**EIA**: Any developmental project is aimed at increasing the quality of life by providing job opportunities, basic needs, healthy environment etc. However, along with this, it is also bound to have certain environmental impacts like pollution, over exploitation of resources etc. Hence, before any project is started, prediction and assessment of its impacts should be done, so that measures could be taken to minimize those impacts. This is known as Environmental Impact Assessment.



Goals of EIA:

⇒ To fulfill the responsibilities/needs of the coming generations.
⇒ To assure safe, healthy and productive sorroundings.
⇒ To ensure sustainable development with minimal environmental degradation.

EIA procedure: EIA procedure is divided into two tasks:

i. IEE ⇒ Initial Environmental examination
ii. EIA

**IEE**: IEE is done to determine whether or not EIA studies can be taken up for a developmental project. It also helps in determining the requirement of a full-scale - EIA for a project. Another words, it includes two steps:

(a) Screening: It is done to see whether a project needs any clearance or not.

(b) Scoping : Involves the extent of EIA required for the project. If the EIA report is based on single season data, it is called rapid EIA. If it is based on detailed data, it is called comprehensive EIA.

Goals of IEE :

⇒ Determination of requirement of EIA for a project
⇒ To ensure proper environmental management
⇒ To minimize the effort, expense and delay in carrying out environmental planning.



Advantages of IEE :

⇒ IEE can be done within a very limited budget.
⇒ Prevents delay in time by eliminating unnecessary discussion from EIA reports.
⇒ It provides the most efficient and feasible preparation of environmental management plans with or without the requirement of full scale EIA.

## Elements of EIA

Impact assessment methods are classified into three analytical functions : identification, prediction and evaluation.

① Methods of identification : includes or involves the components of the environment affected by the activities of the project. The environment affected by the project include natural environment (air, water, land, flora & fauna) and man-made environment (socioeconomic aspects, aesthetics transp$^{n}$ etc.)

(ii) Predictive methods : will define the quantity or the magnitude of the impact on an environmental resource. This can be done using certain mathematical models or mass balance models.

(iii) Methods of evaluation : will determine the groups that may be directly affected by the project.

**Impact evaluation and analysis** : The purpose of an environmental impact evaluation and analysis is to evaluate alternative courses of action.

The major criteria to be followed during evaluation and analysis are as follows :



⇒ Identifying major activities
⇒ Selecting environmental components
⇒ Selecting types of impacts
⇒ Assessing the possibilities and/or probabilities of occurences
⇒ Determine the degree and time frame of impacts.
⇒ Designating impacts as +ve or -ve.
⇒ Determining trade-offs among activities and impacts.

Alternative measures/solns.

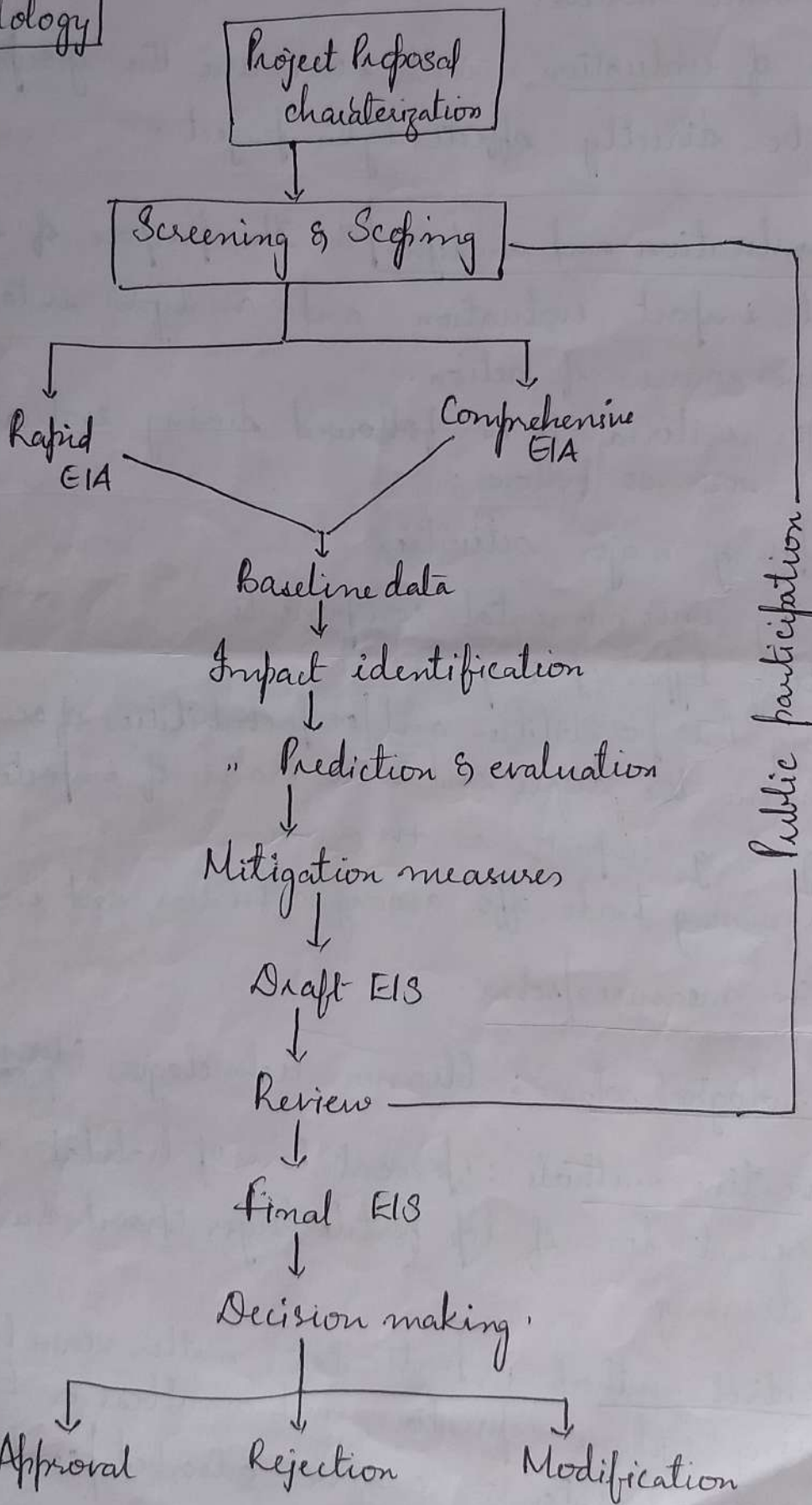
⇒ Technological solns. : Cleaner technologies (less pollutants, optimum use of raw materials)
⇒ Preventive methods : i, prevent loss of habitat of some wild life.
ii, prevent loss of top fertile layer of soil during mining, digging
⇒ Control methods : i, particulate matter can be controlled using cyclone separators, wet scrubbers or EPCs.
ii, Gaseous pollutants can be adsorbed/condensed using suitable methods.

(iii) frequent water spray around stone crushing units.

⇒ Treatment methods.

⇒ Green-belt development.

EIA methodology



## Factors to be considered during an EIA

⇒ (1) Magnitude : of impact whether reversible or irreversible. If reversible, what is the rate of recovery?

(2) Prevalence : small or higher impact.

(3) Duration and frequency : long-term impact or short term

(4) Risk : associated with the project

(5) Importance : of the environmental component that will be effected by the project.

(6) Mitigations :- Solns available or not.



## Preparation of Environmental Base map

An important requirement for EIA as a planning tool is the preparation of an environmental base map. It gives an overall picture of the environmental setting of the project location. The following environmental parameters are usually considered while preparing the base map:

(a) Site location and topography
(b) Regional demography
(c) Land use and water use pattern
(d) Regional landmarks
(e) Geology - land form, soil type, landscape etc.
(f) Hydrology - GW & SW resources, water quality pollution etc.
(g) Meteorological - Temp., windspeed & direction, rainfall
(h) Ecology - Flora and fauna, endangered species

## Classification of env. parameters :

Classified into 4 :-

(a) Natural physical resources

(b) Natural ecological resources

(c) human / economic development resources

(d) Quality of life values [aesthetic and cultural values]

## List of EIA methods :

i) Adhoc methods

ii) Checklists methods

iii) Matrices "

iv) Networks "

v) Overlays methods



### Adhoc methods

⇒ Involves assembling a team of specialists to identify impacts in their area of expertise.

⇒ Each env. area such as air, water etc. is taken separately and nature of impact whether reversible / irreversible, short-term or long term are considered.

⇒ These methods are for rough assessment of total impact significance.

⇒ Serves as a preliminary assessment in areas like : wild life, endangered species, Natural reg$^{n}$, exotic species, Noise, water quality, air quality, recreation, health & safety, Natural drainage etc.

Drawbacks:

⇒ Gives no assurance that it encompasses all relevant impacts.
⇒ Lacks consistency in analysis [as no particular / selective criteria is based to evaluate factors]
⇒ Inefficient as it requires considerable effort to identify and assemble an appropriate panel for each assessment.

## Checklist methodologies

(7)

⇒ Involves listing of env. factors
⇒ Importance weightings for factors
⇒ Application of scaling techniques

These methodologies are strong in impact identification and are capable of bringing awareness and attention in people. This is one of the basic methodologies used in EIA and is broadly categorised into ~~four~~ three types:

⇒ Simple checklists: represents list of env. factors which should be addressed, however no information will be provided on method of how to interpret, measure or assess an environmental parameter.

⇒ Descriptive checklists: includes identification of envi. parameters along with information on measurement, impact prediction and assessment.

⇒ Scaling and weighting checklists: Similar to descriptive ie., along with the above, it also quantifies impacts reasonably well. However, these checklists make no provision for mitigation, enhancement and monitoring programmes

## Matrix methods :

⇒ These are generalized checklists where one dimension of a matrix is a list of environmental, social and economic factors likely to be affected by a proposal.

⇒ The other dimension is a list of actions associated with development.

⇒ Impacts are identified by making cells representing a likely impact resulting from the interaction of a facet of development with an env. feature.

⇒ Matrices provide cause-effect relationships between the various project activities and also the impacts on numerous env. important components.

⇒ It provides a graphic tool for displaying impacts to their audience in an understandable manner.

⇒ Matrices are strong in identifying impacts and unlike checklists, can also represent higher order effects and interaction.

**Matrix methods** : Generalized checklist represented in the form of cells. Includes two dimensions :

One ⇒ list of env., social & economic factors to be affected by the project

Second ⇒ list of actions associated by with dev.

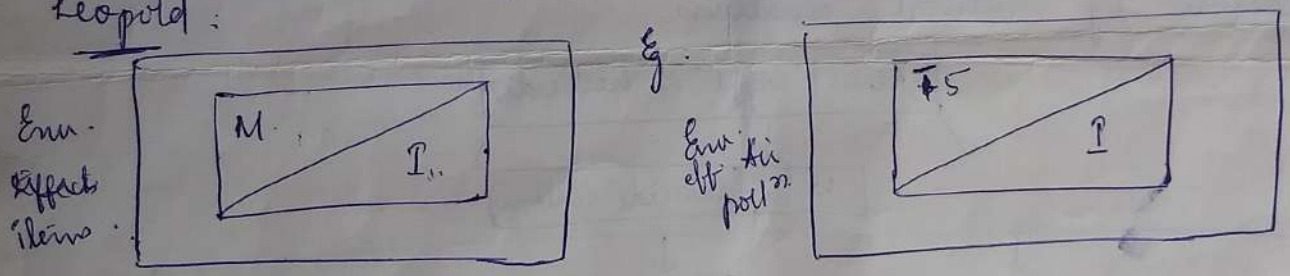
It provides a graphic tool for display.

→ Identifies sources of potential env. impact.
→ Interaction between two or more impacts. } Cause - effect relationship.

- Simple matrices
  - Identify first order impacts
- Interaction matrices
  - also interaction.
    - Simple Intn.
    - Stepped Interaction Matrix. Const$^{n}$ of lower.

(9)

Leopold :




Actions

&

Drilling of Bore

In Stepped, 2° & 3° impacts of initiating action.

ie., In this method one set of env. factors are displayed against another set of env. factors.

Construction of water reservoir

i action → on → fishes → movement ↑ of

effect on fishes

Const$^{n}$ waste → Turbid water → DO ↓ Sunlight ↓ → effect on fishes.

Matrix methods  Network methods.

effects & Interaction between impacts and hence can identify & incoporate mitig$^{n}$ & management measures into planning stages.

=) Suitable for expressing ecological impacts (10)

=) No weighting & ratings.

=) Won't consider social / human / aesthetic aspects.

=) Minimal inform$^{n}$ is provided on the tech. aspects of impact pred$^{n}$.

=) Consider only adverse impacts on the environment, temporal consid$^{n}$ are not properly accounted for and, short term and long term impacts are not differentiated

## Network methods

=) Capable of identifying direct & indirect impacts.

=) Interaction between impacts

=) Causes for impacts

=) Able to identify & incorporate mitig$^{n}$ & manag. measures into the planning stages of a project.

