CHAPTER 1

Fundamental Approach to Environmental Impact Assessment (EIA)

1.1 Introduction

1.1.1 What is an EIA?

Many developmental activities degrade the bio-geochemical environment resulting in health problems and Environmental Impact Assessment (EIA) is an impact assessment tool to predict the nature and extent of impact which will be useful to formulate appropriate preventive and operational programs to reduce the impacts and make necessary legislative measures to control the same.

Thus, any developmental/project activity requires not only the analysis, but also an estimate of the monetary costs and benefits involved, but also most importantly, it requires a consideration and detailed assessment of the effect of a proposed project on the environment.

EIA will greatly help in the execution of development projects by incorporating ecofriendly designs, process, procedures throughout the life cycle of the projects (1, 2). Thus, EIA is an exercise to be carried out before any project or major activity is undertaken to ensure that it will not in any way harm the environment on a short-term or long-term basis.

For each development project a number of alternatives can be examined by carrying-out EIA a planning tool (3,4) to forecast and assess the impacts of each alternative to understand and decide which is environmentally benign. Further EIA will also be useful to enlighten the stakeholders about the likely impacts of each alternative and critical environmental issues need to be considered in arriving at final decisions. Sharing of information on the possible impacts of various alternatives will help in achieving in coordination among stakeholders and decision makers.

In a rational model of planning and decision making, planners, engineers and decision makers based on detailed EIA and cost benefit analysis, prepare different alternatives and their possible impacts on the environment. In these efforts EIA will be of great value as a planning tool to select best environmentally sound alternative.

1.1.2 Basic Principles of EIA (5)

(i) Proactive Planning and Decision Tool

EIA is a proactive planning tool need to be integrated with the final decision process as it will be useful to plan properly to reduce negative impacts of any proposed project.

(ii) Avoidance, Pre-emption and Prevention of Adverse Environmental Consequences

To inform the stakeholders about the disastrous environmental consequences of any development project proposed so that appropriate corrective action can be planned for their avoidance or prevention will be the main aim of any EIA process. EIA process should also provide alternatives in circumstances where the impacts cannot be completely avoided. Alternatively, it can help to reduce and control the extent and strength of impacts within certain limits of acceptable criteria.

(iii) Making Positive Influence on Decision Making at the Earliest Possible Opportunity and Thinking Proactively about Options and Alternatives

It is always beneficial to carry out EIA at the beginning of the project planning stage rather than after starting the project as this will help to increase environmental performance of the project. Prevention of adverse impacts/consequences at the start of the project will save time and costs or one may have to spend more due to expensive or time-consuming remedial measures at a later stage. Thus, by critically analyzing various alternatives, options, costs and their adverse environmental impacts the project can be termed as environmentally benign or not.

(iv) Living Process throughout the Project Cycle

It is necessary to design, EIA process with continuous and dynamic protocols/process for the entire project cycle which can identify/predict the environmentally degrading impacts so that proper planning can be carried-out to implement measures for prevention/reduction of scale and scope of the disastrous impacts within acceptable limits/criteria.

(v) Making EIA Recommendations Enforceable: The final recommendations of any EIA should be very simple, sensible, effective and practically implementable control process. They should clearly specify the responsibility of each of the 5Ws (viz. What mitigation measures need to be implemented, Who, When, Where, and What requirements).The mitigation measures proposed in the final recommendations of EIA should mainly aim in the prevention of adverse impacts than remedial measures after environmental degradation occurs.

(vi) Flexibility Amidst Robustness and Transparency, with Public Participation and with the Ability to Adapt to Change: All the process with the EIA need to be flexible so that they can be adopted to changing circumstances without compromising on basic environmental concerns/issues and should be transparent so that all the stakeholders by their participation in community meetings are properly informed about various environmental consequences.

(vii) **Seeking Practical Environmental Outcomes for the Environment and Community:** The EIA process should be designed to provide and inform realistic adverse /disastrous consequences for the environment and the community.

(ix) **Efficiency amidst Effectiveness:** An EIA will have high productivity if it is designed and developed with efficient and effective approach, well defined aims, objectives and methodical protocols.

(x) **Transparent Agreement among Relevant Parties, Clear Expectations of what needs to be done and what the Performance will be, and Explicit Resolution of any Conflicts:** For sound management of Environment after project execution, it is necessary to clearly communicate to all the stakeholders all the agreements, expectations, performance requirements and any conflict resolutions etc in an open and frank manner. This will greatly help to avoid misunderstanding between stakeholders and get their active participation and help in executing remedial measures recommended in an EIA.

1.1.3 When is an EIA Required? (5)

It is very important to define the guidelines on whether a project needs EIA or not before starting the project as communities, developers and local authorities think from different perspectives. Two types of schedules are provided by EIA regulations. While industries categorized in schedule I need compulsory EIA, industries in category II need to be examined based on factors like size, location, environmental sensitivity to the local environment.

All Projects categorized under schedule I need compulsory EIA

Schedule I projects

- Major power plants
- Chemical works
- Waste disposal incineration
- Major Roads Schemes
- Major Irrigation projects

All projects categorized in Schedule II, require EIA needs to be carried out if they are expected to impact the environment due to their sensitivity, size or location.

Examples of Schedule II Projects include:

- Infrastructure projects
- Waste treatment plants
- Rubber industries
- Foundries and forges
- Diary product production units
- Coke ovens
- Brewing

- Livestock
- Storage of fossil fuel
- Textile operations
- Tourism projects/Golf projects

In assessing which projects in schedule II need EIA it is necessary to examine

1. Whether the specific project falls under schedule II
2. Does the project activities exceed threshold limits of scheduled II
3. If the project is located in environmentally sensitive areas like the National Park, Hospital zone, School zone etc.
4. Whether the project is expected to have significant effect due to it's size or location

If the answer to all three of those questions is 'yes' then an EIA is required.

If the answer to any of those questions is 'no' then an EIA is not required.

1.1.4 Environmental Audit

In the context of EIA, audit refers to (a) the organization of monitoring data to record change associated with a project and (b) the comparison of actual and predicted impacts. An audit can be applied to both pre-project and post-project approval stages. EIA necessarily does not reject a project but does in rare cases. By conducting an early EIA, a timely and suitable modification in the project can be incorporated which ultimately may help the project itself.

1.1.5 Importance of Scientific Knowledge on the Impacts of Various Activities

The development of natural resources for economic benefit is desirable. Whether resource development programs prove to be beneficial or destructive depends largely on how far scientific knowledge is obtained in their formulation and the ability of the government agencies to control their implementation.

Development projects go hand in hand with environmental impact and hence before any project is undertaken, the damages in relation to its benefits should be assessed. EIA is not negatively oriented towards development of a project. EIA has found wide utility both in developed and developing countries in achieving development in an environmentally sound manner, either at national or regional scale or at the level of individual development project. Environmental impact is any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services.

For example, as a simple case, let us examine impacts of any land clearing activity for any proposed development project. Usually these projects need changing/removing the native land cover like trees, bushes, boulders, etc., and one needs examining if this is conducive to the environment.

Land clearing is largely in the form of agriculture or urban/industrial use often may need changing /destruction of native cover like trees, bushes and boulders /rocks etc. to convert

the land into usable form. These activities may result into water pollution, erosion, habitat loss, among others (6-10).

Major impacts of typical Land Clearing Activities (L.C.A) project on the environment are shown in Fig. 1.1.

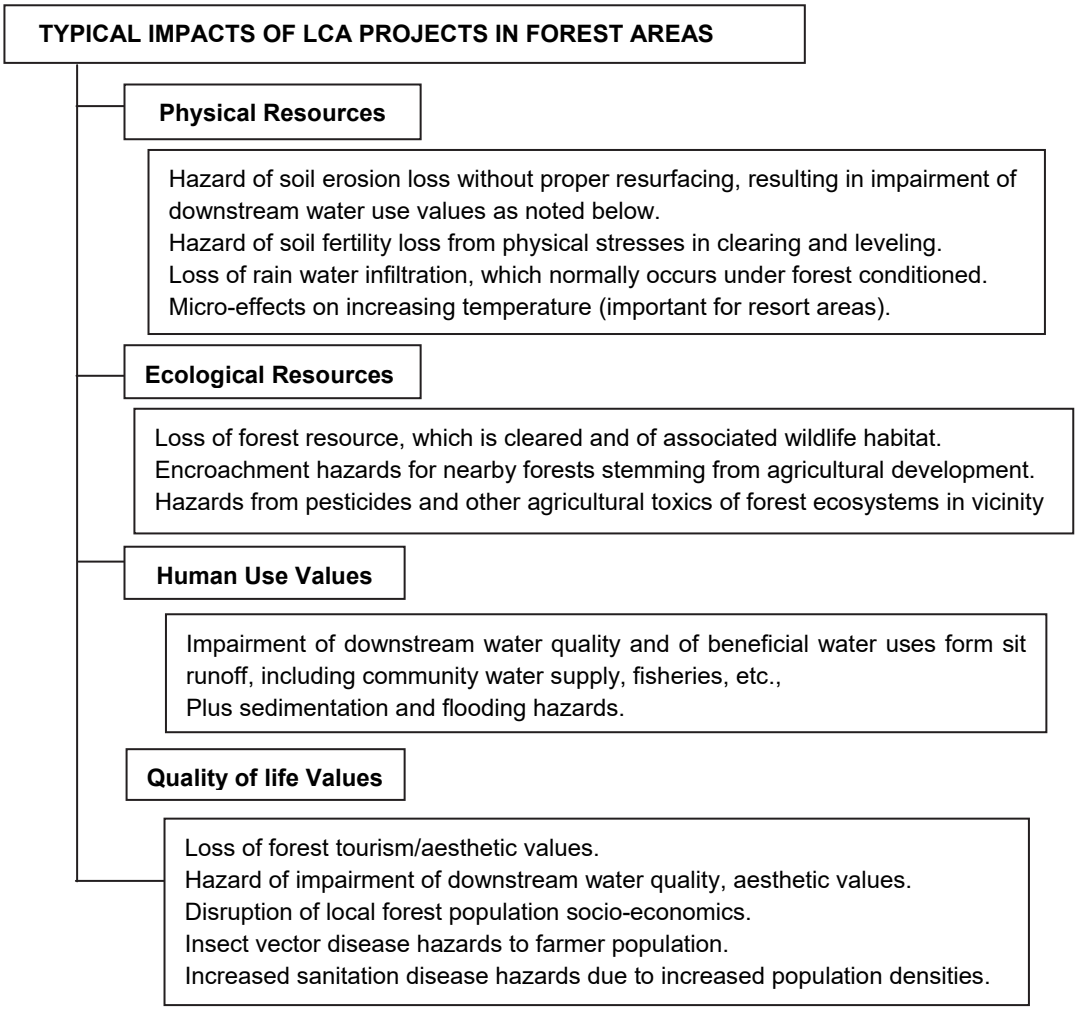


Fig. 1.1 Some major impacts of typical LCA project on environment.

1.1.5.1 Impact of land clearing on climate (11-16)

As an example, land clearing has been shown to affect temperature and rainfall patterns in regional Australia, and land clearing contributes significantly to greenhouse gas emissions. In fact native vegetation absorbs heat and releases moisture into the air, and when removed leads to more hot days, less rainfall and more severe droughts. Australia's greenhouse gas emissions from the land are currently skyrocketing, with land-sector emissions almost doubling in the past three years, and projected to further increase.

Many research reports (Pitman et al. 2004 (15), McAlpine et al. 2007 (14), Deo et al. 2009, (11)) indicate that land clearing and loss of vegetation cover have triggered strong regional climatic effects like

(i) Surface temperature increased in eastern Australia and southwestern Western Australia, particularly in summer;

(ii) Southwestern, Western Australia experienced warming and decreased rainfall

(iii) Eastern Australia experienced decreased summer rainfall (4-12%) and southwestern Western Australia (4-8%);

(iv) In the period 2002/2003 an average of 2 degree rise in temperature was observed resulting drought in eastern Australia;

(v) In the Murray-Darling basin decrease in rainfall intensity was observed

(vi) Southern (New Southern Wales) NSW and northern Victoria have observed decrease in wet days and rainfall around 10-30 mm per year while coastal NSW experienced an increase number of dry days

(vii) Amplification of El Niño events.

Considerable research has been carried out on procedural and methodological issues related to EIA in the past, and an acceptable standard of practice, against which EIA can be reviewed has not emerged.

