefore, it is important for islanders to comprehend and put preventive measures into practice. Environmental impact assessments (EIAs) enhance the process of planning, designing, and making decisions.

Summary

We reviewed a few case studies of EIA for certain projects in this unit. The industries and projects also include mining sector, cement industry, thermal power plants, river valley projects, tourism sector, and cement industry. The projects may have a harmful effect on the local environment and communities. For the sake of our environment and the health of humans, full EIA reports are therefore crucial before permission is granted by the government in the relevant country.

Environmental impact assessment: An analytical procedure that thoroughly considers any potential environmental effects of projects, programmes, and regulations. It is the process of determining ways to reduce environmental harm and determining the anticipated environmental effects of a plan. Before a decision is made, the fundamental goal of an EIA is to inform decision-makers about the proposal's anticipated effects.

Tourism: It is defined as journey, whether for business or pleasure. It also includes the idea and practice of travelling, the industry of luring, hosting, and amusing tourists, and the industry of running tours. International travel is possible, as well as domestic travel.

Fly ash: It is a byproduct of the burning of pulverized coal in thermal and electric power plants. It is a byproduct of coal combustion made up of the flue gases and the particles that are emitted from coal-fired furnaces.

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Terminal Questions (Write your answer in about 50 words.)

1. **Explain the case study of EIA of a river valley project.**

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2. **Describe a case study of EIA of a thermal power plant project.**

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3. **Make a short note of a case study of an EIA of an oil refinery.**

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4. **Write a case study of an EIA of a cement industry.**

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Unit 12: Basic Concepts of Environmental Auditing

Unit Structure

12.0Learning Objectives
12.1. Introduction
12.2. Objectives
12.3. Scope
12.4 Types of environmental audits
12.4.1 Objective-based types
12.4.2 Client-driven types
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Summary
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12.0Learning Objectives

After completing this Unit, you should be able to:

- Define and discuss the objectives of an environmental audit;
- describe the objectives and scope of environmental audits
- explain the types of environmental audits
- Discuss the general audit methodology

12.1. Introduction

In the earlier units, we discussed the preparation and review of a EIA report, and in the present Unit, we will discuss another tool for environmental management – environmental auditing. As environmental legislations are becoming increasingly stringent across the world, industries are required to demonstrate improvements in environmental performance for their survival and growth. In the wake of environmental regulations that proliferated in the 1970s and 1980s, environmental audit was born as an environmental management tool for industries and other organisations seeking to monitor their compliance performance on environmental matters. The main purpose of environmental audit is to

identify, assess and address environmental concerns in order to establish environmental quality assurance. That said, in the first three Sections of this Unit, we will discuss the basics of environmental auditing (EA) by explaining the objectives, scope and types of EA as well as the methodologies, stages and procedures involved in carrying out an auditing. We will also discuss waste, liability, industrial and EMS audits.

An environmental audit (EA) is a systematic, independent internal review to check whether the results of environmental work tally with the targets. It studies whether the methods or means used to achieve the goals or ends are effective. EA involves studying documents and reports, interviewing key people in the organisation, etc., to assess the level of deviations between targets and results. It is defined as a systematic and documented verification process of objectively obtaining and evaluating evidence to determine whether an organization's EMS conforms with audit criteria set by the organization, and for communicating the results of this process to management (ISO 14001). Environmental audits are being used as a tool and an aid to test the effectiveness of environmental efforts at local level. They can be carried out for a number of reasons including the following:

- To verify compliance.
- To review implementation of policies.
- To identify liabilities.
- To review management systems.
- To identify needs, strengths and weaknesses.
- To assess environmental performance
- To promote environmental awareness.

12.2. Objectives

The objectives of an environmental audit are to evaluate the efficiency and efficacy of resource utilization (i.e., people, machines and materials), to identify the areas of risk, environmental liabilities, weakness in management systems and problems in complying with regulatory requirements and to ensure the control on waste/pollutant generation. The areas an environmental audit deals with can be categorized as under:

a) **Design specification and layout:** While setting up an industry, adequate provisions are made in the design specification and layout to augment the production capacity but corresponding provisions to meet the environmental criteria are often overlooked. Adequate provisions are, therefore, necessary to upgrade pollution control measures to meet the future environmental standards that are getting stringent day by day. The audit will help in identifying specific areas of concern to meet the future requirements of environmental measures.

b) **Resource management:** The resources include air, water, energy and other raw materials. The audit will provide data to the management on the efficient use of the resources per unit production, and, thereby, help reduce resource consumption and waste minimisation.

c) **Pollution control systems and procedures:** The audit helps ensure that the systems and procedures governing the environmental activities/operations of pollution control equipments are rightly followed and determine the efficiency of the system in identifying conditions and inviting corrective actions in a timely and effective manner.

d) **Emergency plans and response/safety system:** As the emergency plans more often than not remain in the safe custody of senior management, staff may not have immediate access to the right action during an emergency. The problem becomes acute when new persons are employed/deployed. The review of the emergency response system will ensure adequate knowledge, alertness and readiness of the staff concerned to effectively face an emergency.

e) **Medical and health facilities/industrial hygiene and occupational health:** The productive element of an industry is dependent on the health of its human resources. The primary facilities to suit the occupational needs of the industry are, therefore, vital. Audit in this regard will provide an insight into the actual requirements to warn suitable orientation of existing facilities.

f) **Confirmation to regulatory requirement:** The regulatory mechanism of environmental compliance is gradually becoming more and more comprehensive.

New regulations and standards are being stipulated at such a pace that they render the existing systems archaic. Factory managers may not be fully aware of the latest requirements and this will make the top management/owners vulnerable for prosecution under various environmental acts. An audit helps compare the existing status with the stipulation and standards prescribed by various agencies and ensure compliance.

12.3. Scope

The scope of an environmental audit can fall under either of the following two options:

(i) To limit scope of the audit to an assessment only of the degree of compliance with policies, requirements-type documents and procedures.

(ii) To assess the adequacy of the policies, requirements-type documents and procedures to begin with and, given their adequacies, to assess the degree to which compliance with these documents is achieved.

The argument for limiting the audit scope only to the assessment of compliance is that the policies, requirements-type documents, and procedures have been developed and approved by the key affected technical and managerial personnel. The audit objectives, however, should be both to assess the degree of compliance with policies, requirement documents, and procedures and to assess their adequacy as well, with the following constraints:

- When a function, process or area is subject to frequent, periodic audit, it need not address the adequacy of the environmental programme. The large majority of the audits should address only the degree of implementation compliance with, and the adequacy of the programme. When the adequacy of the programme is to be addressed, there should be a higher-level overview by the management of the auditing organisation, i.e., an overview of any findings related to programmatic inadequacy. The purpose of this overview should be to assure that either each issue is fresh or each issue warrants a revisit before putting other units of the organisation through the perturbation of addressing the issues (B. W. Marguglio).

Note that a company's motivation for carrying out an environmental audit will determine the type of audit it chooses to implement.

12.4 Types of environmental audits

In this Subsection, we will discuss the two main types of environmental audits, i.e., objective-based and client-driven.

12.4.1 Objective-based types

As mentioned earlier, environmental audit covers assessment of any activity that impinges on the environment. The scope and objectives of the audit more usefully distinguish different audit categories and how the audit results are to be used. However, you must note that objectives and scope are often a combination of several audit types and are usually defined on a case-by-case basis. Organizations have developed audit programmes to fit their particular needs. Based on objectives, environmental audits can be categorized as under:

(i) **Liabilities audit:** Compliance audit, operational risk audit, acquisition audit and health and safety audit form liabilities audit. These are often conducted as a prelude to gaining insurance cover and as a means of demonstrating the regulatory compliance. Compliance auditing is probably the most common form of environmental audits; it is a verification process whereby the facility establishes the extent to which it is complying with environmental legislations, regulations, emission limits, etc. Operational risk concentrates on the potential frequency and consequences of environmentally damaging activities in the raw material and product storage/handling and manufacturing process. Compliance with regulations does not necessarily reduce liability due to operational risks. Acquisition audits assess the liability due to contaminated land and building remediation costs. Health and safety audits normally form part of health, safety and environment (HSE) audit and involve assessment of adequacy of personal protective equipment (e.g., safety shoes, goggles, helmets, etc.), emergency preparedness and disaster management plans.

