

Environmental Impact Assessment(EIA)

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Chapter One

1. General Introduction to Environment

What is Environment

Environment is:

■ **Dynamic system** that comprised of **hydrosphere**, **atmosphere**, **lithosphere**, **biosphere**.

👉 **Environment** (from the French environmter: to encircle or surround) can be defined as

- ⌘ The circumstances and conditions that surround an organism or a group of organisms or
- ⌘ The social and cultural conditions that affect an individual or a community

Environment, therefore, includes:

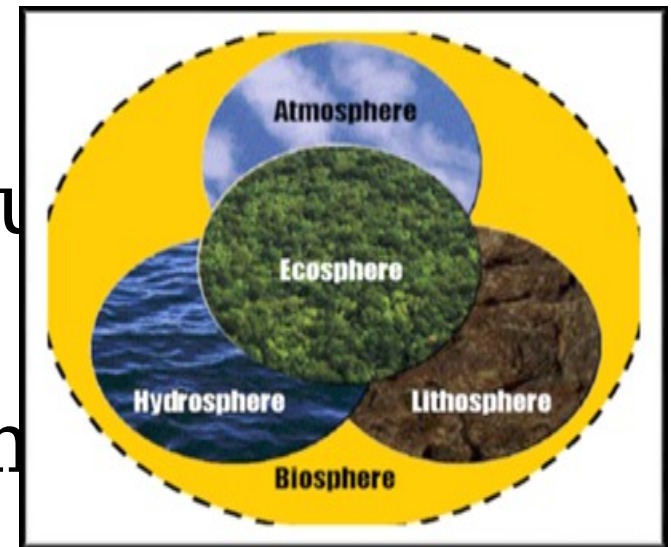
- ✍ Ecosystems and their constituent parts (abiotic & biotic components including people and communities)
- ✍ All natural & physical resources (like land, water, air and minerals)
- ✍ Physical qualities & characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, cultural & recreational attributes
- ✍ The social, economic and cultural conditions which affect the matters stated in above or which are affected by those matters

Humans inhabit two worlds

- **The natural world:** Plants, animals, soils, air, & water that preceded us by billions of years & of which we are a part.
- **The world of human society:** technology, social institutions and artifacts. We create for ourselves using science, technology, and political organization.
- **Both worlds** are essential to our lives, but needs to be integrated successfully and properly.

Structure & Functions of the Environment

- **Structure** -: A multidimensional system that consists of **four** interacting spheres
- Atmosphere
- Lithosphere
- Hydrosphere and Natural Resources
- Ecosphere-biosphere
- Anthroposphere-Man-made



Atmosphere

- ✓ **is a mixture** of
 - ☞ nitrogen (78%),
 - ☞ oxygen (21%), and
 - ☞ traces (remaining 1%) of carbon dioxide, argon, water vapor and other components.
- ✓ **It provides**, shelter, air, rain, temperature regulation, energy and supports many natural and socio-economic processes but also it is a prime mean for the spatial diffusion of pollutants and a temporary mean of their accumulation.

Hydrosphere

- ✓ is the **accumulation of water** in all its states (solid, liquid & gas) and the elements dissolved in it in **(sodium, magnesium, calcium, chloride and sulphate)**.
- ✓ It provides water, habitat for much of biodiversity, regulates temperature and supports several other physical, biological and socio-economic systems.
- ✓ It covers around **71% of the earth's surface** and is an important **accumulator of pollutants** and a significant vector of diffusion.
 - ☞ 97% of the water forms the oceans,
 - ☞ 2% is ice (north and south poles) and
 - ☞ 1% Forms Rivers, lakes, ground water and atmospheric vapor.

Lithosphere

- ✓ is the thin crust between the mantle & the atmosphere.
- ✓ Although the lithosphere is around 100 km thick, **only 1 km of it can be considered in interaction with the biosphere.**
- ✓ It provides the land, soil, subsurface for life, minerals, heat sink, water sink, is key component for meteorological processes. Provides a diversity of resources to human life.
- ✓ Main constituents are
 - ↳ oxygen (47%),
 - ↳ silicon (28%),
 - ↳ aluminum (8%),
 - ↳ iron (5%),
 - ↳ calcium (4%),
 - ↳ sodium (3%),
 - ↳ potassium (3%) and
 - ↳ magnesium (2%) in a crystalline state.
- ✓ The lithosphere is the main source **of pollutants and a permanent accumulator**
- ✓ Some are naturally released through sources like **volcanic eruptions**, while others like **fossil fuels** are the result of artificial extraction and combustion.

Biosphere - ecosphere

- ✎ refers to the **biologically inhabited**/ biologically active/ **biotic** part of the earth that occurs at the interface of the Atmosphere, Lithosphere and Hydrosphere.
- ✎ It is the set of all living organisms, including animals and plants.
- ✎ They are temporary accumulators (like lead) and sources for pollutants (natural forest burning) in a very complex set of relationships with the atmosphere, hydrosphere and lithosphere

Anthroposphere

- ✓ It is part of the environment that is made or ***modified by humans for use in human activities***
- ✓ As human technology becomes more evolved, so do the **impacts of human activities on the environment.**
- ✓ The anthroposphere encompasses the total human presence throughout the Earth system including our ***culture, technology, built environment, and activities associated*** with these.
- ✓ It is the major source of pollutants and an important accumulator of pollutants.

Dimensions of the Environment

➤ **Environment** can be structured in several ways ;
including:

- ✓ Scale (spatial and temporal) space and time
- Environmental components (biosphere dimension) and the physical environment which include all media susceptible to pollution, i.e.

□ ***Air (atmosphere)***

□ ***Water (hydrosphere)***

□ ***Soil(Lithosphere)***

□ ***Flora and fauna (Ecosphere))***

Economic and socio-cultural dimensions

- ❖ include: economic structure, labor markets, demography, housing, services (education, health, police, fire, etc.), life-styles and values
- ❖ Human beings, urban & rural landscape & the built heritage (Anthroposphere).

In general Environment includes:

✍️ *flora*, fauna, ecosystems & biodiversity

✍️ *soil, water, air*, climate and landscape

✍️ Use of land, natural resources and raw materials

✍️ Protected areas & sites of special significance

✍️ Heritages, recreation & amenity assets

✍️ socio-economic issues

Sustainable Development

- ✎ **Sustainable development** is development that meets the needs of the present without compromising the ability of future generations to meet their own need (WCED 1987)
- “Environment” and “development” are **not separable**
 - Much of USAID’s Africa portfolio is already a direct response to—or directly affected by—these environmental trends.
 - But good development **does not simply** respond to external environmental challenges. . .

- ❖ Good development is **AWARE** of its **potential adverse impacts** on ecosystems, environmental resources and environmental quality and **PROACTIVELY seeks to limit these adverse impacts**, particularly **where they affect health and livelihoods**

Key principles of sustainable development

- Anticipating and preventing problems is better than trying to react and fix them after they occur.
- Accounting must reflect all long-term environmental and economic costs, not just those of the current market.
- The best decisions are those based on sound, accurate, and up-to-date information.
- We must live off the interest our environment provides and not destroy its capital base
- The quality of social and economic development must take precedence over quantity.
- Everyone shares the responsibility for suitability for a sustainable society.
- We must respect nature and the rights of future generations.

Environmentally Sustainable development

- 👉 In life: Don't spend more than you earn!
- 👉 In business: Don't spend your capital!
- 👉 In general: Don't behave as if there is no tomorrow!
- 👉 Don't behave as if tomorrow will never come.
- 👉 Meet present needs without compromising the ability to meet the

❖ The WCED 'Brundtland' Report 1987

- ✓ The World Commission on Environment and Development (WCED), an independent body set up in
- ✓ 1983 by the UN produced a report entitled *Our Common Future* which **re-examined the critical environmental and development problems in an attempt to formulate realistic proposals to solve them** (WCED, 1987).
- ✓ The 'Brundtland' report, as it became known, authored by Dr. Gro Harlem Brundtland (Director General of the World Health Organization), explicitly introduced the term '**sustainable development**' as a conceptual bridge to bring together environmentalists and industrialists.

Cont'd

A key part of the Brundtland report was the identification of **six elements** considered important in a successful sustainable development policy:

- 👉 Reviving economic growth
- 👉 Changing the quality of growth
- 👉 Meeting essential needs for jobs, food, energy, water and sanitation
- 👉 Ensuring a sustainable level of population
- 👉 Reorienting technology and managing risk
- 👉 Merging environment and economics in decision-

- This report gave political support to sustainable development, resulting in many countries beginning to promote it as a desirable policy.
- It also had a significant effect in defining what is meant by sustainable development, providing the most instantly recognizable interpretation of the term –
- The Brundtland definition: ***‘Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.’ (WCED, 1987)***
- The report explained that this definition contains two key concepts.
 - **‘Needs’**, in particular the essential needs of the world’s poor, and
 - **‘Limitations’** imposed by the state of technology and social organization on the environment’s ability to meet present and future needs (WCED, 1987).

Earth Summit I

- ❖ The findings of the Brundtland report and the WCS **increased the pressure for a new summit** to follow up Stockholm, leading to the UN planning a Conference on Environment and Development to **spellout how to achieve sustainable development**.
- ❖ The Conference became known as the 'Earth Summit' and was held in Rio de Janeiro in 1992, drawing representatives from 178 countries (UNCED, 1992).
- ❖ A total of five important Agreements were reached at the conference, which together formed a framework for further action. These were:
 - 📖 *The Rio Declaration on Environment and Development* – 27 principles guiding action on environment and development
 - 📖 *Agenda 21* – a comprehensive action programme to help achieve a more sustainable pattern of development
 - 📖 *A Statement of Principles* – to guide the management, conservation and sustainable development of all types of forest
 - 📖 *A UN Framework Convention on Climate Change* – an agreement between countries for action to reduce the risks of global warming by limiting the emission of greenhouse gases

- ❖ *Agenda 21* proved to be one of the most significant **outcomes of the Earth Summit**, as it **set out an action plan for achieving sustainable development in the twenty-first century**.
- ❖ This document consisted of **40 chapters** setting **out policy areas dealing with social and economic issues**, e.g.
 - ✓ **combating poverty,**
 - ✓ **the protection of human health and the promotion of sustainable human settlements,**
 - ✓ **the conservation and management of resources to allow for future development,**
 - ✓ **the meeting of agricultural needs without destroying land,**
 - ✓ **the protection of ecosystems, and the safeguarding of oceans and halting the spread of deserts (UNCED, 1992).**
- ❖ The meeting and subsequent documents agreed at **Rio were important** because it **produced an agreement in principle that nations would attempt to promote sustainable development**.
- ❖ However as *Agenda 21* **did not** have any legal status to require governments and other groups to abide by it, its overall impact was somewhat diluted.

