UNIT-1

BASICCONCEPTOF EIA

1.1 Definition of EIA

Environmental impact Assessment is an activity carried out to determine and minimize the impact of any project on physical,chemical,biological parameters of environment and also on human health is termed as "Environmental Impact Assessment".

Or

The Systematic approach of Identification, prediction, Analysis and evaluation of all possible potential hazards of impacts of a proposed industry.

The main aim of environmental impact Assessment is to determine the overall impact of project on environment

EIA is carried out before any project is started and ensure that any activity in the project `will not harm the environment either in small duration of time or in long duration.

Every project should involve the detailed assessment of its effect on environment besides being assessed for analysis,costs and benefits.

EIA can be carried out in two ways. They are:

1) Comprehensive EIA

2)Seasonal or Rapid EIA

Comprehensive EIA:

The time period to conduct this EIA is 1year.In the span of 1 year complete comprehensive environmental parameters will be documented.

Seasonal or Rapid EIA:

This investigation will be studied for a period of 3 months. In the span of these 3 months a detail report of environmental parameters of a particular season will be documented.

Objectives of EIA/ Environmental Management planning:

Environmental Management refers to the management of all components of the biophysical environment including biotic (living) and a biotic (non living) factors.

Protection, conservation and preservation of environment and its resources. Proper land and waste water management for a sustainable environment.

Preserving the ecological heritage for our future generations. Promoting eco-friendly technologies.

Involving men, women, children and NGO's in all environmental related activities.

Strategic measures for afforestation od denuded waste lands.

Mandatory environmental education course in all educational institutions.

Help government at local,state and national level to frame laws for environmental conservation.

1.2 Features of EIA

To identify the negative impacts of environment in irrigation development are increased soil erosion, pollutionof surface water and ground water,water logging, increased incidence of diseases due to polluted water.

To identify the positive impact of irrigation development are suitable water supply for irrigation, domestic and industrial use.

To plan the project in such a way that the negative impact of project on environment are reduced to a considerable extent.

The reduction of negative impact may be done either by considering an alternative project or by modifying the proposed project

To check the implementation of planned project and its effectiveness using a monitoring programme.

1.3 Impacts of EIA

Primary impacts are those impacts that are directly affecting the environment during the construction projects i.e.,release of air pollutants,release of heat, changes in the ambient noise levels.

The secondary impacts are the indirect effects stimulated by project activities such as changes in the socio-economic factors i.e.,changes in air quality,deposition of particulates on water and land,climate changes etc.

1.4 Key elements of EIA.

1.Institutional frame work &guide lines:

Once the EIA is conducting for a proposed industry Proper document should be maintained as per government.

While predicting the impacts care must be taken and suitable assumptions should be made.

By reviewing the other industry copy works of a proposed industry. 2.Basic Responsibility:

The team consists of Geologist, surveyor, planner, economier and other government people has to fulfil all the responsibilities.

They should investigate all the impacts by reviewing exact condition that they should be documented in such a way and then they get the clearance from MOF.

1.5 Scoping of EIA:

The Scope of EIA consists "what to consider&what not to consider" by the investigation of environmental parameters which are extensively depends on the nature of the project.

Based on parameters that are considered to the level of scope will be identified and also the

Time period that is required can be identified by analyzing the parameters which are tend to change due to seasonal fluctuations.

1.6 Alternative Methods:

A proper alternative method has to be designed to overcome the possible environmental degradative environmental consequences.

Quality control &Quality assurance:

The identified & predicted impacts should be more accurate.

The alternative methods that are designed should be reliable &cost effective.

The predicted & alternative impacts are made to promote sustainable development.

1.7 Public Involvement:

Public involvement should be there before getting clearance from MOUF.And public hearing should consists in presence of members from MOUF, district magistrates, MRO, Sarpanch and

all other local important people.

IF any inconvenience to the local people due to theproposed industry that should be rectified by giving clear assurance from the concern people & departments to sanction the EIA.

1.8 Factors affecting EIA

An EIA should include details of following aspects at proposed project site. Meteorology and Air Quality Land use

Topography Soil conditions

Water Mineral Resources

Demographics Ecological studies

Meteorology and Air Quality:

It includesThe effect of temperature. Precipitation,relativehumidity,evaporation and fog conditions. Wind patterns.

Severe weathers(such as hurricanes,volcanoes)Air Quality and levels.

Sound levels and sources of sound at proposed project development site.

Topography:

It includes the local and regional geology studies,major land formations, geologic structure and resources,seismic hazards.

Water:

The Quality of surface water and ground water along with hydrological studies.

Demographics:

This refers to the population distribution,change in population numbers, population characteristics,municipal services such as social services, hospital beds, school places etc

Land use:

This includes the purpose for which the land is used namely agricultural activities, industrial activities or mining activities etc.

Soil conditions:

It includes classification of soil,properties of soil, soil mapping.

Mineral Resources:

The mineral resources available at proposed project development site are uranium,coal,otherminerals,oil and gas etc.

Ecological studies:

This includes data on type and dominant species of flora fauna,reptiles amphibians, endangered species,migratory species.

All these factors have to be taken in to consideration during EIA process to enable better design building.other factors includesPopulation density

Extent of developmental activity Resource availability Environmental resilience Sustainability of environment Absorptive capacity of environment. Initial Environmental Examination:

It is the first phase of the EIA process to review both the positive and negative impacts on environment caused by proposed development project.

It contains a brief information of the major environmental issues.

The main objective of IEE is to enable the decision makers to compare alternative project proposals.

1.9 Role of Stakeholders (public) in EIA preparation:

When draft of proposed action is ready,it is sent for approval from government agencies which requires notification in newspapers,media to let the general public know about it.

The process involves preparing questions for a survey to be carried out on various aspects of proposed action. The entire process is systematic, time bound and carried out in transparent manner ensuring possible public participation at the project site..

The comments,opinions and suggestions from public are analyzed and reviewed by implementing agency.

Temperature, PH, turbidity, conductivity, total dissolved solids, hardness, total alkalinity, Acidity,contents of calcium, magnesium, dissolved O_2 etc.

