

**LECTURE NOTES ON
ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT
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EIA METHODOLOGIES

Process And Framework Of EIA

The United Nations Conference on Human Environment held at Stockholm in June, 1972 urged developing countries to take appropriate steps for the protection and improvement of human environment. Long term and sustainable development can only be achieved through sound environmental management. Needs methodologies, analytical tools and conceptual frameworks to integrate environmental concerns in development plans, programmes and projects. National and international funding agencies are eager to identify and adopt methodologies to improve project financing making projects more multidisciplinary, less sectoral, and more responsive to ecological constraints and parameters.

Though the bad effects of development activities are identified it may not always be possible to make a quantitative evaluation in terms of money of certain environmental effects or the cost of long term damage.

Environmental Impact Assessment (EIA) is one of the most important tools to assess the viability of any development project from all points of view including cost, environment and sustainable development/. The preparation of EIA is closely related to cost benefit analysis. EIA has to specially deal effectively with the following.

- i. Risk evaluation in terms of long-term consequences, with special reference to events with high negative effects like desertification, rehabilitation, deforestation etc.
- ii. Comparative weighing with the present and future costs and benefits.

DEFINITION AND FRAME WORK OF E I A

Environmental impact analysis (EIA) is a study of the effects of a proposed action on the environment. Environment in this context will include all aspects of the natural and human environment. Environment is made up of both biophysical and socio-economic elements. Thus depending upon the scale of the proposed action, EIA may include studies of air, water, land ecology, sound, weather, flora and fauna, human health, urban migration, economics, resources etc. EIA will seek to establish the condition of physical, biological, social, economic and other parameters before and after a project is undertaken. The type and the number of parameters to be studied in different projects will vary from project to project. Impact means change, either positive or negative from a desirability standpoint. An environmental impact analysis is, therefore, a study of the probable changes in the various socioeconomic and biophysical characteristics of the environment which may result from a proposed or impending action.

For any given project, there can be a number of alternative approaches including a zero option approach, which means not taking up the project at all. Each option will have economic costs and benefits, as well as losses and beneficial environmental impacts. Adverse environmental impacts may be reduced at a higher project cost. Economic benefits to an individual industry may have to be reduced to some environmental cost resulting in social benefit. All feasible alternatives are supposed to be studied in an EIA of any project. EIA should finally determine mix of environmental and economic costs and benefits.

The framework for EIA can thus be summarized as:

1. The study of the effects of a proposed action on the environment.
2. The comparison of various alternatives by which a desired objective may be realized and seeks to identify the one which represents the best combination of economic and environmental costs and benefits.
3. The prediction of changes in environmental quality which would result from the proposed action.

4. An attempt to weigh economic costs and benefits .

5. A decision making tool.

DESCRIPTION OF ENVIRONMENTAL SETTING

Environment in India is made of villages, towns, cities etc; and their surroundings made up of irrigated land, forest land , rivers, hillocks, wastelands, reservoirs etc. In pre-independence days, Indian villages, towns, and cities used to present a peaceful and meaningful life. But with increasing population, industrialization and urbanization, the physical scenario in Indian villages, towns and cities has deteriorated with corruption, improper implementation of rules and regulations and lack of civic sense.

Comfortable housing , sufficient quality of safe drinking water, proper civic amenities like drains, roads, street lights, parks and gardens and other public conveniences have become a rarity. Construction of big dams, and starting of big industries without considering their impact on environment have resulted in rehabilitation of villages, inundation of forests, reduction in flora and fauna, pollution of air, water and land, increase in slums, deforestation, desertification etc. Industrialisation around Bombay and Hyderabad, Bhopal gas tragedy, smog atmosphere in Delhi during winters, load quality of life in Rajasthan and Orissa villages , pollution of Dhal lake in Kashmir are all examples of improper development without caring for the environmental impact.

Before initiating any action like the construction of a dam, or the construction of a long irrigation canal, or a the construction of a big industry, site –specific environmental setting has to be understood properly . In an systematic procedure, information on environmental setting as a quesifiltering mechanism, eliminating consideration of impacts unrelated to the specific site.

NEED OF ENVIRONMENTAL IMPACT ANALYSIS

Development through use of technologies is necessary to improve the standard of living. In view of the fact that development projects are interfering too much with the environment, before any development project can be taken up there should be an analysis of the necessary for the development by comparing the monetary costs and monetary benefits. Of recent, society has become aware of the need for assessing the effect on the environment or it is ecological cost and benefit. Environmental impact analysis involves a combination of the ecological and monetary benefits and coast.

