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Program : **B.Tech**

Subject Name: **Environmental Impact Assessment**

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UNIT-II

Methods of Impact Identification: Environmental Indices and indicators for describing the affected environment, matrix methodologies, network, checklist, and other method.

Environment Impact Assessment or EIA can be defined as the study to predict the effect of a proposed activity/project on the environment. A decision making tool, EIA compares various alternatives for a project and seeks to identify the one which represents the best combination of economic and environmental costs and benefits.

EIA – Three core values

1. Integrity: The EIA process should be fair, objective, unbiased and balanced

2. Utility: The EIA process should provide balanced, credible information for decision making

3. Sustainability: The EIA process should result in environmental safeguards

Environmental indicators

"An environmental indicator is a numerical value that helps provide insight into the state of the environment or human health. Indicators are developed based on quantitative measurements or statistics of environmental condition that are tracked over time.

Environmental indicators are simple measures that tell us what is happening in the environment. Since the environment is very complex, indicators provide a more practical and economical way to track the state of the environment than if we attempted to record every possible variable in the environment. For example, concentrations of ozone depleting substances (ODS) in the atmosphere, tracked over time, is a good indicator with respect to the environmental issue of stratospheric ozone depletion..

Environmental indicators have been defined in different ways but common themes exist.

"An environmental indicator is a numerical value that helps provide insight into the state of the environment or human health. Indicators are developed based on quantitative measurements or statistics of environmental condition that are tracked over time. Environmental indicators can be developed and used at a wide variety of geographic scales, from local to regional to national levels."

"A parameter or a value derived from parameters that describe the state of the environment and its impact on human beings, ecosystems and materials, the pressures on the environment, the driving forces and the responses steering that system. An indicator has gone through a selection and/or aggregation process to enable it to steer action.

The five key global environmental indicators are:

1. **Biological diversity.**
2. **Food production.**
3. **Average global surface temperature and CO_2 concentrations in the atmosphere.**

4. **Human population.**
5. **Resource depletion**

Environmental monitoring describes the processes and activities that need to take place to characterize and monitor the quality of the environment. Environmental monitoring is used in the preparation of environmental impact assessments, as well as in many circumstances in which human activities carry a risk of harmful effects on the natural environment. All monitoring strategies and program have reasons and justifications which are often designed to establish the current status of an environment or to establish trends in environmental parameters. In all cases the results of monitoring will be reviewed, analyzed statistically and published. The design of a monitoring program must therefore have regard to the final use of the data before monitoring starts.

Methodologies:-

Methodology means the structural approaches for doing one or more activities of EIA.There are some specific characteristic which an EIA methodology should depict.

These are :-(1) it should be appropriate to the necessary task of EIA process such as impact identification/comparison of alternatives.

(2) It should be significantly free from assessor's bias

(3) It should be economical in terms of costs, and its requirement of data, investigating time , personnel, equipment and facilities.

Impact Analysis:-

This stage of EIA identifies and predicts the likely Environmental and social impact of the proposed project and evaluates the significance.

Method for Impact Analysis

1. **Impact identification**
2. **Impact prediction**
3. **Impact evaluation**

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

   1. **Ad hoc method**
   2. **Checklists**
   3. **Matrices**
   4. **Overlays**
   5. **Networks**

1. **Ad hoc method:- Simple method based on subjective environment impacts on broad aspects. Ad hoc method is useful when time constraints and lack of information require that the EIA must rely exclusively on expert opinion. It provides minimal guidance for total impact assessment while suggesting the broad areas of possible impacts and the general nature of these possible impacts. When more scientific methods are available, it is not recommended. Ad hoc methods indicate broad areas of possible impacts by listing composite environmental parameters (Ex: flora and fauna) likely to be affected by the proposed activity.**

   These methods involve assembling a team of specialists who identify impacts in their area of expertise. Here, each parameter is considered separately and the nature of impacts (long term or short term, reversible or irreversible) is considered. These methods give a rough assessment of total impact while giving the broad areas and the general nature of possible impacts. In this method, the assessor relies on an intuitive approach and makes a broad-based qualitative assessment. This method serves as a preliminary assessment and helps in identification of important areas like:

   1. **Wildlife**
   2. **Endangered species**
   3. **Natural vegetation**
   4. **Exotic vegetation**
   5. **Grazing**
   6. **Social characteristics**
   7. **Natural drainage**
   8. **Groundwater**
   9. **Noise**
   10. **Air quality**
   11. **Visual description and services**
   12. **Open space**
   13. **Recreation**
   14. **Health and safety**
   15. **Economic values and**
   16. **Public facilities**

Types of Ad hoc method:-

- **Opinion polls.**
- **Expert's opinion.**
- **Delphi methods**

This method is very simple and can be performed without any training. It does not involve any relative weighting or any cause-effect relationship. It provides minimal guidance for impact analysis while suggesting broad areas for possible impacts. Moreover, it does not even state the actual impacts on specific parameters that will be affected.

The drawbacks of this method are listed below:

1. **It gives no assurance that a comprehensive set of all relevant impacts have been studied**
2. **Analysis using this method lacks consistency as it different criteria are selectively evaluated by different groups**
3. **It is blatantly inefficient as it requires a considerable effort to identify and assemble a panel for each assessment.**

2. **Checklist method: - Checklist means listing of potential Environmental Impacts.This method is done to assess the nature of the impacts i.e. its type such as adverse /beneficial, short term or long term, no effect or significant impact, reversible or irreversible etc.**

Types of checklist:-

- **Simple Lists.**
- **Descriptive Checklists.**
- **Scaling Checklists.**
- **Questionnaire Checklists**

1. **Simple checklists: - List of parameters without guidelines regarding either interpretation or measurement of environmental parameters or specific data needs or impact prediction and assessment.**
2. **Descriptive checklists: - It include list of environmental factors along with information on measurement, impact prediction and assessment.**
3. **Scaling and weighting checklists: - It facilitate decision making. Such checklists are strong in impact identification. While including the function of impact identification, they include a certain degree of interpretation and evaluation. The aforementioned factors make these methods attractive to decision-making analysis.**

However, the scaling and weighting methods are subjective and hence pose the danger of imparting equal importance to every impact. Another defect observed by critics is that numerical values assigned to impacts can be derived on the basis of expert knowledge and judgment alone.
Scaling and weighting checklist techniques quantify impacts reasonably well although they use subjective estimates. However, they make no provision for assessing dynamic probabilistic trends or mitigation, enhancement and monitoring programs. These methods cannot identify higher order effects, impacts and interactions. Simple and descriptive checklists simply identify the possible potential impacts without any rating regarding their relative magnitudes. Scaling and weighting checklists remove decision making from the hands of decision makers while they impart a single number to various inherently different impacts and this aspect prevents the decision maker to consider the possibility of trade-offs.

Matrix Methodologies: - Matrix and its variants provide us a framework of interaction of different actions/activities of a project with potential EI caused by them. A simple interaction matrix is formed where project actions are listed along one axis i.e. vertically and EI are listed along the other side i.e. horizontally. It was pioneer by Leopold et al (1971). It lists about 100 project actions and about 88 environmental characteristic and condition.

The advantage of the matrix method:-

1. **It links action to impact**
2. **This is a very good method for displaying EIA results**

The disadvantages of this method are listed below:

1. **It is difficult to distinguish between direct and indirect impacts using this method**
2. **There is potential for double-counting of impacts**
3. **It is qualitative in nature and does not refer to quantity of impact**

4. **In checklist method, the impacts are tabulated in the form of cells with information either in the descriptive form that gives information regarding possibility or potential existence of an impact whereas in the scaling or weighing methods the magnitude or importance of impact is given. Weighing methods used in EIA are shown below:**

Factors	Weights	Alternative one			Alternative Two		
		Raw Data	Scaled	Weighted	Raw Data	Scaled	Weighted
1. Wildlife Habitat Preserved		500			10000		
2. Employment Increase		500			3000		
3. Wildlife Habitat Index	1		0.5			1	
4. Employment Increase index	1		1			0.6	
5. Wildlife Habitat Weighted Index	0.2		1	0.1			0.2
6. Employment Increase Weighted Index	0.8			0.8			0.48
7. Grand Index		N/A	1.5	0.9	N/A	1.6	0.68