2.0 Life cycle analysis of EIA:

It is a technique for assessing environmental aspects and potential aspects associated with a product.

Evaluating potential environmental impacts associated with those inputs & outputs.

LCA can be considered as systematic environmental management tool to assess the environmental aspects of goods and services which includes extraction of rawmaterials , manufacture of product ,reuse or recycling,final disposal of product and identifying environmental impact at each stage.

AIM:

IT enables the decision makers to take appropriate measures for improving environment by using sustainable materials for manufacture of products.

It helps to analyse the origin of problems related to the product. It helps to design new products that are eco-friendly.

2.1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) PROCESS:

The first phase of an environmental assessment is called an Initial Environmental Examination (IEE) and the second is Environmental Impact Studies (EIS) or simply detailed EIA.

Initial Environmental Examination (lEE)

IEE is carried out to determine whether potentially adverse environmental effects are significant or whether mitigation measures can be adopted to reduce or eliminate these adverse effects. The IEE contains a brief statement of key environmental issues, based on readily available information, and is used in the early (pre-feasibility) phase of project planning. IEE requires more in depth analysis than applied in the screening procedure. Consequently, an IEE involves more time and resources. IEE also requires expert advice and technical input from environmental specialists so that potential environmental problems can be clearly defined. When an IEE is able to provide a definite solution to environmental problems, an EIA is not necessary.

To prepare an IEE, it is necessary to initially make a checklist that briefly describes the project activities to be implemented and natural resources to be affected.

Typical activities such as siting of the project, resource demand, waste production and regulation, policies and guidelines are required to be included in IEE process. For any

particular project only a few of these may be significant and therefore the first step is to narrow the list of activities likely to be produce significant effects on the environment.

2.2 Environmental Impact Assessment (EIA)

EIA is a procedure used to examine the environmental consequences or impacts, both beneficial and adverse, of a proposed development project and to ensure that these effects are taken into account in project design. The EIA is therefore based on predictions. These impacts can include all relevant aspects of the natural, social, economic and human environment. The study therefore requires a multi-disciplinary approach and should be done very early at the feasibility stage of a project. In other words, a project should be assessed for its environmental feasibility.

EIA should therefore be viewed as an integral part of the project planning process. Unlike the environmental audit (EA), which is conducted on existing projects, the EIA is applied to new projects and the expansion aspects of existing projects.

Screening

Screening is the first step in any EIA process, to decide whether EIA should be applied for the project or not. It helps to clear projects that are not likely to cause serious environmental problems and also to identify projects that may cause huge environmental problems.

In this stage, the Government agencies in company of the assessor review the project proposal.

Screening process divides the project proposals within the following three categories

project clearly requiring an EIA

project not requiring an EIA and

project for which application of an EIA is not clear

If the project clearly requires EIA, the next stage of scoping is initiated.

If the project does not require EIA, environmental clearance is given without EIA.

When there is no clarity of judgment, the proponents /assessors are asked to carry out Rapid Assessment.

Rapid Assessment is a process that uses available data and collects data for one season alone and judgment is based on these data. If the results of the rapid assessment show that there are

no significant impacts (known as FONSI – Finding of No

Significant Impact), then the environmental clearance is granted. If some significant impacts are found, then the proponents are advised to move to the second stage of scoping.

Screening may be done by

Measuring against simple criteria such as size or location of the project

Comparing with list of projects requiring EIA

Estimating impacts and performing analysis using readily available data and

Based on the previous experiences with a similar situation

The output of the screening process is often a document called an Initial Environmental Examination or Evaluation (IEE).

2.3 Scoping

The scoping stage, sometimes merged with screening, involves identification of important issues and preparation of Terms of Reference (TOR).

The aim of scoping is to ensure that the study addresses all issues of importance to decision makers and therefore it is more qualitative than quantitative. This deals with a more detailed plan of study for the project to identify major concerns and key impacts and to decide assessment methods and models to be used. It involves assembling baseline information, identifying major issues of concern, and establishing environment assessment priorities, based on public participation.

Public Participation is highly important in case of scoping and the issues can be identified only based on the views from publics, special interest groups and decision makers.

At the end of scoping, the Terms of Reference is prepared.

The TOR is a document containing written requirements governing EIA implementation, consultations to be held, data to be procured, methodology to be used etc. After the approval of TOR by the decision makers, the assessor moves to the third and most important step of Impact Analysis.

Purpose of Scoping Scoping is used to

Define the proposed action,

Enlist the cooperation of agencies,

Identify what's important,

Identify what's not impol1ant,

Set time limits on studies,

Determine requirements of the study team,

Collect background information,

Identify required permits,

Identify other regulatory requirements, and

Determine the range of alternatives.

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

Scoping should be an ongoing exercise throughout the course of the project.

2.4 Baseline data collection

The term "baseline" refers to the collection of background information on the biophysical, social and economic settings proposed project area. Normally, information is obtained from secondary sources, or the acquisition of new information through field samplings, interviews, surveys and consultations with the public. The task of collecting baseline data starts right from the period of project inception; however, a majority of this task may be undertaken during scoping and actual EIA.

Baseline data is collected for two main purposes

To provide a description of the current status and trends of environmental factors (e.g., air pollutant concentrations) of the host area against which predicted changes can be compared and evaluated in terms of significance, and

To provide a means of detecting actual change by monitoring once a project has been initiated

Only baseline data needed to assist prediction of the impacts contained in the Toor and scoping report should be collected.

2.5 SYSTEMATICAPPROACHFORUSINGEIAASA PLANNING TOOL FOR MAJOR PROJECT ACTIVITIES

Introduction

The concept of ETA as a planning tool requires that it be concerned with all phases of project development including

planning,

final design/construction start-up, and

project operations.

Fig. illustrates the relationship between the various stages of a project development and the timing for the tasks to be included in the EIA process.