(ii) Management audit: Corporate audit, system audit, policy audit and issues audit form management audit. These pay considerable attention to management systems as they guide the efficient and effective running of the operations. A corporate audit is initiated by the main Board of a parent company and is concerned with organisation structure, roles and responsibilities, policy implementation, awareness and communications with a subsidiary. This is carried out as a reassurance to the main Board that its aims and objectives are being implemented throughout the corporate structure. Management system audits are carried out to check the systems against the policy and standards such as British Standard 7750 or ISO 14001 (discussed in detail in Unit 7). Policy audit is carried out to review and reassess the relevance of policy in light of developments (legal, technical, financial) within the organisation and outside. Issues audit is carried out to establish environmental management plan and targets.

(iii) Activities audit: Site audit, waste audit, product audit and cross-boundary audit form activities audit. These cover auditing of select technical and management issues. Environmental site audit examines all aspects of the facilities performance with respect to the environment. It combines most of the elements of other types of EA and, when undertaken in depth, involve considerable time and cost. The waste audits are of two types. The first identifies and quantifies waste streams and is a precursor to waste minimization programmes. The second type assesses waste management practices and procedures. Product audits cover several aspects of their environmental impacts through design, manufacture, use and disposal. Such audits are prerequisites for identifying environmentally friendly products for "Green Labelling" (explained in Unit 9). Cross boundary audits assess activities, which cut across departments or business units (e.g., transport and supply chain audits). Figure 12.1 illustrates the objectives-based audit types:

Figure 12.1 Environmental Audit Categories

Liabilities Audits	Management Audits	Activities Audits
Compliance Audit	Corporate Audit	Site Audit
Operational Risk Audit	Systems Audit	Waste Audit
Acquisition Audit	Policy Audit	Product Audit
Health & Safety Audit	Issues Audit	Cross-boundary Audit

12.4.2 Client-driven types

The different types of audits are based on the client, who has commissioned or ordered the audit procedure:

(i) Regulatory external audit: This often entails an examination carried out by or for an environmental regulatory agency, with the goal of ensuring that a facility is meeting the relevant legislation and regulations. The regulatory agency can use the methodology of audit as a tool to systematically enhance its overview, including the possibility of verifying the accuracy of any reports, which a company is required to submit to the authority.

(ii) Independent external audit: This is conducted by external auditors entitled to perform audits. As the environmental factors have gained importance for a firm's market relations, shareholders such as banks and investment funds, insurance companies, environmental groups, potential buyers, customers, local government and environmentally aware citizens are demanding independent external audits to assess how the firm deals with environmental issues.

(iii) Internal environmental audit: This often involves an inquiry commissioned by management. In practice, such audits are commonly ordered by senior management located at some distance, in both physical and operational senses, from the factory or site of environmental concern. In such cases, the environmental audits are internal in that the results will remain within the organization. However, for the facility under investigation, the internal audit will have the same effect as an external audit. One reason why firms conduct internal environmental audits is to diminish their liability to pay fines, damages or clean-up costs as the result of breaking the law (e.g., releasing more emissions than permitted).

Figure 12.2 Environmental Audit Categories: Client Driven

Category of Audit	Ordered By	Desired Result
Regulatory External	Regulatory Authority	Enhanced oversight
Independent External	Buyer, bank, customer, insurance firm, etc.	Objective information
internal	Top management Members of Board	Reduced risk
Third Party	Top management Members of Board	Certified environmental protection system

(iv) Third party audits: These represent the audits certifying organizations carry out to verify as to whether internal/ external audits meet the standards set. In Table 12.2, we illustrate the client-driven audit types:

12.5 General Audit Methodology

What the foregoing discussion suggests is that the focus of environmental audit differs, depending on the specific requirements of the clients. In other words, audit methods and tools are tailored to suit the purpose for which they are intended. However, any audit programme must conform to the basic framework. We will explain the basic structure of, and the steps involved in, an audit programme in Subsections 5.2.1 and 5.2.2, respectively.

12.5.1. Basic structure of EA

Though different production facilities and activities, audit orders and types of audits place different requirements on the structure of an audit, there are certain elements, which should be present in any effective environmental audit programme. These common elements include:

(i) Explicit top management support for environmental audit and commitment to follow-up on audit findings.

(ii) An environmental audit function independent of audited activities.

(iii) Adequate team staffing and auditor training.

(iv) Explicit audit programme objectives, scope, resources and frequency.

(v) A process, which collects, analyses, interprets and documents information sufficient to achieve audit objectives.

(vi) A process, which includes specific procedures to promptly prepare candid, clear and appropriate written reports on audit findings, corrective actions and schedules for implementation.

(vii) A process, which includes quality assurance procedures to assure the accuracy and thoroughness of environmental audits.

12.5.2. EA steps

The four general steps involved in an audit procedure are:

(i) Audit preparation: This includes choice of auditor/audit group, collection of background material and planning of the audit orientation. Audit preparation is crucial in determining the methodology, practical tools and materials that will be required for the completion of the audit. In many cases, the available materials such as manuals, questionnaires, etc., may not be well suited to the type of activity that is to be audited, or the type of audit that is performed. This means that part of the preparatory activities may have to involve development of audit-specific tools or further development of existing materials and tools. In such cases, this may require a preliminary review of the facility or activities to map out specific details and requirements to be observed in the development of the particular tools.

(ii) A systematic scrutiny or review of a facility: Depending on the orientation and goals of the audit, the focus of the scrutiny differs. For example, an environmental audit can be conducted without dealing with the processes involved in production. However, an audit, which is considered part of a programme of preventive environmental protection, needs to deal with the production processes and material flows. Common to all audits is an analysis and evaluation of the information that has been obtained and an analysis of the outcome visa-versa the goals and expectations of the initiator of the audit. This helps in identifying the areas of improvement.

(iii) Reporting: This step involves reporting of observation of deficiencies and possible alternatives. It is important to be aware that an environmental audit by itself does not solve any problems. In fact, during the work on the audit, it may appear that the environmental problem is increasing because the audit process brings to attention the hitherto unknown problems or deficiencies. Audits often point to the need for the changes in organisation and improvements in education, increased environmental responsibility, and investments in new equipment and environmental protection technology. An important pre-condition for the success of an audit, especially if it is internally initiated, is that everyone is prepared to accept the consequences and take steps to solve the deficiencies and problems, which the

audit may reveal. Thus, the persons whose areas of responsibility have been the object of scrutiny must make decisions and have plans in place to eliminate the problems.

iv) Follow up: Following up of the results is an important part of the audit process. An evaluation of the results of the remedial actions is a logical step. This can be done either as part of the subsequent audit or as part of a continuing process of enhancing environmental protection procedures. However, we must note that mere following up on the results may result in a control routine and a stagnation in work on environmental problems. It is, therefore, important that a follow up process also analyses the methodology and orientation of the previous audits to ensure that it remains a dynamic factor. Figure 12.2 presents the basic steps in an audit procedure:

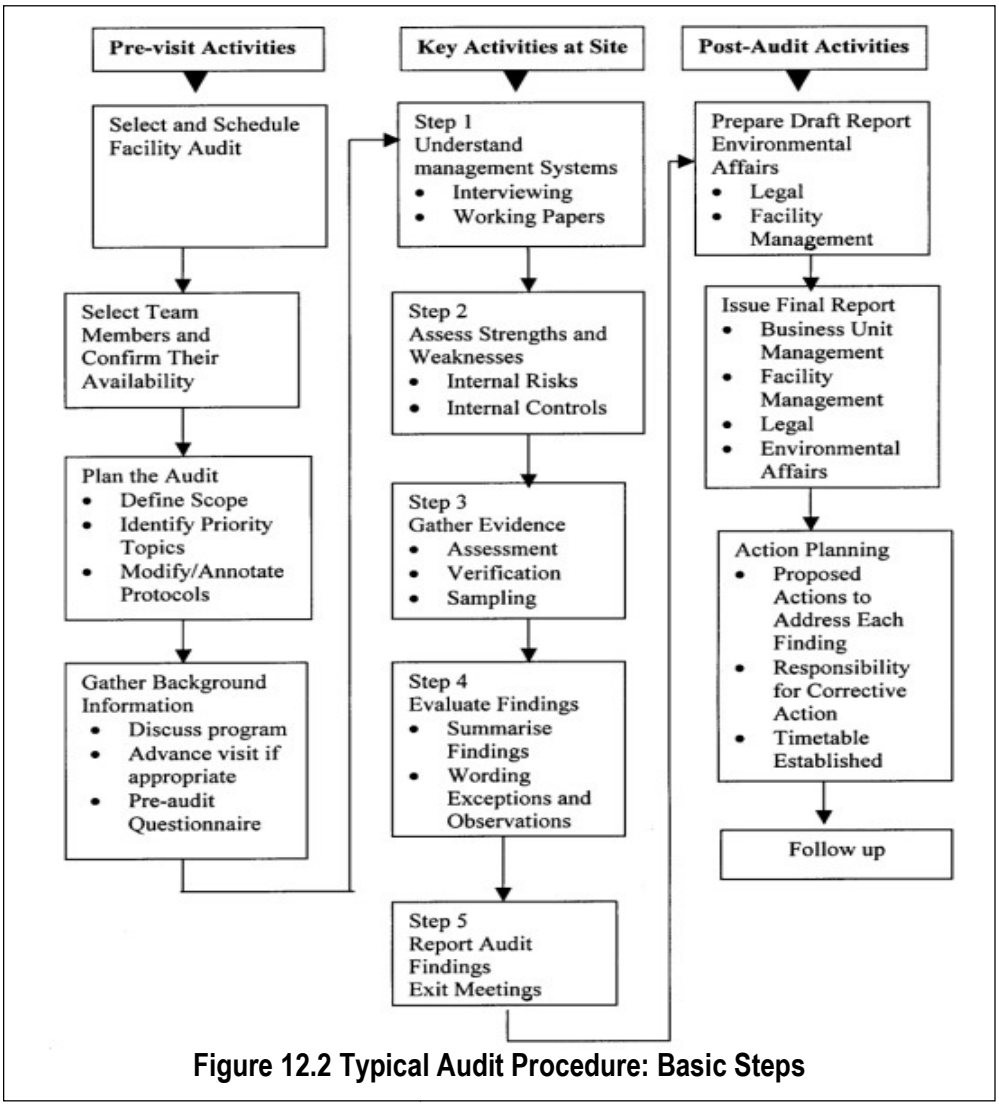

Figure 12.2 Typical Audit Procedure: Basic Steps

Having discussed the basics of an environmental audit, let us now look into the issues involved in planning an audit.

Summary

In the present Unit, we have discussed another tool for environmental management i.e., environmental auditing. An environmental audit (EA) is a systematic, independent internal review to check whether the results of environmental work tally with the targets. It studies whether the methods or means used to achieve the goals or ends are effective. EA involves studying documents and reports, interviewing key people in the organization, etc., to assess the level of deviations between targets and results. It is defined as a systematic and documented verification process of objectively obtaining and evaluating evidence to determine whether an organization's EMS conforms with audit criteria set by the organization, and for communicating the results of this process to management (ISO 14001). Environmental audits are being used as a tool and an aid to test the effectiveness of environmental efforts at local level. They can be carried out for a number of reasons including the following:

- To verify compliance.
- To review implementation of policies.
- To identify liabilities.
- To review management systems.
- To identify needs, strengths and weaknesses.
- To assess environmental performance
- To promote environmental awareness.

The objectives of an environmental audit are to evaluate the efficiency and efficacy of resource utilization (i.e., people, machines and materials), to identify the areas of risk, environmental liabilities, weakness in management systems and problems in complying with regulatory requirements and to ensure the control on waste/pollutant generation. The areas an environmental audit deals with can be categorized as design specification and layout, resource management, pollution control systems and procedures, emergency plans

and response/safety system, medical and health facilities/industrial hygiene and occupational health and confirmation to regulatory requirement

The scope of an environmental audit can fall under either to limit scope of the audit to an assessment only of the degree of compliance with policies, requirements-type documents and procedures or to assess the adequacy of the policies, requirements-type documents and procedures to begin with and, given their adequacies, to assess the degree to which compliance with these documents is achieved.

The audit objectives, however, should be both to assess the degree of compliance with policies, requirement documents, and procedures and to assess their adequacy.

The two main types of environmental audits, i.e., objective-based and client-driven. Based on objectives, environmental audits can be categorized as Liabilities audit, Management audit, Activities audit Whereas Client-driven types are based on the client, who has commissioned or ordered the audit procedure. It may be Regulatory external audit, Independent external audit, and internal environmental audit and Third party audits.

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Unit 13: EA Process, Strategy and Management

Unit Structure

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13.0. Learning Objectives

After completing this Unit, you should be able to:

- Discuss the elements of an environmental audit;
- explain waste audits and pollution prevention assessments;
- discuss liability, industrial and EMS audits;
- discuss the potential of environmental audit as a tool for environmental management to identify, assess and address environmental concerns;
- conduct/ co-ordinate an environmental audit and critically evaluate its outcomes.

13.1 Elements of Audit Process

In this Section, we will discuss how to plan an environmental audit. In planning an environmental audit, it is important to decide about the scope of the audit within an organization (given that an audit need not necessarily cover the entire organization), audit team, objective of audit and audit methodology.

13.1.1 What to audit?

An audit can cover anything from environmentally-related decisions to the function and maintenance of an individual piece of environmental protection equipment. In other words, concerning what should be audited; many definitions permit a rather broad approach to organizational, administrative and technical matters. A typical result of preliminary audits is that some sort of organizational structure is created within the firm, or just at the production site and that some procedures for dealing with environmental problems are established. An obvious result of these actions is that future audits ought to evaluate whether the organization and the procedures function in the ways that they were intended. A natural turn of these developments is that environmental audits become more and more management systems-oriented as a firm's environmentally-related activities become increasingly formalized and systematized For instance, in the management context, the transition from problem solving to quality assurance mechanisms, which attempt to prevent problems, is a natural development. The process seems to be no different in the environmental management context as well. The pattern of transition, in fact, is reminiscent of financial audit where a distinction can be made between records investigation and internal control evaluation. As methods of internal control are developed, for example, audits can concentrate increasingly on verifying those organizations, practices, procedures, the divisions of work and responsibility and other features which function as they were intended. Increasingly, in the same way, quality environmental audit is being equated with the audit of quality management systems, even where there are other types of quality audits, which are more technically-oriented towards processes

and products. In short a commonly recognized element that needs auditing include policy, principles, systems, procedures, practice and performance of the particular organization.

13.1.2 Who should audit?

The question of who should conduct an audit remains open. A clear strategy on the part of industry has been to try to reserve the use of this tool for industry itself. On the other hand, regulatory agencies have seen the possibilities of audit in their efforts to improve their insight into the environmental impacts of production. These ambitions need not be in opposition with each other, rather, they should serve as complements. The questionnaires and checklists, which companies have developed prior to conducting an internal audit often show similarities to those that the regulatory agencies use during their periodic inspections and general evaluations. In addition to environment regulatory agencies and firms themselves, there are many other actors in society who have an interest in how the environmental issues are dealt with in companies. These actors can use the tools and methodology of environmental audits to seek objective information. Increasing environmental consciousness among consumers, efforts to improve quality and development towards greater standardization are the three factors that have led to the inclusion of environmental relations in quality parameters. In the future, it may become commonplace for various interested parties to examine not only production and product quality, but also environmental quality, to estimate the viability of the firm in the marketplace. Environmental audit may, therefore, be used by many parties to secure their interests. Thus, it should not be defined in a manner that limits its use to a particular group.

13.1.3 Why an audit?

The definition of the primary purpose for conducting an environmental audit is often a reflection of priorities and interests. Industries, on the one hand, see environmental audits as means of reducing their own environmental risk taking. On the other hand, environmental groups and organizations emphasize that it is

the risks to the environment that are to be minimized through environmental audit. A reduced risk of legal action against a firm, as the result of excessive emissions or accidents, may also spare the environment from certain types of pollution and waste. There are also differences inherent in these perspectives about the purpose of environmental audits. For example, potential risks may be identified based on fulfilling legal requirements or from a purely environmental perspective. To consider everything that is not specifically forbidden by law as permissible could be a defensible position, which some firms do, provided that environmental regulations expressed some sort of optimal level of pollution. Yet, it is becoming more commonly understood that this is not the case. Pollution and waste always represent a loss of materials and an environmental burden, which also always entails costs for the firm and the environment. A certain broad agreement on continued efforts and goals for environmental protection is developing. Concerned regulatory authorities, political parties, businessmen, unions, researchers, environmental organizations and increasingly environmentally aware consumers are tending to agree on the idea that sustainable development must be based on a strategy of preventive environmental protection. This strategy can be expressed in many ways, including the definition of the purposes of environmental audits.