- ❖ Contained within *Agenda 21* was the introduction of what became known as 'Local Agenda 21' (LA21), which provided an important mechanism for **identifying the actions needed to pursue sustainable development at the local level. Agenda 21 stated:**
- ❖ *'By 1996 [later extended to 2000] most local authorities in each country should have undertaken a consultative process with their populations and achieved a consensus on a Local Agenda 21 for the community.'* (UNCED, 1992)
- ❖ This process of LA21 has come to mean two things, **firstly** a consultative process leading to wider involvement and empowerment, and **secondly**, implementing *Agenda 21* at a local level in such a way as to involve the community and other interested parties. In the UK, local authorities have been actively involved in developing their own LA21 policies as a response to that suggested in *Agenda 21*.

1.2. Environmental Mainstreaming

- ② It is recognized that all types of social, cultural and technological activities carried out by human beings have a profound influence on various components of the environment.
- ② Thus various built structures, materials and technological innovations also became part of the environment.
- ② So now all biological (biotic) and non-biological (abiotic) entities surrounding us are included in the term 'environment'.

- ④ The impact of technological and economic development on the natural environment may lead to degradation of the social and cultural environment.
- ④ The EIA is one of the most commonly used environmental management tools to integrate environmental concerns effectively in the dev't process.
- ④ Therefore, the concept of environmental mainstreaming refers that every development interventions or all human activities must consider safety of natural and human environment.

Chapter Two

2. Environmental Impact Assessment (EIA)

Meaning of EIA

- ❑ EIA is a Systematic & interdisciplinary *identification, prediction & evaluation, mitigation & management of impacts* from a proposed document & it's reasonable *alternatives*.
- ▮ An instrument used to *forecast & evaluate* both + or – environmental consequences of proposed projects.
- ❖ "An activity which identifies, predicts, interprets and communicates information, and proposes ameliorative measures, about impacts of a proposed action or development proposal on human health and the well-being of the ecosystem upon which human survival depends" (Sadar et al., 1994).

- Is a method of **identifying and analyzing** the potential impacts of a project, with a view to ensuring environmentally sustainable development.
- The results of the **assessment** - which are assembled in a document known as an **Environmental Statement**.
- The **level of an impact assessment** will depend on:
 - ✓ the **nature** and **scale** of the development **proposal**;
 - ✓ its **complexity**;
 - ✓ the **sensitivity** of the **environment**; and
 - ✓ **issues** identified **during** the **scoping process**.

2.1. EIA: Basic concept, Purpose and Benefit

Basic concept of EIA

- 👉 As a proactive development control tool, EIA represents an attempt to apply and instigate the principle of '**prevention is better than cure**'.
- 👉 “Early precaution is the best protection of the environment.
- 👉 To assess environmental impacts means *to early, systematically, transparently, and reasonably investigate, evaluate, & consider relevant environmental impacts of all projects, measures, and productions in the decision making process.*” (Environmental Impact Assessment Society of Germany).

The purposes of EIA -*An aid to decision-making*

- ❖ EIA helps to clarify some of the trade-offs associated with a proposed development action, which should lead to *more rational and structured decision-making*
- ❖ The EIA process has the potential to be a basis for *negotiation between the developer, public interest groups and the planning* regulator
- ❖ This can lead to an outcome that *balances the interests of the development action and the environment.*

An aid to the formulation of development action

- EIA benefits developers since it provides a framework for considering location & design issues & environmental issues in parallel
- EIA can indicate areas where the project can be modified to minimize or eliminate the adverse impacts on the environment
- The consideration of environmental impacts early in the planning life of a project can lead to:
 - ❖ ***Environmentally sensitive development***
 - ❖ ***Improved relations B/n developer, authority & local communities***
 - ❖ ***A smoother planning permission process***
 - ❖ ***A worthwhile financial return on the extra expenditure incurred***

An instrument for sustainable development

- ✎ EIA is one of the instruments to be used to achieve sustainable development: ***development that does not cost the Earth!***
- ✎ It would be better to mitigate the harmful effects in advance, at the planning stage, or in some cases avoid the particular development altogether. ***Prevention is better than cure.***
- ✎ Economic and social development must be placed in their environmental context.
- ✎ Increased output brings not only goods & services but also more waste products. Increased inputs will demand more resources. **The natural environment is the "sink" for the wastes & the "source" for the resources.**
- ✎ Environmental pollution & resource depletion are invariably the ancillaries to economic development.

Benefits of EIA

- ✎ The benefits of EIA can be direct, such as the improved design or location of a project, or indirect, such as better quality EIA work or raised environmental awareness of the personnel involved in the project.
- ✎ In these cases, there will be with flow-on effects in their future work. As mentioned above, these potential gains from EIA increase the earlier the process is applied in the design process.
- ✎ In general the benefits of EIA include:
 - ❖ ***Better environmental planning and design of a proposal.***
- ✎ Carrying out an EIA entails an analysis of alternatives in the design and location of projects.
- ✎ This can result in the selection of an improved technology, which lowers waste outputs or an environmentally optimum location for a project. A well-designed project can minimize risks and impacts on the environment and people, and thereby avoid associated costs of remedial treatment or compensation for damage.

❖ ***Ensuring compliance with environmental standards.***

- Compliance with environmental standards reduces damage to the environment and disruption to communities. It also avoids the likelihood of penalties, fines and loss of trust and credibility.

❖ ***Savings in capital and operating costs.***

- EIA can avoid the undue costs of unanticipated impacts. These can escalate if environmental problems have not been considered from the start of proposal design and require rectification later.
- An 'anticipate and avoid' approach is much cheaper than 'react and cure'. Generally, changes which must be made late in the project cycle are the most expensive.

❖ ***Reduced time and costs of approvals of development applications.***

- ✓ If all environmental concerns have been taken into account properly before submission for project approval, then it is unlikely that delays will occur as a result of decision-makers asking for additional information or alterations to mitigation measures.

❖ ***Increased project acceptance by the public.***

- ✓ This is achieved by an open and transparent EIA process, with provision of opportunities for public involvement that are appropriate to the people who are most directly affected by and interested in the proposal.

2.2. EIA Procedure

Basic Features and Procedural Elements of Typical EIA System:

❖ Most forms of EIA should attempt to conform to four fundamental tasks and thus an EIS prepared for a project will normally be expected to cover the following types of items:

1. Project description: They should identify the nature of the proposed project & induced activities

☞ introduction of a process

☞ description of the main characteristics of the project

☞ estimation of the residues & wastes that it is likely to create

☞ assessment of the compatibility of the project with environmental regulations & land use plans

2. Elements/aspects of the environment: They should identify the elements of the environment that will be significantly affected; including a description of the baseline condition of these aspects of the environment (e.g. air, water, soil, wildlife, etc)

3. Impacts: They should evaluate the initial and subsequent impacts; analysis of the likely significant effects of the proposed project on the environment including a description of the forecasting techniques and data used to assess these effects (e.g. pollution, species extinction, soil erosion, deforestation etc)

4. Management: They should be concerned with the management of the beneficial and adverse impacts which are generated; description of the measures envisaged to reduce harmful effects (this may be extended to include a consideration of alternatives to the proposed project and the reasons why they were rejected)

❖ The EIS is not, in itself, a decision. The EIA may suggest to the decision-maker one of the following options:

❖ **Accepted**

- ✓ the proposed development is acceptable at the suggested site

❖ **Accepted After Modification**

- ✓ the proposed development is not acceptable at the site suggested, but may be acceptable at an alternative site
- ✓ **Site modification**
- ✓ a modified proposal may be acceptable either at the site suggested, or at an alternative site
- ✓ Activity/ process modification

❖ **Rejected**

- ✓ the proposed development is unacceptable at any site

General Procedural Elements

➤ The main procedural elements of the EIA process will normally include the following:

1. The developer (with assistance from consultants, regulatory bodies and other organizations) prepares an EIS

2. The EIA/EIS will be used as a basis for consultation involving both authorities possessing relevant environmental responsibilities and the general public

3. The EIS with the findings of the consultation process are submitted to the competent authority along with the application for project authorization (e.g. the local planning authority) project authorization

4. The assessment study and consultation findings accompany the proposed project through the remainder of the competent authority's authorization³⁸

General Procedural Elements in list

- ✓ Regulatory bodies & other organizations
- ✓ Developer/proponent
- ✓ The consultant
- ✓ General public consultation
- ✓ Submission to competent authority, EIA, consultation findings, Project authorization
- ✓ Remainder of the competent authority: Accept, revise, reject then, letter of approval or Environmental Clearance Certificate.