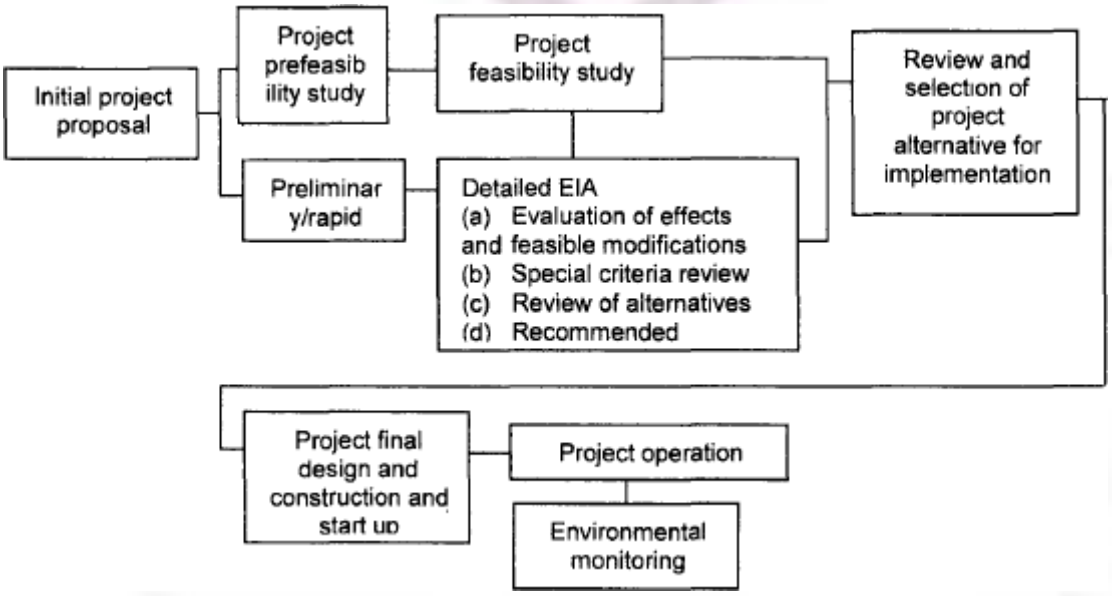

Fig. Relationship of EIA process to project planning andimplementation

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

In respect of step (iii) project operations, the EIA will be mostly concerned with the provision of continuing to monitor the project's impacts, with feedback, so this information can be used

to for bringing about improvements in the project as shown by the monitoring data.

Environmental inventory is a complete description of the environment as it exists in an area where a particular action is being considered. It is included in impact statement and serves as the basis for evaluating the potential impacts on the environment, both beneficial and adverse of a proposed action.

2.6 Preparation of Environmental Base Map (EBM): An important requirement is preparation of an environmental base map (EBM or maps) showing the salient information as in (i) and (ii).

This includes the essential background information on the environmental situation so that the reviewer, by referring to this, can readily interpret the report text and especially the conclusions and recommendations.

For an Industrial Development Project EIA thus usually includes demography, land use infrastructure, receiving water, ground water and soil conditions, other industries and their waste streams, institutions, ecological resources, areas of cultural, archaeological and tourist.

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

Identification of Study Area

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

Classification of Environmental Parameters

The environmental data at site, where a particular proposed action is being considered for EIA study collected by EIA team members comprising of administrators,biologists, local politicians,geologists,journalists, sociologists,economists& engineers

The environmental parameters are classified as follows. Land: The following details of land are necessary

Land ownership Existing land use Crop productivity Natural vegetation

Flora: The study of flora at proposed at proposed development site should includeInventory of terrestrial & aquatic flora. Population of different types of vegetation Density data ofdifferent types of vegetation. Identification of valuable species.Identification of endangered species.

Fauna: The study of fauna at proposed at proposed development site should includeInventory of terrestrial & aquatic fauna. Population of different types of fauna. Density data of different types of fauna. Data on permanent & migratory population. Data on endangered species Terrain Analysis: It includes following Geology & geomorphology Classification of land Hydrogeology Soil classification, characteristics like grazing land, wet landErosion potential.

Air Quality studies:

The amount of suspended particulate matter. Concentration of gaseous emissions like SO2 etc. Water Quality studies:This study includesQuality of surface water and ground water resources.Temperature,PH, turbidity,conductivity, total dissolved solids, hardness, total alkalinity, Acidity,contents of calcium, magnesium, dissolved O2 etc.

Formation of EIA Study Team

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

Preparation of Terms of Reference

The first step in undertaking any EIA is to carry out a preliminary evaluation of the situation. If done by a skilled environmental analyst within a short period, say two weeks, it is possible to size up the situation, identify the beneficial uses which are likely to be significantly affected make preliminary estimates of the magnitudes of these effects and preliminary delineation of the feasible measures which will be needed to minimize/offset degradation, and draw conclusions on

whether a detailed EIA follow-up study is needed, and if so, to prepare the Terms of Reference (TORs) and recommended budget, and

if not, to prepare a report on the initial work which in itself becomes the final EIA for the project.

2.7 Preparation of an EIA Report

Numerous techniques are available for the assessment of environmental impacts and preparation of EIA reports.

The project proponent is free to select the method most appropriate for the specific situation.

Essential steps to complete an environmental impact assessment include:

Describe the proposed project as well as the options

Describe the existing environment

Select the impact indicators to be used

Predict the nature and extent of the environmental effects

Identify the relevant human concerns

Assess the significance of the impact

Incorporate appropriate mitigating and abatement measures into the project plan

Identify the environmental costs and benefits of the project to the community

Report on the assessment.

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

Environmental Monitoring and Management Plan

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

Draft and Final Environmental Impact Statements

The most detailed procedure for analyzing potential environmental impact of alternatives of a proposed project or action is the Environmental Impact

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

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

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

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

Purpose of and Need for Proposed Action

Alternatives

Affected Environment

Environmental Consequences

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

DEIS Processing

When the DEIS is completed, it is circulated among the Central, State, and Local agencies

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

After the public hearing and the review period, the comments received are evaluated, and a required additional analysis is conducted. Alternatives and

mitigation measures may be revised based on the comments received and the responses are prepared to each substantive comment.