13.1.4 How to audit?

Finally, when it comes to how to conduct an environmental audit, it is natural to relate this to the methodology and practices used within financial and quality audits. There is no advantage to have environmental audits depart radically from established procedures in related areas. Common to both financial and quality audits is the demand to be systematic, objective and independent. This means that competent individuals who do not have direct responsibility for the areas that are to be investigated conduct the audit. Yet, to ensure that the audit process is not associated with direct methods of control and supervision, the audit should be conducted with cooperation from the personnel who work in the area under investigation. An additional advantage of involving personnel in the audit

procedure is that this may lead to a better understanding of why improvements and corrective actions are necessary.

Documentation and periodicity, i.e., the frequency of reports or analyses, is a general requirement in definitions of environmental audits, even if they may seem to be redundant. The need for documentation of the audit procedure and its results should be obvious, while periodicity is a function of the purpose of the audit. If the primary purpose, for example, is to ensure that a dynamic process continues in the direction of diminishing environmental bidets, then a high frequency of audits may be required. This last aspect of audits raises the question of the auditor's freedom to provide advice or recommendations to the organization that is the object of scrutiny. An advisory capacity is often thought to be in conflict with the requirement of objectivity, because the auditor runs the risk of examining his or her own proposals in a future audit. Yet, this has not hindered the making of recommendations by those involved with financial or quality audits. The audit process assumes that the competent and experienced auditor recommends improvements in an objective and independent way. This means that it must be clear to all parties involved in an audit that the process of environmental audit does not assume any part of the operative responsibility for environmental protection that is the prerogative of management.

13.2. Waste Audits and Pollution Prevention Assessments

As mentioned earlier, waste audits are intended to identify the possibilities for improvement. The recommendations contained in waste audits are not based on objective comparisons between expectation and results, but instead are based on technical and economic evaluation of various waste minimization alternatives. The origin of the term waste audit can be traced to the amendment of the Resource Conversation and Recovery Act (RCRA) enacted in the USA during the early 1980s. The RCRA was revised because of the problems involved in the handling and land filling of hazardous wastes. The work on revising the RCRA resulted in the Hazardous and Solid Waste Amendment of 1984, in which the US

Congress declared the highest priority to be preventive measures. The amendments required all large producers of hazardous wastes to put a programme in place to reduce the volume and toxicity of wastes. Further, waste producers were required by law to submit biennial reports to the environmental authorities on the results of efforts to reduce waste volume and toxicity. This legislation led to a widespread introduction of waste minimization programmes within industries to identify the potential for reducing wastes at source. These minimization programmes required systematic procedures to localize and characterize all types of waste streams, and this led to the creation of formal methodologies for waste minimization audits. The US Congress Office of Technology Assessment (OTA) defines waste audit as a systematic, periodic internal review of a company's processes and operations, designed to identify and provide information about opportunities to reduce wastes (OTA, 1986). Note that waste audit encompasses the term waste but does not refer to merely hazardous and other solid waste; it refers to all byproducts of production, including emissions to the air and water. UNEP and UNIDO are promoting waste audits as an operational management tool. Figure 13.1 shows a schematic presentation of their recommended work procedure.

Audits, which contain an explicit pollution prevention approach, are considered to be pollution prevention audits. This classification is used regardless of whether the audit is conducted independently, or the pollution prevention approach is integrated into compliance, management, and/or risk audits, as represented in Figure 13.2

Note that pollution prevention audits are operative in the sense that they include the creation and analysis of correction and improvement alternatives. In formal environmental audit, this is a task reserved for management.

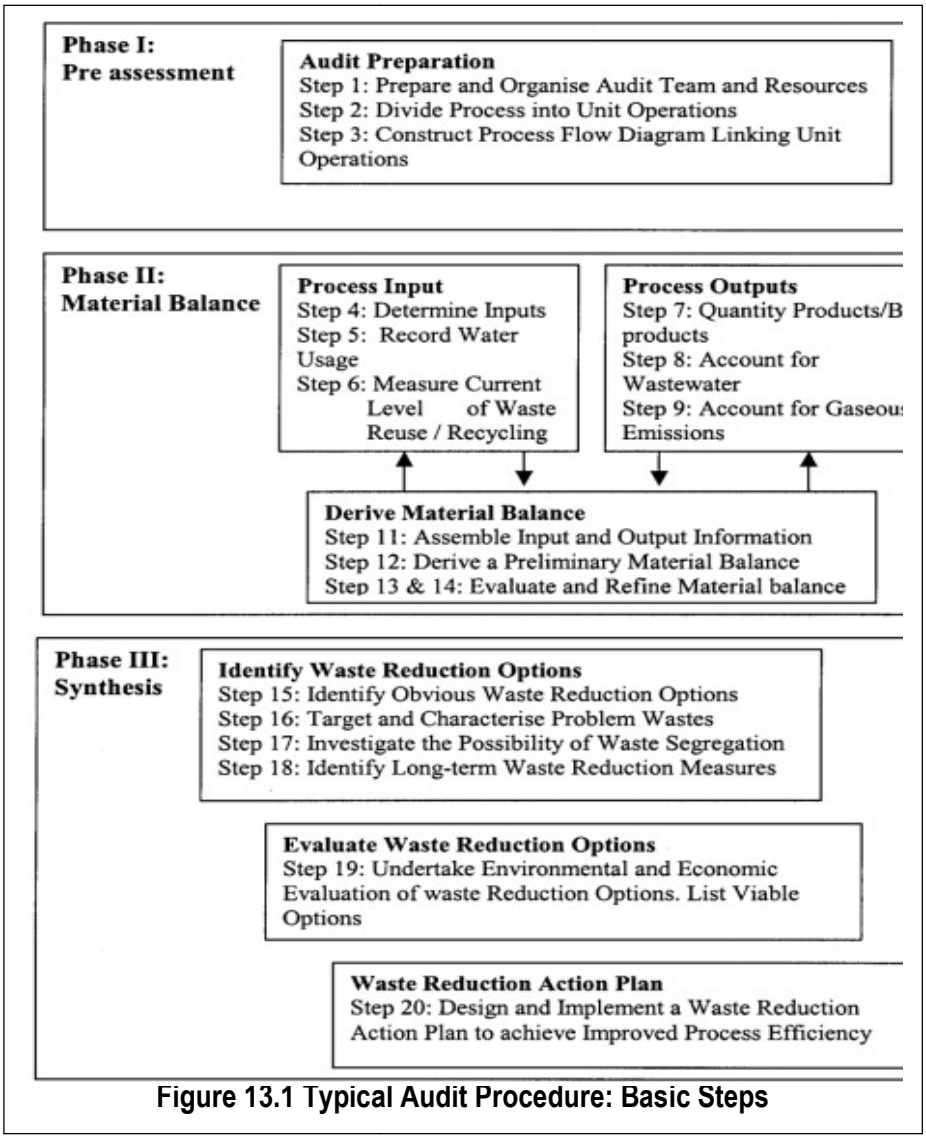

Figure 13.1 Typical Audit Procedure: Basic Steps

Figure 13.2 Typical Audit Procedure: Basic Steps

Furthermore, pollution prevention audits and similar audits require the active involvement of management in information gathering and proposals for change. For reasons such as these, in this context, the term assessment is considered to be more appropriate than audit. The term environmental audit covers a wide range of activities based on formal performance evaluation of an organization or a facility in relation to environmental objectives.

13.3 EA in Industrial Projects

An environmental audit is a process for assessing the nature and extent of environmental concerns at an existing facility – an industrial plant, an abandoned site, a mine area or any other site, where industrial pollution problems are identified or anticipated (Pollution Prevention and Abatement Handbook, 1998). It is used to provide data on the extent of pollution in an industrial area, to quantify the scale of pollution at a particular site or to examine the causes and potential remedies of problems at a facility. This Section provides guidance on the uses of environmental audits in industrial pollution management and on the scope of a typical audit. Site audit A site audit is often the first step in obtaining a quantitative understanding of pollution problems. In many cases, the audit allows an evaluation of priorities, the extent and cost of control and remediation measures. This information then shapes all remediation actions and investments. In an industrial context, the overall objective of a site audit is to understand the scale and sources of the pollution problems at a facility or in a defined area and to set out the options available for dealing with those problems. This is often a staged process of investigation in which each stage is narrower in scope but more detailed than the preceding one. An initial assessment can be relatively quick, drawing on readily available sources, including site interviews, and providing an overview of the actual or suspected sources of pollutants and the extent of their impact. This overview can be carried out during project definition or in the scoping stage and provides a basis for further detailed investigations or for defining priorities for action. An initial assessment also helps describe or indicate where site sampling and monitoring might be cost-effective. A full site audit is

detailed, requiring careful site inspections, (perhaps, including sampling and testing) and review of past and present production processes, as well as pollution emissions and control measures. The audit should also clarify the legal and regulatory framework, licensing agreements, corporate policies, and management structures and priorities that affect the environmental performance of the plant. In many cases, relevant technical and environmental standards for performance may be ill defined or may not exist, and professional judgments will have to be made as the appropriate benchmarks. However, it is essential that the standards or emissions limits proposed for the plant be clearly defined and that the rationale for their selection be given. If plant requirements appear unachievable with the current plant, the audit should address what might be acceptable as realistic interim requirements.