The evaluation of the impact of any development project is a part of many steps to be followed by any development project. Steps to be followed in a project are listed below:

- i. Prepare a statement of the major objectives of the proposed project.
- ii. Analysis the technologic possibilities of achieving the objectives.
- iii. Identify actions to achieve the stated objectives. Alternative plans for achieving the set objectives have to be identified.
- iv. Prepare a report on the condition of the existing environment before the proposed action.
- v. Finalize about principal engineering proposals with analysis of monetary benefit and costs.
- vi. Prepare Environmental impacts analysis of the magnitudes (degree, extensive and importance of impact). The pertinence of each action is reflects by numerical values of magnitude and importance.
- vii. Assess the impacts of the separate actions which comprise the project upon the different environmental factors.

- viii. Summarize and give recommendations including a discussion on the relative merits and rationales of the action plan.

For maintaining clean and healthy environment, the state and central government have a responsibility to protect the environment. Through the department of Environment, Government of India has to formulate and recommend :national policies for the improvement of the quality of the environment. Through gathering information, reviewing programme, conducting investigations and by preparing Environmental impact Assessment for different projects the departmental of Environment will keep informs the central Government about environmental status around the country. Environmental Impact Analysis is thud mandatory for all big projects like constructions of major dams. Major industries, mining activity, development of townships etc. The environmental impact statement should include a description of the environmental impact of the proposed action, unavoidable adverse impacts which would result should action take place, possible alternatives and discussion on short term versus long-term advantages of the proposal . It is obligatory to circulate the Environmental impact analysis publicly and consider both the analysis made by experts and publicly response to it when making it is final decision on the proposal. The specific purpose of Environmental impact Assessment , is to influence the decisions to be made for maintaining the environment and its values, for sustainable development. Through the world has gained by industrialization, we are now facing many environmental problems like holes in the ozone layer , global warming , green house effect, acid rains, deforestation etc. Poverty and environmental degradation are the two sides of the same coin and a good approach to development through proper environmental impact analysis will result in better things to happen.

The need for Environmental Impact Analysis can be summarized as:

- i. To identify all environmental factors in the project area which will be influenced by all the activities of the project under consideration.
- ii. To identify alternative approaches including no action plan, their levels of impacts and economic considerations.
- iii. To describe the environmental setting, to collect data and the factors associated with the proposed action. Methods for impact analysis can aid in identifying data needs and planning field studies.
- iv. To identify the tools and methodologies to be adopted in the Environmental impact Analysis.
- v. To evaluate control measures.
- vi. To provide information and encourage public participation in evaluating the impact of the proposed project

CRITERIA FOR CHOOSING A METODOLOGY:

There are number of methodologies evolved by different people. For preparing Environmental Impact Analysis. Depending upon the specific needs of the user and the type of project being undertaken, one particular methodology may be more useful than the other. To select the most appropriate methodology, the following criteria have to be considered.

- i. What is the objective of the proposed E.I.A?

Is the analysis primarily a decision or an information document?. A decision document is impartment for determining the best course of action , and required emphasis on identification of key issues, quantification and direct comparison

of alternative. On the other hand, an information document primarily. On the other hand, an information document primarily revolves implications of the selected choices and required a more comprehensive analysis and concentrations on interpreting the significance of a broad spectrum of possible impacts.

- ii. What are the available resources like money, time, skill, data and computer facilities? Comprehensive E.I.A. require more of everything.
- iii. Is the person in charge of preparing E.I.A. familiar with the type of action contemplated and the area in which the project has to come up? Graded familiarity will improve the quality of E.I.A.
- iv. How big are the issues being dealt with? All other things being equal, the bigger the issue, the greater the need to be explicit, to quantify and to identify key issues. Arbitrary comparison of one type of impact, say for example on environment, with another type of impact, say like economic, and become less appropriate.

DIFFERENT METHODOLOGIES OF E.I.A

Any Environmental impact Analysis methodology should effectively deal with

- a. impact identification, impact measurement, impact interpretation
- b. impact communication to information users

E.I.A, methodologies have not yet been standardized and are not yet well documented. From the available literature, it can be understood that six methods are referred frequently. Based upon the way impacts are identified, the six methods are named as

- i. Ad Hoc method
- ii. Overlays methods
- iii. Checklist method
- iv. Network method
- v. Method of Matrix
- vi. Combination –computer aided method

The names of the methods are self explanatory and description of each one of the six methods is made below.

- i. **Ad Hoc Method:** Broad areas of possible impacts like impacts upon flora and fauna, impacts on lakes and forests etc.; are identified in this method. This method does not define specific parameters to be investigated, and so may not provide sufficient guidance for impact assessment. A team of specialists will identify the nature of the impacts such as no effect, short or long term, reversible or irreversible etc. Ad hoc methods are for rough assessment of total impact giving the broad areas of possible impacts and general nature of these possible impacts.