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

Final Environmental Impact Statement (FEIS)

The FEIS document is the preferred alternative consisting of the DEIS with modifications.

In some cases, where minor changes are required, the abbreviated form of the FEIS can be used which merely attaches the required changes or findings to the DEIS

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

EIA Methodologies

Introduction

There are a number of methodologies evolved by different people for preparing Environmental Impact Analysis. Depending upon the specific needs of the user and the type of the project being undertaken, one particular methodology may be more useful than the other.

EIA methods range from simple to complex, requiring different kinds of data, different data formats, and varying levels of expertise and technological sophistication for their interpretation. The analyses they produce have differing levels of precision and certainty. All of these factors should be considered when selecting a method.

Many times an EIA analyst or the person charged with the preparation of an EIA report is faced with a vast quantity of raw and usually unorganized data.

Hence, each technique and method for the evaluation of impacts should have the following qualities and characteristics:

It should be systematic in approach;

It should be able to organize a large mass of heterogeneous data;

It should be able to quantify the impacts;

It should be capable of summarizing the data;

It should be able to aggregate the data into sets with the least loss of information because of the aggregations;

It should have a good predictive capability;

It should extract the salient features, and

It should finally be able to display the raw data and the derived information in a meaningful fashion.

Each of the different methodologies for the assessment of environmental impacts of development projects has their advantages and disadvantages and their utility for a particular application is largely a matter of choice and judgment of the analyst.

Nevertheless, some objective criteria exist in making such a choice and these are stated below under the key areas that involve the assessment process.

Criteria for the Selection of EIA Methodology

1. General

(a) Simplicity: The methodology should be simple so that the available manpower with limited background knowledge can grasp and adopt it without much difficulty.

b) Manpower time and budget constraints: The methodology should be applied by a small group with a limited budget and under time constraints.

(c) Flexibility: The methodology should be flexible enough to allow for necessary modifications and changes through the course of the study.

Impact Identification

Comprehensiveness: The methodology should be sufficiently comprehensive to contain all possible options and alternatives and should give enough information on them to facilitate proper decision-making.

Specificity: The methodology should identify specific parameters on which there would be significant impacts.

2. Isolation of project impacts: The methodology should suggest procedures for identifying project impacts as distinguished from future environmental changes produced by other causes.

Timing and duration: The methodology should be able to identify accurately the location and extent of the impacts on a temporal scale.

3. Impact Measurement

Commensurate units: The methodology should have a commensurate set of units so that comparison can be made between alternatives and criteria.

Explicit indicators: The methodology should suggest specific and measurable indicators to be used to qualify impacts on the relevant environmental parameters.

Magnitude: The methodology should provide for the measurement of impact magnitude, defined as the degree of extensiveness of scale of the impact, as distinct from impact importance, defined as the weighting of the degree of significance of the impact.

Objective criteria: It should be based on objective criteria and the criteria should be stated explicitly.

4. Impact Interpretation and Evaluation

Significance: The methodology should be able to assess the significance of measured impacts on a local, regional and national scale.

Explicit criteria: The criteria and assumptions employed to determine impact significance should be explicitly stated.

Portrayal of "with" and "without" situation: The methodology should be able to aggregate the vast amounts of information and raw input data.

Uncertainty: Uncertainty of possible impacts is a very real problem in environmental impact assessment. The methodology should be able to take this aspect into account.

Risk: The methodology should identify impacts that have low probability of occurrence but a high potential for damage and loss.

Depth of analysis: The conclusions derived from the methodology should be able to provide

sufficient depth of analysis and instill confidence in the users, including the general public.

Alternative comparison: It should provide a sufficiently detailed and complete comparison of the various alternatives readily available for the project under study.

Public involvement: The methodology should suggest a mechanism for public involvement in the interpretation of the impacts and their significance.

5. Impact Communication

Affected parties: The methodology should provide a mechanism for linking impacts to specific effected geographical or social groups.

Setting description: It should provide a description of the project setting to aid the users in developing an adequately comprehensive overall perspective.

Summary format: It should provide the results of the impact analysis summarized in a format that will give the users, who range from the lay public to the decision makers, sufficient details to understand it and have confidence in its assessment.

Key issues: It should provide a format for highlighting the key issues and impacts identified in the analysis.

Compliance: One of the most important factors in choosing a methodology is whether it is able to comply with the terms of reference established by the agency.

EIA Methods:

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

Ad-hoc methods

Checklists methods

Matrices methods

Networks methods

Overlays methods

Environmental index using factor analysis

Cost/benefit analysis

Predictive or Simulation methods

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

Ad hoc Methods:

These methodologies provide a minimum guidance for impact assessment. They merely suggest broad areas of possible impacts (e.g., impacts on lakes, flora and fauna, forests, etc.), rather than defining specific parameters to be investigated.

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. For example, the impacts on animal and plant life may be stated as significant but beneficial.

The information is stated in simple terms that are readily understood by the lay person. No information about the cause-effect relationship between project actions and environmental components is provided. The actual impacts on specific environmental components likely to be affected by the project or those that may require further investigation are not identified. The method merely presents the pertinent information without resorting to any relative weighting of importance.

A good example of an ad hoc method is a team of experts assembled for a short time to conduct an EIA. Each expert's conclusions are based on a unique combination of experience, training and intuition. These conclusions are assembled into a report. Sometimes this is the only required or possible approach.

The ad hoc method has the following drawbacks:

it may not encompass all the relevant impacts;

because the criteria used to evaluate impacts are not comparable, the relative weights of various impacts cannot be compared;

it is inherently inefficient as it requires sizeable effort to identify and assemble an appropriate panel of experts for each assessment; and

it provides minimal guidance for impact analysis while suggesting broad areas of possible impacts.

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

Checklists:

These methodologies present a specific list of environmental attributes to be investigated for possible impacts. They need not necessarily attempt to establish the cause-effect links to project activities.

They may or may not include guidelines about how attribute data are to be measured and interpreted.

Checklists are standard lists of the types of impacts associated with a particular type of project.