**Developer/
proponent**



**regulatory
bodies & other
organizations**

General Procedural Elements

**The
consultant
General
public
consultation**



**Submission to
competent authority
EIA, consultation
findings
Project
authorization**



**remainder of the competent
authority
Accept, revise, reject
Developer/ proponent letter of
approval or Environmental
Clearance Certificate**



Sustainability: EIA process should result in sustainable development by establishing long-term environmental safeguards



Integrity: EIA process will confirm to agreed and established requirements



Utility: EIA process will provide balanced, credible information for decision making



Equity: EIA ensures fairness in the distribution of costs or benefits

❖ Guiding principles of EIA

✓ The basic guiding principles that underlie the EA objective are:

👉 **Early application:** proactive consideration & integration of environmental concerns should be at the earliest stages of the conceptualization of the projects, programs or policies

👉 **Participation:** appropriate & timely access and opportunity to the process for all interested and affected parties

👉 **Issues based:** the focus of an EIA is on the resolution of major issues of significant impacts. Hence should be issued by the concerned body

👉 **Consider alternatives:** all feasible options to a project, policies, programs or its components like site, processes, products, raw materials etc. including the “no go” option should be considered

- 👉 **Accountability:** refers to answerability of a proponent, consultant and environmental agencies for their respective roles and responsibilities
- 👉 **Flexibility:** the assessment process should be able to adapt to deal efficiently with changing circumstances and decision making situation
- 👉 **Credibility:** assessments and reviews are undertaken with professionalism and objectivity
- 👉 **Time and Cost-effectiveness:** the assessment process, its outcomes and decision taking will ensure environmental protection at the least cost and within reasonable time to society and developer alike

- 👉 **Transparency:** all assessment decisions, and their basis, should be open and accessible to the public
- 👉 **Supportive:** the review and decision making process should enhance and support sustainable development and environmentally friendly investment efforts
- 👉 **Conservation based:** the EA process should strive to promote conservation based development. Integrating conservation elements in the development planning that extend beyond conventional impact fixation approach can do this
- 👉 **Practicality:** the information and outputs provided by the assessment process are readily usable in the decision -making and planning

Operating principles of EIA

➤ Operating principles are the reason why EIA is undertaken. It includes:

- ✍️ Modify and improve design
- ✍️ ensure efficient resource use
- ✍️ enhance social aspects
- ✍️ identify measures for monitoring & managing impacts
- ✍️ promote sustainable productivity within the natural & social system capacity
- ✍️ meet environmental requirements & make continuing improvement in environmental performance
- ✍️ provide accurate & appropriate information for sound decision

Problems In EIA Implementation

- ✚ EIA requirements are often avoided due to political interferences
- ✚ EIA is often not carefully integrated into planning in many projects
- ✚ EIA is done primarily for projects, not programs or policies
- ✚ Cumulative impacts are not assessed frequently
- ✚ Public participation in EIA is often inadequate
- ✚ Proposed mitigations may not be implemented
- ✚ Post project monitoring is rarely conducted
- ✚ Assessments of risk & social impacts are often omitted from EIAs
- ✚ Mandated capacity of competent agencies are often limited

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- ✍️ provide accurate & appropriate information for sound decision

Opportunities of EIA

- ✓ enhanced environmental awareness amongst developers, local communities & decision-makers
- ✓ better cooperation between private & public sectors (e.g. through informal discussions in the preparation of an EIS)
- ✓ improved coordination between authorities & other public agencies with environmental interests (e.g. discussions between a local planning authority, nature conservancy groups, pollution control agencies and water utilities during the evaluation of an EIS)
- ✓ greater use of technologies designed to minimize waste outputs
- ✓ better understanding of environmental processes & tolerances (e.g. through the post-development monitoring of actual environmental impacts)

- ✓ The better integration of environmental considerations with economic & social aspects of development proposals
- ✓ More environmentally sustainable design
- ✓ Better compliance with standards
- ✓ Saving in capital and operating costs
- ✓ Reduced time and costs for approval
- ✓ Avoids later plan adaptations
- ✓ Reduces health costs
- ✓ Increased project acceptance

2.2.1. Pre screening consultation and Screening
[Pre-screening consultation](#)



❖ ***Project screening*** What is screening?

- ❖ The screening process determines:
 - ✓ Whether or not EIA is required for a particular project, or
 - ✓ An administrative decision is sufficient
 - ✓ What level of EIA is required
- ❖ It helps to save unnecessary wasting of both time & efforts, incase projects do not require EIA

❖ Screening may be determined either by internal or external conditions or by both :

➤ □ EIA regulations operating in a country at the time of assessment



Internal condition

Or

➤ □ International conventions and donors Operational Policy (OP) or Bank Procedures (BP), EC directives and others



condition

External

Internal condition

- **Based on EIA regulations operating in a country** According to the 2000 EIA guideline, projects are categorized into three schedules:

Schedule 1: Projects which may have adverse & significant environmental impacts therefore require a full Environmental Impact Assessment

Schedule 2: Projects whose type, scale or other relevant characteristics have potential to cause some significant environmental impacts but not likely to warrant a full EIA study

Schedule 3: Projects which would have no impact & do not require an EIA

- The guideline

External condition

The EIA Directive of EEC in force since 1985

Mandatory EIA:-

❖ Discretion of Member States (screening):-

- Considered as having significant effects on the environment the national authorities have to decide whether an EIA is needed by the "screening procedure", which determines the effects of projects on the basis of thresholds/criteria or a case by case examination

❖ **Lists of projects in Annex 1 of EC Directive includes:**

➤ Projects that Require Full EIA in many countries

- 👉 ☐ Crude oil refineries
- 👉 ☐ Thermal power stations
- 👉 ☐ Combustion installations
- 👉 ☐ Nuclear power stations
- 👉 ☐ Nuclear reactors
- 👉 ☐ Storage of radioactive waste
- 👉 ☐ Disposal of radioactive waste
- 👉 ☐ Melting of cast iron & steel Installations
- 👉 ☐ Installations of asbestos extraction
- 👉 ☐ Integrated chemical installations
- 👉 ☐ Construction of motorways, express roads & railway traffic & airports
- 👉 ☐ Trading ports & inland waterways traffic
- 👉 ☐ Waste disposal installations (landfill of toxic & dangerous wastes)

Discretion of Member States (screening):-

❖ Projects listed below **Member states shall decide whether EIA needed or not**

List of Projects included of the EC Directive

- ✓ Agriculture
- ✓ ☐ Extractive industry
- ✓ ☐ Energy industry
- ✓ ☐ Processing of metals
- ✓ ☐ Manufacture of glass
- ✓ ☐ Chemical industry
- ✓ ☐ Food industry
- ✓ ☐ Textile, leather, wood and paper industries
- ✓ ☐ Rubber industry
- ✓ ☐ Infrastructure projects
- ✓ ☐ Miscellaneous

❖ **Member states shall decide**

Screening Criteria

- ❖ Project type, location, size (e.g., capital investment, number of people affected, project capacity, areal extent)
- ❖ Receiving environment characteristics
 - ✓ National Parks
 - ✓ Indigenous people's area
 - ✓ Tourist area
 - ✓ Ecologically sensitive area
- ❖ Strength of community opinion

- ❖ Screening tools
- ❖ Project categories (lists):
 - **Inclusive** — listed projects must undergo EIA
 - **Exclusive** — listed projects exempted from EIA
- ❖ Threshold /criteria based Examination
 - **Case-by-case examinations:** determine whether projects may have significant environmental effects via project assessment or impact assessment if so, project should undergo EIA
- ❖ Combination of above

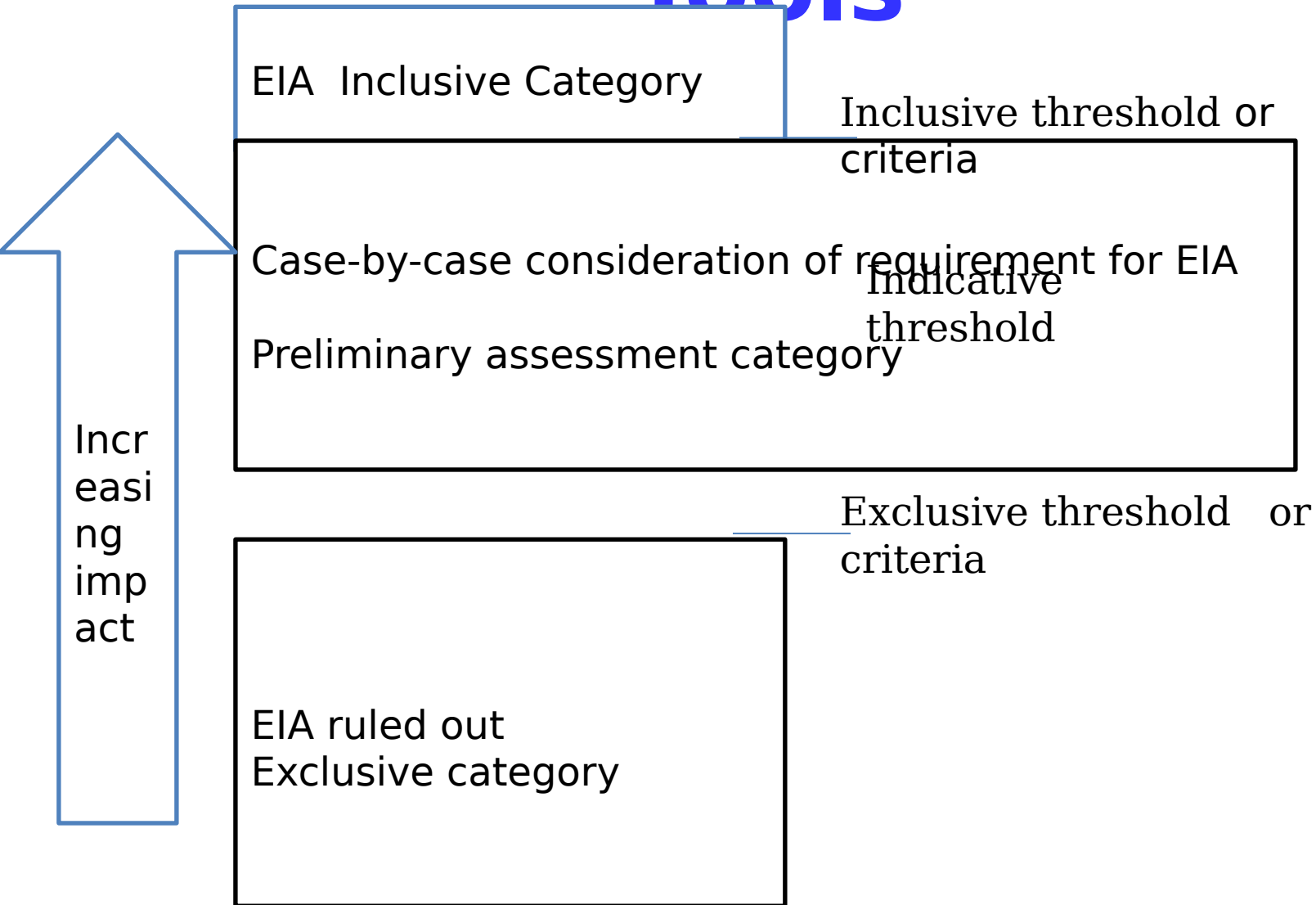
Example of projects under threshold or criteria based examinations:

- ✓ Construction of dams, impounding reservoirs with a surface area of 100 hectares
- ✓ Ground water development for industrial, agricultural or urban water supply of greater than 4000 m³/day
- ✓ Airports with a basic runway length of 2,100 m or more
- ✓ Housing development covering an area of 50 hectares or more
- ✓ Agricultural Projects necessitating resettlement of 100 families or more
- ✓ Development of agricultural estates covering an area of 500 hectares or more involving changes in type of agricultural use
- ✓ Surface water fed irrigation projects covering

Example of projects under case by case examinations:

- Type of the project
- Location of the project (urban-rural, costal zone, wetlands, mt. ecosystem, riverine zone, etc)
- Size of the project (e.g., capital investment, number of people affected, project capacity, areal extent) Receiving environment characteristics (national parks, indigenous people's area, tourist area, ecologically sensitive area, biosphere reserve area, designated area for conservation, etc
- ❖ Project type, location, size capital investment, employees, areal extent etc + Impact on environmental variables (air, water, soil, ecosystem, fauna, flora, etc

framework for Screening Tools



❖ **Outcome of Screening** Could be one of the following:

1. No EIA Required - Identify projects not requiring EIA

2. Limited EIA Required

❖ Identify projects that required preliminary Assessment (PA) when:

- ✓ Projects with limited impacts,
- ✓ Projects in which the need of EA is unclear, and
- ✓ Proposals with inadequate information

❖ Preliminary Assessment leads, therefore, to either

- •FONSI: Finding of No Significant Impact
- •DMI -Declaration of Mitigated Impact
- EIS - Need for a thorough Environmental Impact Assessment

3. Full or Comprehensive EIA Required

- Identify projects where full scale EIA is needed-when there is sufficient ground for detail assessment
- EIA, if required, results in an EIS or EIR

Project Screening Form

- ❖ Proposed Env'tal & Social Screening Form (ESSF) will allow reviewers to determine the characterization of the prevailing:
 - ✓ Local biophysical and social env't impacts
 - ✓ Potential socio-economic impacts
 - ✓ Mitigation measures
 - ✓ Resettlement & compensation measures ESSF should accurately completed by qualified env'tal professional(s)
 - ✓ The screening process would form the same purpose as a "Preliminary EIA".

- ❖ Therefore, the **proponent** should submit to the **Competent Agency** a **screening report** that contains the following:
- ✓ the **title** of the **proposed activity**;
 - ✓ the **name** of the **proponent** and the **consultant(s)** representing the proponent;
 - ✓ the **address** of the **proponent** and the **consultant(s)** representing the proponent (including telephone numbers, fax numbers and e-mail address)
 - ✓ location of the proposed development;
 - ✓ the proposed extent of the activity; and
 - ✓ Any potential environmental issues identified by the proponent (which may include a short description of the affected environment).

- ❖ Scoping is the process of identifying and “narrowing down” the potential environmental impacts associated with the development.
- ❖ The process of deciding from all of a project’s possible impacts and from all the alternatives that could be addressed, which are the significant ones. An initial scoping of possible impacts may identify:
 - An early stage of the EIA process
 - establishes the content and scope of an EIA report
 - determines which impacts & issues to consider
 - begins once screening is completed
 - identifies key issues and impacts to be considered
 - the most important step in EIA
 - lays the foundation of an effective process, saves time and money, and reduces conflict
 - Initial consultation with interested and affected parties (IAPs) really determines the scope of the impact assessment (or whether a full EIA is in fact required at all).
 - It is important to maintain the scope throughout the assessment process.

- ❖ **Public consultation** and **participation** aims to assure the quality, comprehensiveness and effectiveness of the environmental assessment.
- ❖ It ensures that the views and concerns of all **interested** and **affected parties** are taken into consideration.
- ❖ Various **techniques** may be employed through the **participation** exercise, including:
 - ✓ public meetings;
 - ✓ telephonic surveys;
 - ✓ exhibits, displays and “open days”;
 - ✓ newspaper advertisements;
 - ✓ written information
 - ✓ surveys, interview s and questionnaires
 - ✓ working with established groups (e.g. NGO’s, community organisations etc)
 - ✓ workshops and seminars

❖ **The purposes of scoping are to:**

- ✓ Involve potentially affected groups
 - ✓ Consider reasonable alternatives
 - ✓ Evaluate concerns expressed
 - ✓ Understand local values
 - ✓ Determine appropriate methodologies
 - ✓ Establish the terms of reference
- Raise **questions** like which parties, what alternatives, what methods, which culture, which is more concerned, which values.

❖ **Scoping should include:**

- ✓ A brief description of the activity to be undertaken (A description of all tasks to be performed)
- ✓ A schedule of tasks to be completed
- ✓ An indication of the stages at which the relevant authority will be consulted; and
- ✓ A description of the proposed methods of identifying the environmental issues and alternatives.

Key Components of Scoping

- ✓ Obtain information about the project including the spatial extent, timing, frequency and duration of the project
- ✓ Carry out a desk study to gather information (site, the study area and identify data gaps)
- ✓ Identify project likely impacts (damage, stress, disturbance or impact on ecosystems processes)
- ✓ Determine the zone of influence
- ✓ Evaluate experience from previous projects and their outcomes
- ✓ Identify other significant projects within the zone of influence and evaluate effects in-combination or opportunities for enhancement etc
- ✓ Identify stakeholders be engaged
- ✓ Identify opportunities for enhancing biodiversity
- ✓ Ensure that the final scoping report provides the terms of reference for EIA

Types of scoping

1. Closed scoping: wherein the content and scope of an EIA Report is pre-determined by law and modified through closed consultations between a developer and the competent authority.

2. Open or Public scoping:

- ✓ A transparent process based on public consultations
- ✓ Who should be involved in scoping?
- ✓ proponent
- ✓ EIA consultant
- ✓ supervisory authority for EIA
- ✓ affected public
- ✓ interested public
- ✓ other responsible agencies

❖ **Steps in the scoping process**

1. Prepare a scope outline
2. Develop the outline through informal consultation with env'tal & health authorities
3. Make the outline available
4. Compile an extensive list of concerns
5. Evaluate relevant concerns to establish key issues
6. Organize key issues into impact categories (study list)
7. Amend the outline accordingly
8. Develop 'Terms of reference' (ToR)
9. Monitor progress against the ToR, revising as necessary

❖ **As a minimum, the report should reflect**

- ✓ A brief description of the project
- ✓ All the alternatives identified during the scoping process
- ✓ All the raised issues by interested & affected parties (IAPs) & how these will be addressed
- ✓ A description of the public participation process
- ✓ A list of interested & affected parties, & minutes of meetings
- ✓ A detailed plan of study

❖ **Outline of a Term of Reference:**

❖ EIA 'Terms of Reference (ToR)' to be included in outline

- ✓ background to the proposal
- ✓ study area and boundaries
- ✓ context of the problem
- ✓ alternatives to be examined
- ✓ impacts and issues to be studied
- ✓ approach to be taken or analysis of impacts
- ✓ requirements for mitigation and monitoring
- ✓ Type & list of data to be included in the EIA report (i.e., project ,location, etc
- ✓ Timetable for completion of the EIA process
- ✓ Ways of opportunities for wider public and institutional involvement
- ✓ conclusions and recommendations

- ❖ The process of identifying all potentially significant environmental impacts (adverse or favorable) and taking into account in the EIA process
- ❖ Hence it brings project and baseline environmental characteristics together with the aim of ensuring all potentially significant impacts identification.
- ❖ **EIA Impact Identification Methods**
 - ✓ Various methods of impact identification
 - ✓ Simple & complex

❖ Qualitative & quantitative

- Checklists
- Matrices
- Networks
- Overlays/GIS
- Computer Expert Systems
- Risk Assessment

qualitative

quantitative

Selection of Appropriate Methods

Type and size of proposal

- ✓ Type of alternatives being assessed
- ✓ Nature of likely impacts
- ✓ Experience using EIA methods
- ✓ Resources available
- ✓ Nature of public involvement
- ✓ Procedural/administrative requirements

❖ **NB:** Complexity of the methods chosen are parallel with the complex nature of the projects life cycle.

❖ **Most methods** and techniques for identifying, measuring, and assessing impacts rely on expert **judgment**.

❖ In fact, many **checklists**, **matrices**, and **models** used in EIA represent decades of experience accumulated by numerous experts. The experts themselves are heavily involved in all aspects of the **assessment** — they are **used** to help:

- **Identify** the **potential** for **significant impacts**,
- *Plan data collection* and *monitoring* programs,
- Provide their *judgment* on the level of significance for specific impacts, and
- Suggest ways of reducing or preventing impacts.

Choosing a Method

- EIA methods range from ***simple*** to ***complex***, requiring different ***kinds*** of ***data***, different ***data formats***, and varying ***levels*** of ***expertise*** and ***technological sophistication*** for their interpretation. The analyses they produce have differing levels of precision and certainty. All of these factors should be considered when selecting a method.
- The EIA practitioner is faced with a vast quantity of raw and usually 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; and
 - ✓ Display the raw data and the derived information in a direct and relevant fashion.