1.1.6 Criticism on EIA

However, despite ample evidence to support the usefulness of EIA, its effectiveness and efficiency are being increasingly questioned. Criticism leveled against EIA include (a) Tokenism (b) unrealistic time constraints (c) Failure to accommodate uncertainty (d) Poor coordination and poorly stated objectives (e) Inadequate research (f) limited use of protective techniques and limited study of indirect and cumulative consequences and (g) being too descriptive and voluminous.

EIA is being criticized for becoming an end in itself and rather than the means to a more balanced process of decision-making. More specifically, the accuracy and precision of impact prediction are being questioned as is the appropriateness of mitigation and the effectiveness of its implementation. A number of studies have, therefore, been undertaken to review EIA methodology in the light of operational experience. Actual effects caused by a project are being compared with predicted effects. Models are being reevaluated and appropriate methodologies and models are being used. Follow-up or post operational studies are being conducted.

1.2 EIA Procedure (17-20)

The entire EIA procedure can be divided into two complementary tasks or sub-reports, (i) the Initial Environmental Examination (IEE) and (ii) the Full-Scale Environmental Impact Assessment (EIA).

1.2.1 Initial Environmental Examination (IEE)

IEE is a means of reviewing the environmental integrity of projects to help determine

whether or not EIA level studies can be undertaken. In this sense IEE can be used for project screening to determine which projects require a full-scale EIA. IEE will have several other uses for ensuring project-oriented environmental management as well as minimizing the effort, expense, and delay in carrying out such planning. IEE involves assessing the potential environmental effects of a proposed project that can be carried out within a very limited budget and will be based on the available recorded information or on the professional judgment of an expert. If the IEE results indicate that a full-scale EIA is not required, then, any environmental management parameters, such as, environmental protection measures or a monitoring program can be adapted to complete the EIA for such a project.

If on the other hand, full-scale EIA is required, IEE can be of great help as a mechanism to determine and identify key issues that merit full analysis in EIA and to designate the issues that deserve only a cursory discussion. It may also identify other environmental review and consultation requirements so that necessary analyses or studies can be made concurrently with EIA. This would reduce delay and eliminate redundant or extraneous discussion of EIA reports. IEE is a means of providing the most efficient and feasible preparation of adequate environmental management plans with or without the requirement of a full scale EIA. Therefore, for most Industrial Development Projects, IEE is desirable simply from the economic point of view.

1.2.2 Full Scale Environmental Impact Assessment (EIA)

A multidisciplinary approach to environmental impact analysis is crucial to the decision-making process and to an equal consideration of all areas of potential impact, when the tradeoffs of particular alternatives are evaluated. Therefore, the professional assessing impacts within a particular area of impact, such as, natural resources, air quality, and neighborhood effects, must be educated and quantified within the disciplinary area.

Impact assessment methods are classified into following analytical functions: **Scope identification, prediction, and evaluation.**

Methods of identification of environmental impacts can assist in specifying the range of impacts that may occur, including their special dimensions and time frame. This usually involves the components of the environment affected by the activities of the project. The natural environment of man consists of air, water, land, noise, flora and fauna, etc., while the man-made environment consists of socioeconomic aspects, aesthetics, transportation etc.

Predictive methods will define the quantity or special dimensions of impact on an environmental resource. It can differentiate between various project alternatives in terms of questions covering "how much?" or "where?" the impact may occur.

Methods of evaluation determine the groups (facility users or populations) that may be directly affected by the project or action. They will communicate to the decision maker what the deficiencies (trade-offs) are between possible alternatives or courses of action and the impacts associated with each alternative. But the number of available tools and techniques for E.I.A, only a few look simple and suitable for developing countries.

1.2.2.1 Analytical Functions Associated with the Environmental Impact Assessment

Analytical functions associated with the environmental impact assessment are

(a) ***Defining scope of an EIA***

1. Important issues and concern,
2. Areas of less concern for the present acts, and
3. Regulations requirement.

(b) ***Identification***

1. To exhaustively describe the present project environment
2. To examine and fix the principle project components
3. To critically analyze and describe various environmental components likely to be impacted/modified by various project activities

(c) ***Prediction***

1. From critical studies fix the significant environmental modification likely to occur due to various project activities
2. On the expected changes in the environment likely to occur, predicting and presenting the intensity and spatial dimensions of impacts
3. Providing estimates of the extent of impacts likely to occur in a given time period

(d) ***Impact Evaluation and Analysis***

1. Examining and assessing the relative impacts of various project alternatives and fixing the best alternative with low impacts
2. By exhaustive and critical studies the significance of various impacts
3. Preparation of draft and final impact statement

1.2.2.2 Defining the Scope of EIA

It is necessary to define the scope of EIA at the early stages of environmental impact assessment so as to reinforce a commitment to an organized, and systematic program of agency and public participation in the environmental process. The public must be made aware in order to be able to make informed choices. Scoping refers to early coordination with interested and affected agencies and the public.

Scoping identifies important issues and concerns, areas of no concern for a particular project or action, and other legislative or regulatory requirements.

Purpose of Scoping

***Scoping is used to*:**

- Define the proposed action,
- Enlist the cooperation of agencies,
- Identify what's important,
- Identify what's not important,
- Set time limits on studies,

- Determine requirements of the study team,
- Collect background information,
- Identify required permits,
- Identify other regulatory requirements, and
- Determine the range of alternatives.

The scoping process should be specifically designed to suit the needs of the individual project or action being proposed. It can be a formal, extensive process or an informal, simple process. There are many options for the extent and format of meetings, mailings, and agency and local group contacts.

Scoping is also used to identify the cost and time of the assessments and therefore is a very important step both in identifying the impacts and controlling the limits of the EIA process. As a systematic approach, the commonly used techniques for scoping include Checklist, Matrix, Networks and Overlay methods.

1.2.2.3 Baseline Data Collection

Following scoping, the next step is the baseline data collection. All relevant environmental data of the project area need to be collected which is termed as baseline studies. Baseline studies are based on primary data, secondary data, relevant reports and research papers and cover everything important that is expected to have a potential impact on the environment in and around the project.

1.2.2.4 Full Scale Impact Assessment

This requires interpretation of the significance of the impacts to provide a conclusion, which can ultimately be used by decision-makers in determining the fate of the project. This step is generally considered the most crucial in the entire EIA process. Its complexity increases as not every impact, especially natural and social impacts, can be quantified. A well balanced approach is essential to help take a final decision regarding the impact of the project on the economic, social and environmental conditions in the region.

1.2.2.5 Identification of Impacts on the Environment by Preliminary Overview Assessment

Often the first step in an environmental impact assessment has been a preliminary overview of the proposed project alternatives and locations. Several steps are included in the overview. First, the project alternatives and characteristics must be reviewed with reference to the following pertinent questions. Is the project a building, a highway, a park, or a land-use plan? What are the characteristics of the setting? Is the potentially affected area urban or rural, natural or made by human beings?

This step is also used to ensure that the proponent has considered other feasible approaches, including alternative project locations, scales, processes, layouts, operating condition including the no-action option.

The purpose of the preliminary assessment is to identify the potential for significant environmental impacts of the initial set of alternatives. The results then function to refine

the alternatives and to determine the appropriate subsequent environmental documentation. A few examples of the types of questions included in an initial assessment overview, in areas of potential physical, biological, social and economic impacts, are as follows: Will the proposal either directly or indirectly:

- Modify a channel or a river or a stream?
- Reduce the habitat of any unique, threatened, or endangered species?
- Divide or disrupt an established community?
- Require the displacement of businesses or farms?

In the identification of impacts one should establish the already existing state and clearly identify:

1. What will happen if the project does not come into existence?
2. What will happen if the project comes up? The impacts of a project can be depicted only through certain parameters.

Some typical expected changes in the environment and human aspects of various project activities are presented in Tables 1.1 and 1.2.

Table 1.1 Possible impacts of various project activities on the various components of environment.

Component	Important Considerations
Air	Degradation, type of emissions released and the extent to which they affect air quality, creation of excess noise and the effect on man.
Water	Availability, use and quality of water, effects on the aesthetics and aquaculture potential of the ecosystems, effect on the canal system, depletion of ground water, pollution of waters by hazardous and toxic substances, effect on temperature and siltation capacity.
Solid waste facilities	Excess generation of solid waste. Stress on the existing facilities..
Vegetation	Destruction of forest cover, depletion of cultivable land, changes in biological productivity, changes in the species diversity and hastening the disappearance of important species.
Energy and natural resources	Effects on physio–chemical characteristics of soils, effect on stability or instability of soils.
Soils and local geology	Impact on availability of energy sources in the area. Thermal power generation, natural gas consumption, and effect on local natural resources.
Processes	Floods, erosion, earth quake, depositions, stability, and air movements.
Man-made facilities and activities	Structures, utility networks, transportation, and waste disposal.
Cultural status	Employment situation, life style of people, and health services.
Ecological relationship	Food chain, diseases/vectors.

Table 1.2 Impacts of various project activities on certain human aspects.

Economic and occupational	Displacement of population, reaction of population in response to employment opportunities, services and distribution patterns,: property values.
Social pattern or life style	Resettlement; rural depopulation: population density : food; housing, material goods, nomadic; settled: pastoral clubs; recreation ; rural; urban.
Social amenities and relationships	Family life styles, schools; transport, community feelings; disruptions, language, hospital clubs, neighbours.
Psychological features	Involvement, expectations, stress, work satisfaction challenges, national or community pride, freedom from chores, company or solution; mobility.
Physical amenities (intellectual, cultural, aesthetic and seasonal)	National parks; wild life, art galleries, museums, historic and archaeological monuments, beauty, Land scape; wilderness, quiet; clean air and water.
Health	Freedom from molestation; freedom from natural disasters.
Personal security	Changes in health, medical services, medical standards.
Regional and traditional belief	Symbols; taboos; values
Technology	Security hazards, safety measures: decommissioning of wastes; congestion, density.
Cultural	Leisure; fashion and clocking changes; new values.
Political	Authority, level and degree of involvement priorities, structure of decision-making responsibility and responsiveness, resources allocation: local and minority interest: defence need contributing or limiting factors;
Legal	Restructuring of administrative management: changes in taxes; public policy.
Aesthetic	Visual physical changes, moral conduct, sentimental values.
Statutory laws	Air and water quality standards; nation building acts; noise abatement byelaws.

Some of the selected relevant environmental parameters are:

1. Crop productivity,
2. Air quality,
3. Water quality of aquatic resources,
4. Nutrient status of water,
5. Drinking water quality and
6. Availability of agricultural land.

1.2.2.6 Classification and Prediction of Impacts (21-24)

Impact Types

Environment impacts arising from any development projects fall into three categories:

(i) Direct impacts,

(ii) Indirect impacts; and

(iii) Cumulative impacts.

These three groups can be further broken down according to their nature, into

- Positive and negative impacts;
- Random and predictable impacts;
- Local and widespread impacts; and
- Short – and long term impacts.

An interdisciplinary approach helps in assessing environmental impacts. The analysis considers potential consequences which may be long-term and short-term; direct and indirect, secondary, individual and cumulative; beneficial and adverse. Environmental issues are interdisciplinary, interactive, biological and probabilistic.

Indirect, or secondary effects are those that may occur remote as they are far in distance or time from the actual proposed project. An example is the construction of a major employment center, which may have direct effects related to aesthetics in the area, traffic at nearby intersections, removal of natural vegetation, or interference with natural waterways. Additional employment opportunities in the location, however, may prompt additional housing or commercial uses to support employees. Potential impacts of this housing or additional business activity would then be a secondary, or indirect effect of the construction of the employment center and should be evaluated to the best extent possible in the environmental analysis.

Cumulative impacts occur in those situations where individual projects or actions may not have a significant effect, but when combined with other projects or actions, the individual project's incremental contribution of adversity may cause an overall adverse cumulative effect.

Impacts of some typical projects are discussed below for clear understanding.

1.3 Examples of Various Types of Impacts that Occur in a Typical Road Development Project

1.3.1 Direct Impacts

Road formation itself involves different land use accompanied by destruction of vegetation and farm land. Further use of gravel in road construction which is removed from a nearby pit will make a direct impact on the pit area. However, direct impacts can be easily identified, assessed, and controlled.

1.3.2 Indirect Impacts

Secondary or tertiary or chain impacts are known as indirect impacts which normally arise due to various project activities and many times are associated with significant impacts on the environment. Further indirect impacts over time can affect larger areas than predicted and are difficult to measure.

Examples include degradation of surface water quality by the erosion of land cleared as a result of a new road Fig. 1.2 and urban growth near a new road. Another common indirect impact associated with new roads is increased deforestation of an area, stemming from

easier (more profitable) transportation of logs to market, or the influx of settlers. In areas where wild game is plentiful, such as Africa, new roads often lead to the rapid depletion of animals due to poaching.