Checklists methods are primarily for organizing information or ensuring that no potential impact is overlooked.

There are four general types of checklists:

Simple Checklists: "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, how to interpret and measure an environmental parameter.

Descriptive Checklists: "Descriptive checklists" refer to methodologies that include lists of environmental factors along with information on measurement and impact prediction and assessment. 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).

Scaling Checklists: These are similar to a descriptive checklist, but with additional information

on subjective scaling of the parameters.

Scaling checklists go a step further and include simple devices for assessing importance or significance of suspected impacts. This might be through the use of letter or numeric scales, assigned after comparison with criteria supplied in the checklist, to indicate the importance of an impact. Another approach is to use threshold values, based on statutory criteria (e.g. for water quality standards) or on derived measures (e.g. visitor carrying-capacity for a given locality). The suspected impact can be estimated in broad terms and given a value to represent its significance. On that basis, a start can be made on comparing and ranking alternative project options.

Scaling Weighting Checklist: These are similar to a scaling checklist, with additional information for the subjective evaluation of each parameter with respect to all the other parameters.

Questionnaire checklist is a form of scaling checklist but uses a series of carefully directed questions to elicit information about possible impacts and their likely importance.

For preparing check lists information expertise at different levels are required. While simple check lists require information of impacts on general environmental factors scaling weighing check lists require more detailed expert knowledge.

There are several major reasons for using checklists:

they are useful in summarizing information to make it accessible to specialists from other fields, or to decision makers who may have a limited amount of technical knowledge;

scaling checklists provide a preliminary level of analysis; and

weighting is a mechanism for incorporating information about ecosystem functions.

Some of the drawbacks with checklists when used as an impact assessment method:

they are too general or incomplete;

they do not illustrate interactions between effects;

the number of categories to be reviewed can be immense, thus distracting from the most significant impacts; and

the identification of effects is qualitative and subjective.

Matrices:

In matrix methods interactions between various activities and environmental parameters will be identified and evaluated. Matrix methods are basically generalized checklists where one-dimensionof a matrix is a list of environmental social and economic factors likely to be affected by a project activity. The other dimension is a list of actions associated with development. These relate to both the construction and operational phases.

In a Leopold matrix the columns of the matrix correspond to project actions (for example, flow alteration) while the rows represent environmental conditions (for example, water temperature). The impact associated with the action columns and the environmental condition row is described in terms of its magnitude and significance.

In Leopold matrix One 100 different types of impacts and 88 environmental characteristics are identified in the system giving a total of 8800 possible interactions, but in practice it can usually be quickly reduced to a fewer number of related items.

In the use 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.

Next the interaction in terms of its magnitude and importance will be considered in the method. The '"magnitude" of an interaction is described by the assignment of a numerical value from 1 to 10, with 10 representing a large magnitude and 1 a small magnitude. Assignment of numerical values for the magnitude of an interaction should be based on an objective evaluation of available facts and data 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 judgment of the expert group, or interdisciplinary team working on the study.

The matrix approach is reasonably flexible. The total number of specified actions and environmental items may increase or decrease depending on the nature and scope of the study

Matrices can be tailor-made to suit the needs of any project that is to be evaluated. They should preferably cover both the construction and the operation phases of the project, because

sometimes, the former causes greater impacts than the latter.

Simple matrices are useful:

early in EIA processes for scoping the assessment;

for identifying areas that require further research; and

foridentifyinginteractionsbetweenprojectactivitiesandspecific environmental components.

However, matrices also have their disadvantages:

they tend to overly simplify impact pathways,

they do not explicitly represent spatial or temporal considerations, and

they do not adequately address synergistic impacts.

they tend to be difficulty to get an overview when many variable are included.

Network Methods:

These methodologies work from a list of project activities to establish cause- condition-effect relationship. It is generally felt that a series of impacts may be triggered by a project action. They define a set of possible networks and allow the user to identify impacts by selecting and tracing out the appropriate project actions.

To develop a network a series of questions related to each project activity (such as what are the primary impact areas, the primary impacts within these areas the secondary impact areas the secondary impacts within these areas and so on) must be answered.

In developing network diagram, the first step 'is to identify the first order changes in environmental components. The secondary changes in other environmental components that will result from first order changes will be then identified. In turn third order changes resulting from secondary changes will be then identified. This process will be continued until the network diagram is completed to the experts' satisfaction.

Network analyses are particularly useful for understanding the relationship between environmental components that produce higher order impacts, which are often overlooked in some major 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.

Overlay Methods:

Overlay methods involve preparation of a set of transparent maps, which represent the spatial distribution of an environmental characteristic (e.g., Extent of dense forest area, susceptibility to erosion, etc.,).

Information on wide range of variables will be collected for standard geographical units within the study area which will be recorded on series of maps typically one for each variable. These maps will be overlaid to produce a composite map. The resulting composite maps characterize the area's physical, social, ecological, land use and other relevant characteristics relative to the location of the proposed development.

To evaluate the degree of associated impacts many project alternatives can be located on the final map and validity of the assessment will be related to the type and number of parameters chosen. Normally to have some clarity the number of parameters that can be overlayed in a transparency map is limited to 10.

These methods are widely used for assessing visually the changes in the landscape before and after the activity. Secondly it can be used for preparing combined mapping with an analysis of sensitive areas or ecological carrying capacity. As these methods are spatially oriented, they can very clearly show the spatial aspects of cumulative impacts.

Their limitations relate to:

lack of causal explanation of impact pathways; and

lack of predictive capability with respect to population effects. Combination Computer-aided:

These methodologies use a combination of matrices, networks, analytical models, and a computer-aided systematic approach. Since this is a combination of difficult methodologies, it is a multiple-objective approach to:

Identify activities associated with the governmental policies and programmes;

Identify potential environmental impacts at different levels;

Provide guidance for abatement and mitigation techniques;

Provide analytical models to establish cause-effect relationships and to quantitatively determine potential environmental impacts, and

Provide a methodology and a procedure to utilize this comprehensive information in decision-

making.