➤ The needs of the target audience should also be

- ❖ **Appropriate methods**, *skillfully applied*, can *save time and money*, and can *generate valuable support* for a proposal.
- ❖ At later stages of comprehensive EIAs, decision makers include those with a mandate to approve and set the conditions for going ahead with a development.
- ❖ For an informed decision to be made, the *decision makers* need to *understand* the *nature* and *extent* of *potential impacts* and the *tradeoffs* involved.
- ❖ Whatever methods are chosen, the focus of impact assessment has evolved from *generating* a *list of potential impacts* on selected environmental components.
- ❖ Today's methods consider the environment to be a *dynamic, integrated* group of **natural** and **social** systems. Impacts occur over **time** and **space**. Some *impacts* are *immediate* while others are *delayed*. Some impacts occur as a direct result of an activity; others occur as secondary or higher order impacts resulting from changes in other environmental components.
- ❖ In *selecting assessment methods*, it helps to *understand two perspectives* underlying the utility of EIA.

- ❖ **First**, EIA is a technique to *analyze* the impacts of project activities, and is a *complex* and *complicated* procedure. The complexity is increased by the diversity of the disciplines involved: **social**, **physical**, and **biological**. This perspective holds that scientific *experts* should be *responsible* for *conducting* and *reviewing* EIAs, and that the maximum possible quantification should be accomplished. This element of decision-making should be incorporated into the EIA process.
- ❖ **Second**, EIA is primarily an opportunity to allow *groups* that are *potentially affected*: **populations**, development **agencies**, and project **proponents** — to participate in the decision-making process.
- ❖ This perspective suggests that:
 - ✓ Decision making should *not* be *restricted* to *scientific* opinions *alone*, but should also reflect *social* and *cultural* viewpoints; and
 - ✓ A key role of EIA is to identify and communicate potential impacts to the *concerned people* and encourage rational discussion.

Important Terminology and concept

- ❖ Some basic terminology has been adapted to aid in the presentation and comparison of methods:
- @ An ***activity*** is the basic element of a project or plan that has potential to affect any aspect of the environment. Projects are composed of activities. Activities are often called *actions*.
- @ An ***environmental component*** is a basic *element* of the *physical, biological, social, or economic* environment. Environmental components receive environmental impacts from activities. Environmental components can be aggregated into super-components or desegregated into sub-components. Most methods define a hierarchy of components (e.g., physical may be split into atmosphere, water, soils, etc. and atmosphere might be split into air quality, meteorology, climate, etc.)
- @ An ***environmental change*** is the measurable change in *physical* and *biological* systems and environmental *quality* resulting from a development activity.
- @ An ***environmental impact*** is an estimate or judgment of the significance and value of environmental effects on physical, biological, social or economic environment.
- @ A ***component characteristic*** is a *qualitative* description or a *quantitative* measurement of a component.

- ② A **factor** is the basic element of analysis used in any method. In most methods, factors relate to some form of environmental impact.
- ② A **factor index** is a numerical value (e.g., from 0 to 1) representing impact or level of importance associated with a factor. Factor indices are used in all methods that use rules for aggregating impacts associated with individual factors into a grand index.
- ② A **grand index** is a single numerical value calculated by aggregation (usually by linear combination) of factor indices. In most methods, the grand index is calculated by the summation of weighted factor indices.

Table 1, Objective criteria for selecting an EIA method

Key Area of the Assessment Process	Criteria	Criteria Description
Cost /Time Effectiveness Criteria	Expertise Requirements	Simple enough to allow the available manpower with limited background knowledge to grasp and apply the method without difficulty.
	Data Requirements	Does not require primary data collection and can be used with readily available data.
	Time Requirements	Can be completed well within the time requirements for the EIA review.
	Flexibility	Flexible enough to allow for <i>modifications</i> and <i>changes</i> during the course of the <i>study</i> , especially if more detailed study is required.
	Personnel Level of Effort	Can be performed with limited <i>manpower</i> and <i>budgets</i> .
Impact Identification	Comprehensiveness	Comprehensive enough to contain <i>all</i> possible <i>options</i> and <i>alternatives</i> ; able to give <i>sufficient information</i> about the impacts to enable effective decision-making.
	Indicator-based	Able to identify <i>specific parameters</i> with which to <i>measure significant</i> impacts.
	Discriminative	Requires and suggests methods for <i>identifying</i> project <i>impacts</i> as <i>distinguished</i> from <i>future</i> environmental changes produced by other causes.
	Time Dimension	Can identify impacts on a temporal scale.
	Spatial Dimension	Can identify impacts on spatial scales.
Impact Measurement	Commensurate	Uses a commensurate <i>set of units</i> so that comparison can be made between <i>alternatives</i> .
	Quantitative	Suggests specific and <i>measurable indicators</i> to be used to quantify relevant impacts.
	Measures Changes	Provides for the measurement of impact <i>magnitude</i> as distinct from impact significance.
	Objective	Is based on explicitly stated objective criteria.
Impact Assessment	Credibility	Provides sufficient <i>depth of analysis</i> and instills <i>confidence</i> into the <i>users</i> and the general <i>public</i> .
	Replicability	Analysis can be replicated by other EIA practitioners.
	Significance-based	Can explicitly assess the significance of measured impacts on a local, regional, and national scale. Explicitly states criteria and assumptions employed to determine impact significance.
	Aggregation	Aggregates the <i>vast</i> amounts of <i>information</i> and raw <i>data</i> .
	Uncertainty	Accommodates a degree of uncertainty. Identifies impacts that have <i>low probability</i> of occurrence but a high potential for damage and loss.
	Alternative Comparison	Provides for a <i>comparison</i> of impacts of project alternatives. Clearly <i>portrays</i> the <i>impacts</i> on the environment <i>with</i> and <i>without</i> the <i>project</i> .
Communication	Communicability	-Provides a sufficiently detailed and complete comparison of the various project alternatives available. -Requires and suggests a mechanism for <i>public involvement</i> in <i>interpreting</i> the impacts and their significance

CHECKLISTS METHOD

- ❖ Checklists methods are primarily useful for organizing information or ensuring that no potential impact is overlooked.
- ❖ Checklist methodologies range from *listings* of environmental factors in highly structured approaches involving importance *weightings* for factors and application of *scaling* techniques for the impacts of each alternative on each factor.
- ❖ Checklists in general are strong in impact identification and are capable of bringing them to the attention and awareness of their audiences.
- ❖ *Impact identification* is the most *fundamental* function of an *EIA* and in this respect, all types of *checklists*, namely *simple*, *descriptive*, *scaling* and *weighting* checklists do equally well.
- ❖ All checklists have *boxes* or *cells* that must be *filled* with *information* about the *nature* of the impact. The **simplest** methods merely **determine** the possibility or **potential existence** of an impact, while others, like *weighting-scaling checklists*, make *judgments* about the *magnitude* and *importance* of the impact.

There are four general types of checklists:

- A. *Simple Checklists*:** that are a list of parameters *without* guidelines provided how to *interpret* and *measure* an environmental parameter.
- B. *Descriptive Checklists*:** that includes an identification of environmental parameters and *guidelines* on *how* parameter data are to be *measured*.
- C. *Scaling Checklists*:** that is similar to descriptive checklist with the addition of information basis to subjective scaling or parameter values.
- D. *Scaling-Weighting Check Lists*:** are capable of quantifying impacts.
 - Though, here we see simple and descriptive checklist method.

A) Simple Checklists method
Table II, Simple checklist developed for the Road Project

Items	Nature of likely impact										
	Adverse							Beneficial			
	ST	LT	R	IR	L	W		ST	LT	SI	N
Aquatic Ecosystems		X		X	X						
Fisheries		X		X	X						
Forests		X		X	X						
Terrestrial Wildlife		X		X		X					
Rare & Endangered Species		X		X		X					
Surface Water Hydrology		X		X		X					
Surface Water Quality		X		X							
Groundwater	*	*	*	*	*	*		*	*	*	*
Soils											
Air Quality	X				X						
Navigation					X						
Land Transportation									X	X	
Agriculture								X			X
Socioeconomic									X		X
Aesthetic		X			X						

Legend

x- Indicates potential for type of impact, **ST**- denotes Short Term, **LT**- denotes Long Term, **R** - denotes Reversible, **IR** -denotes Irreversible, **L**- denotes Local, **W**- denotes Wide, **SI**- denotes Significant, **N**- denotes Normal, * denotes Negligible

- ❖ Varying levels of information and expertise are required to prepare checklists. Simple checklists may require only a generalized knowledge of the environmental parameters likely to be affected, and access to an information base. Alternatively, simple checklist methods can be used to summarize the results of an EIA. Scaling weighted checklists are likely to require more expertise to prepare.
- ❖ There are several major reasons for using checklists:
 - ✓ They are useful in *summarizing information* to make it accessible to specialists from other fields, or to decision makers who may have a limited amount of technical knowledge;
 - ✓ *Scaling* checklists provide a preliminary *level of analysis*; and
 - ✓ *Weighting* is a mechanism for *incorporating information* about *ecosystem* functions.

Table III, Evaluation of Simple Checklists

Key Area of the Assessment Process	Criteria	L- denotes Criteria Completely Satisfied P -denotes Criteria Partially Satisfied; N - denotes Criteria Not Satisfied
Cost /Time Effectiveness Criteria	1. Expertise Requirements	L
	1. Data Requirements	L
	1. Time Requirements	L
	1. Flexibility	L
	1. Personnel Level of Effort	L
Impact Identification	1. Comprehensiveness	L
	1. Indicator-based	N
	1. Discriminative	N
	1. Time Dimension	N
	1. Spatial Dimension	N
Impact Measurement	1. Commensurate	N
	1. Quantitative	N
	1. Measures Changes	N
	1. Objective	N
Impact Assessment	1. Credibility	P
	1. Replicability	N
	1. Significance-based	P
	1. Aggregation	N
	1. Uncertainty	N
	1. Alternative Comparison	P
Communication	1. Communicability	L
	1. Summary Format	L

Are these applications appropriate for developing countries? Yes, but checklists must be specifically developed for application to sector and country conditions. General checklists adopted from other countries and industrial sectors are of limited use

- ❖ The four most common types of scales encountered in EIA methods are (Westman, 1985):
 - 1) Nominal,
 - 2) ordinal,
 - 3) interval,
 - 4) ratio
- ❖ Most *descriptive* information is categorical data measured on *nominal* scales.
- ❖ *Evaluative* information is normally measured on *ordinal*, *interval*, or *ratio* scales. The choice of scale is extremely important.
- ❖ *Only interval* and *ratio* scales can be used to *aggregate information* on individual environmental factors into an *overall grand index*. Regardless of which scale is used, it must always be carefully defined.