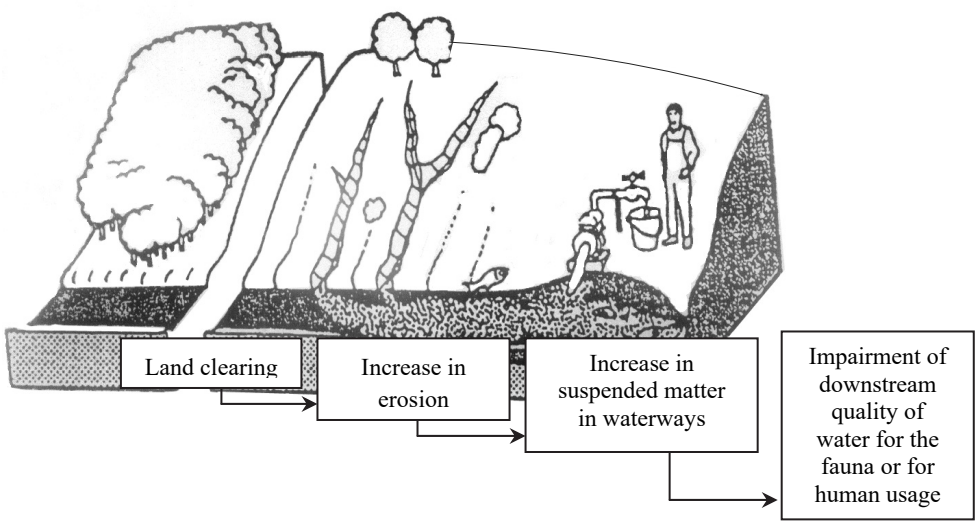


Fig. 1.2 Indirect impacts : the example of land clearing.

Environmental impacts should be considered not only as they pertain to road rights-of-way, but also to sites associated with the road project, which include deposit and borrow sites, materials treatment areas, quarries, access roads and facilities provided for project work.

Some potential Direct and Indirect impacts are summarized in Table 1.3.

Table 1.3 Potential direct and indirect environmental impacts of a typical road construction project in mangroove swamp and rice growing area.

Direct Impact (D); indirect impact (1)
Soils
Compaction of alluvial soils by earth moving equipment (D)
Erosion and modification of surface relief of borrow zones (275,000 square meters) (D)
Loss of topsoil (165 hectares) in the borrow areas(D)
Over-exploitation of agricultural soils due to future development in a zone sensitive to erosion (I)
Irreversible salinization and acidification of mangrove swamp soils (I)
Water
Modification of flowing surface water in borrow areas, causing erosion and silation (I)
Modification of water flows during construction (stream diversion, modification of water table recharging) (D)
Sedimentation near crossings of presently cultivated flood plain (D)
Modification of surface and subterranean water flows and resulting drying or flooding (I)
Pollution of water tables by equipment lubricants, fuels, and detergents (D)
Displacement of salinity threshold into the mangrove swamp zone: effect on fauna and flora, impregnation of soils with tannin, erosion of coastline (I)

Flora

260 hectares of deforestation and undergrowth clearance (D)
Destruction of plantings (28, 00 oil palms, 1,600 various trees)(D)
Reduction of cornice forests around swamps, from modified water flow and increased agricultural use (I)
Disappearance of reproduction and food zones for species of fish, aquatic and migratory birds (I)
Reduction of mangrove plant population (habitat for fauna, purifying micro fauna, firewood (D)
Erosion of the coastline (I)
Increase in farming activity, reduction of fallow times, and impoverishment of the soils (I)

Fauna

Reduction in mangrove fauna (crabs, shrimps, egrets, herons, kingfishers, spoonbills, ibises, terns, and other species (I)
Increase in poaching during the works period, and subsequent hunting and fishing (I)
Increase in tourism (Tristan Island, the center for many migratory birds)(I)

People

Loss of farms and homes (1,300 square meters) (D)
Reduction in agricultural production per surface unit (over-exploitation, impregnation of soils with tannin)(I)
Increase in consumption of wood, particularly from the mangrove swamps: erosion (I)
Reduction in fishing potential (I)
Increase in land tenure conflicts, and conflicts between farmers and nomad cattle breeders (I)
Increase in speed of propagation of endemic disease (I)

Positive Impacts

Providing all weather road link for coastal population with major urban markets, institutions and goods (D).
Sale of dried fish products (90 percent of national production) increased through quicker transport and access (D).
More effective sale of rice from industrial growers (35, 00 hectares) and small-scale growers (D).
Creation of jobs, Improved access to medical help etc. (I)

Source*:* SETRA

1.4 Impact Prediction and Assessment

1.4.1 Main Objectives of any Environmental Impact Assessment are:

- To predict significant particular environmental impact
- To determine the significant residual environmental impact predicted
- To examine and select the best from the project options available
- To identify and incorporate into the project plan appropriate abatement and mitigating measures
- To identify the environmental costs and benefits of the project to the community

Thus, Impact prediction and assessment is the major step in any environmental assessment process. It involves projection of environmental setting into the future with the proposed action and predicting the impact and assessing the consequences.

Taking a holistic approach of impacts is very important as many times synergistic relationship between impacts occur which have to be closely examined, since indirect effects frequently lead to synergistic impacts.

It is with indirect effects that impact linkages between the natural and social environment often take place. For example, the appropriation of land to build a road may displace farmers, and may interfere with their cropping pattern and force them to use another water supply. This change could result in a depletion of a groundwater aquifer, intensification of new land clearing, erosion, water runoff contamination with added fertilizers and pesticides, etc.

1.4.2 Cumulative Impacts (21)

The process of cumulative environmental change can arise from any of the four following types of events:

(i) Single large events, i.e., a large project;

(ii) Multiple interrelated events, i.e., road project with a region;

(iii) Catastrophic sudden events, i.e., a major landslide into a river system; and

(iv) Incremental, widespread, slow change, such as a poorly designed culvert or drainage system along a long road extending through a watershed.

These can generate additive, multiplicative or synergistic effects, Fig. 1.3 which can then result in damage to the function of one or several ecosystems (such as the impairment of the water regulation and filtering capacity of a wetland system by construction of a road across it), or the structure of an ecosystem (such as placement of a new road through a forest, leading to in-migration or land clearing which results in severe structural loss to the forest).

A cumulative impact, in the context of road development, might be the de-vegetation and eventual erosion of a roadside pullout. Roadside vegetation is damaged by vehicle and foot traffic, and the soil is left unprotected. Subsequent rainfall causes erosion and siltation of nearby watercourses. The vegetation never has enough time to recover (because of high traffic volume on the road), and the problem is exacerbated over time.

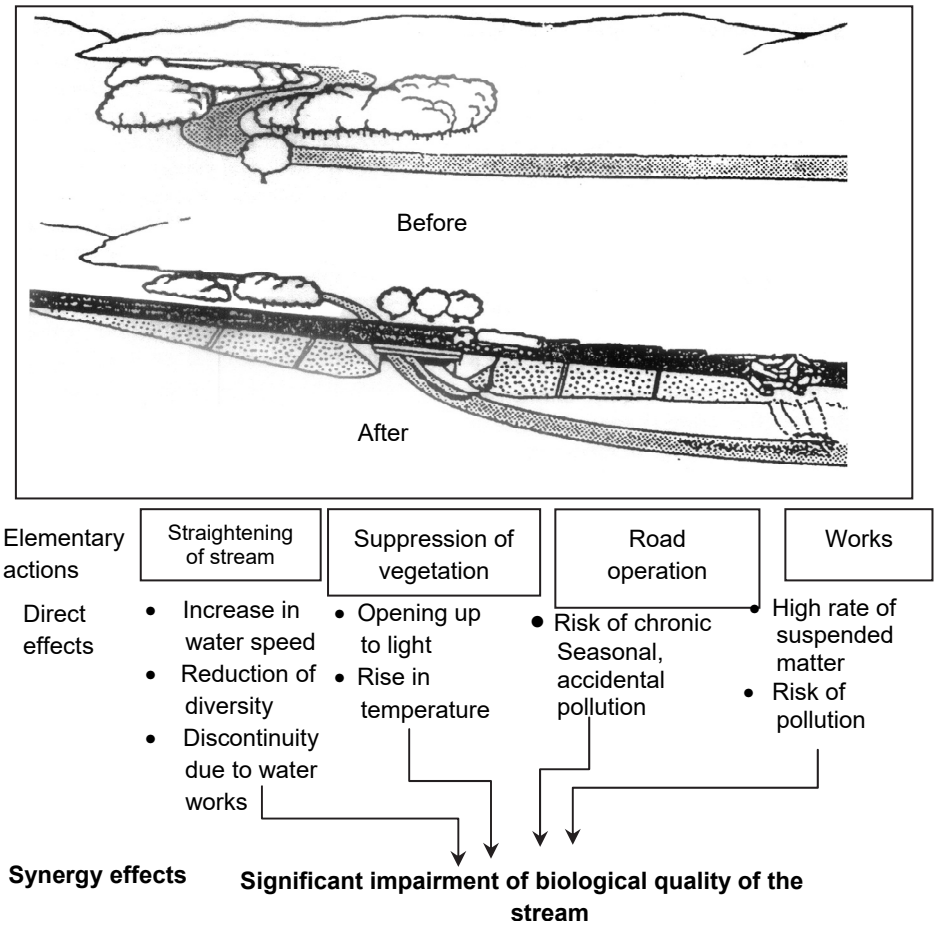
As this example illustrates, cumulative effects assessment is a complex process which requires extensive knowledge of ecological principles and ecosystem response mechanisms on the following aspects.

- It is necessary to define the spatial and temporal boundaries for the assessment of the impacts
- Of the various variables of the project activities, it is necessary to identify which are measurable
- Establish the relationship between choosing variables

Evaluate the cumulative effects of the proposed road project by

The cumulative effects of the proposed road project on the local environment can then be evaluated by:

- Identifying the list of important project activities
- Assessing the impacts of various project activities on the measured variables
- Assessing the spatial and temporal boundaries of the impacts on the measurable impacts



Each-elementary action produces a certain effect or a risk that can be limited, but the combination of such actions and therefore their consequences may be the source of significant effects. In this example, steps can be envisaged with reference to each elementary action, in order to avoid the synergy effect.

Fig. 1.3 Cumulative impacts : the example of a stream.

Cumulative effects assessment is an effective impact assessment tool, but it must be carried out properly in order to produce reliable results.

1.4.3 Ecosystem Function Impacts

Technically a subset or variant of cumulative impacts, ecosystem function impacts, which disable or destabilize whole ecosystems are the most dangerous and often the least likely to manifest themselves over a short period of time. Many road-related examples deal with roads which need to traverse watersheds in which surface and subsurface water movement is complex. One striking example is the highway constructed across a mangrove forest (100 ha in size) along the Caribbean coast. It was not fully understood at the planning stage to what extent the fresh and sea water needed to mix in order for the healthy forest to survive on both sides of the road. As a result, most of the forest has died. On one side the waters were

not saline enough, and on the other there was not enough mixing with fresh water. The effect on the ecosystem was devastating and the impact on the local population, which used the mangrove forest area was severe. Almost certainly, no sign of this impact appeared until two to three years after the road was built. A second example, could develop in situations where roads bisect wildlife migration routes, which can inflict stress on the migratory population for many generations, or even permanently, and cause instability, increased mortality, and possibly catastrophic decline.

1.4.4 Assessment of Significance of an Impact

The determination of *significance* is defined in terms of context and intensity. *Context* refers to the geographical setting of a proposed project or action. When a proposed shopping center is evaluated, the context for the determination of significance in the immediate setting and the general community or area of influence, but not any country as a whole.

Intensity refers to the severity of impact

- The degree to which the proposed action affects public health or safety
- The presence of unique characteristics in the geographic setting or area, such as, cultural resources, parklands, wetlands, ecologically critical area, or wild and scenic rivers
- The degree at which the effects are likely to be highly controversial
- The degree at which the action would establish a precedent for further actions with significant effects.
- The degree at which the possible effects will be highly uncertain or involve risks
- The degree of effect on the sites listed in the Central Court Register of Historic Places
- The degree of effect on the threatened or endangered species or their habitats
- Whether the action conflicts with other Central, State, or local laws or requirements.

Initial the environmental settings of the project area needed to be described to predict and assess the impacts the impacts associated with various project activities. This provides base line environmental information as input to comprehensive EIA and prediction and assessment of impacts of project activities will be made with the reference baseline environment.