This method was used initially in 1971 as a planning tool for siting power generation and power transmission facilities. The approach considers a range of pollution, and ecological, economic and

ii. Overlays Method :

A set of transparent maps giving physical, social, ecological, aesthetic characteristics of the project area are overlaid to produce a composite characterization of the regional environment. By overlaying maps, area of preferred variable and area of adverse impacts and their geographical locations are identified. Overlays method has been used popularly in highway route selection and selection of transmission line corridors. This method is useful as a first-out method of identifying and shifting out alternative projects sites prior to preparing a detailed impact analysis. However, this method is unable to quantify and identify possible impacts. High degree of skill and training are required to prepare the map overlays. The best utility of the overlays method is to perform an initial screening process to identify feasible alternatives which would then be subjected to a more detailed analysis available through other means.

iii. Checklist Method:

A comprehensive listing of environmental parameters which are related to a particular type of action, is done in checklist method. This is a very popular method in EIA. Studies. Check list method helps order thought, aids in data gathering and presentation and acts against the omission of possible impacts. Four broad categories of check lists are in vogue, viz.

- i.. Simple check lists ii. Descriptive checklists
- Scaling checklists iv. Scaling weighting
- iii. and checklists

Simple checklists are a simple list of environmental parameters without any reference to as to how environmental parameter data are to be measured and interpreted. Descriptive checklists identify environmental parameters and give guidelines on how parameters data are to be measured. But no numerical ranking is use in evaluating the level of impact. Adkins and Broke

(4) used scaling checklists, involving the scaling of impacts on a relative basis from minus five to plus five. Scaling –weighting checklists represent scaling checklists with information provides as to subjective evaluation of each parameter with respect to every other parameter. Scaling weighting checklists employ both magnitude and importance factor.

Magnitude is considered to be a measure of the degree or severity of an impact and is assessed after the analysis of the impact . Importance is defined as the baseline level significance of an impact and is used to weight the impact appropriately as determined through the subjective judgment of a scientific team, determine prior to impact analysis. Table given below gives an examples of scaling –weighting checklists . the lists has to be very comprehensive to include all environmental parameters which will be effected by a project.

TABLE

An example checklist for a proposed industry in a study area

Sl.No	Environmental parameter in the descending order of important	Rating or weight	Possible score on Environmental impact
1	Air pollution	High	10
		Medium	5
		Low	0
2	Water pollution	High	10
		Medium	5
		Low	0
3	Rehabilitation	High	10
		Medium	5
		Low	0

The major feature of the checklist system is that environmental impact is expressed in commensurate units. The steps involved in the development of commensurate units include transformation of parameter estimates into an environmental quality scale, assignment of importance weights to the individual parameter, and the multiplication of scales value any importance value to obtain environmental impact units. One of the important environmental quality to assess the status of river is the concentration of dissolved oxygen, which may vary from 0 to 9 mg/l. Environmental quality scale can be identified for concentration of settleable dust in ambient air, leaching of pollutants into ground water etc. For any given project a panel of engineers can prepare a detailed list of environmental parameters which may be allocated by the project in the project are m, assign environmental quality indices and prepare values function graphs with environmental parameters like dissolved oxygen In river water, ambient dust fall concentration, concentration of dissolved solids in ground water, level of noise pollution, quality of solids waters etc. on the abscissa and environmental quality scale on the ordinate.

iv. Networks Method:

A project is related to its potential impact through a cause –condition-effect network. Through this method is not necessarily a full methodology, it will be useful in identifying the impacts. Projects activities are related to first order condition charges, which in turn cause second and third order condition charges, leading finally to effects. In network diagrams, the impact of one environmental factor on other environmental or socio-economic factors and other similar interactions are identified.

Subsequently, network diagrams will act as a guide for impact identification and presentation of results Odom (5) who wrote a book on Ecology used network diagram to depict the concept of energy flow between different components of oceans, rivers, forests, grasslands etc. Network methodology was first used to identify potential commercial, residential and transportation use of sea coasts.

V. Method of Matrices:

Matrix method aims at relating projects activities to their environmental impacts. After the identification of project activities and their environmental impacts, their interdisciplinary team of specialists should assess the magnitude and importance. The matrix method is a convenient method of visual display of both total project activities and their impacts. The Matrix method comprising of a series of rows depicting project activities and a series of columns depicting environmental impacts, has the ability for factor expansion, depending upon the project analysis.

The methods of assigning weights to the interactions can take various forms including the assignment of three levels of impact viz :major, minor, intermediate, or assignment of negative as well as positive scores to indicate the adverse or beneficial nature of the impact. Scales have also been used to describe the possibilities of impact occurrence as well as the extent of potential impact reversibility.