Table IV, Types of scales commonly used in EIA methods (source: Westman, 1985).

Scale	Nature of Scale	Examples	Permissible Mathematical Transformation	Measure of Location	Permissible Statistical Analysis
Nominal	Classifies Objects	Species Classification, Coding soil types	One-to-one substitution	Mode	Information Statistics
Ordinal	Ranks Objects	orderings: - minimum to maximum - worst to best - minor to major	equivalence to non monotonic functions	Median	Non parametric
Interval	Rates objects in units of equal difference	time (hours), temperature (degrees)	linear transformation	arithmetic mean	Parametric
Ratio	rates objects in equal difference and equal ratio	height, weight	multiplication or division by a constant or other ratio scale value	geometric mean	Parametric

B) Descriptive Checklists

- ❖ Descriptive checklists are widely used in environmental impact studies. For example, Carstea developed a descriptive checklist approach for projects in coastal areas.
- ❖ For each of the items, environmental impact information was provided on potential changes in erosion, sedimentation and deposition; flood heights and drift; water quality; ecology; air quality; noise; safety and navigation; recreation; aesthetics; and socio-economics.
- ❖ Several descriptive checklists have been developed for water resources projects. For example, Canter and Hill suggested a list of about 65 environmental factors related to the environmental quality account used for project evaluation.
- ❖ For each factor information is included on its *definition* and *measurement*, *prediction* of impacts, and functional curves for data interpretation (where one was available or easily developed).
- ❖ A portion of a descriptive checklist containing several factors for housing and other land development projects are shown in next Table. The basis for estimates column presents a simplified, brief listing of key data models needed, if any for the factor.

Table V, Descriptive checklist for land development projects.

Factor	Bases for Estimation
1. Local economy	
Public fiscal balance Net change government fiscal flow (revenue less expenditures)	Public revenues expect household income by residential housing type; added property values Public expenditures: analysis of new-service demand, current costs, available capacities by service
Employment Change in numbers and percent Employed Unemployed, and Underemployed, by skill level	Direct from new business, or estimated from floor space, local residential patterns, expected immigration, current unemployment profiles
Wealth : Change in land values	Supply and demand of similarly zoned land, environmental changes near property
2.Natural environment: Air quality Health: Change in air pollution concentrations by frequency of occurrence, and number of people at risk.	Current ambient concentrations, current and expected emissions, dispersion models, population maps
Nuisance Change in occurrence of visual, (smoke, haze) or olfactory (odor) air quality nuisances, and number of people affected	Baseline citizen survey, expected industrial processes, traffic volumes
Water quality Changes in permissible or Tolerable water uses, and Number of people affected for each relevant body of water	Current and expected effluents, current ambient concentrations, water quality model
Noise Change in noise levels and Infrequency of Occurrence, and Number of people bothered	Changes in nearby traffic or other noise sources and in noise barriers; noise propagation model or nomographs relating noise levels to traffic, barriers, etc.; baseline citizen surveyor current satisfaction with noise levels

Important Characteristics of Simple and Descriptive Checklists

1. Simple and descriptive checklists consider environmental factors and/or impacts, which can be helpful in planning and conducting an EIS, particularly if one or more checklists for the specific project type can be utilized.
2. Published agency checklists and/or project specific checklists represent the collective professional knowledge and judgment of their developers; hence, they have professional credibility and usability.
3. Checklists provide a structured approach for identifying *key impacts* and/or pertinent environmental *factors* for consideration in impact studies. More-extensive lists of factors of impacts do not necessarily represent better lists, since relevant factors or impacts will need to be selected. Checklists can be easily modified (items can be added or deleted) to make them more pertinent to particular project types in given locations.

5. Insuring a checklist it is important to carefully define the utilized spatial boundaries and environmental factors. Any special impact codes or terminology used within the checklist should also be defined.

6. Documentation of the rationale basics to identifying key factors and/or impacts should be accomplished. In this regard, factor-impact quantification and comparison to pertinent standards can be helpful.

7. Factors and/or impacts from a checklist can be grouped together to demonstrate secondary and tertiary impacts and/or environmental system interrelationships.

8. Important weights could be assigned to key environmental factors or impacts; the rationale and methodology for such importance weight assignments should be clearly delineated.

9. Key impacts, which should be mitigated, can be identified through the systematic usage of a simple or descriptive checklist.

Environmental impact checklists (significance or importance-rated)

Actions affecting environmental resources & values	Impact on environment	Recommended feasible protection measures	Level of impact			
			No significant effect	Significant effect		
				Small	Moderate	major
1. Environmental problems due to project location						
Resettlement	-Loss of property -Loss of income -Cultural damage	-Allocation of suitable land -Compensation plan -Employment plan in the project activity	×			
Encroachment into precious ecology	-Loss of flora -Harsh micro climate -Loss of habitat	-Avoid dev't in the vegetated areas -Avoid dev't in the wildlife areas				×
2.Problems related to project design						
Road network Planning	-Cutting of trees -Soil erosion	-Utilize existing track & path -Roadside plantation -Ban grazing				×

ADVANTAGES

- Simple to understand & use
- Good for site selection & priority setting

DISADVANTAGES

- Do not distinguish **b/n** direct & indirect impacts
- Do not link action & impact

Therefore, Checklists are simple listing of factors. Also include information on:

- Type of impacts
- Ranking of impacts
- Including mitigation measures

MATRICES METHOD

- ❖ Matrices are commonly used to organize and present information. Many of the more sophisticated methods and techniques often use checklists and matrices as a starting point for analysis
- ❖ Matrices have boxes or cells that must be filled with information about the nature of the impact. Matrix methods identify interactions between various project actions and environmental parameters and components. They incorporate a list of project activities with a checklist of environmental components that might be affected by these activities.
- ❖ A matrix of potential interactions is produced by combining these two lists (placing one on the vertical axis and the other on the horizontal axis).
- ❖ One of the earliest matrix methods was developed by Leopold et al. (1971). In a Leopold matrix and its variants, the columns of the matrix correspond to project actions (for example, flow alteration) while the rows represent environmental conditions (for example, water temperature).
- ❖ The impact associated with the action columns and the environmental condition row is described in terms of its *magnitude* and *significance*.

- ❖ Most matrices were built for specific applications, although the Leopold Matrix itself is quite general.
- ❖ Matrices can be tailor-made to suit the needs of any project that is to be evaluated. They should preferably *cover* both the *construction* and the *operation phases* of the project, because sometimes, the former causes greater impacts than the latter.
- ❖ There are two general types of matrices:
 1. Simple interaction matrices; and
 2. Significance or importance-rated matrices.
- ❖ *Simple* matrix methods simply *identify* the *potential* for *interaction*.
- ❖ **Simple** matrices are useful because:
 1. Are *early* in *EIA processes* for scoping the assessment;
 2. For *identifying areas* that *require* further *research*; and
 3. For identifying *interactions* between project *activities* and specific *environmental* components.
- ❖ However, matrices also have their **disadvantages**: they tend to overly simplify impact pathways, they **don't** explicitly represent *spatial* or *temporal* considerations, and they do not adequately address *synergistic* impacts.

Cont'd

- ❖ Matrices require information about both the environmental components and project activities.
- ❖ The *cells* of the matrix are *filled* in using *subjective* (expert) judgment, or by using extensive data bases.
- ❖ **Significance** or importance rated methods require either more extensive data bases or more experience to prepare.
- ❖ Values assigned to each cell in the matrix are based on scores or assigned ratings, not on measurement and experimentation.
- ❖ Each action and its potential for impacting each environmental item is 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**, or alternatively, the scale of importance/significance also ranges from 1 (very low interaction) to 10 (very important interaction) or (**no impact, insignificant impact, significant impact, or uncertain**).
- ❖ Assignment of numerical values for importance is based on the subjective judgment of the interdisciplinary team working on the EIA study.

Cont'd

- ❖ The *matrix* approach is reasonably *flexible*.
- ❖ The total number of specified actions and environmental items may *increase* or *decrease* depending on the *nature* and *scope* of the study and the specific TOR for which the environmental impact study is undertaken.
- ❖ This is one of the *attractive features* of the Leopold Matrix.

Cont'd

- Technically, the Leopold Matrix approach is a gross screening technique to identify impacts.
- It is a valuable tool for explaining impacts by presenting a visual display of the impacted items and their causes.
- Summing the rows and columns that are designated as having interactions can provide deeper insight and aid further interpretation of the impacts.
- The matrix can also be employed to identify impacts during the various parts of the entire project cycle construction, operation, and even dismantling phases.

Simple interaction matrices

Table VI, Simple environmental impact matrix for the Pulp Mill (*source: Lohani and Halim, 1983*).