1.4.5 Impact Evaluation and Analysis (22, 24)

Environmental impact evaluation and analysis is meant for relative evaluation and assessment of different alternatives in project activities which also includes what will happen to the environment if no action/no- build alternative exists. In this exercise prediction, analysis and judging the environmental impacts are the major steps which involve the following aspects

1. Formulation of major activities of the project
2. Identification of important environmental components
3. Identifying various types of impacts likely to occur
4. Assessing the possibilities and or probabilities of occurrences

5. Assessing the intensity and the time frame of the impacts
6. Identifying positive, negative and neutral impacts
7. Assessing and evaluating tradeoffs among activities and impacts

For understanding various deleterious effects of the proposed project activities likely to impact the environment, EIA provides in the form of critical Environmental information to the decision makers. However, as EIA involves predictive techniques and evaluation methods which have uncertainty in error margins, the EIA results need to be checked /corrected by a feedback mechanism from decision makers and other stakeholders. This should involve actual transfer of knowledge about the actual environmental effects of a project action instead of predictions. Environmental Audit (EA) is an exercise which involves post project monitoring environmental quality through which feedback mechanism is incorporated in the EIA process.

Mitigation Measures

Mitigation measures to be implemented by project proponent are normally included in any EIA in order to reduce the magnitude/intensity of the impacts affecting the environment. Appropriate mitigation measures based on their cost effectiveness and environmental protection need to be implemented to make the project environmentally sustainable and economically viable.

1.4.6 Evaluation of Least Environmentally Damaging Alternatives

One of the most important contributions of an initial overview assessment is the early input of environmental considerations for the design or development of the project, action, or plan. If coordination is efficiently among the various members of the team for the project or action, the information provided by an initial overview can lead to better projects with fewer environmental impacts. These “least environmentally damaging” alternatives are then the ones evaluated in the subsequent detailed environmental studies and public and agency review process.

The development and analysis of alternatives form the very core of environmental impact assessment which is nothing but a comparative analysis of alternatives. Environmental Impact Statements are often titled Draft (or Final) Environmental Impact Assessment Alternatives Analysis. The driving impetus for conducting environmental impact studies is to make a comparative study of the effects of the proposed alternatives so as to be able to arrive at a better decision-making.

Due to its importance in the impact analysis, the study of alternatives should be a thorough and systematic process. It should include input from Central and State governments, local agencies and the general public. Decisions made in every phase of analysis should be logical and documented on the bases of a solid platform of evaluation criteria. The alternatives section of the Environmental Assessment/Finding of no significant Impact or the Draft and Final Environmental Impact Statements is the most noteworthy portion of the environmental document.

1.4.6.1 Examination of Project Alternatives

The necessity to develop alternatives is warranted by the deficiencies, if any, in the existing

position. Similarly, the need for transportation projects is based on the deficiencies of the existing transportation system, such as, lack of safety, and inability to handle existing or projected traffic volumes, and meet air quality standards for a region. A National Forest Management Plan may need updating because of a regulatory requirement for periodical reevaluation, a change in use, demand or objectives, or because the present management techniques may not be producing the desired results. For instance, a more spacious jail may be proposed since the present jail is congested. Similarly a new low-income housing project may become imperative on account of the shortage of houses as against the demand.

Thus a need–based project should take into account the following:

1. The deficiencies in the existing circumstances
2. The present projected and specific needs
3. The goals and objectives of these needs.

The first section of any Environmental Assessment (EA) or Draft Environmental Impact Statement should thus be a consideration of the purpose and need. It should logically lead to the adopted list of goals and objectives for a proposed project or action plan. Depending on the type and size of this project or action plan, review of and concurrence with the purpose-and-need summary should be obtained from Central or State Govt., or local agencies.

1.4.6.2 Developing a Preliminary Range of Alternatives

The development of an initial range of alternatives will logically follow an analysis of purpose-need activity. For this purpose, all possible alternatives that satisfy the goals and objectives, as well as action plans even if they are outside the jurisdiction of the project sponsoring agency must be considered.

For example, these alternatives identified to correct transportation deficiency may include the following:

- Constructing a new highway at the location of the problem
- Constructing a new highway or widening an existing route at another location that may divert traffic away from the problem area
- Widening existing highways
- Providing HOV (high occupancy vehicle) lanes
- Increasing bus services
- Constructing or extending commuter rail systems
- Revising traffic signal timing, adding left-turn lanes or other such measures to improve traffic flow
- Implementing inspection and maintenance programs to check vehicles for emissions
- Switching to natural gas vehicles to limit air pollutants
- Encouraging major employers to offer incentives for corporate employees
- Encouraging major employers to implement staggered work hours
- Recommending that major traffic generators such as shopping centers or housing developments be located at alternative areas or sites.
- Coordinating with local planning officials in tackling potential future traffic problems through reasoning or limiting permits.

1.4.7 Factors to be considered for taking decisions based on Assessment of Significance of an Impact

There are six factors that should be taken into account when assessing the significance of an environmental impact arising from a project activity. The factors are interrelated and should not be considered in isolation. For a particular impact some factors may carry more weight than others, but it is the combination of all the factors that determines the significance.

1. ***Magnitude*****:** Will the impact be irreversible? If irreversible, what will be the rate of recovery or adaptability of an impact area? Will the activity preclude the use of the impact area for other purposes.
2. ***Prevalence*****:** Each action taken separately, might represent a localized impact of small importance and magnitude, but a number of actions could result in a widespread effect,
3. ***Duration and Frequency*****:** The significance of duration and frequency is reflected in the following questions: Will the activity be long-term or short-term? If the activity is intermittent, will it allow for recovery during inactive periods?
4. ***Risk*****:** To accurately assess the risk, both the project activity and the area of the environment impacted must be well known and understood.
5. ***Importance*****:** This is defined as the value that is attached to an environmental component.
6. ***Mitigations*****:** Are solutions to problems available? Existing technology may provide a solution to a silting problem expected during construction of an access road, or to bank erosion resulting from a new stream configuration.

The possible assessment decisions, using the above criteria are:

1. No impact
2. Unknown and potential adverse impact
3. Significant impact

1.4.8 Critical Assessment Criteria

The EIA methodology constitutes the use of assessment criteria concerned with the utilization of precious irreplaceable resources. The methodology includes questions such as (a) how is the project justified if it results in the loss of precious/irreplaceable natural resources? (b) whether the project will sacrifice important long-term environmental resources and values (ERVs) for the sake of immediate gains, (c) if it creates environmental issues which are likely to be highly controversial, (d) if the project endangers survival of species, then how is it justified, (e) whether the project will establish a precedent for future actions involving sensitive environmental issues (f) whether the project, while in itself, not causing serious impacts, will be related to other actions where the accumulated total effects could be serious, (g) whether the project is consistent with national energy policies, (h) whether the project is consistent with national foreign exchange policies, and (i) whether due consideration has been given in the project feasibility study, to alternative projects which could realize the desired development objective, and whether any of these alternatives might offer a better overall solution when all applicable project constants including environmental effects have been considered.

The steps involved in the assessment are: (i) description of the study area, that island/water areas affected by the project, including all significant environmental resources and values (ERVs) in the area, (ii) description (at the feasibility study level) of the project (proposed or existing) including the project properly and operations involved in transporting materials to and from the project vicinity, (iii) description and quantification of the impacts or effects of the project on ERVs, including legal implications, field investigations and sampling/analyses for obtaining other additional information required, and (iv) development of conclusions and recommendations on the environmental integrity of the project and on feasible measures which should be considered by the project planners to modify the project plan in order to offset or minimize adverse effects on ERVs.

1.4.9 Public Participation

Public participation and awareness about the social and environmental impacts of a project is extremely crucial. At numerous points throughout the process it is essential to engage with various stakeholders for successful grounding of the project. It should be a two-way exchange of information and views. Public participation may consist of informational meetings, public hearings, and opportunities to provide written comments about a proposed project.

1.5 Systematic Approach for using EIA as a Planning Tool for Major Project Activities

1.5.1 Introduction

The concept of EIA as a planning tool requires that it be concerned with, all phases of project development, including (i) planning, (ii) final design/construction start-up, and (iii) project operations. Fig. 1.4 illustrates the relationship between the various stages of a project development and the timing for the tasks to be included in the EIA process.

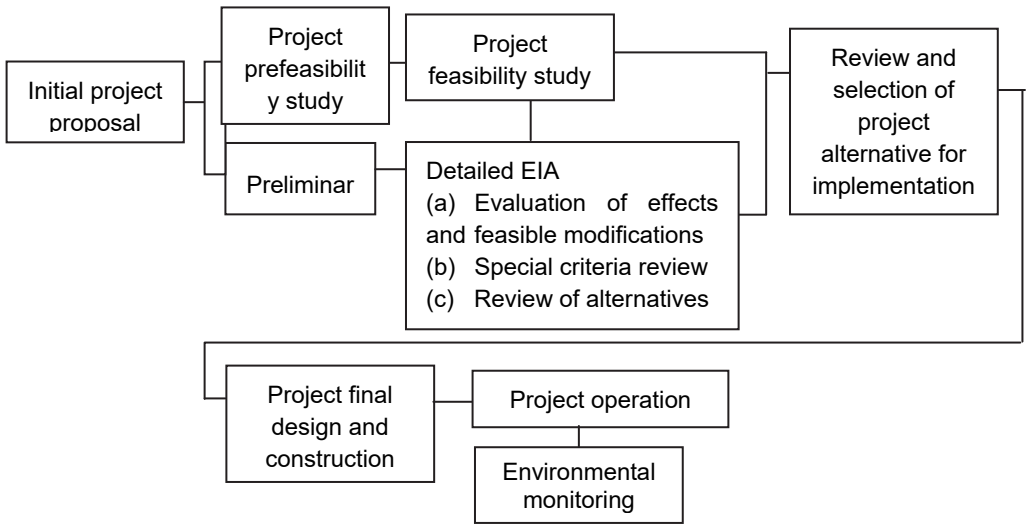


Fig. 1.4 Relationship of EIA process to project planning and implementation.

Source: Environmental Impact Assessment.

**Guidelines for Planning and Decision Makers,
UN Publication ST/ESCAP/351, ESCAP, 1985 (1)**

For the EIA being of optimal value in influencing the overall project's impact on the environment, the EIA itself should be a part of step (i) of the planning activity.

In respect of step (iii) project operations, the EIA will be mostly concerned with the provision of continuing to monitor the project's impacts, with feedback, so that this information can be used for making improvements in the project as shown by the monitoring data. However, for assessing the impact of the project on environmental values, such as water quality, some initial monitoring may be needed in the pre construction period for establishing a "baseline" picture of the pre-project situation and preparing environmental baseline impacts. Environmental inventory is a complete description of the environment as it exists in an area where a particular action is being considered. It is included in impact statement and serves as the basis for evaluating the potential impacts on the environment, both beneficial and adverse of a proposed action.

1.5.2 Preparation of Environmental Base Map (EBM)

An important requirement is the preparation of an Environmental Base Map (EBM) or maps showing the salient information as in (i) and (ii). This includes the essential background information on the environmental situation so that the reviewer, by referring to this, can readily interpret the report text and especially the conclusions and recommendations. For an Industrial Development Project EIA thus usually includes demography, land use, infrastructure, receiving water, ground water and soil conditions, other industries and their waste streams, institutions, ecological resources, areas of cultural, archaeological and tourist interest, and meteorological conditions.

The EBM should be portrayed as simply as possible (it should not include extraneous information which may obscure the presentation) and for this purpose a schematic-type drawing will usually be more appropriate than a map drawn strictly to scale.

1.5.3 Identification of Study Area

The EIA study area should include water bodies, land, and population centers where the project activities will have significant effects : General environmental parameters likely to be affected by developmental activities include: ground water hydrology and quality; surface water hydrology and quality; air quality; land quality and land uses; vegetation; forests; fisheries; aesthetics; public and occupational health and socio-economics. The size of the study area will vary according to the type and size of the project activities and the characteristics of the surrounding environment. The meteorological conditions would also be considered in determining the study area.

1.5.4 Classification of Environmental Parameters

Most EIA guidelines follow the relatively simple methodology in which environmental resources or values are classified into four general categories, namely, (a) natural physical resources, (b) natural ecological resources, (c) human/economic development resources, and (d) quality-of-life values including aesthetic and cultural values which are difficult to assess in conventional terms.