13.3.1. Audit purpose

An audit should provide a list of recommended actions, in terms of increasing cost-effectiveness in addressing the critical environmental issues. This list should include interim and long-term targets and a timetable for achieving them, together with indication investments and other resources (e.g., human, information, and so on) that would be required. The scale and cost of site audits can vary widely, depending, above all, on the extent of field data collection required. One or two people can carry out a scoping study in a couple of days, with cooperation from site personnel. A full site audit of a typical industrial plant can be carried out within one to two months, of which perhaps one week is spent on the main fieldwork, usually followed by a shorter visit to verify initial findings.

13.3.2. Terms of reference

The terms of reference (TOR) of a site audit will obviously be site specific. However, a typical TOR includes the following:

- Overall objective.
- Specific objectives.

- General scope of work.
- Baseline data.
- Principal sources of contamination.
- Area of impact.
- Technical approach.
- Work plan.
- Prevention, control, and mitigation.
- Recommended priority actions.
- Environmental management plan.
- Site-specific scope of work (by site).
- Laboratory services.
- Norms and standards.
- Pre-bid site visits.
- Client contacts and counterparts.
- Facilities provided by the client.
- Reporting and deliverables.

A site audit report may contain the following sections:

- Executive summary.
- Project description.
- Regulatory setting.
- Audit procedure.
- Mitigation.
- Costs and schedule.
- Annexure.

13.3.3. Points of procedure

The following points relate to the procedures for the execution of a site audit.

(i) Selection of auditors: Various forms of certification of environmental auditors are under discussion in different countries. Although many of the skills required for a site assessment are general environmental or engineering skills, it is important that the audit team has personnel with detailed knowledge of the specific industry being addressed. The selection of auditors should follow the normal procedures for consultants, and arrangements should be made to allow bidders to become familiar with the site before the tender closure date.

(ii) Briefing and TOR: It is essential that the consultants selected have a clear understanding of the objectives of the work, especially if the audit is to become part of the overall environmental assessment for the project. The TOR, therefore, needs to be as specific as possible.

(iii) Preparation phase: An audit plan should contain a description of the information required, the site visit schedule and the site personnel to be involved or interviewed. A protocol may also be prepared defining the specific information that will be sought during the site visit. The protocol should be provided to the enterprise well in advance of the visit. Available file information on the facility should be obtained and reviewed before the visit, and the audit plan should then be refined, if necessary.

(iv) Execution of the audit: Active cooperation of the plant owners and managers is essential for a good result and should be secured in advance. As effective coordination reduces delays and costs, site visits, interviews, and any sampling should be organized as early as possible. The site inspection should be carefully documented to support the findings and recommendations and to provide a reference for future audits.

(v) Review of findings: It is important that the management in place be allowed to comment on the findings and recommendations of the audit.

Our discussion so far may give us an impression that environmental audits are relevant only to industries. In reality, however, these are useful in other sectors as well. For example, waste audits are used to identify a potential site contamination. Let us discuss this aspect in Section 14.7.

13.4. Liability Audits and Site Assessment

With the advent of stringent legislation on liabilities for contaminated soil and groundwater, there has been a growing demand for information on the environmental state of properties and the potential for on- and off-site pollution migration. In the United States, for example, 100,000 sites have been labeled as contaminated, of which 10,000 have been described as priority cases, and these properties are called brownfields. The US Environmental Protection Agency (EPA) defines brownfields as abandoned, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. Contaminated land is also fairly common in Central and Eastern Europe and in industrialized regions in many developing countries like India. Many of these sites offer attractive financial opportunities, but a major obstacle to their redevelopment is the fear of contamination (left by past users) and associated liabilities. Major liabilities include potential remediation/cleanup; regulatory compliance; fines and penalties for regulatory non-compliance and compensation to private parties. Under the US Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), often referred to as Superfund, the current owner of a contaminated site may be held liable for the cost of clean up. In India, the responsibility of the occupier and operator of a facility handling hazardous wastes is also defined under hazardous waste (Management & Handling Amendment Rules, 2000). Often, the costs of investigations and remediation measures exceed the value of the property. Investigations to identify actual or potential site contamination are called site due diligence or liability audits. At times they are referred to as environmental site assessments (ESA).

13.4.1. Liability audit- Phase 1

The term Phase 1 liability audit is used for investigations that involve collecting information from interviews, by studying available historical information and by performing visual inspections of sites. It is also known as pre-acquisition site assessment, preliminary site assessment, liability audit and environmental due diligence. In general, Phase 1 audit is carried out based on the country specific guidelines or standards, as illustrated below:

- American Society for Testing and Materials (ASTM) Standard E 1527-97 entitled Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.
- ASTM Standard E1528-96 entitled Environmental Site Assessments: Transaction Screen Process.
- The Interdepartmental Committee (of the UK Department of Environment) on the Redevelopment of Contaminated Land (ICRCL) guidance note 59/83 (2nd Edition, July 1987).

In practice, it is indeed often necessary to take a phased approach, with a Phase 2 audit following a Phase 1 audit. Phase 1 audits, which are relatively inexpensive and quick, can help screen out those sites that do not require further investigation, thereby reducing the uncertainty of potential environmental liabilities.

The audits should also identify the needs for, and possibly the scope of, more thorough investigations in the form of a Phase 2 audit. The findings in the Phase 1 audit should state as to whether or not contamination is suspected as well as the likelihood of contamination. This approach can limit the need for drilling, sampling and analysis, and thereby reducing costs. A Phase 1 audit should also place the site-specific findings into the context of the surrounding environment.

13.4.2. Liability audit: Phase 2

Phase 2 liability audit refers to investigations that involve detailed physical sampling and testing of contaminants in laboratories.

The outcome of the Phase 1 audit forms the basis of the exploratory subsurface investigation (Phase 2). This involves drilling, sampling and analysis of primarily soil and groundwater and assessment of respective contamination against clean up standard (e.g., The Dutch Ministry of Public Housing, Land Use and Environmental Guidelines Soil and Groundwater Standards). This also involves collection of geological and hydro-geological data of the site to establish lateral and vertical extension of the contaminants, if any. Note that in the absence of any soil and groundwater standards, this or other country-specific standards can be adopted in India for assessment purpose.

Phase 2 audit helps determine the need for additional investigations or remediation. If contamination is identified through this process, the question of remediation and clean up is dictated by a number of factors such as legislation, future land use, risks of contaminant spreading and possible impacts on human health and the environment. If necessary, a remediation plan is developed as part of, or as follow-up to, the Phase 2 audits.

The remediation activities are sometimes termed as Phase 3 of the process. It is important to strike a balance between the time and costs of investigations and the need for additional information to reduce uncertainties about possible contamination. The uncertainties inherent in site investigations make it crucial to document observations, findings and how conclusions have been formed. It is also important to use the information obtained in one part of an audit (e.g., the site inspection) to confirm or invalidate observations from other parts (e.g., record reviews or interview sessions).

Typically, the scope of liability audit includes the following:

- Initial briefing sessions at the company's facilities between the consultant and appropriate company staff.
- Review of relevant environmental and occupational health and safety legislation.

- Review of existing documentation pertinent to all of the facilities and the environmental and occupational health and safety aspects of the facilities.
- Inspection of all buildings and properties in which significant manufacturing, laboratory, or chemical storage/disposal operations are to be included in the audit.
- Identification of all environmental and occupational health and safety concerns related to both past and ongoing activities.
- Preparation of a prioritized list (i.e., high, medium and low) of concerns related to past and ongoing activities.
- Providing recommendations and estimated costs on what additional remediation measures required for both past and ongoing environmental concerns.
- Preparation of a report that identifies all relevant environmental and occupational health and safety legislations/concerns; prioritization of all concerns related to past activities as also ongoing activities; recommendations on what further action is required along with a cost estimate for such actions for both past and ongoing activities and an executive summary highlighting the key findings.