Environmental Components	Project Activities								
	Plant Construction	Farming of Kenaf	Use of Pesticide Fertilizer	Transport of Raw Materials	Water Intake	Solid Waste	Effluent Discharge	Emissions	Employment
Surface Water Quality			X			X	X		X
Surface Water Hydrology					X				
Air Quality				X				x	
Fisheries			X				X		
Terrestrial Wildlife Habitat	X								
Terrestrial Wildlife	X								
Land Use Pattern		X							
Highways/ Railways				X					
Water Supply			X				X		
Agriculture		X							
Housing									X
Health						X	X	X	
Socioeconomic									X

Table VII, Simple Matrices for Mining project

Receptor Activity		Physical						Biological						Socio-economic				Other s			
		Air quality	Climate	Resource use	Ground water	Soil	Land escape	Subsurface Geology	Flora	Fauna						population	Migration	Occupation			Noise
Mining	Site clearing	√				√	√		√	√										√	√
	Site excavation	√																			
	Blasting																				
	Other earth &ground leveling																				
	Crushing stone																				
	Mobilization of work force																				
	Erection of buildings & assembly of the plant																				
	Demobilization																				

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ADVANTAGES & DISADVANTAGES of MATRICES

❖ ADVANTAGES

- ✓ Link action to impact
- ✓ Good method for displaying EIA results

❖ DISADVANTAGES

- ✓ Difficult to distinguish direct & indirect impacts
- ✓ Significant potential for double-counting of impacts
- ✓ Qualitative

Networks method

- Is a type of diagram or chart showing & integrating impact causes & consequences
- Useful for identifying impacts with a project
- Aid in organizing impacts for discussions
- Minimal information on technical aspects of impacts.

Networks

ADVANTAGES

- ✓ Link action to impact
- ✓ Useful in simplified form in checking for **second order** impacts
- ✓ Handles **direct** and **indirect** impacts

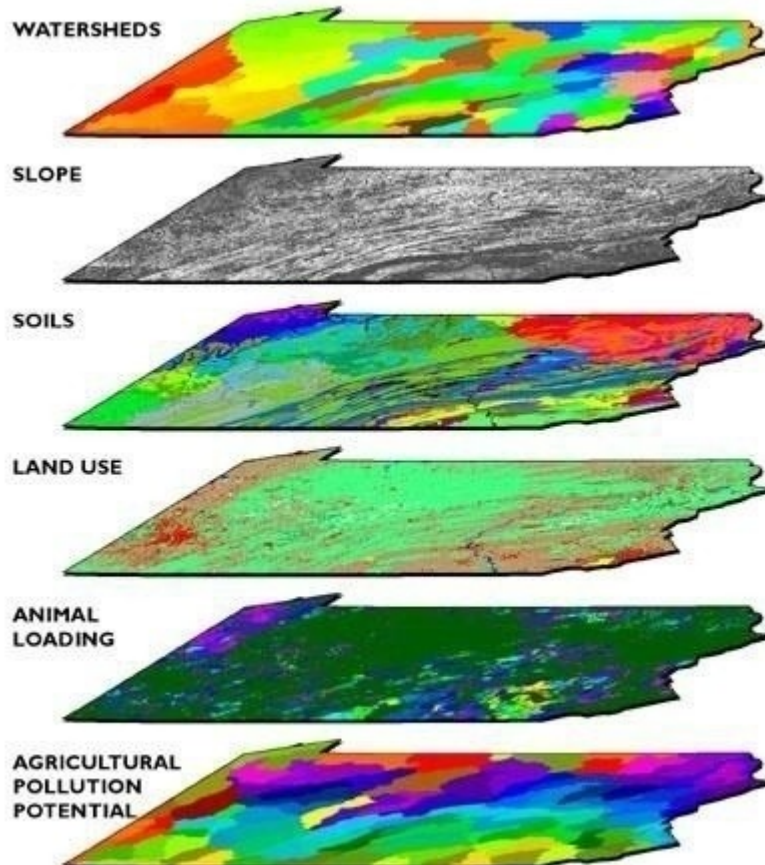
DISADVANTAGES

- ✓ Can become overly complex if used beyond simplified version
- ✓ Qualitative

IV) Overlays method

- ❖ New impact attribute relations can be created by overlaying the different impacts map
- ❖ Features from each impact layer are combined to create new output of impact maps
- ❖ Attributes of each impact map are combined from the different input layers to describe each new impact map, thus creating new impact attribute relationships
- ❖ This is done in a stepwise fashion
- ❖ Two input layers are combined to form an intermediate layer, this intermediate layer is then combined with a third layer to form another intermediate layer, and so forth until the desired resultant map layer is achieved.

Example on Overlay/GIS Analysis



Impacts on watershed characteristics
settlement, geology, vegetation
infrastructure

Impacts on soil fertility, structure, erosion

Impacts on physical topography

Impacts on land use, land cover, etc

Impacts on wild life, livestock etc

Impacts on water bodies, nutrient
pollution

Overlays

ADVANTAGES

- ✓ Easy to understand and use
- ✓ Good display method
- ✓ Good for site selection setting

DISADVANTAGES

- ✓ Address only direct impacts
- ✓ Do not address impact duration or probability

V) Computer Expert Systems

Expert systems are computer applications that perform a task that would otherwise be performed by a human expert

Some expert systems are designed to take the place of human experts, while others are designed to aid them

Expert systems are part of a general category of computer applications known as *artificial intelligence*

Computer Expert Systems

ADVANTAGES

- Excellent for impact identification and analysis
- Good for experimenting
- Semi-quantitative to quantitative

DISADVANTAGES

- Heavy reliance on knowledge and data
- Often complex and expensive

VI) Environmental Risk Assessment

- ❖ Environmental Risk Assessment (ERA) is the examination of risks that threaten ecosystems, animals and people etc.
- ❖ Based on the function of assigned values of:
 - ✓ The likelihoods of risk occurrence = L
 - ✓ Potential consequences = C
 - ✓ Probability = P etc
 - ✓ Risk score = $L \times C \times P$

Likelihood			Consequence		
	Description	Score		Description	Score
Almost certain	Expected to occur in most circumstances	5	Catastrophic	Critical impact, major consequent disruption, heavy cost	5
Likely	Will probably occur	4	Major	Intense impact, manageable but at considerable cost and some disruption	4
Possible	Might occur at some time in the future	3	Moderate	Serious impacts occurring but with ready capacity to manage	3
Unlikely	Could occur but doubtful	2	Minor	Minor management action required	2
Rare	May occur but only in exceptional circumstances	1	Insignificant	Impact not requiring any treatment	1

	Item	Consequence of occurrence	Likelihood of occurrence	Land sensitivity	Overall Risk score
	Land: inappropriate cleaning, excavation or earthworks result in major erosion	3	2	3	18
	Land: poor management of chemicals result in contamination	2	2	3	12
	Land: loss of land productivity	2	4	2	16
	Biodiversity: loss and fragmentation of habitat and ecological communities through clearing native vegetation	3	2	3	18
	Biodiversity: propagating plant disease, weeds and feral animals	3	2	3	18
	Water: inappropriate altering of hydrology	2	2	3	12
	Water: inappropriate management of chemicals, effluent, waste and by products	2	2	3	12
	Water: inappropriate polluting works in waterways	2	2	3	12
	Water: over use of water	2	2	3	12
	Water: ground water risk	2	1	3	6
	Cultural heritage: disturbance or degradation of key cultural resource and loss of cultural heritage	3	2	3	18

Risk Categories		
Low Risk	Most Optimistic	<10% impact is by the project
	Optimistic	10 - 25% impact is by the project
Moderate risk	Most Likely	25 - 50% impact is by the project
	Pessimistic	50 -75% impact is by the project
High Risk	Pessimistic	>90% impact is by the project

Consideration of alternatives

Consideration of alternatives seeks to ensure that:

The proponent has considered other feasible approaches (i.e., alternative project locations, scales, processes, layouts, operating conditions, and the "no action" option)

Suggested alternatives may include

“No-action” /“No Go” option (*status quo alternative*)

- ✓ Location alternatives
- ✓ Activity alternatives
- ✓ Design/ layout alternatives
- ✓ Technology to be used in the activity/ process alternatives
- ✓ Demand alternatives
- ✓ Supply or input alternatives
- ✓ Routing alternatives
- ✓ Scale alternatives
- ✓ Scheduling alternatives

Note: The No-Go Option

- ❖ The assessment of alternatives must at all times include the consideration of the “no-go” option as a baseline against which all other alternatives must be measured.
- ❖ The option of not proceeding with the activity must always be assessed.
- ❖ It is best practice to consider at least two alternatives against the no-go option

Types of Alternatives	Explanation/ Examples
Location alternatives	Location alternatives refers to the both alternative properties as well as alternative sites on the same property
Activity alternatives	Incineration of waste rather than disposal at a landfill site/provision of public transport rather than increasing the capacity of roads.
Design or layout alternatives	Design: e.g different architectural and/or engineering designs. Site layout: consideration different spatial configurations of an activity on a particular site (e.g sitting of noisy plant away from residences)
Technology to be used in the activity/ process alternatives	Consideration of such alternatives is to include the option of achieving the same goal by using a different method or process (1000 megawatt of energy could be generated using a coal-fired power station or wind turbines.
Demand alternative	Arise when a demand for a certain product or service can be met by some alternative means (e.g demand for electricity could be met by supplying more energy/using energy more efficiently by managing demands)
Input alternative	Input alternatives by using different raw materials or energy sources in their process (e.g industry may consider using either high sulphur coal or natural gas as a source of fuel.
Routing alternatives	Alternative routes generally apply to developments such as power line, transport and pipeline routes.
Scale alternatives	Activities that can be broken down into smaller units and can be undertaken on different scales (e.g for a housing development there could be the option 10, 15 or housing units. Each of these alternatives may have different impacts).

Activity Alternatives

- ✓ Public transport rather than increasing the capacity of roads.
- ✓ Incineration of waste rather than disposal in a landfill.

Process Alternatives

- ✓ Generating a1000 MW energy using a coal fired power station or wind turbines
- ✓ Recycling of process water or the minimization of wastes

Location Alternatives

- ✓ location of a nuclear, processing plant and ports near residence/recreational areas or away from residence

Design/ layout alternatives

Oil transport by train:

- ✓ Focusing on various routes rather than different ways to transport the oil.
- ✓ Oil transport by train - more seriously considered by TransCanada Pipeline Company

Environmental Management Plan

- It is a set of mitigation, monitoring, and institutional measures to eliminate impacts, offset them, or reduce them to acceptable levels
- Management plans (mitigation & monitoring plans) are essential elements of EA reports
 - ✓ The plan also includes the actions needed to implement these measures
 - ✓ To prepare a management plan, the EA design team
 - a) Identify the set of responses to potentially adverse impacts (alternatives)
 - b) Ensure that those responses are made effectively and in a timely manner (appropriate)
 - c) Describe the means for meeting those requirements (whom?, what?, which? And when?)