1.5.5 Formation of EIA Study Team

Since most EIAs involve consideration of environmental parameters covering many disciplines, to produce a meaningful EIA will require inputs of expertise from all the disciplines involved in a particular project. This does not mean that a large team must be organized to include inputs from each discipline. The key point is that the individual in charge of the EIA must have certain skills so that findings from the environmental studies can be used appropriately for modifying the project plan to obtain a more optimal economic-cum-environmental development project. The composition of the team should depend on the nature of the activity. This can be determined only after the key users have been identified. In any use the team should include persons familiar with the particular type of operations. The number of persons required will depend on the size and complexity of the activity to be investigated.

1.5.6 Preparation of Terms of Reference

The first step in undertaking any EIA is to carry out a preliminary evaluation of the situation. If done by a skilled environmental analyst within a short period, say two weeks, it is possible to size up the situation, identify the beneficial uses which are likely to be significantly affected, make preliminary estimates of the magnitudes of these effects and preliminary delineation of the feasible measures which will be needed to minimize/offset degradation, and draw conclusions on (a) whether a detailed EIA follow-up study is needed, and if so, to prepare the Terms of Reference (TORs) and recommended budget, and (b) if not, to prepare a report on the initial work which in itself becomes the final EIA for the project.

1.5.7 Preparation of an EIA Report

Numerous techniques are available for the assessment of environmental impacts and preparation of EIA reports. Alternative assessment techniques are continuously developed and utilized. The project proponent is free to select the method most appropriate for the specific situation.

The manual presents a recommended standard format for the organization of EIA reports. Essential steps to complete an environmental impact assessment include:

1. Describe the proposed project as well as the options
2. Describe the existing environment
3. Select the impact indicators to be used
4. Predict the nature and extent of the environmental effects
5. Identify the relevant human concerns
6. Assess the significance of the impact
7. Incorporate appropriate mitigating and abatement measures into the project plan
8. Identify the environmental costs and benefits of the project to the community
9. Report on the assessment.

The sequence may be repeated for a number of project options and for a selected project concept with mitigating or abatement measures incorporated.

However, the following is a standard format for EIA reports as per Central Pollution Control Board of India.

(a) ***Introduction*****:** This constitutes the purpose of the report, the extent of the EIA study, and a brief outline of the contents and techniques.

(b) Description of the project.

(c) ***Description of the existing environment*****:** This first requires identification of the project "area of influence". The environmental resources within the "area of influence" are then identified as physical resources, ecological resources, human and economic values, development, and quality-of-life values.

(d) Anticipated environmental impacts and plans for protection as follows:

(i) *Item-by-item review*: impacts resulting from project implementation are evaluated and quantified wherever possible;

(ii) *Mitigating and offsetting adverse effects*: a plan is presented for offsetting or compensating for significant adverse impacts and for enhancement of positive impacts;

(iii) Identification of irreversible impacts and irretrievable commitments of resources;

(iv) Identification of impacts during construction and appropriate protection measures.

(e) ***Consideration of alternatives*****:** for each alternative considered the probable adverse impacts are identified and related to the proposed project and other alternatives.

(f) ***Monitoring program*****:** this is so designed that the environmental agency receives monitoring reports which will ensure that all necessary environmental protection measures are being carried out as listed in the approved project plan.

(g) ***Summary and conclusions*****:** the summary and conclusions section is prepared in such a way that it is a complete and comprehensive document in itself. This section includes;

(i) A review of gains versus losses in environmental resources and values, and of the overall net gains which presumably justify the project

(ii) An explanation of how unavoidable adverse impacts have been minimized, offset and compensated for

(iii) An explanation of use of any replaceable resources

(iv) Provision for follow-up surveillance and monitoring.

1.5.8 Environmental Monitoring and Management Plan

An appropriate plan should be developed and described for constant monitoring to ascertain the impact of the project on those applicable environmental parameters, which are especially sensitive for the project under consideration. These will usually include environmental resources within the industrial plant (for example, occupational health) and those in the region affected by plant establishment and operations.

It is recognized that most developing countries generally have expressed little interest in funding and implementing monitoring programs of this type probably because of the lack of appreciation by decision-makers of their vital role in ensuring optimal overall economic and environmental project benefits.

1.5.9 Draft and Final Environmental Impact Statements

The most detailed procedure for analyzing potential environmental impact of the alternatives of a proposed project or action is the Environmental Impact Statement process. The DEIS contains the final results of environmental studies of proposed alternatives which are available for public and agency review. The DEIS is a "draft" because it compares all proposed alternatives and is the document upon which the decision to proceed with any particular alternative is made. The DEIS is also the tool through which public and agency input is incorporated into this decision-making process. The E.I.S represents a summary of environmental inventory and the findings of environmental assessments.

The alternatives section of the DEIS contains a detailed description of each proposed alternative, including physical characteristics, operating features, costs, schedule, description of the construction process, and all other relevant features of the proposed action. Certain basics, which are required to accomplish an environmental assessment, are related to description of the environmental setting, impact prediction and assessment and preparation of E.I.S.

The *Affected Environment* section of the DEIS contains information on the existing setting. Although the organization and format vary, the following areas may be included.

Land Use and Zoning

Social and neighborhood characteristics

- Demographic characteristics
- Housing
- Travel patterns
- Stability
- Pedestrian and bicycle travel
- Community activities and services (fire, police, hospitals, schools, churches, day care and so on)
- Recreational facilities

Economic factors

- Taxes
- Existing business community
- Proposed developments

Traffic and Transportation Energy

Historic and archaeological resources, Visual resources, Air quality, Noise levels, Geology and soils, including farmland Environmental health and public safety (hazardous wastes)

Water Resources

- Groundwater
- Surface water
- Water supply and wastewater systems

- Wild and scenic rivers
- Wetlands Flood plains and coastal zones
- Vegetation and wildlife.

The *Environmental Consequences* section of the DEIS contains the results of the assessment of impacts. The assessment can be organized by impact category or by alternative; the usual format is by impact category.

This section focusses on relevant environment issues and impacts. Some areas of potential effect must be included regardless of expected impact. Resources protected by statute, regulation, or executive order must be addressed in all the environmental documents. When such protected resources do not exist within the area or will not be affected, the EIS must document that the resource was considered in compliance with the applicable regulation, and statements must be made as to why the resource will not be affected the regulation does not apply.

1.5.10 Impact Analysis

Analysis of environmental impacts begins with a description of the existing environment, the assembly of relevant information and data and finally the evaluation and analysis of the degree of impact. Considered impacts must include direct and indirect effects, cumulative effects, and long-term and short-term effects. In the analysis process, potential mitigation measures are developed and explored.

The preparation of separate methodologies and technical reports supporting the DEIS has to be in accomplice with the area of discipline and contain the detailed information on existing conditions, methodologies, analysis, and results. The technical reports are then summarized in the DEIS.

Technical reports supporting a DEIS can be prepared for:

- Socioeconomic impacts, which include community impacts, land use, economic impacts, visual effects, relocations, traffic and pedestrian and bicycle travel
- Natural resources, which include water quality, vegetation, wildlife, scenic rivers, floodplains, wetlands, and coastal zones, and
- Air quality

1.5.11 Format and Content of a Draft Environmental Impact Statement (DEIS)

After completing the analysis DEIS should have at least the following components:

Cover sheet*, *Summary*, *Table of Contents

(i) Purpose of and Need for Proposed Action

(ii) Alternatives

(iii) Affected environment

(iv) Environnemental Conséquences

List of Agencies, Organizations, and Persons to whom copies of the DEIS are sent should be given as an Index in Appendices

The language of DEIS must be concise and clear, and the data and the information must be relevant.

1.5.12 DEIS Processing

When the DEIS is completed, it is circulated among the Central, State, and Local agencies concerned. In some cases the summary of the DEIS can be circulated instead of the entire document. Notices have to be published in newspapers to notify the public of the availability of the DEIS and the locations in the community where it will be reviewed.

After the public hearing and the review period, the comments received are evaluated, and a required additional analysis is conducted. Alternatives and mitigation measures may be revised based on the comments received and the responses are prepared to each substantive comment.

Based on the review of the comments and the results of additional studies, the sponsoring agency selects the preferred alternative. This selection process should be a systematic evaluation procedure. The process then continues for the preparation of the Final EIS.

1.5.13 Final Environmental Impact Statement (FEIS)

The FEIS document is the preferred alternative consisting of the DEIS with modifications. In some cases, where minor changes are required, the abbreviated form of the FEIS can be used which merely attaches the required changes or findings to the DEIS.

A new section is added at the end of the document. It can be titled *Comments Received on the DEIS and Responses*. It documents the public hearing and summarizes the major comments. It also contains copies of all written comments received from agencies or the public, with written responses to all the substantive comments.

Upon completion, the FEIS is circulated among all interested agencies and persons. A notice indicating the availability of the FEIS should be published or advertised in local newspapers.

1.6 Comparative Evaluation of Alternatives from EIA Studies

1.6.1 Selecting a Preferred Alternative

The Environmental Assessment or Draft Environmental Impact Statement should be made available to the public and other interested agencies for comments and the comments thus received should be summarized. Subsequently, any additional environmental analysis required should be conducted, and then the alternatives considered should be reevaluated for possible changes so as to further minimize the impacts, or respond to comments received.

The revised summaries of the impacts of each alternative should be compared, using the evaluation criteria and measurement parameters. The next task is the selection of the preferred alternative. In some cases, the preferred alternative may be obvious, and the selection process brief. Other proposed projects or actions, a more thorough analysis and process will be required.

Documentation should be prepared of the decisions made and the reasons that prompted each decision. The following is an effective system to use for fairly involved projects or actions.

Each member of the team should prepare a brief summary of the impacts and comments received within his or her discipline, such as, air quality, noise, social effects, and wildlife. These summaries should be circulated among all the members of the team for review. A meeting of all team members can then be held to discuss the pros and cons of each alternative in each area of potential impact.

A good approach is to compare the build, or action, alternatives first. The least environmentally damaging alternative, with mitigation in place, should be identified. If any build alternatives are less responsive to the identified project purpose and need, they should be eliminated first. There is little sense in proceeding with a proposed project or action if it cannot accomplish the basic goals and objectives to meet the established needs.

The next step is to compare the remaining build or action alternatives for legislative or regulatory restrictions. Numerous types of potential impacts are regulated by specific guidelines to prohibit selection of a particular alternative under certain conditions, such as the existence of a feasible and prudent alternative, or a less-environmental-impact alternative, in the remaining set of alternatives. There may also be circumstances where a jurisdictional agency has indicated a future denial of a necessary permit for a particular alternative. Any alternative not meeting the regulatory requirements must be eliminated from further consideration.

The remaining build or action alternatives are then compared in detail, including such criteria as an opportunity for mitigation of adverse effects, project costs, severity of impact in any particular area, public and political opinions, and other established evaluation standards. Through the interaction of the interdisciplinary team, an alternative is selected as the preferred action alternative.

The next step after the preferred build, or an action alternative is selected is to directly compare it with the no-build alternative. The team is now at the final stage of build versus no build. This is the phase where trade-offs should be clearly presented and evaluated. The analysis of benefits versus costs, with the incorporation of any agency specific feasibility criteria, will finally decide whether the identified preferred alternative is the selected build alternative or the no-action alternative.

With the selection of a preferred alternative and completion of the Final Environmental Impact Statement and Record of Decision, the environmental impact study process gets completed. Committed mitigation monitoring programs will continue with the project or action through construction. Other considerations may, however, still prevent the proposed project or action from proceeding with the construction or implementation. A summary of the major factors, which enter the decision-making process for selection of a preferred alternative and for ultimate project completion is illustrated in Fig.(1.6).

Following completion of all appropriate environmental impact assessment studies, the major task is to make the completed analyses productive in the decision-making process. The evaluation of alternatives must result in a clear and concise comparison that easily illustrate the tradeoffs involved between the build and no-build alternatives and the distinguishing degree of impact among the various build or action alternatives.

1.6.2 Conceptual Basis for Trade-Off Analysis

As a systematic approach for deciding upon right alternatives, it is desirable to use trade-off analysis. Trade-off analysis involves the comparison of a set of alternatives relative to a series of decision making factors. The following approaches can be used to complete the trade-off matrix.

1. A qualitative approach, in which descriptive, synthesized and integrated information on each alternative relative to each decision factor is presented in the matrix.
2. A quantitative approach, in which quantitative, synthesized and integrated information on each alternative relative to each decision factor is displayed in the matrix; or a combination of qualitative-quantitative approach.
3. A ranking, rating or scaling approach, in which the qualitative or quantitative information on each alternative is summarized by using the assignment of a rank rating or scale value relative to each decision factor is presented in the matrix
4. A weighted approach, in which the importance of weight of each decision factor is considered, and the resultant decision of the information on each alternative (qualitative, quantitative, or ranking, rating, or scaling,) is presented in Fig 1.5 in terms of the relative importance of the decision factors.