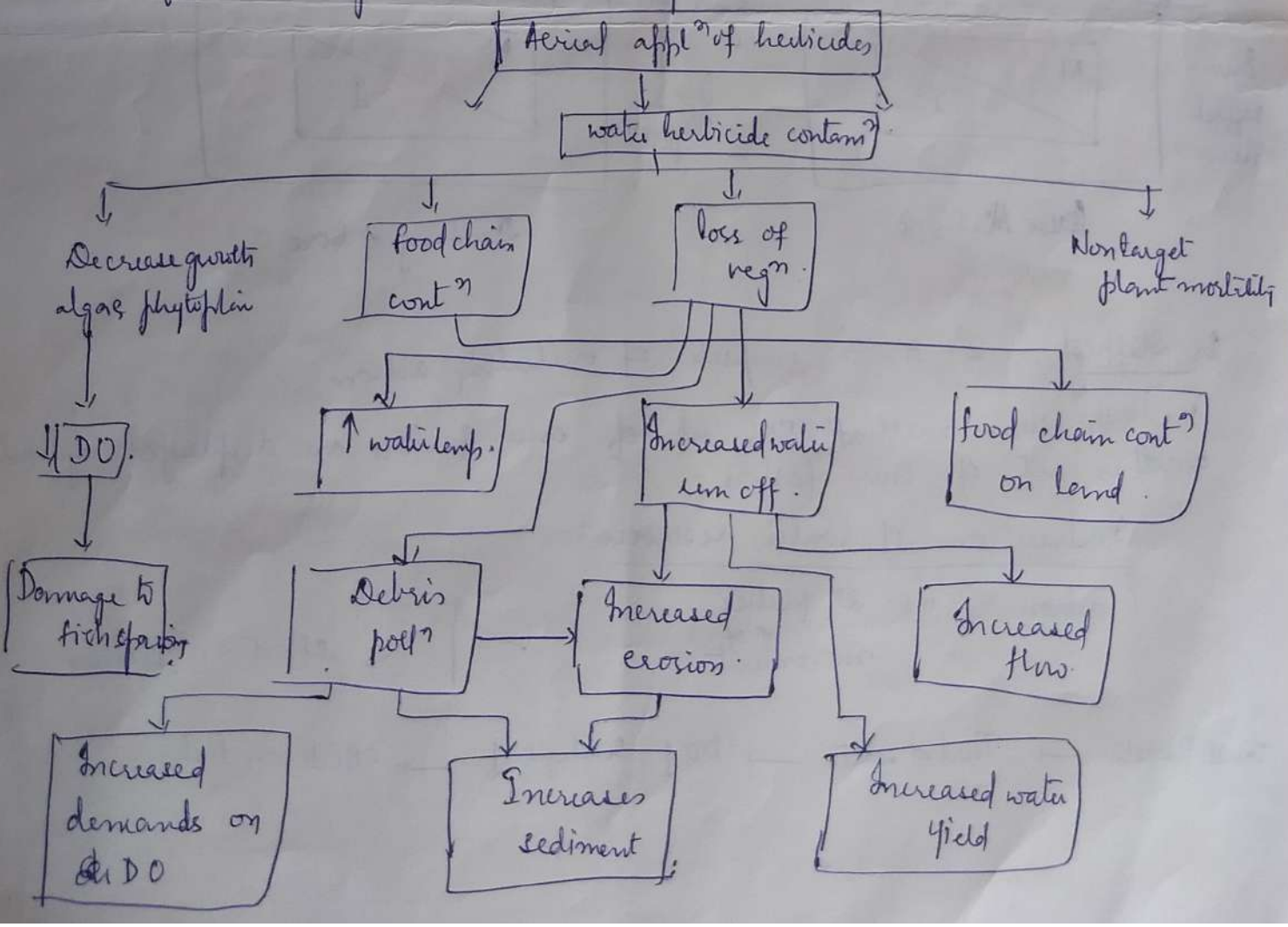
## Drawbacks.



=) Suitable for expressing ecolo. impacts, however it does not consider social, human, aesthetic aspects.

=) No weightings & ratings [are not the features of network analysis]

=) Considers only adverse impacts, no technical aspects of impact pred$^{n}$, decision making in terms of cost & benefit is not feasible by network analysis.

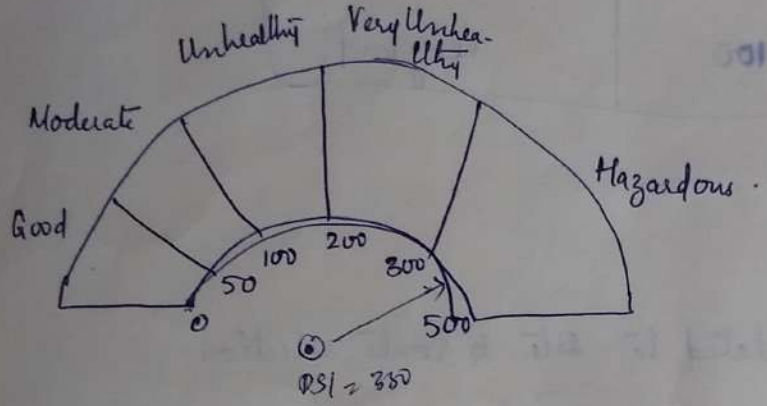


## Environmental Media Quality Index Method

### ① Air Pollution Index ..

PSI : Poll$^n$ standard index : (1976)

EPA ⇒ established acceptable standards of air poll$^n$ i.e, NAAQS ⇒ National Ambient Air Quality Standards .






API :

$$API = \frac{1}{3}\sum_{I=1}^{3} A_I$$

$$A_I = \frac{C_I}{S_I} \times 100$$

C = Conc. of air pollutant

S = Standard value of the pollutant.

I = individual values

PM = Particulate matter

$I_{SO}$ ⇒ Sulphur Oxide.

CO - Carbon monoxide.

$$API = \frac{1}{3}\left[\frac{I_{PM}}{S_{PM}} + \frac{I_{SO}}{S_{SO}} + \frac{I_{CO}}{S_{CO}}\right] \times 100$$

$$API = \frac{I_{SO}}{S_{SO}} \times 100.$$

| Index range | Quality of air |
|---|---|
| 0 - 25 | clean air |
| 26 - 50 | light air poll$^n$ |
| 51 - 75 | Moderate " |
| 76 - 100 | Heavy " " |
| Above 100 | Severe " " |

## Env. media Quality Index method [Env. Quality index EQI]

Components and inputs used in the EQI

EQI = Soil condition index + Water health index + Land habitat index + Air quality index

| Soil condition index | Water health index | Land habitat index | Air quality index |
|---|---|---|---|
| Soil erosion | Lake clarity | Habitat improvement | Air (gaseous) emissions |
| Residue cover/ tillage practice | Riparian buffers | Plants & wild-life | Particulates |
| Cropadalio | | Fragmentation | |

(13)

Air poll$^{n}$ index ⇒ simple & generalized ware to describe the air quality.

| API | Air poll$^{n}$ level | Colors |
|---|---|---|
| 0-50 | Good | Green |
| 51-100 | Moderate | Yellow |
| 101-200 | Unhealthy (for sensitive groups) | Orange |
| 201-300 | very unhealthy | Red |
| 301-500 | hazardous | Purple |
| 500+ | Emergency | Maroon |

API level was based on the level of 5 atmos. pollutants ⇒ $SO_2$, $NO_2$ $PM_{10}$ (suspended particulates), CO, & Ozone

$SO_2$, $NO_2$, $PM_{10}$ ⇒ are measured as average/day.

CO & $O_3$ ⇒ are more harmful and measured as average/hour.

The final API values is calculated per day.

⇒ The higher Air Quality index (AQI), the greater the health concern.

Water Quality index (WQI) ⇒ assessment of Overall water quality of water resources as it relates to both human and aquatic ecosystem health.

↳ Useful to determine

⇒ How water can be used

⇒ for water what water can be used

⇒ How water can support the species & ecosystem process in it.

3 types.

Drinking water quality index (DWQI) ⇒ all parameters regardless of WHO design

Surface water quality index (SWQI) ⇒ ① health and microbial criteria only

② Arsenic, boron, cadmium, Cr, Cu, F, Pb, Mn, Hg, $NO_3$, Nitrite, faecal coliform.

## Acceptable water Quality Index (AWQI)

=) acceptability criteria only

=) $NH_4$, Cl, fe, pH, Sodium, Sulphate, Zn.

### WQI consists of nine tests :

① =) DO
② Faecal coliform
(3) pH
(4) BOD
(5) Temp.
(6) Total phosphate
(7) Nitrates
(8) Turbidity
(9) Total Solids.

(14)

### WQI ranges

| | |
|---|---|
| 90 - 100 | Excellent |
| 70 - 90 | Good |
| 50 - 70 | Medium |
| 25 - 50 | Bad |
| 0 - 25 | Very bad. |

## Water Quality Index

DO
faecal coliform
pH
5day BOD
Nitrates
Phosphates
Turbidity
TS
Temp.

| Index | Water Quality |
|---|---|
| 0 - 25 | Excellent |
| 26 - 50 | Good |
| 51 - 70 | Medium |
| 71 - 90 | Bad |
| 91 - 100 | Very bad. |

(15)

## Overlay methods :

Give more info. to aspects related to site & route selection.

→ Useful for industrial EIA for comparing land capabilities existing, projected land uses, road route alternatives etc ....

Drawbacks :- No Quantifn, no assurance that all impacts will be assessed

GIS, Maps overlay.

## Cost/Benefit Analysis :

Assessment of natural systems → Effects on env. quality
→ Sustainable use of natural resources in that particular region.

Limitations :-

Not useful for small scale projects.

Better suited for the analysis & evaluⁿ of reg. dev. plan.

# Environmental Impact Assessment (EIA) and Environmental Management Plan

## Unit - 1

Industrialization and Urbanization is aimed at increasing the quality of life by providing better opportunities for employment, basic amenities and comforts, healthy environment etc. However, along with growth and development, severe environmental problems like pollution of air, water, soil, depletion of natural resources, energy crisis, climate change, ozone layer depletion and loss of biodiversity are increasing. Thus, the development is bound to have certain environmental impacts. Therefore, before a development project is started, prediction and assessment of its impacts should be done, so that measures could be taken to minimize those impacts. This concept is formulated as a methodological procedure known as "Environmental Impact Assessment" [EIA].

(1)

**Impacts:**

The changes caused by a development project on the landscape and ecology of the area, on the quality of water and air and also on various socio-economic aspects of human life is defined as impact.

Impact

- Negative ⇒ Eg. Sometimes the project has serious -ve socio-economic impacts like during road widening, the locals have to be uprooted from their native place. Then, their rehabilitation is a big issue to be tackled.
- Positive ⇒ Eg. Most development projects are aimed to raise the quality of life.

(ii) Impact

Reversible

Eg. Damage caused to water body near the development can be reversed if we are able to restore its quality using appropriate technologies. Such impacts are for a short term.

Irreversible

Eg. If a development activity involves the destruction of forest and loss of some species, then the impact is a long term impact which cannot be restored.

(iii) Light, moderate and severe impacts: This indicates the magnitude of the impact caused a development project.

Representation

i. Symbols : ○ Small ○ Medium ○ Severe

ii. Numerical values : +/-1 Small +ve or -ve impact +/-3 Medium +ve or -ve impact +/-5 Severe positive or -ve impact.

(2)

Environmental Impact Assessment [EIA]: It is a procedure to plan some developmental activity with well defined environmental goals so that damage due to the activity both during developmental stage and production stage have minimum effect on the natural system and the population in that area.

⇒ In India, Ministry of Environment and Forests (MoEF) provides guidelines for project proponents to have EIA and prepare an EIA statement prior to clearance of the project.

Goals of EIA

⇒ To fulfill the responsibilities towards the coming generations

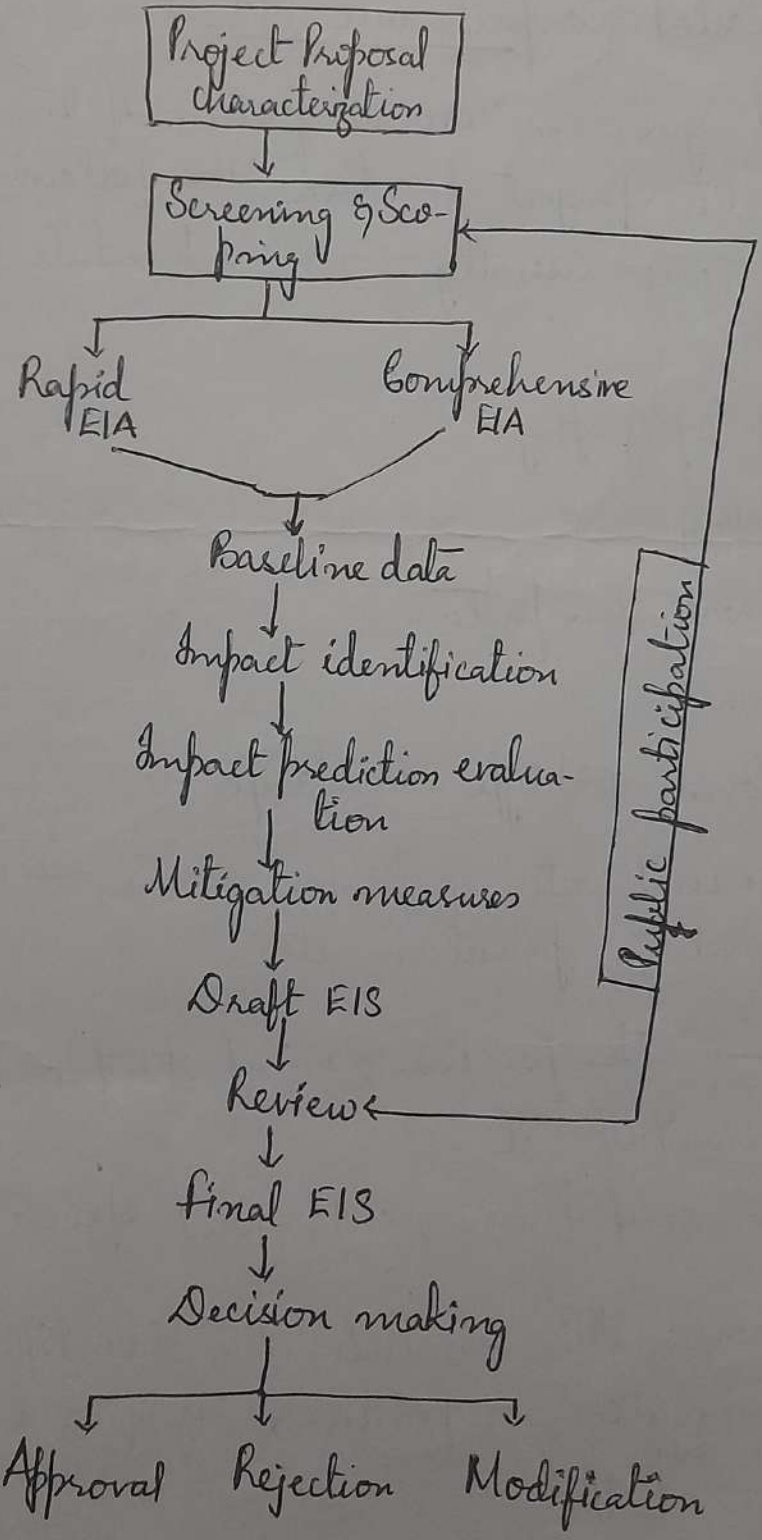
⇒ To assure safe, healthy, productive sorroundings.