13.5. Auditing of EMS

An environmental management system (EMS) audit refers to a systematic and documented verification process of objectively obtaining audit evidence to determine whether an organization's EMS conforms to the audit criteria and communicating the results of this process to the client (http://www.pdfwebsearch.com/regscan/unprotected/ISO+14011- 1996.pdf).

The EMS audit criteria include policies, practices, procedures or requirements, such as those covered by ISO 14001 and, if applicable, any additional EMS requirements against which the auditor compares collected audit evidence about the organization's environmental management system.

13.5.1. Audit objectives, roles and responsibilities

The objectives of a typical EMS audit include:

- determining conformance of an auditee's EMS with the EMS audit criteria;
- determining whether the auditee's EMS has been properly implemented and maintained;
- identifying areas of potential improvement in the auditee's EMS;
- assessing the ability of the internal management review process to ensure the continuing suitability and effectiveness of the EMS
- evaluating the EMS of an organization where there is a desire to establish a contractual relationship (e.g., with a potential supplier or a joint-venture partner).

Auditors and clients have an important role to play in auditing environmental management systems.

13.5.2. Scoping and review

The scope of the audit describes the extent and boundaries of the audit in terms of factors such as physical location and organizational activities as well as the manner of reporting. The client and the lead auditor determine the scope of the audit. The auditee should normally be consulted when determining the scope of the audit. Any subsequent changes to the audit scope require the agreement of the client and the lead auditor. The resources committed to the audit should be sufficient to meet its intended scope. At the beginning of the audit process, the lead auditor should review the organization’s documentation such as environmental policy statements, programmes, records or manuals for meeting its EMS requirements. In doing so, appropriate background information on the auditee's organization must be used. If the documentation is judged to be inadequate to conduct the audit, the client should be informed. Additional resources should not be expended until further instructions have been received from the client.

13.5.3 Preparing the audit

The audit plan should be designed to be flexible in order to permit changes in emphasis based on information gathered during the audit and to permit effective use of resources. The plan should include most of the following elements:

- the audit objectives and scope;
- the audit criteria;
- identification of the auditee's organisational and functional units to be audited;
- identification of the functions and/or individuals within the auditee's organization having significant direct responsibilities regarding the auditee's EMS;
- identification of those elements of the auditee's EMS that are of high audit priority;
- the procedures for auditing the auditee's EMS elements as appropriate for the auditee's organization;
- the working and reporting languages of the audit;
- identification of reference documents;
- the expected time and duration for major audit activities;
- the dates and places where the audit is to be conducted;
- identification of audit team members;
- the schedule of meetings to be held with the auditee's management;
- confidentiality requirements;
- report content and format, expected date of issue and distribution of the audit report;
- document retention requirements.

The audit plan should be communicated to the client, the auditteam members and the auditee. The client should review and approve the plan. If the auditee objects to any provisions in the audit plan, such objections should be made known to the lead auditor and resolved between the lead auditor, the auditee and the client before conducting the audit. Any revised audit plan should be agreed between the parties concerned before or during the audit.

13.5.4 Conducting the audit

Audits are conducted with an opening meeting to:

- introduce the members of the audit team to the auditee's management;
- review the scope, objectives and audit plan and agree on the audit timetable;
- provide a short summary of the methods and procedures to be used to conduct the audit;
- establish the official communication links between the audit team and the auditee;
- confirm that the resources and facilities needed by the audit team are available;
- confirm the time and date of the closing meeting;
- promote the active participation by the auditee;
- review relevant site safety and emergency procedures for the audit team.

Sufficient audit evidence should be collected to be able to determine whether the auditee's EMS conforms to the EMS audit criteria. Audit evidence should be collected through interviews, examination of documents and observation of activities and conditions. Indications of non-conformity to the EMS audit criteria should be recorded. Information gathered through interviews should be verified by acquiring supporting information from independent sources, such as observations, records and results of existing measurements. Non-verifiable statements should be identified as such. The audit team should examine the basis of relevant sampling programmes and the procedures for ensuring effective

quality control of sampling and measurement processes, used by the auditee as part of its EMS activities. After completion of the audit evidence collection phase and prior to preparing an audit report, the audit team should hold a meeting with the auditee's management and those responsible for the functions audited. The main purpose of this meeting is to present audit findings to the auditee in such a manner as to obtain their clear understanding and acknowledgement of the factual basis of the audit findings. Disagreements should be resolved, if possible before the lead auditor issues the report. Final decisions on the significance and description of the audit findings ultimately rest with the lead auditor, though the auditee or client may still disagree with these findings.

13.5.5 Content of audit report

The audit report should be dated and signed by the lead auditor. It should contain the audit findings and/or a summary thereof with reference to supporting evidence. Subject to agreement between the lead auditor and the client, the audit report may also include the following:

- the identification of the organization audited and of the client;
- the agreed objectives, scope and plan of the audit;
- the agreed criteria, including a list of reference documents against which the audit was conducted;
- the period covered by the audit and the date(s) the audit was conducted;
- the identification of the auditee's representatives participating in the audit;
- the identification of the audit-team members;
- a statement of the confidential nature of the contents;
- the distribution list for the audit report;
- a summary of the audit process including any obstacles encountered;
- audit conclusions such as EMS conformance to the EMS audit criteria, whether the system is properly implemented and maintained and whether the

internal management review process is able to ensure the continuing suitability and effectiveness of the EMS.

The audit is completed once all the activities defined in the audit plan have been concluded.

Case Study: Waste Audit: The Viscose Rayon Unit Case

Preamble: Viscose Rayon in South India, manufactures 270 TPD of Rayon Grade pulp, Viscose staple fibre, and Viscose filament yarn. Material, energy, health and safety audits were conducted to identify avenues for savings in the cost of production. Measures suggested herein, if implemented, are envisaged in savings to the tune of Rs 125 lakhs per annum.

Recommendation based on material audit

In Chipping unit, the undersized chip pieces and the sawdust during chipping process amount to about 10 kg/ 1000 kg of wood charged. But due to the operational problems and design of the control system, the waste material is not recovered through the blower system for reuse in the boiler as fuel. Some of the material is lost as waste solid. By implementing a proper dust collecting system, the chipped material can be recovered in larger quantities to reduce the solid waste in the chipper section. At present, the loss of wood in the chipper section is about 1 to 2%. This can be reduced to about 0.5 to 0.75% through proper waste collection and reuse systems. In the pulp plant, about 150 tons of pulp is produced per day. The pulp plant consists of chipper, digester, extraction and drying units. During liquor washing, loss of pulp is identified as 1%, which can be reduced to 0.6 – 0.7% through good housekeeping. The major loss of pulp is in the screening section, which is about 5% due to oversize of cooking material. The washed oversized material can be collected and reused. 4 TPD of pulp is wasted during bleaching process as rejects in the pulp plant. The same can be collected and processed further for second grade pulp. This is economically viable. In digesters, SO2 concentration of CBS should be maintained around 5.0 – 5.5% for reducing the digestion time and increasing the number of batches per day, which is

economically beneficial. In the pulp plant, an excess amount of about 0.04 T of sulphur/T of pulp can be saved if stochiometric quantities of chemicals are used for CBS preparation. **Recommendations based on energy audit**

The plant consumes electrical and thermal energy for the production of staple fibre and rayon yarn. The annual energy consumption of the plant is about 111.8 MkWh of Electricity, 16659 KL of furnace oil, 19016 KL of LSHS, and 1498 KL of diesel. The plant invests Rs 9.91 crores worth of electrical energy apart from self-generation, and Rs 22.6 crores worth of thermal energy. The audit study has identified energy saving opportunities to an extent of 9.8 MkWh of electrical energy, and 542 KL of furnace oil per year. The total estimated savings in energy bill is Rs 205.87 Lakhs per year, which is 6.33% of the purchased energy cost. A detailed analysis of Electrical System has identified following areas for energy conservation: (i) Improving power factor to 0.92 by providing additional capacitors at the main 110 KV outdoor station, and operating the DG sets at optimum power factor. (ii) Achieving the optimum loading on the Effluent Treatment Plant and power plant substation transformers. (iii) The evaluation of performance and loading of various types of electric drives in the plant show energy conservation opportunities as follows: (iv) Replacement of underloaded motors in agitators, exhaust blowers, pumps, driers and air supply fans. (v) Providing electronic devices for energy savings to control power factor in slurry presses. (vi) The lighting system in the Rayon Spinning, Rayon Spindle Expansion, Textile Spinning, and pulp plant shows following areas for energy savings: (vii) Switching off tube lights during 8 AM to 5 PM in Rayon spinning and Rayon Spindle Expansion plant. (viii) Providing individual switches at quality inspection tables. (ix) Providing CFLs in place of bulbs and tube lights. (x) Boiler test was conducted and the efficiency was found to be around 85%. The energy saving opportunity exists in sensible heat recovery from boiler blow down. The following major areas are identified for energy conservation in the process unit: (i) Heat recovery from hot ammonia refrigerant gas in CS2 plant. (ii) Controlling CS2 plant cooling tower fan by temperature sensor. (iii) Minimising

radiation and convection losses in VSF driers 1, 2 & 3, and rayon tunnel drier by increasing insulation thickness. (iv) Recovering sensible heat by returning condensate from spin bath concentrator and tunnel drier to the boiler. (v) Raising steam pressure in H2SO4 plant, waste heat boiler, and supplying HP steam to fibre driers. (vi) Recovering sensible heat from FFFF evaporator foul condensate. The following areas were identified for energy conservation in compressed air system: (i) Cleaning of intercoolers. (ii) Recovering heat from after cooler.