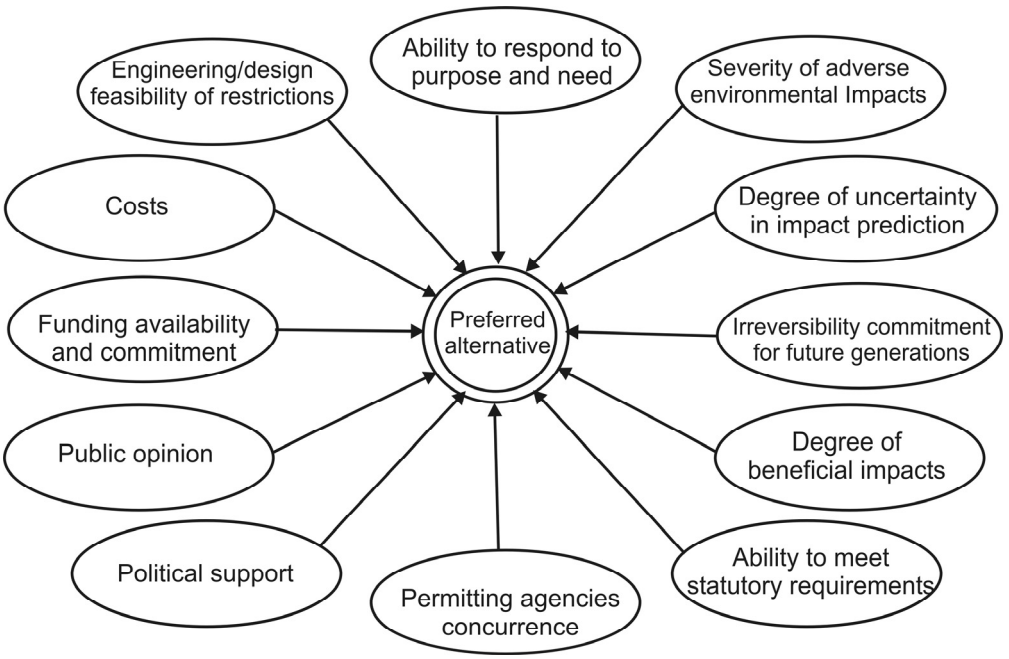


Fig. 1.5 Factors affecting selection of a preferred alternative and ultimate project of action implementation. (Some factors often will be more important than others in the decision-making process).

5. A weight-ranking, rating, or scaling approach, in which the importance of weight for each decision factor is multiplied by the ranking, rating or scale of each alternative, and the resulting products for each alternative are then totaled to develop an overall composite index or score for each alternative; the index may take the form of

$$\text{Index} = \sum_{i=j}^{n} IW_i R_{ij}$$

where

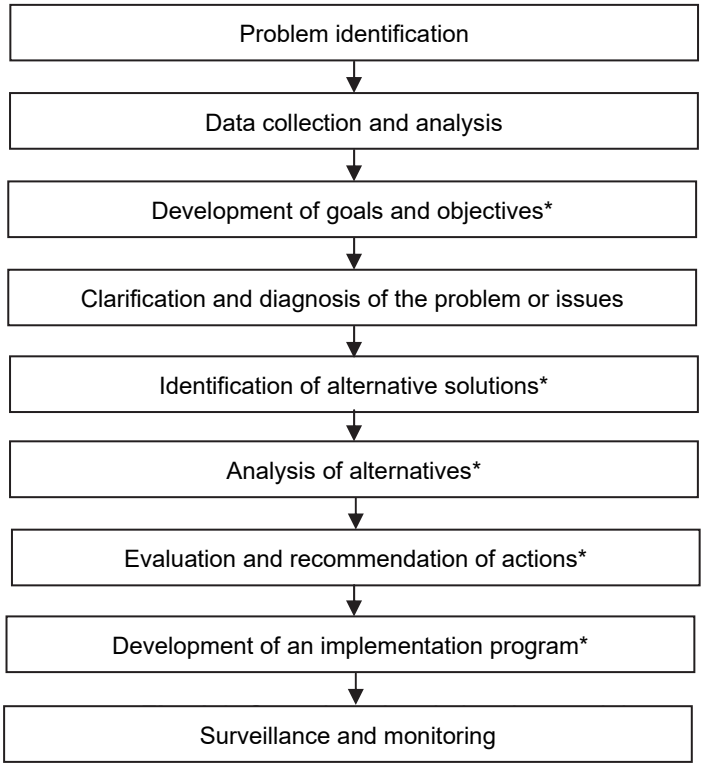
Index_j = composite index for j_{th} alternative

n = number of decision factors

IW_I = importance weight of i_{th} decision factor

R_{ij} = ranking, rating or scale of j_{th} an alternative for i_{th} decision factor

Decision-making in relation to selecting the proposed action from alternatives, which have been analyzed and compared should take place in relation to an overall planning model, which is also called the "rational planning model," as shown in Fig.1.6. An illustration of the application of this model to the selection of a "best practicable environmental option" (BPEO) (in this case, for pollution control) is shown in Fig.1.7. Decision-focused checklists can be used in the "Analysis of alternatives" step in Fig. 1.5, and the "Select preferred option" step in Fig.1.6. Finally, McAllister (2), Fig 1.8., has suggested that evaluation of an alternative can be divided into two phases: analysis, in which the whole is divided into parts, and synthesis, in which the parts are reformed into a whole.



*Denotes components of what is frequently called the rational planning model

This information could be used to prepare a trade-off analysis and select the proposed action. If the qualitative and/or quantitative approach is used for completion of the matrix, information for this approach relative to the environmental impacts should be based on impact prediction. This information would also be needed for impact ranking, rating or scaling.

1.6.3 Importance-Weighting of Decision Factors

If the importance-weighting approach is used in decision-making, the critical issue is the use of an effective method to assign importance weights to the individual decision factors or, at least, to arrange the factors in a rank ordering of importance. Table 1.4 lists some structured importance-weighting or ranking techniques that could be used in numerous EIS decision-making efforts.

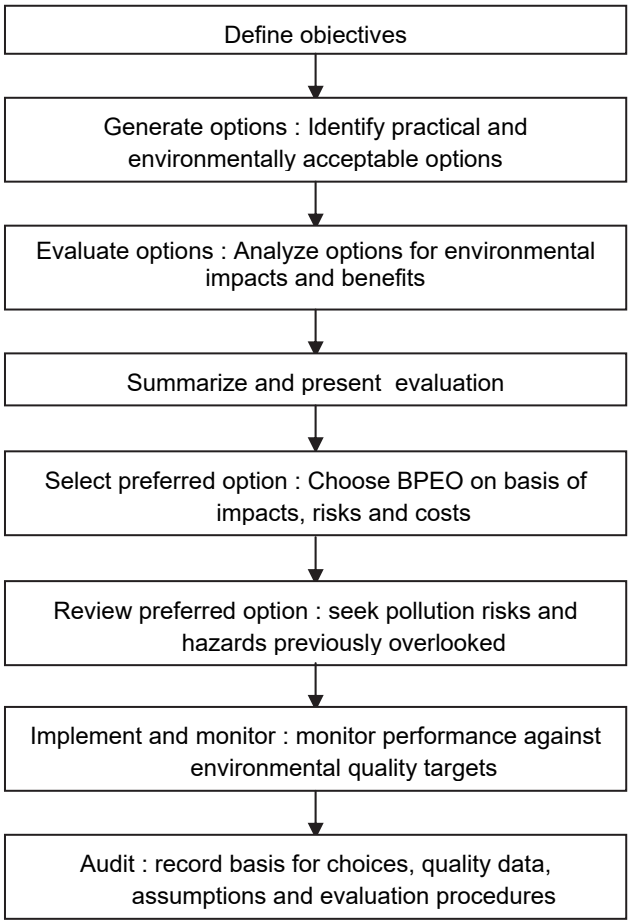


Fig. 1.7 Steps in selecting a best practicable environmental option (BPEO) using the rational planning model (Selman, (3)).

Table 1.4 Examples of types of importance-weighting techniques used in environmental impact studies.

Ranking
Nominal-group process
Rating Predefined importance scale
Multiattribute (or multicriterion) utility measurement
Unranked pairwise comparison
Ranked pairwise comparison
Delphi study

These ranking methods assist the environmental analyst in developing project-specific evaluation methodologies for the particular projects or actions being considered. The actual method, however, should include local factors and opinions of local and state agencies.

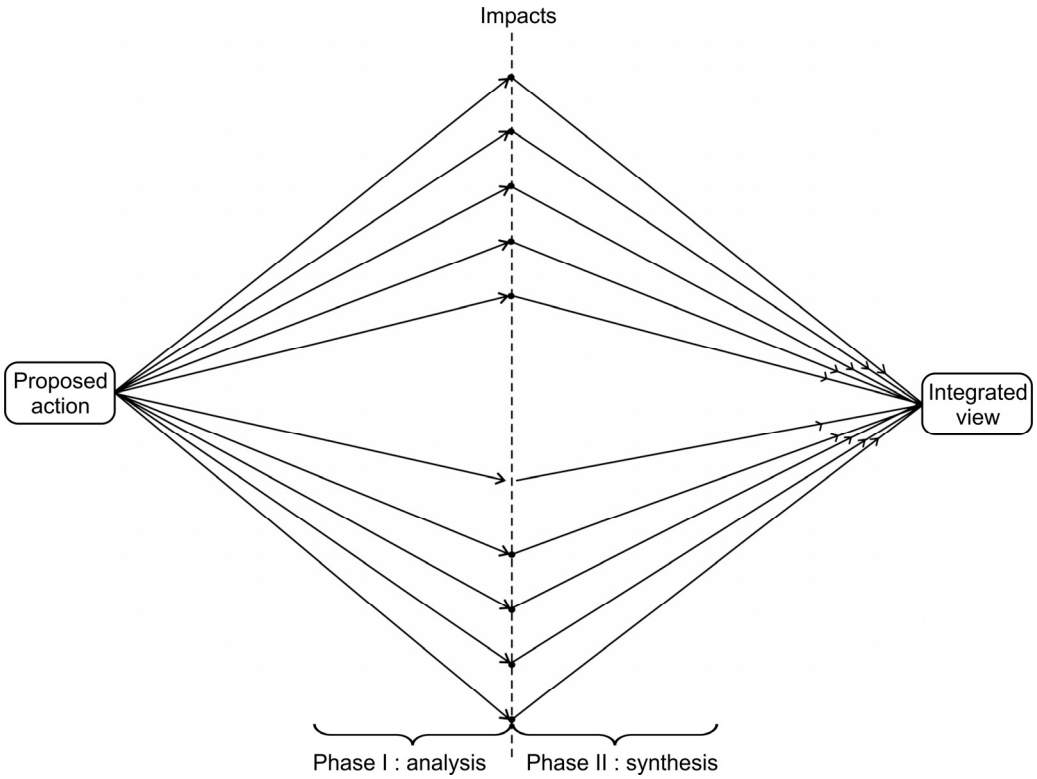


Fig. 1.8 The two phases of the alternative evaluation process (McAllister).

An overview of the total EIA process to assist applicants, stakeholders and public is presented in Table 1.5 giving various systematic steps to be followed for determining whether a new developmental project needs EIA or not (20-25).

1.7 Strategic Environmental Assessment (SEA)

1.7.1 What is Strategic Environmental Assessment (SEA)?

Systematic assessment/evaluation of significant impacts likely to occur whenever a new strategic plan/program/policy is proposed/decided to be implemented is called Strategic environmental assessment (SEA). A number of new welfare/policy decisions are being implemented by various Governmental/Statutory agencies as a part of governing/developmental process. In this context SEA provides a proactive and comprehensive assessment which identifies/evaluates and predicts significant environmental impacts/sustainability risks most likely to occur if the policy or program is implemented. SEA, thus greatly helps policy/program implementing authorities to take into cognizance various environmental issues/sustainability risks most likely to occur and address in the early stages of project/policy implementation (26, 27).

Therivel *et al*., 1992, (28) defined" SEA "as the formalized, systematic and comprehensive process of evaluating the environmental impacts of a policy, plan or program and its alternatives, including the preparation of a written report on the findings of that evaluation, and using the findings in publicly accountable decision-making.