⇒ To preserve historical, cultural and natural heritage. (2)

⇒ To achieve a balance between population and resource use for a good standard of living.

⇒ To ensure sustainable development with minimal environmental degradation.

## EIA methodology




(3)

i, Screening : It is done to see whether a project needs an EIA for clearance or not. [IEE]

ii. Scoping : Involves the determination of the extent of EIA required for the project. When the EIA report is based on a single season data (other than monsoon period), it is called rapid EIA. When the EIA report is based on detailed seasonal data, it is called Comprehensive EIA.

iii, Baseline data : It gives an overall picture of the environmental setting of the project location. The following environmental parameters are usually considered while preparing the baseline data :

(a) Site location and topography
(b, Regional demography (4)
c, Land use and water use pattern
d, Regional landmarks
e, Geology - land form, soil type, landscape etc.
f, Hydrology → Ground water & Surface water resources, water quality, pollution etc.
g, Meteorological → Temperature, wind speed and direction, rainfall etc.
h, Ecology → Flora and fauna, endangered species.

iv, Impact identification : This includes the identification of the impacts, either negative or positive, significant or insignificant related to the project.

v. Impact prediction : The magnitude of changes going to occur due to the project are predicted using mathematical models or mass balance models.

vi. Impact evaluation : This is done by considering the costs and benefits of the project.

vii. Mitigation : Mitigation measures will be suggested to avoid, reduce or rectify the adverse changes due to the project.

viii. Decision analysis : A decision about the project will be made by the involvement of public in group discussion or adopting the questionnaire method. (5)

ix. Environmental Impact Statement (EIS): Based on the data obtained and review suggestion, a final EIS will be prepared as per the guidelines provided by MoEF in our country.

x. Environmental audit : It compares the impacts predicted in EIS before the project was started and actual impacts after the implementation of the project.

## Methods of Baseline data acquisition

Baseline data on the site location is collected by Primary and secondary data.

i. Primary data collection : is done by actual visit to the area and collection of data by survey method.

ii. Secondary data : Various goverment agencies have the relevant data available with them. Eg. Meteorological department possess the data on annual rainfall, temperature, humidity, windspeed, direction etc.

iii) Remote sensing and GIS: Satellite data available through remote sensing and Geographical Information system are very useful for acquisition of base line data.

## Impacts of development on different environmental components

(a) Human resources:

⇒ Social-economic status of the local population or in catchment area is influenced because of development of infra-structure facilities like roads, transportation, settlement colonies with proper hygienic conditions, medical facilities, etc.

⇒ Human health may have to face serious adverse impacts due to gaseous emissions, particulates, effluent discharges etc.

(b) Air: Quality of air is affected by various development projects during construction phase and operational phase. Noise pollution due to various development projects also have very serious long-term or short-term impacts.



(c) Water: Development activities influence water quality of the region, such as various toxic chemicals and debris enter into water bodies with effluent and run-off, thereby adversely affecting water quality and aquatic life.

(d) Flora and fauna: Developmental projects like hydropower plants, mining activities etc. often involve clearing of natural vegetation. If such a project is proposed in a site inhabiting rare, endangered or endemic species, every effort should be made to change the site, because loss of such flora and fauna would be an irreversible impact.

## Prediction of impacts

Two important models of impact prediction are:

i, Mechanistic / Mathematical model : The cause and effect of various activities due to the project are expressed in the form of a flow chart. The various components and their relationships in the flow chart are then expressed in the form of mathematical equation. Generally, this type of model is used for predicting socio-economic impacts.

ii, Mass-balance model : This is usually adopted where physical changes are involved. In this model, all inputs into a system are balanced by the outputs under steady state conditions. (7)

## Environmental Impact Statement (EIS)

The EIS is prepared at the time of submission of the proposal and is called draft EIS. After evaluation and review by the Impact Assessment Agency, the final EIS is prepared. The main purpose of EIA is precisely to estimate the type and level of damage caused to natural environment in a well-defined time scale so that remedial measures can be initiated.

The following points are usually incorporated while preparing the EIS:

⇒ Effect on land including land degradation and subsidence
⇒ Deforestation
⇒ Air pollution
⇒ Water pollution including surface and ground water pollution
⇒ Noise pollution due to the project
⇒ Loss of flora and fauna during the project
⇒ Socio-economic impacts
⇒ Risk analysis and Disaster management
⇒ Recycling and reduction of waste.
⇒ Proper utilization of energy and matter.



## Role of remote sensing and GIS in EIA studies

⇒ Remote Sensing (RS) is a technique for data collection using satellites or sensors on aeroplanes. Geographical Information systems (GIS) is a technique of superimposing various thematic maps using digital data on a large number of interrelated aspects.
⇒ RS-GIS data is useful for land use/land cover data and help in future land-use planning.
⇒ Interpretation of polluted zones, degraded land or diseased cropland etc.
⇒ Location of areas for industrial growth and solid waste management
⇒ Gives information on Urban sprawl and help check unplanned growth and related environmental problems.
⇒ Helps in providing information about forest cover and planning can be done for conservation of various ecosystems.

# Environmental Management Plan (EMP)

* EMP

After impact prediction and evaluation of a development Project, an environmental management plan (EMP) is prepared to reduce the negative impacts, increase the positive impacts and restore the damages done to different environmental components. EMP involves mitigation measures and future guidelines for maintenance of a good quality environment.

① Technological solutions: Cleaner technologies that produce less pollutants in the environment have been developed. Recover and recycling process further help in minimizing the adverse impacts. Selection of appropriate technology and appropriate use of raw materials in the process are very important in reducing the impacts.

(9)

② Preventive measures:

⇒ To avoid damage to the environment by a developmental activity, the harmful or hazardous substances should be handled properly and disposed off safely.

⇒ To prevent the loss of habitat of some wild-life due to a project, measures have to be taken ~~inda~~ inadvance for safe and timely migration of such species to a nearby forest [whether natural or man-made].

⇒ To prevent the loss of top fertile layer of soil during mining, layer by layer dumping of the soil is done during digging which is later restored.

⇒ Use of sensitive building designs, use of silt traps, planting of vegetation covers are some of the measures to be taken to

prevent the adverse / aesthetic impact of some projects.

③ Control methods

⇒ To control the damage caused due to various emissions released from the development projects like industries, power plants, textiles, highway projects etc, various control methods have been developed.

⇒ Particulate matter can be controlled using cyclone separators, bag house fillers, wet scrubbers or electrostatic precipitators.

⇒ Gaseous pollutants can be adsorbed or condensed using suitable methods.

⇒ In case of stone crushing units, boundary walls around them and frequent spray of water will help prevent the particulate emissions. (10)

④ Treatment methods :

Various treatment methods like primary, secondary and 3° treatment technologies are available for wastewaters. Using these methods, suspended solids, organic wastes, excess nutrients are removed from wastewaters.

⑤ Green-belt development :

⇒ Trees and shrubs act as sinks for many toxic gases and particulates.

⇒ They absorb $CO_2$ and release $O_2$ thus purifying the air.

⇒ They are also reported to reduce noise.

⇒ Hence, development of Greenbelts around the industrial sites is very essential.

Impact assessment methodologies are progressively changing from a static, piecemeal approach to the one that reflects the dynamism of nature and the environment (2). Consequently, the trend is away from mere listing of potential impacts towards more complex modes whereby the methodology can identify feedback paths, higher order impacts than merely those apparent, first order ones, and uncertainties. In short, the methodological trend is approaching an overall management perspective.

## 2.3 EIA METHODS

### 2.3.1 List of Environment EIA Methods

*The following are the important techniques :* methodologies of utility for assessing the impacts of developmental activities on the environment.

1. Adhoc methods
2. Checklists methods
3. Matrices methods
4. Networks methods
5. Overlays methods
6. Environmental index using factor analysis
7. Cost/benefit analysis
8. Simulation mode

It is important to understand their drawbacks in order to determine which of the methods are most appropriate. An evaluation of various methodologies (3) is presented in Table 2.1.

### 2.3.2 Ad-hoc Methods

Basically adhoc methods indicate broad areas of possible impacts by listing composite environmental parameters (for example flora and fauna) likely to be affected by any development.

Ad-hoc methods involve assembling a team of specialists to identify impacts in their area of expertise. In this method, each environmental area, such as, air, and water, is taken separately and the nature of the impacts, such as, short-term or long term, reversible or irreversible are considered. Ad-hoc methods are for rough assessment of total impact giving the broad areas of possible impacts and the general nature of these possible impacts. For example, the impacts on animal and plant life may be stated as significant but beneficial.

In the ad-hoc methods, the assessor relies on intuitive approach and makes a broad-based qualitative assessment. This method serves as a preliminary assessment which helps

in identifying more important areas like

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

The adhoc methods, while being very simple and can be performed without any training, merely present the pertinent information of a project's effects on the environment without any sort of relative weighting or any cause-effect relationship. It does not even state the actual impacts on specific parameters that will be affected

The adhoc method has the following drawbacks ;

(a) It gives no assurance that it encompasses a comprehensive set of all relevant impacts;

(b) It lacks consistency in analysis as it may select different crteria to evaluate different groups of factors; and,

(c) It is inherently inefficient as it requires a considerable effort to identify and assemble an appropriate panel for each assessment.

Because of the above drawbacks, it is not recommended as a method for impact analysis. It is after all adhoc method and has utility only when other methods cannot be used for lack of expertise, resources and other necessities.

## 2.3.3 Checklist Methodologies

### 2.3.3.1 Introduction

Checklist methodologies range from listings of environmental factors to highly structured approaches involving importance weightings for factors and application of scaling techniques for the impacts of each alternative on each factor.

Checklists in general are strong in impact identification and are capable of bringing them to the attention and awareness of their audiences. Impact identification is the most fundamental function of an EIA and in this respect, all types of checklists, namely simple, descriptive, scaling and weighting checklists, do equally well.

Checklists are of four broad categories and represent one of the basic methodologies used in EIA. They are:

a) Simple checklists:- that are a list of parameters without guidelines provided on how to interpret and measure an environmental parameter.

b) Descriptive Checklists:- that includes an identification of environmental parameters and guidelines on how parameter data are to be measured.

c) Scaling Checklists:- that are similar to descriptive checklist with the addition of information basis to subjective scaling or parameter values.

"Simple checklists" represent lists of environmental factors, which should be addressed; however, no information is provided on specific data needs, methods for measurement, or impact prediction and assessment. " Descriptive checklists" refer to methodologies that include lists of environmental factors along with information on measurement and impact prediction and assessment.

Scaling and weighting inherent in the latter types of checklists facilitates decision- making. Such checklists, apart form being strong in impact identification, also incorporate the functions of impact measurement and to a certain degree of interpretation and evaluation, and it is those aspects that make them more amenable to decision- making analysis.

But the impact of scaling and weighting is, nevertheless, subjective and this poses the danger that society holds all diverse impacts to be equally important. Further, it implicitly assumes that numerical values assigned to impacts can be derived on the basis of expert knowledge and judgement alone.

Scaling and weighting checklists, while capable of quantifying impacts reasonably well, albeit using subjective estimates, make no provision for assessing dynamic probabilistic trends or for mitigation, enhancement and monitoring programmes. Identification of higher order effects, impacts and interactions are outside their scope.

But simple and descriptive checklists offer no more than this. They merely identify the possible potential impacts without any sort of rating as to their relative magnitudes.

Methods that involve scaling and weighting and the consequent aggregation remove decision making from the hands of decision makers. Further they incorporate into one number various intrinsically different impacts and this deprives the decision maker of the possibility of tradeoffs.

### .3.3.2 Simple Checklists

Simple checklists represent a valid approach for providing systemization to an EIS and Table 2.2 presents a list of environmental factors to be considered in construction and operational phases. The checklist also includes information on mitigation.

**Table 2.2 Environmental factors to be considered in Construction and Operating phase**

**CHECK LIST METHOD**

| | Construction phase | | | Operating phase | | |
|---|---|---|---|---|---|---|
| | Adverse effect | No. effect | Beneficial effect | Adverse effect | No effect | Beneficial effect |
| **(A) Land Transportation and Construction** | | | | | | |
| (a) Compaction and settlement | | | | | | |
| (b) Erosion | | | | | | |
| (c) Ground cover | | | | | | |
| (d) Deposition | | | | | | |
| (e) Stability (slides) | | | | | | |
| (f) Stress – strain(earth peaks) | | | | | | |
| (g) Floods | | | | | | |
| (h) Waste control | | | | | | |
| (i) Drilling and blasting | | | | | | |
| (j) Operational failure | | | | | | |
| **(B) Land Use** | | | | | | |
| (a) Open space | | | | | | |
| (b) Recreational failure | | | | | | |
| (c) Agricultural | | | | | | |
| (d) Residential | | | | | | |
| (e) Commercial | | | | | | |
| (f) Industrial | | | | | | |
| **(C) Water Resources** | | | | | | |
| (a) Quality | | | | | | |
| (b) Irrigation | | | | | | |
| (c) Ground water | | | | | | |

### 2.3.3.3 Descriptive Checklists

Descriptive checklists are widely used in environmental impact studies. For example, Carstea (5) developed a descriptive checklist approach for projects in coastal areas. The methodology addresses the following issues, actions, and projects: riprap placement, bulkheads; groins and jetties; piers, dolphins, mooring piles, and ramp construction; dredging (new and maintenance); outfalls, submerged lines, and pipes; and aerial crossings. For each of the items, environmental impact information was provided on potential changes in erosion, sedimentation, and deposition; flood heights and drift; water quality; ecology; air quality; noise; safety and navigation; recreation; aesthetics; and socio-economics.