2.2.4 Mitigation

- ❖ Mitigation is the implementation of measures designed to reduce the undesirable **effects** of a proposed.

Mitigation involves measures to:

- ✓ Avoid
- ✓ Reduce
- ✓ Remedy or
- ✓ Compensate for any significant adverse impacts
- ❖ **Avoiding impacts:** E.g. Control solid and liquid waste on site.
- ❖ **Removing** them from the **site** or establishment of buffer zones to **avoid** impacts on local **ecosystem**.
- ❖ **Reducing impacts**
 - ✓ E.g. silting trapping or **planting** of **temporary cover crops**, and scheduling of activities during the dry months to **reduce erosion** and sedimentation
- ❖ Remedying impacts (repair, rehabilitate or restore affected components)
 - ✓ E.g. Quarry sites may be restored, polluted stream may be cleaned and rehabilitated, lost wetlands would be restored

Compensating for impacts

- ✓ E.g. For a loss of public recreational space, or a wildlife habitat, the provision of land with recreational facilities, or creation a nature reserve.

Example of mitigation measure:

Dust blowing from construction

Action:

- Dust blowing from unpaved roads during construction and movement of vehicles

Impact:

- ✓ Health hazards due to dust pollution
- ✓ Damage to vegetation and trees along the road

Mitigation Measures:

- ✓ Control moisture content during construction by watering.
- ✓ Stabilize road surface with a suitable stabilizer
- ✓ Increase vegetation cover on road surface and slopes

EIA for mitigation of Biological impacts

- ❖ The impacts of vegetation and wildlife will be most likely intense in rural areas and for proposed projects or actions covering large geographic areas or setting future management policies. In urban areas, however, small tracts of natural vegetation and habitat may be extremely important if there is an absence of similar habitat in the area or region. Wetlands are a significant habitat for numerous species of plants and animals. Vegetation and wildlife studies often focus on threatened or endangered species.
- ❖ The environmental analyst should assess the possible project or action effects on vegetative ecosystems and wildlife species that are protected by law. Game species and other unprotected species and the systematic approach for this involve mostly, (a) assigning the existing biological resumes, (b) impacts analysis of project activities, and (c) mitigation.
- ❖ The typical regulatory mitigation measures for the mitigation of biological impacts in various developmental activities are summarized in following Table

Regulatory Mitigation measures for the mitigation of Biological Impact

Biological impact	Possible mitigation measures and regulatory program requirement
Loss of wildlife and application. wildlife habitat	A wildlife-protection plan is required as part of any mining permit Wildlife agencies must be consulted. Timing, shaping, and sizing operations must be conducted to avoid breeding or nesting season and trees, protecting key food, cover, and water resources. Fencing will keep large mammals from direct contact with toxic chemicals in sedimentation ponds and from roadways to' reduce the number of road kills. Re vegetation must use species with high nutritional or cover value. Topsoil handling and replacement prior to re vegetation must be conducive to wildlife. Topsoil storage must be covered with vegetation, thus providing cover for wildlife. A 30-m buffer zone on each side of streams must be undisturbed.
Disturbance of aquatic habitat	A regulatory program designed for restoration, protection, organisms enhancement, and maintenance of aquatic life must be habitats implemented. Surface and underground mine openings must be cased and sealed to prevent escape of acid and toxic discharge. Buffer strips must be left between mining operations and waterways. All streams restoration is to include alternating patterns of riffles, pools, and drops. All diversions must be removed.
Erosion and sedimentation	Surface runoff must be collected in sediment ponds. Disturbed soils must be re vegetated.
Destruction of vegetation	Affected land must be restored to premining productive capacity. Topsoil must be removed, segregated, stored, and redistributed with minimum loss or contamination. Topsoil and subsoil may be removed separately and replaced in sequence. Native vegetation or appropriate substitutes after mining must be established. Agricultural lands must be returned to the same or greater productive capacity obtained under premining conditions.

2.2.5 Reporting

- ❖ A detailed, written report of the environmental consequences of a development project (EIA Report)
 - ✓ The concise presentation of EIA for non-experts that enables them to comprehend EIA
 - ✓ It is important that the EIA report is clearly and concisely documented, so that key issues can quickly and efficiently be identified by decision makers.
- ❖ EIS is also called “EIA report” It is:
- ❖ EIS normally supports the developer's application for project authorization.
- ❖ A formal EIA system should require to consider at least
 1. Human beings, fauna and flora
 2. Soil, water, air, climate and the landscape
 3. The interaction between the two groups above
 4. Material assets and the built cultural heritage

Contents of EIA Report

Executive summary

- ✓ Policy, legal, and administrative framework
- ✓ Project description
- ✓ Baseline data
- ✓ Environmental impacts
- ✓ Analysis of alternatives
- ✓ Environmental management plan (EMP)

Appendixes

List of EA report producers-individuals and organizations.

- ✓ References both published and unpublished
- ✓ Record of consultation meetings
- ✓ List of associated reports (e.g., resettlement plan or indigenous people's development plan)

2.2.6. Reviewing

- ❖ **Reviewing is** Systematic examination of EIA reports based on operating guidelines and principles.
- ❖ The **purpose of review** is to **examine** and **determine** whether the EIA report is an **adequate, sufficient**, relevance and **quality** for decision-making When completed, the competent agency should decide whether
 - ✓ to accept the application as it stands
 - ✓ reject the application or
 - ✓ request that the document be amended

Reviewing may include considerations of:

compliance with the "approved TOR"

- ✓ The examination of alternatives
- ✓ Assessment of impacts
- ✓ Appropriateness of mitigation measures
- ✓ monitoring schemes
- ✓ The use of scientific and analytical techniques
- ✓ Public involvement
- ✓ Stockholders involvement
- ✓ Socio- economic context and potential benefits
- ✓ Effect on public health or risk to life
- ✓ Scale
- ✓ Geographical extent;
- ✓ Duration and frequency
- ✓ Reversibility or irreversibility
- ✓ Ecological context;
- ✓ Regional, national or international important ace
- ✓ Degree of uncertainty.

2.2.7. Decision Making

- ❖ *Decision-making on the project involves a consideration by the relevant authority of the EIS (including consultation responses) together with other material considerations*
 - ✓ Planning department or lead agency recommends an action based on the EIS
 - ✓ Recommendation and decision is made for
 - Approval – perhaps after redesign
 - Approval with mitigations
 - Denial, with reasons given
- ❖ **Possible decisions include:**
 - **Accepted (Approved) with no reservation:** Approval of the implementation of the proposal without conditions.
 - **Accepted (Approved) with some reservation:**
- ❖ Approval of the EA report at various stages in the project cycle
- ❖ Request for supplementary, or new EA report
- ❖ Approval subject to ongoing investigation
- ❖ **Disapproval:** Rejection

2.5.8. Monitoring

- ❖ Systematic measurement of key environmental **indicators** over time, within a particular geographic area.
 - ❖ **The Signals of or proxies for aspects of**
 - ❖ **Environmental health & Ecosystem function**
 - ❖ The **indicators** are: The area in which the environmental impacts of the activity may be felt. This may be: a stream, lake or pond; a watershed, an ecosystem, a village, etc.
1. Systematic evaluation of the implementation of mitigation measures. Post-decision monitoring involves the recording of outcomes associated with development impacts, after a decision to proceed.
 - ❖ The objectives of project-based monitoring programs are to:
 - ❖ Ensure compliance with the mitigation measures (including off-setting and enhancement measures) identified in the EIA.
 2. Determine the project's actual env'tal impacts so that modifications can be made to the project or the project's mitigation measures.

- ❖ Environmental monitoring is required to assess whether the various mitigation measures are effective in attaining the goals of environmental protection.
- ❖ Without an environmental monitoring program, it is not possible to determine whether the environment is being protected or not. The absence of such a program also leaves the EIA process without a mechanism for evaluating its performance against its goals. Environmental monitoring can help to:
 1. Describe the extent of environmental effects and resource losses;
 2. Provide scientific information about the response of an ecosystem to a given set of human activities and mitigation measures; and
 3. Provide data for use as a part of environmental auditing of environmental management practices.

3. Environmental Impact Statement and Environmental Auditing

- ❖ It compares the impacts predicted in EIS before the project was started and actual impacts after implementation of the project.
- ❖ *Auditing follows from monitoring. It can involve comparing actual outcomes with predicted outcomes, and can be used to assess the quality of predictions and the effectiveness of mitigation.*
- ❖ *It provides a vital step in the EIA learning process.*
- ❖ Unlike the environmental audit (EA), which is conducted on existing projects, the EIA is applied to new projects and the expansion aspects of existing projects.
- ❖ Environmental auditing is the systematic, periodic and documented evaluation of the environmental performance of facility operations and practices, and this area has seen the development of procedures, such as the International Standard 14001 (ISO 14001).

- ❖ the term *environmental auditing* is currently used in two main ways. *Environmental impact auditing*, which involves comparing the impacts predicted in an EIS with those that actually occur after implementation, in order to assess whether the impact prediction performs satisfactorily.
- ❖ The audit can be of both impact predictions (how good were the predictions?) and of mitigation measures and conditions attached to the development (is the mitigation effective? are the conditions being honored?).
- ❖ This approach to auditing contrasts with *environmental management auditing*, which focuses on public and private corporate structures and programmes' for environmental management and the associated risks and liabilities.
- ❖ In total, monitoring and auditing can make important contributions to the better planning and EIA of future projects.
- ❖ **Environmental monitoring can help to:** provide data for use as a part of environmental auditing of environmental management practices.