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 principal methods available for placing monetary values (costs and benefits) on environmental impacts, a taxonomy of valuation methods, and steps involved in economic evaluation of environmental impacts are discussed under this category.

A Critical Overview of EIA Methodologies

Methodology	Areas of Usefulness	Drawbacks
(a) Ad Hoc	- Simple and no training / skills needed. - In-depth and focused analysis on few; When no expertise and resources available, this is the best. - Gives preliminary understanding. - Project's effects on environment given without any weighting and cause-effect relations.	- Restricts to broad areas only. - Not all relevant impacts covered. - Selective and biased. - Lacks consistency due to different criteria to evaluate different groups of factors.
(b) Checklists	- Strong in impact identification. - Effective in evoking public attention. - Simple and easy to understand; comprehensive. - Most useful at the stage of initial environmental examination (IEE).	- Scaling and weighting subjective. - Leaves interpretation to decision makers. - Measurement deficient.
(c) Matrices	- Provides cause-effect relations between project activities and impact on various attributes. - Graphical display of impact gives better understanding. - Strong in impact identification and their interaction is possible.	- Information is lost due to quantification. - Scaling and weighting become subjective.
(d) Networks	- Capable of identifying both direct and indirect effects and their interaction. - Capable of incorporating mitigation and management measures at the planning stage of a project.	- Less useful in considering socioeconomic environment. - Display becomes large and unwieldy when large industrial complexes or regional plans are considered.
(e) Overlays	- Useful in site and route selection. - Effective presentation and display. - Useful in transport projects and road route alternative; land use planning.	- Quantification and measurement weak. - Not all impacts covered. Higher order impact cannot be identified. - Social environment not considered. Subjective. - Self-limiting in scope.

UNIT-2

ASSESSMENT OF IMPACTS ON VEGETATION AND WILDLIFE

1.1 Introduction

Vegetation refers to the variety of plants inhabiting a given area. And wildlife includes all animals - whether large or small, herbivores or carnivores, game animals and also the birds inhabiting a given area, precisely a wild-area.

Wild-areas are those areas that are out of reach or are not frequently disturbed by human beings implying thereby, that all the species occurring therein are in perfect harmony with nature. They are well adapted to the climate, soil types and the overall geographical conditions of that area. In addition, they are capable of surviving and completing their life cycle, one season after the other, all by themselves without any human care and help.

Presently, the scope of wildlife is not limited to animals only. Now it includes all living beings occurring in wild conditions - the animals, the plants, the microorganisms and all other lesser known living beings. Hence, vegetation is a component of 'wild-life'.

The impacts of vegetation and wildlife will be most likely intense in rural areas and for proposed projects or actions covering large geographic areas or setting future management policies. In urban areas, however, small tracts of natural vegetation and habitat may be extremely important if there is an absence of similar habitat in the area or region.

Wetlands are a significant habitat for numerous species of plants and animals.

Endemic species – species confined to a particular region, e.g., neem is endemic to Indian sub-continent

Endangered species –A species is considered endangered when its numbers are so few and/or its habitat is so small that it may become extinct if not given adequate protection.

Vegetation and wildlife studies often focus on threatened or endangered species. The environmental analyst should assess the possible project or action effects on vegetative ecosystems and wildlife species that are protected by law by a systematic approach that involve mostly,

Assigning the existing biological resumes,Impacts analysis of project activities, and

Mitigation.

The typical regulatory mitigation measures for the mitigation of biological impacts in various developmental activities are summarized in Table below.

Biological impact	Possible mitigation measures and regulatory program requirement
Lossofwildlife	A wildlife-protection plan is required as part of any mining permit. Wildlife agencies must be consulted. Timing, shaping, and sizing operations must be conducted to avoid breeding or nesting season. Fencing will keep large mammals from direct contact with toxic chemicals in sedimentation ponds and from roadways to' reduce the number of road kills. A 30-m buffer zone on each side of streams must be undisturbed.
Disturbance of aquatichabitat	A regulatory program designed for restoration, protection, organisms' enhancement, and maintenance of aquatic life must be habitats implemented. Surface and underground mine openings must be cased and sealed to prevent escape of acid and toxic discharge. All diversions must be removed.
Erosionand sedimentation	Surface runoff must be collected in sediment ponds. Disturbed soils must be revegetated.
Destruction of vegetation	Topsoil must be removed, segregated, stored, and redistributed with minimum loss or contamination. Topsoil and subsoil may be removed separately and replaced in sequence. Native vegetation or appropriate substitutes after mining must be established.

Table : Regulatory Mitigation measures for the mitigation of Biological Impact.

Describing Existing Resources

Vegetation and wildlife studies begin like most other studies with co-ordination with central, state, and local agencies for information on the presence of any special species or particularly valuable vegetation types in the project area.

Goals and objectives for the area should be reviewed particularly if the project involves a large geographic area.

For small, simple projects or actions, it will be sufficient to verbally describe the existing resources. At the level expected impact increases, photographs and vegetation (habitat) mapping will most likely be required. Detailed studies are usually contained within a supplying technical report to the Draft Environmental Impact Statement or the Environmental Assessment. Habitat mapping can begin with a review of aerial photographs of the project area. Much preliminary work can be accomplished prior to doing any field surveys. Field surveys will then verify the habitat mapping and finalize the classification of vegetation communities.

Vegetative communities can be described generally or in terms of dominant species.

Significant secondary species and understory species complete the descriptions. Any special wildlife habitat features, such as, feeding or nesting sites, water supplies, cover, or travel corridors, should be individually identified and emphasized. Unique or rare habitats or vegetative communities, relative to the presence of similar habitat types in the area or region, should be noted.

These are examples of the types of general vegetative community or wildlife habitat descriptors that may be used:

Hardwood forest - areas where greater than 50 percent of the area is dominated by trees,

Abandoned field Scrub - areas not subject to moving for at least the current growing season and subject to invasion of woody plants,

Agricultural - areas maintained for annual crop production or pasturing include hedgerows and drainage ways, and

Human-dominated - moved aprons, lawns, and residential landscaping and gardens.