Several descriptive checklists have been developed for water resources projects. For example, Canter and Hill (6) suggested a list of about 65 environmental factors related to the environmental quality account used for project evaluation in the United States. For each factor, information is included on its definition and measurement, prediction of impacts, and functional curves for data interpretation (where one was available or easily developed).

A portion of a descriptive checklist containing several factors for housing and other land development projects is shown in Table 2.3. The basis for estimates column presents a simplified, brief listing of key data models needed, if any, for the factor.

### 2.3.3.4 Important Characteristics of Simple and Descriptive Checklists

1. Simple and descriptive checklists consider environmental factors and/or impacts, which can be helpful in planning and conducting an EIS, particularly if one or more checklists for the specific project type can be utilized.
2. Published a gency checklists and/or project specific checklists represent the collective professional knowledge and judgement of their developers; hence, they have professional credibility and usability.
3. Checklists provide a structured approach for identifying key impacts and/or pertinent environmental factors for consideration in impact studies. More-extensive lists of factors of impacts do not necessarily represent better lists, since relevant factors or impacts will need to be selected. Checklists can be easily modified (items can be added or deleted) to make them more pertinent to particular project types in given locations.
4. Checklists can be used to stimulate or facilitate interdisciplinary team discussions during the planning, conduction, and/or summarization of EISs.
5. In using a checklist it is important to carefully define the utilized spatial boundaries and environmental factors. Any special impact codes or terminology used within the checklist should also be defined.

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

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

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

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

### 2.3.3.5 Scaling Checklists

Simple and descriptive checklists in general are strong in impact identification and are capable of bringing them to the attention and awareness of their audiences. Impact identification is the most fundamental function of an EIA and in this respect, all types of checklists simple descriptive scaling and weighting checklists do well. But simple and descriptive checklists offer no more than this. They merely identify the possible potential impacts without any sort of rating as to their relative magnitudes. As a result they are most applicable at the IEE stage of an assessment.

The Oregon Scaling Check- list methods go a step further and provide an idea of the nature of the impact by means of assigning a textual rating of the impact as long- term, direct, and so on. Nevertheless this approach is not suitable for impact measurement and does not aid much in the decision- making process. Rather it identifies the impacts and leaves the interpretation to the decision makers.

The element of scaling and weighting that is inherent in the latter types of checklists makes it easier for decision -making. Such checklists, apart form being strong in impact identification, also incorporate the functions of impact measurement and to a certain degree those of interpretation and evaluation and it is these aspects that make them more amenable for decision- making analysis.

Scaling and weighting checklists, while capable of quantifying impacts reasonably well, albeit using subjective estimates, make no provision for assessing dynamic probabilistic trends or for mitigation, enhancement and monitoring programmes. Identification of higher order effects, impacts and interactions are outside their scope.

Methods that involve scaling and weighting and the consequent aggregation remove decision-making from the hands of decision-makers. Further they incorporate into one number various intrinsically different impacts and this deprives the decision- maker of the possibility of trade-offs.

The transformation of a parameter estimate into environmental quality is achieved by using "value functions" devised by a group of experts. Changes that might occur if development were to proceed are projected using predictive techniques. Projected parameter values are used to determine the environmental quality score. Each parameter quality score is multiplied by the number of "parameter impact units" allotted to that parameter, giving a final score for each parameter in term of ''Environmental impact units''. This method is less cumbersome but the definition of environmental quality is arbitrary and decided by a panel of experts.

## Matrix Methods

### General Characteristics

Matrix methods are basically generalized checklists where one dimension of a matrix is a list of environmental social and economic factors likely to be affected by a proposal. The other dimension is a list of actions associated with development. These relate to both the construction and operational phases. Impacts are identified by making cells representing a likely impact resulting from the interaction of a facet of the development with an environmental feature. With some matrices qualitative representation of impact importance and magnitude are inserted in individual cells.

Matrices provide cause effect relationships between the various project activities and their impacts on the numerous environmentally important sectors or components. Matrices provide a graphic tool for display impacts to their audience in a manner that can be easily comprehended.

Simple matrices, though able to identify first order effects, cannot show higher interactive effects between impacts. Simple, interaction matrices largely overcome this limitation. But such matrices are generally useful for depicting ecological interactions only for the sake of documentation. While the scale of the interaction is identified, individual actions of the project are not correlated with the resulting impacts on the environmental components.

The most serious criticism of such weighting matrices, which can also be extended so scaling and weighting checklists, is that through the inherent aggregation process, decision-making is, in effect, removed from the hands of the decision- makers and the public concerned A great deal of information that is valuable to decision-making is lost in the conversion to number.

(a) Weights are assigned to environmental components and consequently to impacts without any guarantee that such weights and rating will represent the actual impacts that will be apparent once the project is implemented and operational;

(b) What is generally called an objective procedure, the assignment of weights and the subsequent quantification is, in fact, an arbitrary assignment of scales of "environmental

quality" based on the value judgement of "experts";

(c) Aggregation of numerical impacts through suitable transformation functions results in the combination of inherently different items into a single index or number and leads to loss of information about the various impacts from the numerous project actions, thereby precluding the possibility of tradeoffs by the decision makers.

Matrices are strong in identifying impacts and unlike checklists, can also represent higher order effects and interaction. Some of the dynamic nature of impacts can also be identified. They can also provide the functions of impact measurement interpretation and evaluation, and can communicate the results in an easily understandable format to their audiences. But they cannot compare alternatives in a single format, and different alternatives need to be assessed and presented separately. The purpose of a matrix is to help the project planner to

1. Identify specific sources of potential environmental impact
2. Provide means of comparing the predicted environmental impacts of the various project options available
3. Communicate in graphic form
   (i) Potentially significant adverse environmental impact for which a design solution has been identified
   (ii) Adverse environmental impact that is potentially significant but about which insufficient information has been obtained to make a reliable predication
   (iii) Residual and significant adverse environmental impact and
   (iv) Significant environmental impact

## 4.2 Salient Features of Matrices Methods

1. It is necessary to define the spatial boundaries of environmental factors, the temporal phases and specific actions associated with the proposed project; and the impact rating or summarization scales used in the matrix.
2. A matrix should be considered a tool for purposes of analysis, with the key need being to clearly state the rationale utilized for the impact ratings assigned to a given temporal phase and project action, and a given spatial boundary and environmental factor.
3. The development of one or more preliminary matrices can be a useful technique in discussing a proposed action and its potential environmental impacts. This can be helpful in the early stages of a study to assist each team member in understanding the implications of the project and developing detailed plans for more extensive studies on particular factors and impacts.
4. The interpretation of impact ratings should be carefully and critically considered, particularly when realizing that there may be large differences in spatial boundaries as well as temporal phases for a proposed project.
5. Interaction matrices can be useful for delineating the impacts of the first and second or multiple phases of a two-phase or multiphase project; the cumulative

impacts of a project when considered relative to the other past, present, and reasonably foreseeable future actions in the area; and the potential positive effects of mitigation measures.

6. If interaction matrices are used to display comparisons between different alternatives, it is necessary to use the same basic matrix in terms of spatial boundaries and environmental factors, and temporal phases and project actions for each alternative being analyzed. Completion of such matrices can provide a basis for trade off analysis.

7. Impact qualification and comparisons to relevant standards can provide a valuable basis for the assignment of impact ratings to different project actions and environmental factors.

8. Color codes can be used to display and communicate information on anticipated impacts. For example, beneficial impacts could be shown by using green or shades of green; whereas, adverse effects could be depicted with red or shades of red. Impact matrices can be used without the incorporation of number, letter, or color ratings. For example, circles of varying size could be used to denote ranges of impacts.

9. One of the concerns relative to interaction matrices is that project actions and/or environmental factors are artificially separated, when they should be considered together. It is possible to use footnotes in matrix to identify groups of actions, factors, and/or impacts which should be considered together. This would allow the delineation of primary and secondary effects of projects.

10. The development of a preliminary interaction matrix does not mean that it would have to be included in a subsequent EA or EIS. The preliminary matrix could be used as an internal working tool in study planning and development.

11. It is possible to utilize importance weighting for environmental factors and project actions in a simple interaction matrix. If this approach is chosen, it is necessary to carefully delineate the rationale upon which differential importance weights have been assigned. Composite indices could be developed for various alternatives by summing up the products of the importance weights and the impact ratings.

12. Usage of an interaction matrix forces the consideration of actions and impacts related to a proposed project within the context of other related actions and impacts. In other words, the matrix will prevent overriding attention being given to one particular action of environmental factors.

### 2.3.4.3 Interaction-Matrix Methodologies

In interaction matrix method project actions or activities will be displayed along one axis with appropriate environmental factors listed along the other axis of the matrix. If a particular activity is likely to cause an effect on any environmental factor, it will be noted at the intersection point in the matrix. The magnitude of separate or combined effects and their importance considerations will also be considered.

### 2.3.4.3.1 Simple Interaction Matrix Method

For a simple interaction matrix method, the one developed by Leopold (7) will serve as an example. In this method approximately 100 specified actions and 90 environmental items can be examined. Table 2.4 presents the list of the actions and environmental items. In the uses of the Leopold matrix, each action and its potential for creating an impact on each environmental item will be considered. Where an impact is anticipated, the matrix is marked with a diagonal line in the appropriate interaction box.

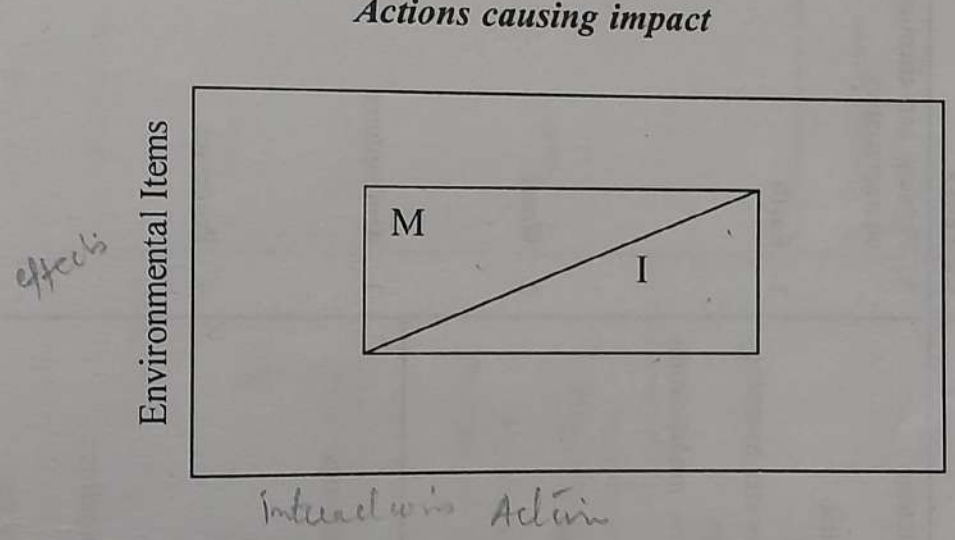



**Figure 2.2 Leopold interaction Matrix:: M = magnitude; I = importance (Leopold (7)).**

Next the interaction in terms of its magnitude and importance will be considered in the method. The "magnitude" of an interaction is its extensity or scale and is described by the assignment of a numerical value from 1 to 10, with 10 representing a large magnitude and 1 a small magnitude. Values near 5 on the magnitude scale represent impacts of intermediate extensity. Assignment of a numerical values for the magnitude of an interaction should be based on an objective evaluation of facts related to the anticipated impact. The "importance" of an interaction is related to its significance, or an assessment of the probable consequences of the anticipated impact. The scale of importance also ranges from 1 to 10, with 10 representing a very important interaction and 1 an interaction of relatively low importance. Assignment of a numerical importance value is based on the subjective judgement of the expert group, or interdisciplinary team working on the study.

## 2.3.5 Network Methods

Networks are capable of identifying direct and indirect impacts, higher order effects and interactions between impacts, and hence are able to identify and incorporate mitigation and management measures into the planning stages of a project. They are suitable for expressing ecological impacts but of lesser utility in considering social, human and aesthetic aspects. This is because weightings and ratings of impacts are not features of network analysis.

Network analyses are particularly useful for identifying anticipated impacts associated with potential projects. Networks can also aid in organizing the discussion of anticipated project impacts. Network displays are useful in communicating information about an environmental impact study to an interested public. The primary limitation of the network approach is the minimal information provided on the technical aspects of impact prediction and the means for comparatively evaluating the impacts of alternatives. In addition, networks can become very visually complicated

Networks generally consider only adverse impacts on the environment and hence decision- making in terms of the cost and benefit of a development project to a region is not feasible by network analysis. Temporal considerations are not properly accounted for and shortterm and longterm impacts are not differentiated to the extent required for an easy understanding.

While networks can incorporate several alternatives into their format, the display becomes very large and hence unwieldy when large regional plans are being considered. Further, networks are capable of presenting scientific and factual information, but provide no avenue for public participation.

The typical networking of impacts by creating an implement or aerial application of Herbicide are shown in Fig.2.3 and 2.4 respectively.

## 2.3.6 Environmental Media Quality Index Method

### 2.3.6.1 Generic Steps

Several generic steps are associated with the development of numerical indices or classification of environmental quality, or pollution potential of human activities. These include factor identification, assignment importance weights, establishment of scaling sections or other methods for factor evaluation, termination and implementation of the appropriate aggregation approach, and application of field verification.

Factor identification basically consists of delineating key factors that can be used as indicators of environmental quality, susceptibility to pollution, or the pollution potential of the source type.