Recommendations based on water audit

Total water requirement is 624 m3 /day in chipper house. The segregation of ejector and pump cooling water from digester house (264 m3 /d), and reusing the same in chipper house flume, reduces the total requirement by 360 m3 /day which saves Rs 96,000 per annum, whereas installation of piping for reuse costs around Rs 20,000. Total fresh water requirement in first screen area is 6000 m3 /d excluding the warm water requirement. The backwater overflow from intermediate pulp storage chest is contaminated only with fibres, and hence 3100 m3 /day can be recycled for pulp dilution in common screen.

Recommendations based on environmental quality audit

Stack emissions: Gaseous pollutants like SO2 and NOx from pulp plant boiler stack exceed the CPCB standards. Higher SO2 content is due to higher % sulphur content in the liquor which is used as a fuel in boiler, whereas NOx and CO show the incomplete combustion of fuel. For improved combustion techniques following measures should be adhered to: (i) Proper burner maintenance. (ii) Good atomisation of liquid fuel. (iii) Provide bio-scrubbers or wet-scrubbers for controlling SO2 content in the emissions.

Ambient air quality: (i) The SPM, SO2 and NOx concentrations were below the limits prescribed by CPCB for industrial mixed zones. Higher concentrations were observed in downwind directions. (ii) Work zone monitoring results show that at all places concentrations are within the limits prescribed by TNPCB. However, further reductions are possible through control of leakages in the

process. It is suggested that leakages in the process are detected and measures taken to control the same to ensure conservation of raw materials. (iii) During the audit, odour problem was discernible. It is thus advised that SIV takes odour control measures through scrubbers.

Wastewater: (i) During study period, two equalisation basins were in operation. Running of two equalisation tanks concurrently is not required. (ii) As a standard practice, airflow rate in equalisation basin should be in the range of 0.01 to 0.0115 m3 of air/m3 of tank to maintain the solids in suspension. So, for a tank of 9500 m 3 , the airflow rate should be 5700 m3 /hr. Considering the capacity of existing air blowers, i.e., 2450 m3 /hr each, even if two blowers are operated simultaneously, the air supply will be insufficient to keep solids in suspension, resulting in accumulation of solids in equalisation basin. (iii) Wastewater from equalisation basin is pumped to clariflocculator by 3 pumps (1 standby). Capacity of each pump is 1500 m3 /hr. For optimal performance, it is required to pump wastewater at constant (design) flow rate for which existing configuration of pump is not appropriate. (iv) At present, lime is used to raise pH to 7 at equalisation basin for subsequent precipitation of zinc in clariflocculator. But, for optimum zinc removal, pH should be between 9 - 9.5. Therefore due to low pH conditions, zinc removal efficiency is low. With the existing treatment scheme, it is technically not feasible to meet prescribed limit for zinc of 1 mg/l by lime precipitation alone. (v) In case of aerated lagoons, the flow is not being divided properly and sufficient submersion for aerators is not kept. Hence the desired effluent standards are not being met. (vi) Provision of preclarifier is necessary for pulp plant effluent. Total effluent from pulp section is 1600 m3 /hr. Providing 1 hour detention time, a preclarifier of 20 m x 30 m x 3 m should be constructed wherein the fibrous material can settle. The cost savings are Rs 200/T. With this provision, frequent cleaning of equalisation tank will be avoided (presently cleaning is done two times in a year spending around Rs 1.50 lakhs). (vii) During the audit, it was observed that some of the weir plates in clariflocculators were missing which need to be replaced immediately. (viii) As the existing effluent

treatment plant cannot meet the stipulated standards, it is suggested that the extended aeration process is provided (with a settling tank after aerated lagoons I & II). A circular tank of 40 m diameter and 3 m depth can be constructed along with recirculation arrangement for the sludge to maintain 4000 mg/l of MLSS concentration. Excess sludge can be sent to the existing vacuum filter. With this, 95% BOD5 can be removed and zinc concentration will be less than 1 mg/l in the final effluent. (ix) In rayon plant, nest position in most of the machines are observed to be corroded, and nest water is leaking into the bottom of spinning machine, which must be rectified immediately. (x) Section wise norms are to be firmed for water consumption and strictly adhered to. (xi) Aiming at techno-economic feasible solution, it is suggested that the following streams be segregated, and appropriate treatment given: High concentration zinc bearing effluent from VSF and Rayon sections. Acid condensate stream containing high BOD from wood pulp plant. (xii) The Viscose staple fibre and rayon plants discharge the effluent with rich content of zinc. Zinc can be precipitated from zinc bearing solution by the addition of lime and maintaining a pH of 9 in the treated solution or by using NaOH at a pH ranging from 9.3 to 9.5. Based on these principles, a method has been devised in which the raw wastewater is first treated with lime to raise its pH to 6, and the treated solution is settled to remove the mixed precipitates of calcium sulphate and zinc hydroxide. The supernatant is then treated with caustic soda and its pH adjusted to 9.3 when almost complete precipitation of zinc as hydroxide occurs. (xiii) Colour removal from final effluent is a must before discharging to River Bhavani, warranting a physio-chemical treatment unit. (xiv) As extended aeration must be practiced, there is no need of treating the effluent again in Aerated Lagoon III. It can be directly discharged into river Bhavani. By stopping all 7 aerators in aerated lagoon III, a saving of Rs 43,45,000 per annum can be achieved.

Noise: (i) In high noise areas like boiler and H2SO4 plants, acoustic chambers with automatic spring doors should be constructed. (ii) Near boiler, compressor room and new H2SO4 plant noise levels were observed to be higher than 90 dB.

Workers in these areas should be mandated to use earmuffs. (iii) Although the SIV has provided ear protective muffs, it was observed that most of the workers do not use them. High noise areas must be declared as Ear Protective Areas. (iv) Noise-effect awareness programmes should be arranged among the workers.

Solid/hazardous wastes

(i) Sludge generated from the ETP at SIV falls under hazardous waste category No. 12. (ii) Sludge has been characterized for leachate as well as its constituents. Yearly consumption of heavy metals (copper, zinc, lead, cadmium, nickel and chromium) exceeds the quantities defined in Hazardous Waste Management and Handling rules, 1989, Govt. of India. The recovery of zinc from ETP sludge must be practiced to minimize expenses on secure landfill disposal. (iii) Quantity of Ash generated in boiler house due to combustion is 19 T/day. At present, it is being disposed without any precautions. The disposal of this sludge must be in a secure landfill. (iv) Filter clothes from all sections in VSF are being dumped adjacent to respective sections. These filter clothes contain Viscose and caustic soda. During rains, these chemicals will reach ground water deteriorating its quality. Thus the filter clothes should be disposed in a secure landfill.

Recommendations based on health and safety audit

(i) It is recommended that the safety function be reinforced to lay special emphasis on occupational health aspects such as in work areas toxins. (ii) The storage of chlorine in the pulp plant needs a closer examination, and appropriate provision to deal with emergencies. (iii) The safety organization, though adequate to meet the requirements of Factories Act, does not possess expertise and facilities for analyses and investigations on work area toxins. It is recommended that a qualified person, with specific responsibility of dealing with the occupational health, be employed forthwith. (iv) Accidents should be avoided while feeding logs to the flume in chipper section of pulp plant. (v) A mild chlorine leakage in bleaching section of pulp plant was observed during the audit. Such incidents must be avoided. (vi) Major (reportable) accidents are caused in wood yard and chipper section (50%) and sheeting section including baling section (35%).