Table 1-Weighing methods

4. Overlays

This method depends on a set of maps of a project area's environmental characteristics covering physical, social, ecological and aesthetic aspects. It enables separate mapping of critical environmental features at the same scale as project's site plan (Ex: wetlands, steep slopes, soils, floodplains, bedrock outcrops, wildlife habitats, vegetative communities, cultural resources, etc). In the old technique, environmental features were mapped on transparent plastic in different colors. Modern technique of the same activity is done using computer software, hardware, data and skilled people. It is called GIS (Geographic Information Systems)

The advantages of this method are:

1. It is easy to understand and use
2. It has a good display and
3. It is good for setting site selection

The disadvantages of this method are:

1. It addresses only direct impacts
2. It does not address impact duration or probability

Network method:- It uses the matrix approach by extending it take into account primary as well the secondary impacts. Identification of direct, indirect /short and long term environment impact is a crucial and intact basic step of making Impact tree. Used to identify cause-effect linkages Visual description of linkages.

Example of a Network analysis:-

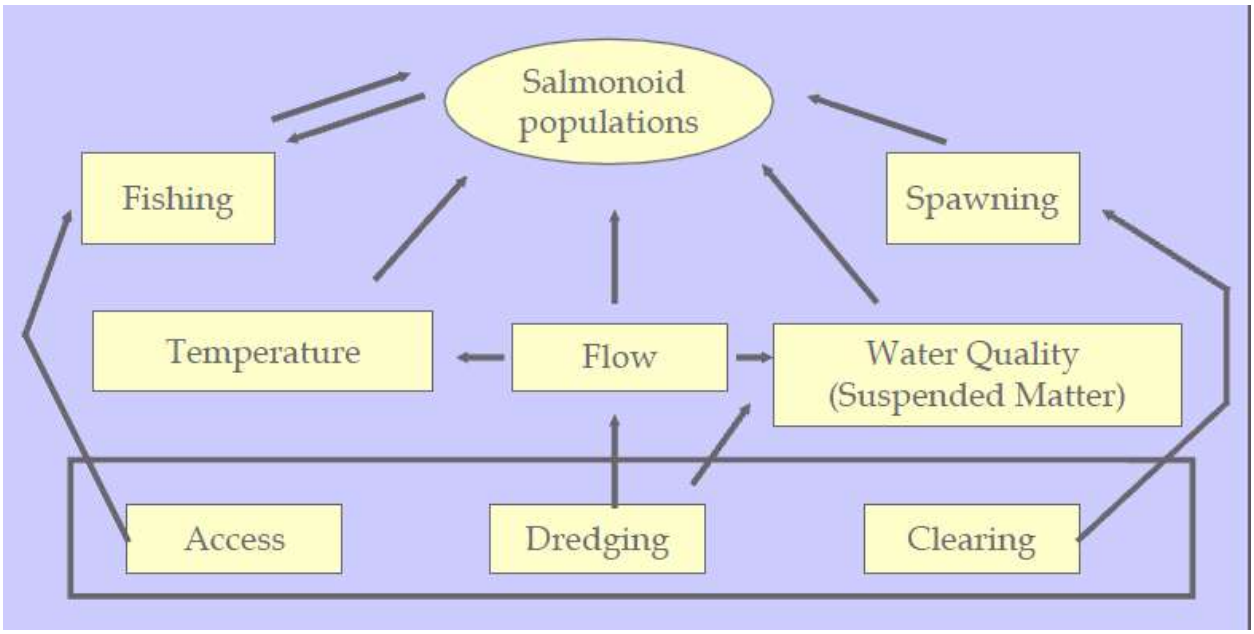

Fig. 2 Sequence diagram

The advantages of the network method are:

1. It links action to impact
2. It is useful to check second order impacts in a simplified form
3. It handles direct and indirect impacts

The disadvantages of this method are:
It becomes overly complex if used beyond simplified version

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