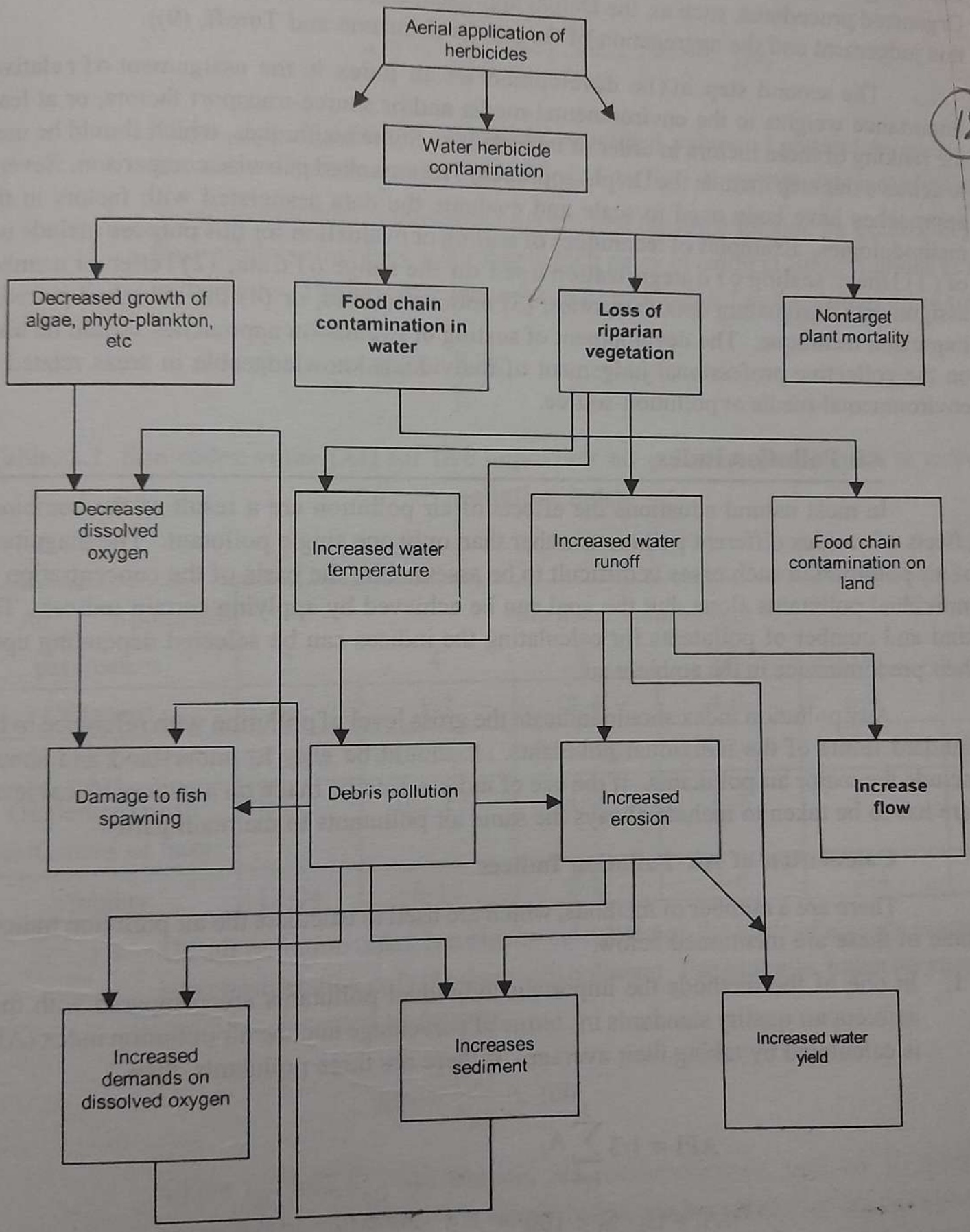



**FIGURE 2.4 Measure diagram for the aerial applications of Herbicide**

To calculate the aggregate water quality index either weighted leaner sum of the subindices (WQ Ia) or a weighted project aggregte function (WQ Im) can be used. These are expressed mathematically as

$$WQ\ Ia = \sum_{C=1}^{n} wi\ Ii \qquad \text{.....(2.4)}$$

$$WQ\ Im = \prod_{l=1}^{n} Ii\ Wi \qquad \text{.....(2.5)}$$

The typical WQIa and WQIm values for a set of water quality parameters are shown in Table 2.11, while the interpretation of the resultant water quality index is presented in Table. 2.12.

## 2.3.7 Overlay Methods

Overlays are very subjective in that they rely on the judgement of the analyst to evaluate and assess questions on compatibility relating to the existing lane use patterns and the prospects of the development use patterns and the development activity. In practice, overlays are self-limiting because there is a practical limit on the number of transparencies that can be overlaid (2).

Overlays are useful when addressing questions of site and route selection. They provide a suitable and effective mode of presentation and display to their audiences. But overlay analysis cannot be the sole criterion for environmental impact assessment.

There is no provision for quantification and measurement of the impacts nor is it assured that all impacts will be covered. The considerations in overlay analysis are purely spatial, temporal considerations being outside its scope. Social, human and economic aspects are not accorded any consideration. Further, higher order impacts cannot be identified. The methodologies rely on a set of maps of environmental characteristics (physical, social, ecological, aesthetic) for a project area These maps are overlaid to produce a composite characterization of the regional environment. Impacts are identified by noting the impacted environmental characteristics lying within the project boundaries. The approach seems most useful as a method of screening alternative project sites or routes, before detailed impact analysis.

Overlays can be useful for industrial EIA of any project for comparing land capabilities existing and projected land uses, road route alternatives and other under parameters, and alternative levels of air quality conditions along with pollution control.

The overlay approach is generally effective for selecting alternatives and identifying certain types of impacts; however, it cannot be used to quantify impacts to identify secondary

and tertiary interrelationships. Overlay techniques utilizing computerization for more effective data analysis have been developed. Geographic information systems are now being used as layered overlay techniques. Computer modules can be used to store the characteristics of the proposed developments and the surrounding area. This enables us to introduce impact weightings into assessment. The computer can perform the complex mathematical operation required when a large number of variables are weighted.

### 2.3.8 Cost/Benefit Analysis

Cost/benefit analysis provides the nature of expense and benefit accruable from a project in monetary terms as a common practice in traditional feasibility studies and thus enables easy understanding and aids decision-making.

The difficulty encountered in the use of these techniques has been that impacts have to be transformed and stated in explicit monetary terms, and this is not always possible, especially for intangibles like the monetary value of health-related impacts of industrial development.

Cost/benefit analysis of the type for assessment of natural systems is not merely concerned with the effects on environmental quality, but rather, it seeks the conditions for sustainable use of the natural resources in a region. This type of approach is not useful for small scale development projects, but is better suited for the analysis and evaluation of a regional development plan. Even thought it may not be possible to place an economic value on environmental losses or gains resulting from a developmental project, decision makers should take into account implied environmental values in their decision-making

To facilitate the decision making process, therefore, assessors conducting environmental impacts, should not just identify environmental impact, they should also provide information on the implied values of the environmental losses and gains.

The evaluation of site\sites and major design options should be taken together, within the economic and technical limitations imposed by the aim of the project, the combination of project site and project design needed to produce no significant environmental impacts, should also incur the least economic cost to the community.

If, for the preferred site and project option, the assessor has predicted potentially significant environmental impacts, he should consider the cost to the community of any mitigating or abatement measures and their alternatives before adopting them into the project plan. Whenever there is a choice of measures to mitigate or abate a significant potential impact he should select the solution that will incur the least economic cost to the community.

The evaluation of the environmental and development benefits and costs is an essential aid to decision making. The information that an assessor should provide in detailed assessment

3. What are the steps involved in the study of impact assessment on soil and groundwater. (or) Discuss in detail the assessment of impacts on soil and groundwater.

Sol⇒ The steps involved in the study of impact assessment on soil and groundwater are as follows:

Step 1: A clear dileneation of the EIA study area

Environmental site assessment (or Pre-acquisition site assessment), where a proposed action is planned is essential to define the characteristics of the area, which is likely to be significantly affected by the proposed project. This step should include the land-use map, land-use policies, zoning and details of the development project to be undertaken.

The land-use map should depict the following: ①

* Residential area
* Commercial area.
* Industrial areas
* Institutional, Parks or recreation area.
* Infrastructure or built up land (roads, railways, airports, mining/quarrying sites, etc.)
* Dump sites
* Natural areas (Forest land, agricultural land, wildlife sanctuary, grazing land, Wastelands, National parks, waterbodies)

Characteristics of the study area:

The different characteristics of the study area to be considered for EIA are:

1. Geology - Nature of rock, soil and geological resources.
2. Topography - land features.
3. Soils - Type of soil in the project area, black, red or yellow.
4. Groundwater resources - Quality of groundwater from deep wells & subsurface aquifers.
5. Surface water resources
6. Terrestrial, botanical and zoological communities.
7. Aquatic communities
8. * Environmentally sensitive area
9. Air quality.
10. Landuse - landuse pattern
11. Demographic profile.
12. Sound levels.
13. Socio-economic condition
14. Infrastructural services
15. Transportation - Highways, roadways. etc.
16. Cultural resources - eg archaeological, historical, cultural areas.
17. Project economics. - Costs & benefits from the proposed project activity.

Step 2: Identification of impact of project on soil and/or groundwater. (1)

1. Landforms:

Landforms created by different natural forces include mountains, valleys, deserts, plateaus, plains, hills, loess, etc. Man-made changes in landforms include development of ports on levels lands close to waterways, railway lines.. etc & streets on gentle terrain, agriculture and parklands on areas prone to occasional flooding.; central business districts on levelled land.

(3)

2. Soil profile:

Soil is the loose superficial layer of the earth's crust, containing of mineral matter, soil water, soil organic matter, soil organisms and soil air. The types of soil impacts include soil removal, soil profile mixing.. etc.

3. Soil composition

4. Slopes.

5. Seismicity

6. Land subsidence, collapse and shrinkage

7. Flood plains

8. Land use

9. Mineral or Engineering resources.

10. Buffer zones

Step 3: Description of the existing environment

The description of the following components of the environment must be included;

(a) Air environment.

(b) Water environment.

(c) Noise environment. (4)

(d) Meteorology and climate data

(e) Vegetation found in the study area.

1. ~~Chemical composition of groundwater~~:

Step 4: Acquisition of significant information related to quality and quantity of soil and/or groundwater.

The soil at the proposed construction site should be given maximum importance for EIA. Because,

* Any developmental activity causes disturbance to the soil
* The agricultural land may be disturbed or lost
* Contamination of land is likely to occur.

The condition of soil at the project site can be assessed by three ways:

(a) Desk study: Involves collection of information by literature review related to the soil characteristics and geological infor-

(c) Tertiary impact

* Impact on human health
* Impact on aesthetics
* Impact on agricultural productivity
* Impact on flora and fauna
* Impact on economic output
* Impact on socio-cultural environmental.
*

The anticipated impacts due to construction activity are :

(a) Soil compaction by earth movers and other heavy equipment.

(b) Soil erosion.

(c) Overexploitation of agricultural soil.



(d) Soil salinization and soil acidification.

(e) Dust pollution by brick, silica and asbestos.

(f) Noise pollution by construction equipment, diesel generator operations

(g) Damage to environment.

(h) Damage to the health of construction workers.

Step 6 : Interpretation of the anticipated project induced changes.

The anticipated project induced changes can be addressed in the following ways :

mation at the proposed construction site.

(b) Field work :

The field work involves observation of the colour and texture of soil at the proposed project site.

(c) Laboratory tests :

Involves the use of soil kits & petrolrometers to determine the physical and chemical properties of soil such as moisture content, texture, density, pH, cation and anion exchange capacity.

Step 5: Analysis of anticipated environmental impact of developmental project and impact prediction

The potential environmental impacts, during the considered construction and operation of the project, can be broadly categorized into the following types,



(a) Primary impact

* Release of air pollutants
* Release of heat
* Changes in ambient noise levels.

(b) Secondary impact

* Changes in air quality
* Impact on visibility
* Particulates deposition on water and land.
* Climate change

(a) Statistical approach :

In this method, the percentage and direction of project induced change from natural variation is calculated

(b) Review of plans and policies by competent authority

(7)

7. a) Write a detailed note on identification of surface water quantity & quality impacts.

A. The steps involved in the evaluation of impacts of various development activities on surface water environment are as mentioned below:

Step 1: Identification of surface water quantity or quality impacts of proposed projects.

* The Water quality defined in terms of physical, chemical and biological constituents of surface water is discussed below: (1)

* The physical properties of water include the temperature, colour, conductivity, ~~acidity~~, turbidity total suspended solids, total dissolved solids, oil and grease etc.,

* The chemical parameters of coater are broadly categorized into:-

(a) organic content of coater:- It includes the Biological oxygen demand (BOD), chemical oxygen demand (COD), Total organic carbon (TOC), Total oxygen Demand (TOD).

(b) Inorganic content of coater:- It includes the Salinity, hardness, acidity, alkalinity, $P^H$, cations such as Ag, Al, Na, K, Fe etc., Anions such as Cl, F, $SO_4$, CN.

(c) The Biological components of coater include total coliform content count and falcal coliform count (Faecal streptococci and salmonella sps).

The sample of water are collected for quality analysis in upstream and downstream of the proposed development site, prior to onset of any potential impacts arising from the development activities & sent to laboratories for qualitative analysis & field observations are documented by field staff. Any unacceptable changes in the water quality parameter should be readily detected and timely action need to be taken to rectify the situation.

Step 2:- Analysis of the potential Impacts of the Developme-nt project on the surface water conditions.

This step is accomplished by the use of several Mathematical models to determine the changes in water quantity and quality as well as flow patterns.

Some of mathematical models used in EIA are:-

i) Fundamental runoff formula for predicting SW runoff.

ii) Rational formula:- This is used to compute the peak discharge flow rate.

iii) Navier-Stokes equation:- This equation is used to determine water flow patterns.

iv) Dissolved oxygen saturation formulation.

Step 3:- Collection of significant information related to quality and quantity of surface water.

The aquatic environment in water body provides diverse habitat for aquatic life, clean water for animals and humans. Therefore, it is imperative to understand the SW quality. Several factors that contribute significantly to the water quality are: climate and precipitation soil type, geology, vegetation, ground water flow condition Human activities too contribute to the water quality.

The pollutants generated by anthropogenic activities are carried to far off places by atmospheric processes and deposited on land and water bodies

The Bureu of Indian standards specifications IS 10500-1991 govern the quality of drinking water. This is based on the international standards for water quality issued by the WHO.