Hence, workers needs proper training in material handling to avoid accidents. (vii) During audit; broken door glass, broken gadgets, broken funnel, blocked spinneret, damaged pot cover in Rayon spinning section, worn out flange packing in VP section, and leaking valves in spinning section were observed which are unsafe conditions, and must be rectified at the earliest. (viii) Slippery floor in CS2 plant and damaged step of a ladder in Rayon bleaching section can be classified under poor housekeeping conditions which require immediate attention. (ix) Wet floor and spurting of hot pulp from alkali tower causes unsafe conditions in pulp plant. (x) More stress on communication between the management and employees on safety is essential so that it creates an awareness leading to employees' acceptance of the safety programme.

Annexure Preliminary Environmental Review
A possible protocol

COMPANY & SITE INFORMATION

Site Manager?
Building layout plan?
Site description: Is planning permission in order?
Surrounding area? Sensitivity?
Site operation? Normal operational hours? Any variations? Prescribed Processes?
A / B / None? Discharge consents?
Licences, IPC ,IPPC etc?
How long has the company been on site?:
Company own the site or tenant?
Does the company lease any of its land to other tenants?
Previous history of site. Evidence of contaminated land?
Any surveys carried out?
No. of employees: Company turnover: Any complaints?:
Any incidences of vandalism?:
Any previous environmental audits completed of site?
Convictions under environmental legislation?

MANAGEMENT SYSTEMS COMMUNICATION

Quality management system in place?
Is quality management system externally accredited?
By whom?
For how long?
List non- - conformance from last audit?
Company environmental policy?
Environmental management systems in place?
Certified / verified? By whom?
For how long?
List non - conformance from last audit?
Written procedures for which processes?
Who has responsibility for environmental management?
Corporate annual report published?
Are the quality & environmental systems integrated?
Company Health & Safety policy?
Quality and EMS integrated with health & safety?
Are regular audits carried out of site?
COSHH data available?
Up to date?

ON - SITE STORAGE

Are material and waste storage facilities appropriate and sufficiently organized?:
Are they located close to areas of potential damage / incident?
Has an environmental risk analysis been completed?
Is there adequate containment (such as bund walls) present for spillage?:
Are there contingency plans in the event of spillage?:
Is condition of storage containers checked on regular basis?:
Are materials stored in excess or is delivery “just in time”. Any incidence of spillage?
Are these recorded?
Who is responsible for storage?
Underground storage tanks?
Are these regularly inspected for integrity, levels?

RAW MATERIALS

Purchasing responsibility: Is an inventory kept?
Details including quantities and costs: Who supplies the raw materials?
Do they have an environmental policy?
Track record of suppliers?
Are the materials environmentally sensitive?
End of use disposal problems?
Life cycle analysis completed on materials?
Alternative materials available?
Are they as effective?
What is the additional cost of alternatives?

COMMUNICATION

Environmental staff training?:
Staff awareness of company's environmental issues?:
Responsibility for environmental issues?:
Environmental records available? Which?
Communication with external interested parties?:
Any contact with Regulators?
EA/ WW/ LA Are contractors and suppliers aware of and complying with company environmental policies?
Is there external pressure from customers to improve environmental performance?
Complaints procedure?

PROCESS DESIGN & OPERATION

Process flow diagram with descriptions?
Waste arising from each stage of process?
Mass balance completed?
Highlight any environmental aspects and areas of concern: What new technology is available that could improve the efficiency of the process?
Cost, availability & grant aid?
Are there procedures in place to identify new techniques that could improve the process?
Have experts been consulted on improving efficiency of process?
Cost of initiatives? Payback period or other financial appraisals?

PRODUCT DESIGN

Production throughput?
For what reasons is the product designed as it is?
Historical, Industry standard, customer preference?
Has a life cycle analysis been completed on products?
Are there any environmental considerations built into the processing and design of product? BATNEEC, BPEO, BAT etc Is there potential for introducing any?
At what cost? Is there any environmental legislation influencing the design process?
Is use of the product environmentally benign?
Does disposal of the end - of - life product create environmental problems?
Has the company investigated possibility of replacing existing product with more environmentally responsible design?

ENERGY USE AND EFFICIENCY

Does the company have an energy policy? Who is responsible for monitoring energy?
Types of energy used? Type of supply, 3 phase, 1 phase etc? Annual energy consumption and cost data? By production area?
Is the process and product design the most energy efficient available?
What energy efficiencies have and could be made? Resultant savings?
Fabric and Process insulation?
What preventative measures are in place to avoid energy loss?
Where could these be introduced most effectively?

WASTE MANAGEMENT

Manager having overall responsibility for waste disposal?
Company waste policy?
What wastes do you create?
Type Quantity Cost of disposal Method of disposal
Any potential for recycling? Detail:
Compliance with Duty of Care? Documentation in order? Where are transfer notes held?
Audits of waste carrier and disposal site?
Any special wastes on site?
What proportion of raw materials are wasted?

ACCIDENTS

Have the potential consequences of environmental accidents been considered?
Are there plans in place for the prevention and limitation of accidents?
Are there contingency plans in place in the event of an accident?
Are regular exercises completed to establish validity of accident limitation?

TRANSPORT & DISTRIBUTION

Does the company have a transport policy? Targets? Environmentally responsible purchasing policy?
What is the transport fleet used by the company both on and off the site?
Monitoring and targeting undertaken?
Do the vehicles have a tacograph / vehicle management system fitted?
Company vehicles used?
Is there a steam cleaning facility on site? Where does wastewater go?
Are the vehicles serviced regularly?
Possibility for improvements? e.g. driver awareness training, public transport, car sharing, route planning?
Does the company provide a transport service for workers?
Does the company contract vehicles? What is the contractor's environmental position?
Annual cost of company transport and different fuel types?
Is the transport policy discussed with key customers?
Any other measures for reducing energy consumption in transport?
How do the energy performance figures compare with industry norms?

WATER AND EFFLUENT

How much water is used? Incoming and effluent?
Annual cost of purchase and discharge?
Is water consumption metered at different points of process? Process, cooling, cleaning water used?
Any water conservation measures implemented?
Emissions to water & discharge consents? Compliance? Documentation in order?
Current site drainage plan available, marked with material and waste storage areas and in use?
Is location of stormwater and foulwater drains known? Colour coded?
Are drains fitted with interceptors? Location? Inspected regularly? Maintained?
How could the company reduce water consumption?
Could this affect production and cost?

PACKAGING

Where do the company use packaging? Annual through - put and types?
Is the company aware of / does it fall within the Producer Responsibility Packaging Waste Regulations 1997?
How much packaging comes with raw materials?
Is this packaging environmentally responsible?
Is packaging treated as waste, recycled, reused?
Has a strategy to minimize packaging been discussed with suppliers? Initiatives completed? Proposed?
Could waste packaging be sold on?

AIR EMISSIONS

Are all site emissions monitored? If so at what Intervals?
Emissions to air & discharge consents?
Any odours outside site boundary?
What initiatives have been explored to reduce emissions? Specific actions? Costs?
Any burning of wastes on site?

PAPER USE & OFFICE EQUIPMENT

Who is responsible for monitoring paper use?
Annual quantity, colours and types of paper used?
Double - side printing used?
Is paper reused / recycled?
Could systems / procedures be changed to reduce dependency on paper use?
Is there an environmentally responsible purchasing policy for office equipment?

NOISE

Any noise emanating from site perimeter? If so, operational hours of noise source?
Are noise levels within and outside the site monitored? Frequency? By whom?
Are noise reduction facilities or practices used?
Is there future requirement for introducing any?

OTHER IMPACTS

PCB's present on site?
Location & Quantity?
Asbestos? Location?
Does the company use any pesticides, herbicides, insecticides?

Summary

The focus of this Unit was on the emergence of environmental audit as a proactive environmental management tool. We began the Unit by giving you an overview of an environmental audit then discussed various elements of auditing and EA of waste and pollution prevention assessment and also discussed EA in industrial projects. We also discussed the various applications of environmental audit and their scope and in that context explained waste, liability, industrial and EMS audits.

Suggested Reading

British Standards Institute BS 7750:1994 Specification for Environmental Management Systems.

Edward, J. R., (undated) Taking Environmental Audit to the next level: Moving to Pollution Prevention Audits in the 1990s U.S.EPA.

International Chamber of Commerce, 1991, ICC Guide to Effective environmental audit, Paris.

U.S. Environmental Protection Agency, 1986, Waste Minimization Opportunity Assessment Manual Cincinnati.