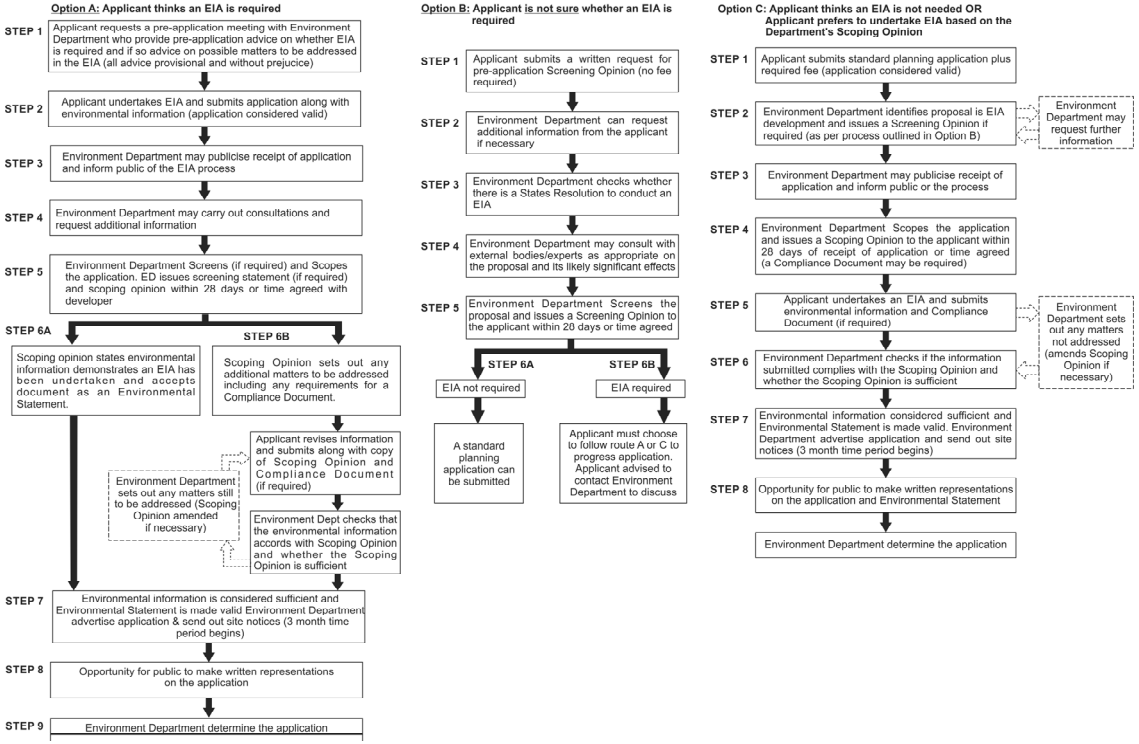
Sadler and Verheem, 1996 (29) defined SEA as "a systematic process for evaluating the environmental consequences of a proposed policy, plan or program initiatives in order to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision-making on par with economic and social considerations.

SEA as a continuous, proactive, integrated decision support process (rather than production of a report) attempts to highlight with broad scope, sustainability policy issues and focus on visions and initiatives rather than on concrete actions and outcomes (30).

Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) effectively promote sustainable development by mainstreaming the environment into economics. The main differences between EIA and SEA are that in the former the likely environmental impacts of various physical activities in a project are examined/ assessed/predicted while in SEA the environmental consequences/risks will be assessed for a new plan/policy/project proposed to be implemented which are need to be visualized. For planners/decision makers, SEA will become an important tool as it provides important information and analysis on environmental issues likely to arise in short, medium, and at long range if certain policies/programs /plans are implemented and what are regional environmental changes likely to occur for different land uses.

Table 1.5

DETERMINING WHETHER A PROJECT NEEDS ENVIRONMENTAL IMPACT ASSESSMENT (EIA)



1.7.2 Strategic Environmental Assessment (SEA) : A Decision Support System

1.7.2.1 SEA as structured a Decision support System

For ensuring that all environmental risks sustainability issues likely to occur are properly addressed in the policy/plan/program planning level, SEA serves as a systematic and structured decision support tool for planners/decision makers/private bodies with the following features

- SEA offers a structured, rigorous, participative, open and transparent Environmental Impact Assessment (EIA) Tool.
- SEA provides a participative, open and transparent, possibly non-EIA-based tool, that can be applied in a more flexible manner to policies
- SEA will be a versatile and simple tool that can be applied in a flexible way to legislative proposals and other policies, plans and programs in political/cabinet decision-making.
  For achieving sustainable development with good governance, SEA serves as a structured and tiered decision support tool which will be more effective, efficient, simple and flexible. This approach will provide substantive focus regarding questions, issues and alternatives to be considered in policy, plan and program (PPP) making.

1.7.2.2 Good Practice SEA

For achieving good output from SEA it is necessary to adopt the following guidelines

- Instead of justifying the proposed policy it is necessary discussed it critically
- All feasible policies and planning options (alternatives) need to discuss critically and compared in terms of their environmental risks and benefits
- In the policy preparation process itself the environmental risks need to be described exhaustively and addressed effectively
- Strategic sustainability assessment need be simple with a clear assessment of environmental impacts
- By involving public at all levels SEA should reflect the view of all stakeholders on possible environmental risks.
- Information on environmental consequences of a new policy should be informed with good communication systems

1.7.3 Background and Origin of SEA Process

1.7.3.1 Chronological Order of Development of SEA

For integrating environmental, economic and social issues in various developmental activities in public/governmental/private decision making, many organizations have started working on the improvement of environmental performance and sustainability issues in these aspects, resulting in significant changes in environmental policy changes. In this context Strategic Environmental Assessment (SEA) has been emerged. The term SEA was first referred in The National Environmental Policy Act (NEPA) 1969. To bring about

substantive environmental reform through the US federal bureaucracy, they were directed to prepare \ environmental impact statement for "legislation and other major federal actions significantly affecting the quality of the human environment" as SEA, which has become a part of (Section 102(2) (c), National Environmental Policy Act of 1969).

The Principal International Instrument on SEA process implementation was promulgated in 2003 the Protocol on Strategic Environmental Assessment in a Transboundary Context (Kiev Protocol) and the European Union (EU) Directive on SEA being a key regional example of its implementation in policy.

The objective of the EU Directive on SEA is stated as being "to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programs with a view to promoting sustainable development, by ensuring that an environmental assessment is carried out of certain plans and programs which are likely to have significant effects on the environment" (EU Directive, Article 31).

The Kiev Protocol describes some of the key elements in an SEA process in its definition of SEA. These include the evaluation of the likely environmental and health effects of a policy, plan or program through the determination of the scope of an environmental report and its preparation, the carrying out of public participation and consultations, and the taking into account of the environmental report and the results of the public participation and consultations in the policy plan or program (Kiev Protocol, Articles 6-12).

1.7.3.2 Relevant Provisions of the Planning and Development Act 2000

Although the SEA Directive was not formally adopted until 2001, its imminent arrival was anticipated by certain provisions of the 2000 Act. The Act required that when Regional Planning. Guidelines, Development Plans, Local Area Plans or Strategic Development Zone (SDZ) planning schemes are being made by the relevant authority, they must be accompanied by information about the likely significant effects on the environment of implementing such plans.

1.7.3.3 Transposition of the SEA Directive into Planning Law

The European Communities (Environmental Assessment of Certain Plans and Programs) Regulations 2004 (S.I. 435 of 2004) amended certain provisions of the Planning and Development Act 2000 to provide the statutory basis for the transposition of the Directive in respect of land-use planning. These amendments facilitated the making of the Planning and Development (Strategic Environmental Assessment) Regulations 2004 (S.I. No. 436 of 2004) which give effect to the SEA Directive in the land-use planning sector.

The latter Regulations, which integrate SEA into current plan-making procedures as far as possible are:

(i) Require SEA in the case of all Regional Planning Guidelines;

(ii) Require SEA in the case of Development Plans, Variations of Development Plans and Local Area Plans likely to give rise to significant environmental effects;

(iii) Require SEA in the case of Planning Schemes in respect of a Strategic Development Zone (SDZ);

(iv) Set out the procedural requirements for the preparation and consideration of the Environmental Report, including scoping and public consultation, and the integration of these new requirements with existing plan preparation/review processes; and designate the Environmental Authorities to be consulted at various stages during the SEA process.

These guidelines relate to the application of the SEA Directive to certain plans prepared under the Planning and Development Act 2000.

The guidelines are addressed to:

(a) Regional Authorities: in relation to the preparation or review of Regional Planning Guidelines;

(b) Planning Authorities: in relation to the preparation or review of Development Plans and Local Area Plans;

(c) Relevant Development Agencies: in relation to the preparation of a Planning Scheme in respect of a Strategic Development Zone (SDZ).

Where the word "plan" is used throughout these guidelines, it will refer to Regional Planning Guidelines, Development Plans, Local Area Plans and Planning Schemes in respect of SDZs for which SEA will be required. Similarly, "plan-making authorities" includes regional and planning authorities, and in the case of a Planning Scheme in respect of an SDZ, the relevant development agency.

A further element in any SEA process is ongoing monitoring of the implementation of particular policies, plans and programs to determine any adverse unforeseen environmental or health effects so as to undertake remediation (32).

However, from a global perspective, SEA for all components of the environment, including the marine environment, is still at an early stage of implementation, Table 1.6 lists a series of key events that have contributed to the evolution and consolidation of SEA.

Table 1.6 Chronological development of SEA Concepts

1969	The National Environmental Policy Act (NEPA) passed by the U.S. Congress mandating all federal agencies and departments to consider and assess the environmental effects of proposals for legislation and other major projects.
1978	US Council for Environmental Quality (USCEQ) issues regulations for NEPA which apply to USAID and specific requirements for programmatic assessments.
1989	The World Bank adopted an internal directive (O.D. 4.00) on EIA which allows for the preparation of sectoral and regional assessments.
1991	The UNECE Convention on EIA in a Transboundary Context promotes the application of EA for policies, Plans and programmes.
1990	The European Economic Community issues the first proposal for a Directive on the Environmental Assessment of Policies, Plans and Programmes.
1991	The OECD Development Assistance Committee adopted principles calling for specific arrangements for analyzing and Monitoring Environmental Impacts of Programme Assistance.

Table 1.6 *contd*…

1995	The UNDP introduces the environmental overview as a planning tool.
1997	The Council of the European Union adopts a proposal for a Council Directive on the assessment of the effects of certain plans and programmes on the environments.
2001	The UNECF issues a draft protocol on strategic Environmental Assessment applying to Policies, Plans and Programmes.
2001	Council of the European Union adopts the Council Directive 2001/42/CE on 27 June on the assessment of the effects of certain plans and programmes on the environment.

1.7.4 SEA's Contribution to Sustainability and Success Factors

1.7.4.1 SEA's Contribution Towards Sustainability

1. SEA helps to get a broader environmental perspective of any policy
2. SEA provides critical information on various environmental risks and sustainability issues likely to arise due to implementation of any policy/planning activity/govt decision which help in incorporating mitigation measures at the policy/project formation stage itself.
3. SEA predicts serious/significant environmental risks/sustainability issues likely to arise due to project/policy implementation
4. SEA helps in formulating a number of environmentally sound chain actions for environmentally sustainable development
5. SEA helps in integrating policy making/planning with various environmental sound mitigation measures for sustainable development.

SEA is an evidence-based instrument, aiming to add scientific rigor to PPP making by using suitable assessment methods and techniques.

1.7.4.2 Success Factors in SEA

- Legal basis, administrative order, policy or recommended requirements are basic success factors
- Achievable and clear environmental policy objectives
- Non biased Environment reporting
- Robust planning process with well structured operations
- Responsibility for compliance
- Proponent commitment and accountability
- Multiple organizations that work together
- Objectives, criteria and quality standards framework
  - to assess proposal need and justification
  - to assess environmental effects (losses/changes)
- Guidelines for good practice
- Resources availability
- Access to information

- Public interest and involvement of non-governmental organizations
- Independent oversight and review of the implementation and performance (quality control)
- Inputs for decision making: are SEA results timely, relevant and influential? (Use versus non-use of SEA in policy design/approvals).

1.7.5 Aims and Objectives of SEA (33)

The following should be the aims and objectives of any SEA for achieving sustainable development:

i. To help achieve environmental protection and sustainable development by:

- Assessment and evaluation of environmental risks /sustainability issues arising out of implementation of the new policy/projects/plans
- Consideration and evaluation of various project options to identify environmentally sound and practicable option
- Develop inbuilt early warning systems for cumulative effects and large-scale changes in the environment due various strategic activities

ii. To strengthen and streamline project EIA by:

- To assess the scale, spatial and temporal variations of the impacts likely to occur due to project activities
- To obtain statutory clearances for various strategic issues and concerns related to the justification of proposals
- Reducing the time for expert reviews

iii. To integrate the environment into sector-specific decision-making by:

- Supporting environmentally sound and sustainable proposals
- Developing objective and rapid decision systems

1.7.6 Elements of SEA and Priority needs for Good Practice of SEA

1.7.6.1 Elements of SEA

In practice, SEA is generally understood as comprising of a flexible framework of key elements which support decisions on development by integrating environmental considerations into the decision making process (30).