Step-4 :- Evaluation and prediction of impact on surface water:

The surface water impacts that are likely to occur as a result of the proposed development activity depends

Prediction of impact :-

The impact may have positive, negative or neutral effect on the environment.

Magnitude of impact :- The magnitude of impact may be categorized as non / negligible, low, moderate or high.

(3) Duration of Environmental impact :- It may be transient, short-term, medium term, long-term, permanent.

Geographical Extent :- It refers to the extent to which the proposed activity is likely to affect - whether it is local, regional, national or international

probability of Impact occurence :- It refers to chance of occurence of impact.

Step-5 :- Analysis of Impact significance

Depending on the types and extent of proposed project the type of resources affected can be ascertained. The information thus obtained can be used to make informed decisions on whether to proceed with the project or not. It may also be used for the identification and evaluation of alternatives if the proposed projects has a significant impact on the community.

Step :- 6 :- Some general mitigation measures should be practiced / followed.

(a) Revegetation and tree Plantations near the proposed construction site.

(b) Preventing the entry of construction material into surface water to prevent the adverse impacts on drinking water supplies, irrigation systems and river ecology.

(c) Prevent the entry of sediments into surface waters by implementing runoff control measures, mechanical sediment control measures, grassed filter strips, mulching and soil bioengineering practices.

(d) Increasing water infiltration into soil.

(e) Controlling excessive storm runoff & soil erosion.

(4)

(b) Describe the important surface water contaminants and their impacts.

A. The contaminants in water and their impacts on water quality and quantity are tabulated below.

| Contaminants in water | Effect on Water. |
|---|---|
| 1. Suspended solids (Colloidal materials such as clay, silt, finely divided organic and inorganic matter, Plankton, microscopic organisms). | 1. Turbidity, algal blooms, decrease in primary productivity, reduce biomass, survival and reproduction of invertebrates impaired, elimination of aquatic population. |
| 2. Biodegradable organisms (proteins, carbohydrates, fats). | 2. Reduction in the availability of oxygen in water leading to severe asphyxiation, organic pollutants may settle at the bottom of the water body and alter its characteristics. |

| Contaminants in water | Effect on water. |
|---|---|
| 3. Pathogens (Bacteria, viruses, protozoa, Helminths) | 3. Increase in the risk of incidence of diseases. |
| 4. Nutrients (Nitrates & Nitrites). | 4. Degradation in water quality, massive blooms of planktonic algal. |
| 5. Priority pollutants (Arsenic, Asbestos, Barium Beryllium, Silver) | 5. Toxic, carcinogenic, mutagenic & tetragenic in nature elimination of entire aquatic communities. |
| 6. Heavy metals (As, cd, Fe, co, zn, Ni) | 6. Bioaccumulative, toxic at high concentration of carcinogenic & neurological impacts. |
| 7. Dissolved inorganics | 7. Health related problems. |

(5)

6Q. Explain in detail the methodology for carring impact assesment on air environment

Ans

Evaluation and identification of sources, types and quantities of pollutants genesated by diff phases of project activity

↓

Detailed evaluation of existing ambient air quality meteorological conditions and natural air quality existing in the project area

↓

Examination of appropriate laws, regulations and criteria to be implemented statutorily for maintaining ambient air quality

↓

Carrying out impact assessment of project activities using mass balance, dispersion calculations

↓

Assessment of significance of anticipated benificial & detrimental impacts

↓

Development of appropriate mitigation remediation measures for the adverse impact

Step 1 + Evalution & identification of source Type and Quantities of Pollunts

In the first step one has to examine what types of air pollutant are likely to be emitted during the construction or/or operational phase of the propsed project activity and their quantities. The typical sources of some project activity are given below

| Activity | Air pollution source |
|---|---|
| Solid waste disposal | Refuse incineration<br>open burning<br>Sewage sludge incineration |
| combustion activity | coal combustion as fuel oil<br>combustion Natural gas combustion (2) |
| Industrial mineral products | coal cleaning<br>Sand and gravel process<br>Stone quarrying process |
| Chemical industrial process | (a) Boiler coal burning<br>(b) Chemical reactor gaseous effluents<br>(c) waste water treatment plant<br>d Acidification and neutralization |

One can use emission factor information based on the project type or activity.

Step 2:- Detailed Evaluation of Existing Ambient Air quality

In term of ambient air quality data emission inventori and meteorological information which relate to atmospher dispersion, the base time air quality information have to be discussed based on various systematic approache

Key Metcorological Data

a) Meteorological data which describes the general air pollution - dispersion characteristic of study area.

b) Meteorological data useful to describe the atmospheric dispersion of air pollutants for a project activity quantitatively.

c) Meteorological data useful and necessary for air pollution dispersion modeling.



Step 3:- Examination of approximate Air quality Emission Regulati Laws:-

The basic information on air quality standard criteria and policies of local state & central Govt agencies which have the statuory authority to maintain the air resources has to be collected. Documentation of this information will allow the determination of the significance of air quality impacts incurred during project activities and will aid in deciding b/w alternative actions or in assessing the need for mitigation measures.

for a given alternative.

Step 4:- Carrying out impact Assessment using mass balance
There are basically three aspects of air quality problem that are amenable to quantitative prediction. In order of increasing complexity they are
1) estimating rates of release of pollutants
2) Predicting atmospheric concentrations of pollutants
3) Predicting deposition rates of pollutants on soil water & vegetation.

(4)

Impact prediction can be carried out using various approaches like mass balances ambient air dispersion models and plume dispersion models. The area likely to recover impact of various pollutants from the various project activity sources should be assessed.

Step 5:- Assessment of significance of impacts
Evaluation of the significance of anticipated changes related to the project should be carried out through conducting public meeting and/or public participation programs. professional judgement based on the percentage changes from baseline condition in terms of air pollutant emissions levels & / or expose human pollutation as the PSI, should carried out

Step 6:- Development of appropriate mitigation or Remediation plans for reduction of adverse Impact.

Remediation or mitigation measures for reducing the adverse impact involve project activity design or operational features that can be used to minimize the magnitude of the air quality impacts.

Some eg are

1) Regulatory control on the practice of open burning of agricultural crop residues.

2) Development of vegetation covers and watering or use of wind breaks, chemical stabilizers.

3) For reducing air pollutant emission from unpaved roads paving the surface treating with penetration chemical working soil-stabilization chemicals into the roadbed, watering

## 7.3 Effects of Noise on People

### Normal hearing

***Frequency range and sensitivity***

The ear of the healthy adult male responds to sound waves in the frequency range of 20 to 16,000 Hz. Young children and women often have the capacity to respond to frequencies up to 20,000 Hz. The speech zone lies in the frequency range of 500 to 2,000 Hz. The ear is most sensitive in the frequency range from 2,000 to 5,000 Hz. The smallest perception sound pressure in this frequency range is 20mPa.A sound pressure of 20mPa at 1,000 Hz in air corresponds to a 1.0nm displacement of the air molecules. The thermal motion of the air molecules corresponds to a sound pressure of about 1mPa. If the ear were much more sensitive, you would hear the air molecules crashing against your ear like waves on the beach.

***Repeated interference with sleep***

Noise can awaken people from sleep and it can keep them awake, frequent awakening or awakening for long periods can be very disruptive. Even if not awakened by noise, a person's sleep pattern can be significantly disturbed, and a reduced feeling of well-being can result next day. Frequent and prolonged sleep disturbances can result in physical, mental or emotional illness, (Fig.7.4a and b).

***Effects on Communication***

External sounds are able to interfere with conservation's and use of the telephone as well as the enjoyment of radios and television programs. (Fig.7.c) It can thus affect the efficiency of the offices, schools and other places, where communication is of vital importance. The maximum acceptable level of noise under such conditions has been 55 sdB. 70 dB is considered very noisy and serious interference with verbal communication is inevitable. Fig.7.d presents how the quality of speech communication will be affected by different background sounds and talker to listener distance.

## 7.4 Physiological Responses

Physiological responses accompanying response and other noise exposures include :

1. A vascular response characteristic by peripheral vaso-constriction, changes in heart beat rate and blood pressure.
2. Various glandular charges such as increased output of adrenaline evidenced by chemical changes in blood.
3. Slow, deep breathing.
4. A change in the electrical resistance of skin with changes in activity of the sweat glands.
5. Brief changes in skeleton muscle tension.

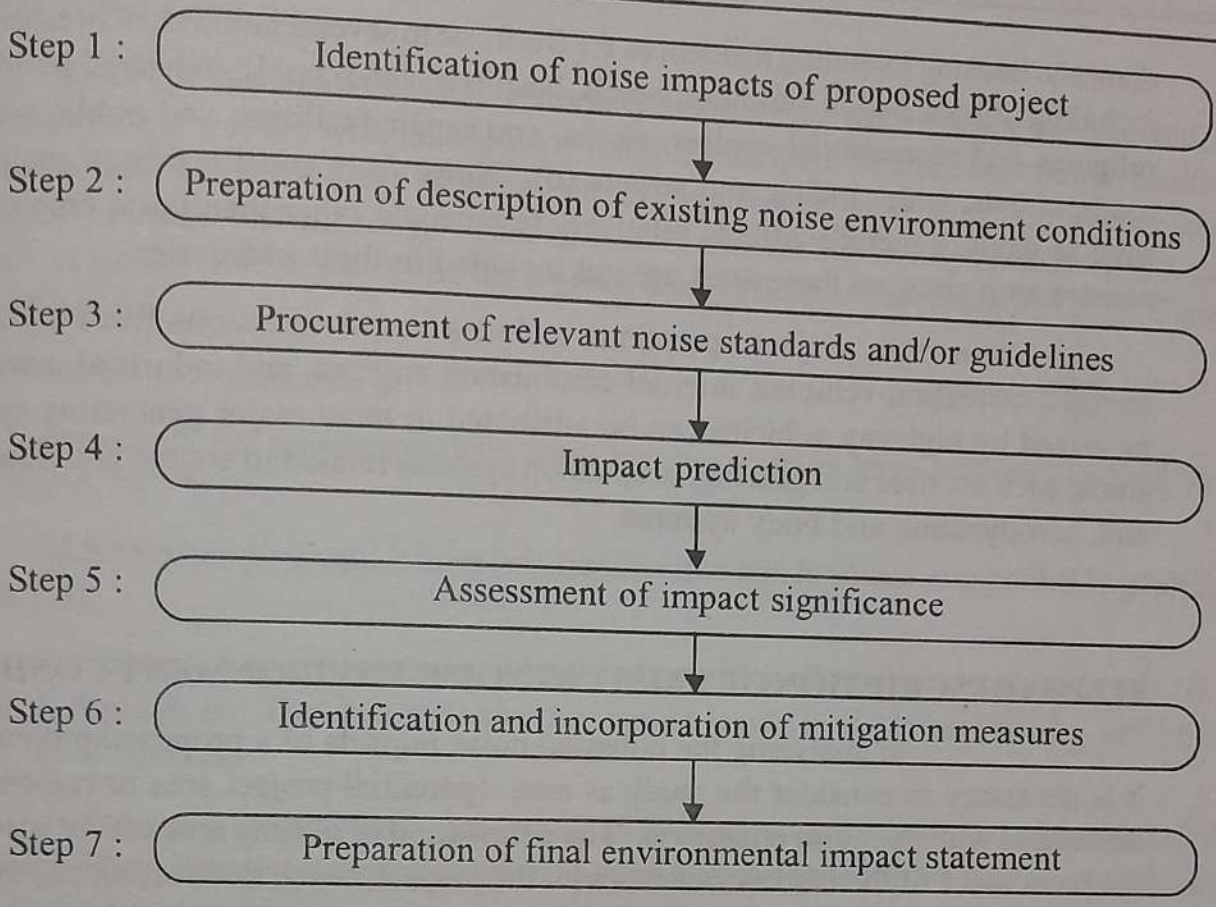



Fig. 7.5 Conceptual Approach for Study Focused on Noise-Environment Impacts.

### 7.5.1.2. STEP 1 : IDENTIFICATION OF NOISE IMPACTS

The first step in the methodology is to determine the potential impacts of the proposed project (or activity) on the noise environment. This requires the identification of the noise levels associated with the project. A considerable body of information exists on noise levels associated with a variety of projects and related activities.

The sources, of noise are numerous, so they may be broadly classified into two classes, namely, industrial and non-industrial. The industrial category may include noises from various industries like transportation, vehicular movements, rockets, defense equipment and explosions. Among the non-industrial category, the notable sources of noise are loudspeakers, traffic, air crafts, trains, construction works, radios, TVs, vacuum cleaners, mixers, power lawn movers and air conditioners in the domestic or commercial use.

### 7.5.1.3 Noise from industry

No environment factor has caused so much confusion regarding its effect on workers' efficiency and workers' health as industrial noise has. Noise in industry originates from processes causing impact, vibration or reciprocation movements, friction and turbulence in air or gas streams.

Construction activities generally generate noise levels in excess of those typically found in the project environs. Construction sites can be categorized into four major types:

domestic housing including residences for from one to several families; nonresidential buildings including offices, public buildings, hotels, hospitals, and schools; industrial buildings including religious and recreational centers, stores, and repair facilities; and public works including roads, streets, water mains, and sewers (6). Noise from construction of major civil works, such as dams, generally affects relatively few people other than those employed at or near construction sites, so these sites are not included in these categories.

Noise from project operations includes sound emissions from highway vehicles, aircraft, recreation vehicles, internal-combustion engines, and industrial machinery. Noise produced by highway vehicles can be attributed to three major generating systems: rolling stock, such as, tires and gearing, propulsion systems related to engine and other accessories: and, aerodynamic and body systems.

(3)

## STEP 2 : DESCRIPTION OF EXISTING NOISE-ENVIRONMENT CONDITIONS

In analyzing the potential noise impacts of a proposed project (or activity), it is necessary to consider the study as area (potential project area or region of influence) associated with the noise emissions. The delineation of a study area can be made based upon the boundaries of the land associated with the project, or the delineation can include a larger area by considering the area of noise influence within the vicinity of the proposed project.