For each of these general descriptors, supporting text, would further describe the resources, including representative plant species. For example, the description of hardwood forest should

include dominant species, understory species, and a discussion of tree, size and forest successional maturity.

For all natural areas, the extent of evidence of disturbance or intervention byhumans may be important to note.

The environmental analyst should become knowledgeable about the communities of fish and wildlife; include reptiles and amphibians that are expected to be present within particular vegetative ecosystems or habitat types in the project area and region. It is not necessary to try to list all possible faunal (animal) species within the technical report or draft environmental document. Most often, such an attempt will not be complete. Examples of common species should be given, however, and any special species of concern should definitely be emphasized.

If the environmental impact assessment is being conducted on a large management plan, as for a national forest or as a part of land management resource area, significantly more details will be involved in the description of existing vegetation and wildlife resources, the assessment of impacts of various management practices, and the selection of indicator species.

1.2 Impact Analysis

The level of detail required for impact analysis for vegetation and wildlife will depend on the specific characteristics of the proposed project alternatives and the expected degree of effects. Examples of the types of impacts that may be applicable are loss of unique vegetative communities, direct loss of wildlife habitat and species, deterioration of remaining habitat, barriers to wildlife travel corridors, and effects on recreational activities and land use.

Loss of Valuable Vegetative Community Types:The analysis of degree of impact of direct loss of vegetation will depend heavily on the value of the vegetative community to be destroyed. If the vegetation is common and unremarkable, the effects can be quantified by the amount of each type of community to be destroyed for each proposed alternative.

Direct Loss of Wildlife and Habitat:For projects or actions requiring land clearance and removal of natural vegetation, the most obvious impact of wildlife will be loss of habitat and individual animals. Species with small home ranges will be most affected. Larger species may immigrate to adjacent areas.

The amount of habitat, by type, destroyed by each proposed alternative should be quantified. Represented species that would incur loss of individuals should also be identified.

Barriers to Travel Corridors:The analyst must consider whether the proposed project action would cause removal of connecting travel corridors between areas of wildlife habitat. Such corridors may cover large areas or may be very small but very important.

Linear projects, such as, highways, railroads, power lines, pipelines, or artificial drainage channels, are particularly likely to produce barriers to wildlife travel.

The effect on wildlife populations can be particularly adverse if feeding or watering areas are separated from nesting or resting areas.

Recreational Use and Enjoyment:Larger natural areas support fishing, camping, hunting, hiking and research studies. To the degree possible, the impact of the proposed project of action alternatives on both active and passive recreational activities and qualities should be comparatively assessed and quantified.

1.3 Mitigation

Mitigation for potential impacts on vegetation and wild life may be very site- specific, such as, replacing landscaping or creating open space and parks in more urban areas; or geographically expansive in scope, such as, implementing particular management techniques in national forests. In some cases, rare plants or particular animals may actually be transplanted or trapped and moved to other safe locations.

Mitigation measures include

Avoiding,

Minimizing,

Rectifying,

Reducing and

Compensating.

If particularly sensitive or valuable natural areas were destroyed the first mitigation technique should be development and feasibility analysis of avoidance alternatives.

Techniques to improve the productivity and functional value of the remaining habitat can be used to offset adverse impacts. Such measures may include installation of nesting boxes or trees, creation of waterholes and open spaces, planting of food supply vegetation, or increasing the overall vegetation diversity.

Habitat impacts can also be mitigated through compensatory preservation or created replacement habitats. Sometimes trees and vegetation removed by the proposed project or action can be saved and used to replant the created habitat.

Barriers to wildlife travel corridors can sometimes be mitigated through provision of wildlife underpasses in highway or railroad fills or similar types of protected travel corridors for power lines or al1ificial drainage channels.

Wildlife losses through road kills can be further minimized by installation of fencing to prevent wildlife from crossing the highway and to direct wildlife movement to the provided underpasses.

1.4 Deforestation

Deforestation is a very broad term, which consists of cutting of trees including repeated lopping, felling, and removal of forest litter, browsing, grazing and trampling of seedlings.

It can also be defined as the removal or damage of vegetation in a forest to the extent that it no longer supports its natural flora and fauna.

Deforestation refers to the loss of tree cover; land that is permanently converted from forest to non-forest uses such as agricultural pasture, desert, and human settlement.

Extent of forest loss in India

India is an agricultural country. The country is losing its forest cover steadily because of clearing forests of is done for agricultural purpose, cattle grazing and plantation crops such as tea, coffee etc.

Deforestation is one of the most serious and widespread environmental problems which India is facing. In India surveys conducted in early seventies and found a forest cover of about 22.7% only instead of 33% considered desirable according to “National Forest Policy”.

What are the Causes of Deforestation?

The most common reason for deforestation is cutting of wood for fuel, lumber and paper. Another important cause relates to the clearing of forest land for agriculture, including conversion to crop land and pasture. The main causes of deforestation are:

Agriculture: The expanding agriculture is one of the most important causes of deforestation. Man has always modified the natural ecosystems in such a way that environment becomes

more favorable for crop growth whether using traditional or modern methods of agriculture. As demands for agricultural products rises, more and more land is brought under cultivation and for that more forests are cleared, grasslands and even marshes, and lands under water are reclaimed.Thus there is much more ecological destruction than gain in term of crop yield.

Grazing Land: Forests are cut down in order create land for grazing cattle. Huge herds of animals require food and forests are cleared out to make way for grazing lands for these cattle.

Demand for firewood: Firewood has been used as a source of energy forcooking, heating etc. Trees are cut down in developing countries to be used as firewood or turned into charcoal, which are used for cooking and heating purposes. India consumes nearly 135-170 Mt (Million tonnes) of firewood annually and 10-15 ha of forest cover is being stripped off to meet the minimum fuel needs of urban and rural poor.

Wood for industry and commercial use: Wood, the versatile forest produce, is used for several industrial purposes, such as making crates, packing cases, furniture, match boxes, wooden boxes, paper and pulp, plywood, etc. 1.24 lakh ha of forest have been cut for various industrial uses. Unrestricted exploitation of timber as well as other wood products for commercial purposes is the main cause of forest degradation.