SEA instruments and policy directives such as the Kiev Protocol and the EU directive on SEA contain provisions prescribing policies, plans and programs which are subject to SEA processes. These are known as screening provisions and refer to those policies, plans and programs likely to have significant effects on the environment. In some cases, they provide a more specific listing of those plans and programs for which a SEA process is mandatory.

SEA typically involves the setting of an overarching environmental vision and objectives for a particular geographic region and activities within that region (33). A broad range of alternative courses of action to achieve the specified objectives are then developed and each

alternative is assessed against specific criteria within the context of the broader environmental vision and objectives.

Alternative courses of action are then assessed against criteria such as sustainability measures and acceptable levels of environmental change for particular species, habitats and ecosystems.

On the basis of this assessment, the most desirable courses of action are selected and implemented in policies, plans and programs in that area.

Elements in a SEA process include an array of "analytical and participatory approaches" designed to "integrate environmental considerations into policies, plans and programs and evaluate the interlinkages with economic and social considerations" (34).

Different tools can be employed at different stages as part of a SEA according to the context of the policy, plan or program being assessed.

These include tools to predict environmental and socioeconomic effects, tools to ensure full participation of stakeholders and tools for analyzing and comparing options.

An OECD Guide to Understanding SEA in the development context provides some useful examples of the different types of tools which can be employed:

1.7.6.2 Priority needs for Good Practice SEA

- Policy context (sustainability policy, objectives and strategies)
- Accountable decision-making systems
- Adaptivity nature of decision-making processes
- Be integral and well coordinated with policy-making
- Simple, interactive and flexible approaches
- Integrated approaches regarding scope and cross-interaction of relevant factors
- Guidance and perhaps minimum regulatory context
- Demonstration of benefits - examples of good and bad
- Practice
- Participated process, including multiple agents and consideration of public priorities and preferences changing attitudes, overcoming prejudices, new routines in decision-making.

1.7.7 Benefits of SEA

One of the main benefits of SEA is that it provides a means of anticipating and avoiding cumulative adverse impacts on the environment (32):

- SEA can play a significant role in enhancing the integration of environmental concerns in policy and planning processes (30). It helps to incorporate sustainability principles in the policymaking process.

- SEA is intended to provide the framework for influencing decision-making to address environmental issues/concerns at an earlier stage when many govt. plans and programs are mainly dominated by sole economic aim.

- SEA facilitates sustainable development through the systematic assessment of policy options.
- SEA specifically designed to address cumulative impacts of individual projects while EIA is not always best placed to address cumulative impacts.
- SEA makes the plan-making process effective by facilitating the identification and assessment of alternative plan strategies:
- SEA brings awareness of the environmental impacts of plans: while it will not always be possible to eliminate all potentially significant negative effects in balancing policy options, SEA at least helps to clarify the likely consequences of such choices, and makes specific provision for mitigation measures where some negative impacts cannot be avoided.
- SEA encourages the inclusion of measurable targets and indicators: which will facilitate effective monitoring of the implementation of the plan, and thus make a positive contribution to subsequent reviews.
- SEA design will facilitate the principles of sustainability to be carried down from policies to individual projects
- Credible and feasible strategic options allow evaluation of a decision based on comparable rather than in absolute value

1.7.8 Methods and Tools used in SEA for Predicting Environmental and Socio-Economic Effects

1.7.8.1 SEA Methods

SEA is carried-out in two phases: to identify and predict the potential impacts of any new policy/project/plant on the physical, biological, ecological, socioeconomic, cultural environment and on human health.

The first phase is called Initial Environmental and Sustainability Evaluation (IESE) and the second phase is Environmental and Sustainability Impact Studies (ESIS).

ESIS is used to identify and evaluate the environmental and sustainability consequences, both beneficial and adverse impacts to ensure that the environmental and sustainability impacts were taken into consideration in organization's planning and decision making process.

The following are a list of some of the SEA methods and techniques adopted for the sustainable project formulation:

1. Expert judgment and stakeholders' sentiments
2. Checklist and matrices
3. Multi criteria analysis
4. Case comparisons
5. Simulation models
6. Software and information system
7. Questionnaires

8. Group discussions
9. Delphi approach
10. Flow charts and decision trees
11. Contingency analysis
12. Overlays
13. Fuzzy logics.

1.7.8.2 Computation Tools for SEA

Modelling or forecasting of direct environmental effects

- Matrices and network analysis
- Participatory or consultative techniques
- Geographical information systems (GIS) as a tool to analyze, organize and present information.

The following are some important steps included in SEA to ensure stakeholder participation

- Stakeholder analysis to identify those affected and involved in the policy, plan or program decision
- Consultation surveys
- Consensus building processes
- Tools for analyzing and comparing options
- Scenario analysis and multi-criteria analysis
- Risk analysis or assessment
- Cost benefit analysis
- Opinion surveys to identify priorities (34).

As per the context of the SEA the above tools can be selected by each of the broad general categories being represented in the mix.

1.7.9 SEA and EIA

SEA proactively examines a wide range of alternatives for policies, plans and programs and selects the preferred course of action with a broader environmental and planning vision in mind. In contrast, EIA is more confined and concrete in focus determining the likely environmental impacts of a particular project or development. EIA examines some alternatives for strategic project activities and mitigation measures to address environmental concerns/risks likely to arise due to project /development.

SEA is a flexible concept than EIA allowing for a more comprehensive and forward looking assessment of environmental concerns at the policy, planning and program level (32-34).

Thus EIA analyses, environmental impacts on certain locations within a given time, whereas SEA covers the environmental impacts of a wide range of project, strategic activities over a large geographic areas as an institutionalized part of decision making on a long term basis. For better understanding of Environmental impacts, vertical integration of

SEA and EIA for various environmental issue/concerns are considered at the policy/planning level and flow down to project level (35).

In descriptions of the relationship between SEA and EIA, EIAs are often described as being nested within a particular SEA. In practice and in the past this has not always happened, with EIAs for specific projects often occurring in the absence of a broader environmental vision for the particular marine region and associated activities and industries.

1.7.9.1 SEA and EIA Relationship

Several authors have discussed comparisons in terms of advantages and disadvantages of SEA with respect to EIA (36-39) which justify the necessity of SEA before any policy/planning decision implementation. The main differences in EIA and SEA are tabulated in Table 1.7.

Table 1.7 Main differences between SEA and EIA (40)

Nature of Action	SEA	EIA
Focus	Critical decision moments (decision windows) along decision processes	Construction/operation actions
Level of decision	Policy, planning	Project
Relation to decision	Facilitator	Evaluator, often administrative requirement
Alternatives	Spatial balance of location, technologies, fiscal measures, economic, social or physical strategies	Specific alternative locations, design, construction, operation
Scale of impacts	Macroscopic, mainly global, national, regional	Microscopic, mainly local
Scope of impacts	Sustainability issues, economic and social issues may be more tangible than physical or ecological issues	Environmental with a sustainability focus, physical or ecological issues, and also social and economic
Time scale	Long to medium term	Medium to short-term
Key data sources	State of the Environment Reports, Local Agenda 21, statistical data, policy and planning instruments	Field work, sample analysis, statistical data
Data	Mainly descriptive but mixed with quantifiable	Mainly quantifiable
Rigor of analysis uncertainty	Less rigor/more uncertainty	More rigor/less uncertainty
Assessment benchmarks	Sustainability benchmarks (criteria and objectives)	Legal restrictions and best practice
Outputs	Broad brush	Detailed
Public perception	Vague/distant	More reactive (NIMBY)
Post-evaluation	Other strategic actions or project planning	Objective evidence / construction and operation

Summary

The general concepts of EIA and the salient features of EIA process are presented in this chapter. In the introduction, the concepts of EIA in different contexts are explained and ten basic principles of EIA are also presented. The criteria to decide which projects need EIA and how to determine is also discussed. Concept of Environmental audit is explained and the importance of scientific knowledge of environmental changes in assessing impacts is explained. As a simple example, various impacts occurring in any land clearing projects which is one of the main activities in any development project are presented. The impact of land clearing activities on climate is also discussed.The various steps involved in the entire EIA procedure are described in detail.

Initial Environmental Examination (IEE) and Full Scale Environmental Impact Assessment which is complimentary tasks of EIA are presented giving the scope and various operational functions.

The various analytical functions to be studied to carry out the full scale EIA of any major project activity like fixing the scope, identification of impacts on ecological sensitive resources, impact prediction, impact evaluation & analysis are discussed with suitable examples.

Systematic approach to be adopted for incorporation of EIA as a planning tool in different phases of major project activities and its advantages are discussed. The usefulness of various components of this approach like environmental base map preparation, delineation of the study area, identification of critical resources likely to have impacts, prediction of impacts, formation of the interdisciplinary study team, preparation of Terms of Reference (TOR), format for the presentation of the EIA report, environmental monitoring and management plan and preparation of draft and final environmental impact statement(EIS), for making EIA as a valuable tool for effectively assessing overall impacts of any major project activity is discussed with examples.

The methodology to be adopted for comparative evaluation of various project alternatives, which are very important in final decision-making, are discussed. A good approach is to compare the build, or action, alternatives first. The least environmentally damaging alternative, with mitigation in place, should be identified.

As a systematic approach for deciding upon right alternatives, it is desirable to use trade-off analysis. Trade-off analysis involves the comparison of a set of alternatives relative to a series of decision-making factors. The basic concepts of tradeoff analysis of various project alternatives and ranking and weighing factors are also discussed.

Strategic Environmental Assessment (SEA) proactively examines environmental impacts of a wide range of alternatives for policies, plans and programs and selects the preferred course of action with a broader environmental and planning vision in mind. This makes SEA as an important tool for planners and decision makers to understand what will happen to an area if there are different land uses. It will try to provide information and analysis of the consequences of different actions and their environmental impacts in the short, medium and long term.

The background and origin of SEA process- and chronological order of development of SEA is discussed. SEA contribution to sustainability and success factors, aims and objectives of SEA, elements of SEA and priority needs for good practice of SEA, benefits of SEA, methods and tools used in SEA for predicting environmental and socioeconomic effects are discussed in detail.

The technical details of Strategic Environmental Assessment (SEA) and in association with Environmental Impact Assessment (EIA) and how it effectively promotes sustainable development is discussed.

In the SEA process how to protect the environment in the planning, economic development and integrating green economy targets into strategic and project-related decision-making are explained.

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Questions

1. What is Environmental Impact Assessment (EIA)?
2. List out the ten basic principles that describe the characteristics of EIA.
3. Discuss the conditions that determine which project activities need EIA.
4. How EIA be useful as a planning tool for Environmental Protection in various developmental projects?
5. What is Initial Environmental Examination (IEE)? Why it is necessary before going for final EIA?
6. Explain the various analytical functions of an EIA.
7. Write short notes on (a) Direct impacts, (b) Indirect Impacts, (c) Cumulative Impacts and (d) short term and long term impacts.
8. Discuss various direct and indirect impacts likely to occur for typical (a) Land Clearing Activity and (b) Road Construction Activity.
9. Discuss the main features of Impact Evaluation and Analysis? What should be the important objectives of any effective EIA?
10. Explain what is meant by the terms significance and intensity of an impact. What are the various factors to be considered for assessing the significance of impact of any project activity?
11. What are the critical assessment criteria in any EIA methodology?
12. Explain various steps involved in adopting EIA as a planning tool for any major project activity.
13. Discuss the following terms in an EIA process

    (a) study area (b) base map (c) terms of reference and (d) study team.
14. Explain the criteria for formalizing various alternatives for any project. How do you make a comparative evolution of different alternatives? Explain trade off analysis?
15. Explain the different STEPS to be followed in a total EIA process to assist applicants, stake holders and public.
16. What is Strategic Environmental Assessment (SEA)? Explain how it is useful as a decision support system.
17. Discuss the evaluation of SEA process. Give the Chronological order of development of SEA
18. What are the ideal aims and objectives of any SEA process. Discuss various success factors.
19. Discuss the various elements of SEA and explain priority needs for good practice of SEA.
20. Explain the benefits of any SEA process.
21. Discuss various Methods and Tools used in SEA for predicting environmental and socio-economic effects.
22. Explain the main differences between SEA and EIA.