The primary information which should be accumulated in step 2 is data on existing noise levels and noise sources within the study area. Land-use and human-population-distribution maps in relation to the proposed project would also be needed.

If no specific data on existing noise levels is available for the study area, it might be possible to use published noise-level information developed for project involving similar land use. For example, Table.7.2 shows typical day-night noise levels in urban areas in the United States. Quiet suburban residential areas have an average $L_{dn}$ of 50 dBA, while very noisy urban residential areas exhibit $L_{dn}$ values of 70 dBA. Typical noise levels in rural settings are 30 to 35 dBA, and in wilderness locations they are in the order of 20 dBA. Seasonal and daily variations in noise levels may occur, particularly at national and state parks and recreational areas (7).

## STEP3: PROCUREMENT OF RELEVANT NOISE STANDARDS AND/OR GUIDELINES

The primary sources of information on noise standards, criteria, and policies will be the relevant local, state, and federal agencies, which have a mandate for overseeing the noise environment of the study area.Additional information may be available from international agencies such as the World Health Organization (WHO) or the United Nations' Environment Program. This information can be used to determine the baseline quality and the significance of noise impacts incurred during projects (or activities); it could also aid in deciding between alternative actions or in assessing the need for mitigation measures for a given alternative.

## General Noise Criteria

Table 7.3 summarizes noise criteria developed by the EPA for the protection of public health and welfare with an adequate margin of safety. The phrase "public health and welfare" is defined as complete physical, mental, and social well-being, and not merely the absence of disease and infirmity. Table.7.3 is useful for noise-impact assessment in the absence of specific noise standards for a given area. The two key terms in Table.73 are $L_{dn}$ (or DNL) and $L_{eq}$.

## Noise Emissions Standards

Standards for noise emissions from various sources have been established by the EPA, Table.7.4.

U.S EPA has given guidelines for classification and land-use-compatibility guidelines. (Table.7.5).

In Table.7.5 noise zones are identified in order of increasing noise levels by the letters. A through D. The day-night average sound level (DNL) descriptor $L_{dn}$ can be used for all noise sources.

Noise emission standards have only an indirect control over the noise radiated by a machine. They state maximum permissible sound levels in work places; acceptable levels for day- time and night- time in residential, commercial and industrial areas and maximum permissible noise crossing industrial and construction site boundaries. The measured noise in such cases may be produced by a single machine or by a combination of many kinds of machinery.

The maximum permissible sound level at a worker's ears and the time of exposure are not related directly to the noise produced by any one machine but depend upon the total noise in the area where the workers are located with respect to the machine and other factors. For this reason, noise emission standards or their intent must be confined to product noise emission regulations.

The maximum permissible sound levels crossing industrial site into residential and commercial zones may be stated in terms of overall A-weighted sound pressure levels. It has been reported that high intensities, high frequencies and intermittent nature of noise are the factors of annoyance for the workers. Such a situation not only causes physical and physiological damages but also impair workers' efficiency resulting in low production and ultimate dissatisfaction. Community response to industrial noise is seen in setting up acceptable limits for community areas but it is difficult to establish this precisely because of the variety and complexity of the different factors involved.

Basic noise levels for industrial zone should not exceed 55 dB at night and 65 dB during the day time. Noise results in cardiovascular problems like heart diseases and high blood pressure. Workers exposed to high noise levels have acute circulatory problems, cardiac disturbances, neuro-sensory and motor impairment and even social conflicts at home and at work.

**STEP 4 : Impact Prediction**

Step 4 involves predicting the propagation of noise from a source and determining the type of affected land- use. Several approaches for predicting noise contours are outlined in the discussion of this step.

One method of expressing both existing noise and predicted noise levels is by using a level- weighted population value (10). A sound-level-weighted population is a single-number representation of the significance of a noise environment to the exposed population. The assumptions are that the intensity of human response is one of several consequences of average sound level, depending upon the response mode of interest (annoyance, speech interference and hearing loss) and that the impact of high noise levels on a small number of people is equivalent to the impact of lower noise levels on a larger number of people in an overall evaluation. Based on these assumptions, the "fractional impact" can be determined as the product of a sound-level-weighting value and the number of persons exposed to a specified sound level. Summing the fractional impacts over the entire population provides the sound-level-weighted population (LWP). The calculation is as follows (10):

$$LWP = \int P(L_{dn}).W(L_{dn})d(L_{dn})$$

(5)

where $P(L_{dn})$ is the population distribution function, $W(L_{dn})$ is the day-night average sound-level-weighting function characterizing the severity of the impact as a function of sound level (its derivation is described below), and $d(L_{dn})$ is the differential change in day-night average sound level. Sufficient accuracy can be obtained by taking average values of the weighting function between equal decibel increments – say, up to 5 dB – and replacing the integrals by summations of successive increments in average sound level (10).

The weighting function $W(L_{dn})$ is based on the reaction of populations to living in noise impacted environments and other social survey data relating the fraction of sampled population expressing a high degree of annoyance to various $L_{dn}$ values. The weighting function is normalized to unity at 75 dB; value of $W(L_{dn})$ is listed in Table.7.6(a).

A noise impact index (NII) can then be used for comparing the relative impact of one noise environment with that of another. It is defined as the sound-level-weighted population LWP divided by the total population $P_{total}$ under consideration:

$$NII = LWP/P_{total}$$

An example calculation for this index is in shown Table 7.6(b).

The NII for existing conditions could be determined based on noise measurements, population data, and the pertinent weighting functions. Prediction of project-induced noise

final result should then be compared to the criteria level, $L_c$, at the observer to define a "no problem" or "potential problem" condition. After identification potential problem area, the observer location in question should be evaluated using the complete method.

The second step of methodology is termed as NCHRP 174 "complete method" which utilizes-a fairly large computer program to refine the predictions made in the first step. The third step in this procedure is termed as "selection of a noise control design". The fourth step is termed as "check the design operation" in which the second step will be repeated and refined to arrive at the final conclusions.

**STEP 5 : Assessment of Impact Significance**

One basis for evaluation of significant impact is public input; this input could be received through a continued scoping process of the conduction of public meetings or public participation programs or both. The general public can often delineate important environmental resources and values for particular areas, and this should be considered in impact assessment. Professional judgement can also be useful to assess the percentage changes from baseline conditions in terms of noise levels and/or exposed human population, or a noise index; discussed in step.4.

6

**5.7 STEP 6 : Mitigation Measures**

Mitigation measures refer to steps that can be taken to minimize the magnitude of the detrimental noise impacts. The key approach to mitigation is to reduce or control the noise expected to be emitted from the project (or activity). Mitigation can proceed along three possible courses of action, either by changing (1) the source of noise, (2) the path of noise from the source to the receiver, or (3) the receiver of noise. Some additional principles of noise control include the reduction of the number of vibrating sources, enclosure of the source, and attenuation of noise by absorbing barriers methods (7.7). Simple hand calculations and/or computer models described earlier can assist in forecasting the relative effectiveness of various designed and/or operational phase mitigation techniques.

Further, various designs can be used to reduce the noise from specific sources; for example, the mechanical noise from the gearbox of large wind turbines can be minimized by adapting specific design features (12).

**7.5.8 STEP 7 : Prediction of Final Impact Statement**

The final environment impact statement should include summary tables and discussion with industries. The results of analysis will help in decision making. Maps should show location of surface receptors and measurement rates and size balance.

## 4.13.4 METHODS OF CONTROL OF NOISE

1. *Reduction in sources of noise:* Sources of noise pollution like heavy vehicles and old vehicles may not be allowed to ply in the populated areas.
2. Machine noise can be reduced by proper machine design involving process modification, changes in shape and material.
3. Noise making machines should be kept in containers with sound absorbing media. The noise path will be in interrupted and will not reach the workers.
4. Proper oiling will reduce the noise from the machinery.
5. Noise levels can be reduced by reducing the noise radiating surfaces.
6. Heavy machines transmit vibrations to the hard surfaces in touch which in turn radiate noise. This type of secondary noise can be reduced by providing pads of suitable material (rubber, felt, cork, etc) to absorb and reduce noise transmission.
7. High frequency noise which gets reflected like beam of light or heat can be reduced by providing sound absorbing acoustical barriers or shields between the noise source and work place. Porous materials absorbent-fibres, glass wool, etc. are sound absorbing materials which can absorb upto 90% of sound energy falling on them depending on the angle of incidence. Ceilings and walls may be provided with layers of such sound absorbing materials to reduce workplace noise.
8. Workers may be deployed in noisy environment with maximum permissible noise levels and the relatively quieter areas in shifts so that the time of exposure to high noise level doesn't exceed that recommended by the Occupational Safety and Health Act.
9. Workers may be provided with ear protectors to reduce noise reaching the eardrums.
10. Planting more trees having broad leaves.
11. *Through law:* Legislation can ensure that sound production is minimized at various social functions. Unnecessary horn blowing should be restricted especially in vehicle-congested areas.

# Assessment of Impact of dev. activities on Veg$^{n}$ & wild life.

Unit - III - (B)

## I Developmental activities

⇒ Site clearance (for constructional activity)

Effects: lack of shelter for nesting birds.
loss of imp. insect sp.
Disturbance in hydrological cycle.
loss of small-scale eco. opportunities like fruit picking, rubber tapping etc....

⇒ Laying of haul roads.

⇒ Ground works at con$^{n}$ site.

⇒ landfills, dumps.

⇒ Residential areas

(1)

## II Impacts :-

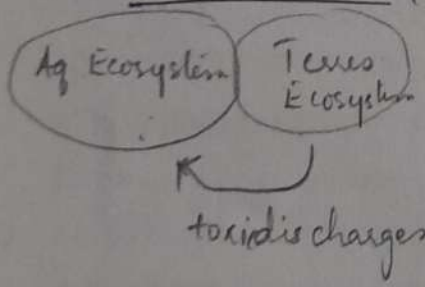
① Habitat loss : Occupying the natural homes of animals/plants.

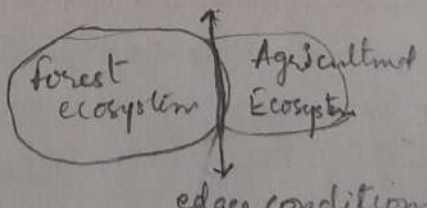
② Habitat fragment$^{n}$ ⇒ Breaking up of natural habitat into progressively smaller & more isolated fragments.

↓ red$^{n}$ in a sp. ability to reproduce.

Crowding effects ⇒ Demand for water, food, shelter etc.

③ Habitat disruption :




edge conditions will be different. ⇒ Man-animal conflicts also arise.

④ changing aq. habitat ⇒

⇒ Const$^{n}$ of dams ⇒ Diversion canals → fishes.

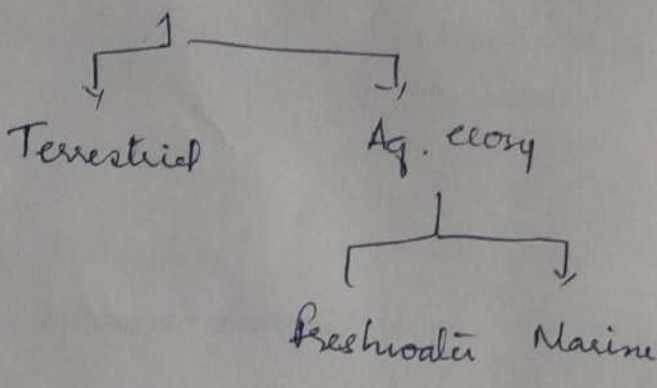
fishes impact.

⑤ Soil Erosion :- → ↑ sed runoff.

⑥ Daily anthropogenic activities ⇒

①

⇒ Delineation of study area ⇒




⇒ Savannahas.
⇒ Temperate Grassland
⇒ Tropical "
⇒ forest [Deciduous | Coniferous]
⇒ Wetlands.
⇒ Mangroves
⇒ Coastal

②

⇒ Description of existing biological environ.
↓
Community types & their geo. distrib^n.

(2)

③ Qualitative identif^n of impacts

(4) Inform^n on legisl^n.

(5) Pred^n of impacts.

(6) Significance of the predicted impact on the overall ecosystem

(7) Identif^n & incorpor^n of mitig^n measures.
concern^s / restor^n.

## Methodology

① Qualitative identifn of impacts on biological environ.
↓
Flora & fauna of particular area.
What types of species of trees, grasses, fish, reptiles, birds & mammals.

② Description of the existing biological environment along
↓
Community types and their geogra. distribution.

Fauna :-

Various groups

Amphibians
Reptiles
Pisces
Birds (Aves).
Mammals

Threatened endangered spp.

Flora

Algae, Fungi, Flowering plants.

Terrestrial, Aquatic
Freshwater
Marine water

③ Obtain inform$^{n}$ on legislation :- ③
rules & regulations, criteria, guidelines related to biolog. env.
Wild life Act, forest act.

④ Prediction of impacts [Mathematical / modelling].
⇒ Habitat Evaluation System (HES)
⇒ Habitat " Procedure (HEP)

⑤ Interpretation of predicted impact on the overall ecosystem.
⇒ imp. of individual sp. in the food web to maintain stability in the ecosystem.
Eg. Bioaccumulation of DDT.
Ospreys:

⑥ Identification & incorporation of mitig$^{n}$ measures :
conservations, restorations.
Major tool in national forest management is the Management Indicator Species (MIS)

# Environmental Impact of Deforestn : Causes & Effects.

Deforestn ⇒ Clearing of forests for some comon purpose.

**Causes**

① Shifting cultivation : Slash & burn agriculture

② fuel requirements : Growing population has created ↑ed demand for fuel wood.

③ Raw materials for industrial use :

⇒ Wood for making boxes [apples, packing tea].
⇒ Pulp for making paper
⇒ Railway sleepers
⇒ Plywood
⇒ Furniture

④ exerted tremendous pressure on forests.

④ Hydroelectric Projects, Big dams, road constn, mining etc.

⑤ Growing food needs : clearing the forests for agricultural use., Settlements are also also created.

⑥ Overgrazing :

⑦ forest fires :

**Effects**

① Threatens the existence of many wild life sp. due to destn of their natural habitat.