The most effective way to use the matrix is to check each action which is likely to be involved significantly in the proposed development project. Each of the action thus checked is evaluated in terms of magnitude of effects on environmental characteristics on the vertical axis, and a slash is placed diagonally from upper to lower left across each block represents significant interaction. After all the boxes which represent possible impact have been marked, the most important ones are evaluated individually. Within each is representing a significant interaction place a number 1 to 10 on the upper, left-hand corner to indicate the relative magnitude of impact (1 is the least impact, 10 is the greatest) in the lower right hand corner of the box, place a number 1 to 10 to indicate the relative importance of the impacts (again 1 is the least impact, 10 is the greatest). Magnitude is defined as the degree or the extensiveness of scale of the impact, while importance is a weighting of the degree of significance of the impact. The former can be based on fact, while the latter is based on judgment.

VI. Combination Computer –Aided:

To identify activities associated with implementing major governmental parameters to identify potential environmental impacts at different user levels, to provide guidance for abatement and mitigation techniques, and to provide analytical models to establish cause –effects relationships to quantitatively determine potential environmental impacts, a combination of matrices, networks, analytical models and a computer aided systematic approach if allowed. Given the appropriate input information for a particular program, the computer-aided system developed will provide relevant environmental information to allow the user to respond to the requirements of environmental quality guidelines. Analytical models, like Economic impact Forecast System(EIFS), , are being developed to quantitatively assess the environmental impacts. Three levels of attributes viz; detailed level, review levels, and controversial attributes, are identified. Ramification remarks regarding potential impacts are presented along with mitigation procedures for minimizing adverse impacts. Instead of a numerical system, potential impacts are identified on a need –to-consider scale, using A,B and C as indicators.

Criteria for choosing an EIA methodology:

A number of people like Adkins, Burke, Dee, Jain, Leopold, Moore, Smith, Warner etc; have used one form or the other of EIA. Methodologies like adhoc, overlay, checklist, matrix, network of combination computer-aided etc. Important criteria to be considered. In choosing and evaluating an impact assessment methodologies are: comprehensive nature, flexibility of detecting project-generated impacts, and objectivity. the methodology chooses should ensure input expertise, utilize the state of the art , employ explicitly defined criteria , provided for assessment of impact magnitude, provide for overall assessment of total impacts and detect environmentally sensitive areas.

In view of the large number of models and methodologies being practiced in EIA .studies, one must choose between two extremes: complete uniformity or complete uniqueness. So far as uniformity, reproducibility and comparability are concerned, it would be profitable if one uniform method could be prescribed for any EIA. On the other hand, each environment is so unique that a standard methodology would most probably neglect the unique factors. This is why many specialists on EIA made their own methodologies for watch one of the projects.

Finally, any EIA methodology is expected to de three main things, viz; i. Identification , ii. Prediction and iii. Evaluation.

In the process of **identification**, the existing system has to be clearly described, the components of the project have to be clearly identified, and modifications in the project area as also in all the projects components have to be defined effectively. In the process of **prediction**, Identification of environmental modifications that may be significant is expected,. It is necessary to forecast the quantity and special dimensions of change in the environment of the project area. I is along with some time frame. In the process of **evaluation** , it become necessary to determine the incidence of costs and benefits to user group and populations affected by the project. It become necessary to prepare specifications and comparisons of the trade off (costs or effects being balanced) between various alternatives

Follow up of E.I.A:

Environmental Impact Assessment should be followed by analytical studies of the special impacts on the environment which appears most adverse. This is achieved by techniques such as materials balance, dispersion modeling, market simulation, marginal cost analysis and trade-off analysis.

The first and most basic analysis is to prepare a materials balance model of projects operational showing all materials inputs and outputs. Inputs will depend on the type of project and residuals released to the environment will be related to the processes involved and the controls incorporated in the project.

It is them, necessary to study the dispersion of residuals released to the ecosystem. In this way we arrive at concentration and movements of pollutants which will allow us

to assess potential damage and other damage costs associated with subsequent uses of the environmental media.

The next step is to construct a market simulation of the ecosystem which involves attaching shadow prices to unpriced values. Easily obtained market prices .will be for project development coasts, materials, power, labour and other operating coasts and product prices. Un priced components will be related to the ecosystem and are the values attached to water quality , air quality, wilderness quality, scenic views, biological health, species balance and hazards to species. Some of these unpriced components, can be valued as the cost of rectification or avoidance; damage costs of poor air, air and water quality can be determined by estimating the costs of removal of pollutants to a desirable or safe level.

The optimum level of environmental quality may not immediately apparent because the marginal cost for each degree of quality is not constant.