② Amt. Rainfall is disturbed thereby causing an imbalance in the hydrological cycle.

③ Soil erosion is ↑ed ⇒ Quality of downstream waterbodies is changed.

④ More carbon is added to the atmosphere.

# Env. Prot$^{n}$ Act, 1986

Unit - IV

(Nov. 19, 1986)

Environment

Env. Poll$^{n}$

Haz. Substance



## Central Govt. (CPCB)

(1) Stands of air / water / soil

(2) Permissible limits (including noise)

(3) Procedures & safeguards (handling of Haz. sub.)

(4) Prohi$^{n}$ & restrictions on location of industries

(5) Safeguards for prev$^{n}$ of accidents which cause env. poll$^{n}$

## State (SPCB)

Coordi Actions:

- Industries checkup
- Modern tech.
- Reuse & recycle.
- Recovery of biogas.

---

Env. Audit (1986)

Haz. Waste Mana. Handling rules (1989)

80)),

Inland waters (30 ppm)

Public sewer (350 ppm)

land (100 ppm)

**The Salient Features of the Indian Wild Life ( Protection) Act 1972**

The Indian wild life act 1972 for the first time regulated the setting up and control of game parks to be referred to as National Parks and declared many species as protected animals and also provided for stringent punishments for poachers or other persons who killed wild animals. Effectively the act banned hunting for pleasure or sport.

India is a land with a rich heritage of wild life. India is home to many big animals and smaller species in large numbers. The Indian jungles are famous and immortalized by Rudyard Kipling in his *Mowgli* books. Elephants, Rhinoceroses, tigers and lions are all at home in the Indian jungles. To get a magnitude of the wild life in India one has only to examine the numbers of these animals as they existed throughout history. Reports indicate that the elephant population number over 500,000 and the lion roamed all over India. The tiger population was over 100,000. But indiscriminate poaching and hunting by Maharajahs and their ilk, depleted the wild life dangerously. The British who for a long period ruled India were not concerned about Indian wild life and over the years the Lion almost became extinct and the number of tigers dwindled dangerously. There were also only 5 wild life parks available when India became free in 1947.

With a dwindling population of wild life in India with mass scale hunting and poaching and deforestation, which destroyed the natural habitat of the Indian species the government of India with pressure from wild life enthusiasts thought it fit to pass a stringent law to curb such practices and also give statutory recognition to game parks and animal reserves. Thus the *Indian Wild Life Protection Act 1972* was enacted by the Indian parliament. The law was made applicable to the entire India state except Jammu and Kashmir which enacted its own wild life act. The law for the first time regulated the setting up and control of game parks to be referred to as National Parks and declared many species as protected animals and also provided for stringent punishments for poachers or other persons who killed wild animals. Effectively the act banned hunting for pleasure or sport.

The act has six schedules which cover the entire gamut of wild life.

a) Schedule I and II are the most potent sections of the act. This section covers animals which are in the category of endangered species. The sections in this schedule give absolute protection to certain species and these cannot be infringed on any account. The value of these sections can bee seen from the fact that the famous actor Salman Khan was sentenced to 5 years rigorous imprisonment for shooting a black buck in Rajasthan. The case is under appeal in the high court. In addition 16 persons have been convicted and sentenced to various terms of prison up to 7 years for killing a tiger.

b) Schedule III and IV. These also have roughly the same provisions of Section I and II, but cover animals that are not in danger of becoming extinct. The penalties under this section are also less than Schedule I and II.

c) Schedule V delineates animals that can be hunted like ducks and deer's. For this purpose the hunter has to apply for a license to the District Forest Officer who will allow a hunter to shoot during a specific season and restricted area. Any infringement can lead to cancellation of the hunting license.

d) Schedule VI concerns cultivation and plant life and gives teeth to setting up more protected animal parks.

## Motor Act, 1988

To regulate the road transport in the country.

⇒ Licencing of motor vehicles
⇒ Traffic control
⇒ Loaded trucks / (rules) trolleys
⇒ Taxes pertaining to movement of vehicles from place to place
⇒ Vehicular pollution
⇒ Noise poll$^{n}$
⇒ ~~Cond~~ Construction, & maintenance of equipment (how occasionally the vehicles need to be serviced).
⇒ Offences & penalties
⇒ Reg$^{n}$ of vehicles.
⇒ Transporting haz. materials
⇒ " solid waste / indust - effluents
⇒ Drivers in buses
⇒ Freight charges (3)

Sections.

(3) ⇒ Offence to drive a vehicle without license.
(112) ⇒ Restrictions on the speed at which the vehicle can be driven depending on the sensitivity of the area.
(113) ⇒ Limits on the weight and use of vehicles in particular area / route
Process
(186) ⇒ Prohibits driving when mentally or physically unfit to drive.
(192) ⇒ Prohibits the use of vehicles without registration

Air ~~Pollution~~ Act, 1981.

⇓

Air pollution

Noise poll$^{n}$ ⇒ 1987


Sec - 20 ⇒ Emission stds from automobiles [Discharge of reg$^{n}$ of vechicles.

Sec - 19 ⇒ State Govt. can declare any area as "air poll$^{n}$ control area".

Sec - 31 ⇒ Provision of appeals



Appellate Authority:

Water Act, 1974. ⇒ Water Cess Act, 1977

⇓

25% refund

⇒ Suitability maintenance of SW & GW.

⇒ Provision for funds, budgets.

CPCB + SPCB

⇓

Knows & tech ass. to SPCB

Awareness progs.

Est. of laboratories for analysis of water/sewage/ind. effluent.

⇓

setting up ETPs, STPs & functioning.

Wild Life Protection Act, 1972.

=) Appointment of Wild life Advisory Board, Wild life warden, their powers, duties etc.

=) Protn of endangered species.

=) Provides for setting up of National Parks, Wild life sanctuaries etc.

=) Provides for the constitution of Central Zoo Authority. (5)

=) " legal powers for officers and punishment to offenders.

Sec-1 & II => covers animals which are in the category of endangered species. Eg Black buck, lions, Tigers etc. 5 wildlife parks. 1947.

Sec-III & IV => cover animals which Not in danger of extinction. like Peacocks, Musk deer etc.

Sec V => delineates animals that can be hunted like ducks & deers.
Hunter apply for a license to District forest Officer
Shoot during ... season and restricted area.

Sec-VI => Concerns cultivation of plant life and setting up of protected animal parks.

## Prep$^{n}$ of EIA for highways & roads projects

(a) Physical resources :

i) Water hydrology : H/R projects that cross water ways both on SW & GW hydrology.

ii) SW quality : ⇒ Debris
spills / accidents of transp materials.

iii) Air quality : - Sources of emissions during const$^{n}$.

- Mobile → Vehicles involved in const$^{n}$ activities.
- Fixed → non-mobile const$^{n}$ equipment compressor, demoli$^{n}$ / excav$^{n}$

(6)

During opn ⇒ Vehicular exhaust.

Sp. attention to be given to adjacent residences + hospitals.

iv) Soils : Cut & fill op$^{n}$s.

Inadequate culvert capacity ↑es soil ero$^{n}$ problems.
results in flooding problems and degrade water resources.

v) Roadways in mountainous terrain ; highly unstable geo. cond$^{s}$ ⇒ landslides can destroy.
reshaping. ←

b) ecolo. resources :

i) Aq. ecology.
ii) Forestry
iii) Wild life.

c) Human use values :

i) Navigation
ii) flood control system alteration

iii) land use.

d) Quality of life values :

i) Socio economic :-
Beneficial effects ↑s land cost.
ii) Resettlement.
iii) Public health.
iv) Aesthetics.
v)

Ref's of EIA of Land clearing Projects sp. imp. to Agriculture.

Critical parameters to be considered

=) Socio-economic conds., site selection (long term effects) Soil stability. etc. * Previous ops.

=) Water hydrology = Change in Ecosystem from forest - agri. can disturb " cycle.

=) Water quality

=) Soil fertility erosion & sedim".

(7)

Eco. resources:

=) Aq. biology & fisheries.

=) Wild life.

=) Forests -) regional | national imp.

=) Threats from insect vectors.

# Environmental Auditing — Unit-V

Defined as a manag. tool for systematic eval$^{n}$ of how well env. manag. systems and equipment are performing

Env. Audit (EA) is one of MIS [Manag. Inform$^{n}$ Systems].

Objectives & Criteria :

⇒ Waste prevention & red$^{n}$. (1)

⇒ Assessing compliance with regulatory requirements

⇒ Controlling env. practices.

Env. audit ⇒ British Petroleum (BP) international Group. (1972)

Objectives :

(1) To determine mass balance of various materials used,

(2) Performance of diff. process equipments ---

(3) To identify the areas of water usage, used waste water, & charact. of WW.

(4) To determine emissions, sources, quantities & impact.

(5) " " Solid wastes & haz. wastes " "

(6) To " impact on socio. env. like GH, stream, res. area, agri. area.

(7) To verify compliance with stds.

Advantages

Types of EA.

(a) Haste audit
(b) Energy "
(c) Health & Safety audit
(d) Compliance audit
(e) Management audit
(f) waste minimization audit
(g) Liabilities def$^{n}$ audit
(h) Property transfer audit.

Audit Protocol => Audit Procedures & Audit findings.

ensures consistency and comprehensiveness in implementing the scope of the audit.

Audit Procedure.

① Pre audit activities
② Activities at site
③ Post audit activities

① Preaudit activities

(a) i, Prelim info Having Program planning choosen an industry to be audited; preliminary infor on the industry is to be obtained through a questionnaire

Inform includes:

i, location of the industry with scale. land use
ii, Climatic conditions
iii, Products manu.
iv, Raw materials use
v, Details of utiliz of water, ww generated, disposal of gaseous emmissions, solid waste / haz. waste
vi, Org. set-up, company policies for Env-manag.

b, Audit team : Basis for auditing exercise.

should include employees from prod quality control / lab, R&D poll control Opern., technical staff for monitoring & analysis of waste samples & env. eq.

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B, ii, ~~Program Planning~}~~

(2) Commitment by manag.

(3)

Comm. by senior manag.

should provide inform$^{n}$ & also resources, if necessary direct persons to co-operate with auditors during process.

Written comm. to follow up and correct problems that the audit will uncover.

(3) Def$^{n}$ of requirements

Process of performing an audit begins ~~with~~ by deciding what type of audit is needed.

=) Soil/water cont$^{m}$

=) Presence of haz. waste

=) Waste discharges into receiving water

=) Proper permits & compliance

(4) Confidentiality

Conduct audit under legal arrangements to protect confidentiality.

Why :- =) Audit report may describe proprietary business info.

= Adverse Community rxn to sensitive inform.

## Onsite audit activities

### Objectives

=) Verifⁿ of legislative & regulatory compliance
=) Assess. of internal policy & procedural conformance
=) Establishment of current practice status.
=) Identifⁿ of improvement opportunities.

### Actions

① Open meeting.

Conduct an onsite audit open meeting with off. managers & site personnel to

=) Introduce audit team members
=) Present audit scope & obj.
=) Outline the " approach & methodology
=) Address questions & concerns of site personnel
=) Rally staff support & assistance.

② Document review: This is done to evaluate whether the records are i, current ii, properly completed, iii, signed and dated iv, consistent v, meet relevant regns. Audit team member to undertake review of relevant document such as

=) Management policy
=) " system documentation
=) Operational procedures
=) Records (utility, inventory, monitoring, calibration)

=) Previous audit reports
=) Green management team meeting minutes
=) Green suggestions.



(3) Detailed Site inspection of

=) Compliance with leg. & regu. requirements
=) Conformance with internal policies, procedures and guidelines
=) Status of operational practice
=) Staff participation in manag. system implement$^{n}$.

(4) Staff interview => to obtain inform$^{n}$ on

=) Actual practices (current & past)
=) Compliance with / deviation from statutory and dept. regs.
=) Awareness of requirements & expectations
=) Ideas to do it better
=) Comments and suggestions.

(5) Review audit evidence

=) Reviewing inform$^{n}$ gathered
=) Collecting additional inform$^{n}$ as needed
=) Substantiating audit findings
=) Summarising and documenting all findings and observe.
=) Identifying issues requiring immediate attention/ mitigation.

⇒ Noting outstanding issues requiring follow-up.
⇒ Preparing debriefing material for the closing meeting.

(6) Closing meeting ⇒ Conclusion of onsite audit.

⇒ Debrief the senior site manag.
⇒ summarise the audit activities & findings
⇒ Highlight system strengths & weaknesses.
⇒ Discuss preliminary findings & recommended corrective actions. (6)
⇒ Bring up findings requiring immediate attention.
⇒ Clarify any outstanding issues.
⇒ Address staff questions or concerns.
⇒ Agree on reporting schedule & chain of communication

Dots

⇒ finger pointing
⇒ Lingering on the negatives
⇒ Arguments.
⇒ Leaving without agreement on contentious issues.

## Post audit activities

(7)

Objectives :

=> To produce an Audit report with audit findings & recommendations.

=> To contribute towards formulation of an Action Plan for continual performance improvement.

Actions :

(1) Collate information & follow up outstanding issues.

The inform" to be organised should include :

=> Completed pre-audit questionnaire, Operational document checklists.

=> Completed onsite survey ", onsite audit protocols

=> All relevant reports, drawings & diagrams

=> Copies of ~~repor~~ records, photographs collected during the site visit.

=> Detailed inspection & interview notes & summaries.

(2) Prepare the audit program.

Audit report should include :

=> An executive summary

=> Introd" & background to the audit

=> Audit scope and objectives

=> Description of audit approach and methodology.

=> Summary of audit findings & recommendations

=> Conclusions.

(3) Circulate Draft Audit report for comments.

Include the following parties on the circulation list:

=) The Audit Management Committee

=) Senior audit site management

=) Site facilitators

=) Site personnel with responsibilities for implementing the major recommendations.

=) Other parties included on the agreed circulation list.

(8)

(4) Final Reporting

=) Incorporate or resolve all comments received before producing the final Report.

=) Issue the report to the Audit Management Committee and site senior manag. for endorsement.