Urbanization and developmental projects:Often urbanization and developmental activities lead to deforestation. The process of deforestation begins with building of infrastructure in the form of roads, railway lines, building of dams, townships, electric supply etc. Thermal power plants, mining for coal, metal ores and minerals are also important causes of deforestation.

1.5 Harmful Effects of Deforestation

Deforestation affects both physical and biological components of the environment.

Heavy Soil Erosion – The roots of the trees hold the soil firmly keeping it intact. With large scale deforestation soil erosion and landslides have become a normal phenomenon. During heavy rains and typhoons soil is washed away to lower regions. This increases the risk for landslides which can cause seriously threaten the safety of the people and damage their properties.

Extinction of flora and fauna – Destruction of the forests leads to a tragic loss of biodiversity. Millions of plants and animal species are on the verge of extinction due to deforestation. Countries with tropical forests suffer the greatest causalities due to deforestation.

Relocation of wild life to urban areas – Many wild animals have started relocating to urban

areas as a result of massive deforestation. There have been many cases of various wild animals like snakes, bats etc causing accidents in urban areas. Many times wild animals get killed in an effort to capture them. There have been instances of carnivorous predators like lions, tigers and wolfs preying on humans in villages surrounded by forests.

Global warming – The trees absorb the harmful carbon dioxide and release the life sustaining oxygen, thus acting as natural friends of humans. Deforestation increases the amount of carbon dioxide in the atmosphere leading to global warming due to green house effect.

Silting of Rivers and Dams – Deforestation causes large scale deposition of sediments in the rivers. This leads to collection of sediments in the dams, thus reducing their lifespan.

Flooding – Trees absorb water in large quantities during heavy rains. But due to large scale deforestation there are very less tress to retain water. This again leads to heavy floods causing heavy loss of life and property.

Desertification – Deforestation is one of the causes behind the conversion of many fertile tracts of land to deserts. This phenomenon is known as desertification. When mountain forest faces desertion, watersheds are degraded and this leads to the loss of sustained water supplies for lowland communities.

Danger of submersion of coastal areas and glaciers – Due to massive deforestation, the average temperature of the earth has risen in the last century. If this phenomenon continues then the increased temperatures would lead to melting of glaciers. This would lead to a massive rise in the sea levels leading to submersion of coastal areas.

Keeping these dire consequences in mind, an honest effort should be made by the human civilization to conserve forests.

1.6 Environment Risk assessment and Risk management in EIA

According to International standard,risk is defined as the chance of something happening,that will have impact on objectives.

According to Environment protection act,risk is the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor.

In general risk can be defined as anything that has a tendency to cause harm to humans and the natural environment medium (including air,water,land,plants and wild life).

Risk management is defined as the culture processes and structures that are directed towards realizing potential opportunities whilst managing adverse effects.Environment Risk Assessment considers the impact on the environment caused by various factors suchas

Natural events(Ex:Chemicalbiological,radiological) Technology

Practices Processes Products

Industrial activities

Environmental conditions (Ex: chemical contamination in air, soil, surface water, changes in climate)

A simple example of environmental risk assessment is that of source- pathway-receptor.Let us consider the source to be a hazardous source (such as source of contamination),the receptor to be the ecosystem.The link between the source and the receptor is the pathway.In the absence of the pathway,no risk exists.

1.7 Risk Assessment and treatment of uncertainty:

Environmental risk assessment has an important role in managing the uncertainty as part of an EIA process.The uncertainty in risk assessments arise due to lack of knowledge regarding a particular parameter.It arises from two sources.

1.8 Randomness:

This is due to the varying phenomena or because all factors affecting a system cannot be modelled.

Incompleteness:

This is due to lack of information about parameter values.

1.8 Key stages in performing ERA:

ERA can be accomplished by the following key stages. 1.Establishing the context:

This stage involves the setting up of the external,internal and risk management contexts to recognize the aim of organization and for quick and easy identification of risks.

1.9 Risk Identification:

This step involves identification of risk that could lead to harm to human health and ecology.The risk Identification is carried out thoroughly to depict what,where,when,why and how a particular parameter can occur and its effects.

Risk analysis:This step involves the following aspects:

Identification of Consequences produced during risk identification. Information about the statement of context.

Additional information about statistical data or expert judgement.

The risk analysis step provides an understanding the nature of risk,the extent of its consequences. Each type of risk is evaluated and given proper risk treatment when needed.

Risk Evaluation:The information collected during the risk identification and risk analysis is used in decision making whether a particular risk falls under the organization's risk criteria and if it requires ant treatment.

2.0 Risk treatment:

Risk treatment involves three basic methods. a) Avoid the Risk

Transfer the Risk

Risk control

UNIT-3

Prediction and Assessment of Impacts on Soil and Ground Water Environment

Introduction

Almost every type of action or project can produce changes on the surroundings of the land.

Some actions and projects will have direct effect, while others may induce changes or have secondary impacts.

The integrity of soils and groundwater can be altered by a variety of physical disturbances, including the

addition/removal of soil and/or water,

compaction of soil,

changes in use of land or ground cover,

changes in water hydrology,

changes in climate (temperature, rainfall. wind),and the

addition or removal of substances or heat (for example.

discharge of effluents into groundwater.

discharge of effluents or disposal of waste onto land,

leaching of contaminants into groundwater,

changes in quality of surface watcr,and

deposition of air pollutants on land).

The effects of these vary from first order effects of leaching into soil and groundwater to changes in groundwater regime, soil structure (including erosion and subsidence), soil quality or temperature, and groundwater quality or temperature.

Methodology for the Prediction and Assessment of Impacts on Soil and Groundwater:

To provide a basis for addressing soil and/or groundwater environment impacts. a model is suggested which connects seven activities or steps for planning and conducting impact studies. (See Fig.1 :)

In analyzing environmental impacts both objective and subjective judgments should be taken into consideration.

Objective judgments are defined as "those which involve or use facts that are observable or verifiable especially by scientific methods and which do not depend on personal reflections, feelings, or prejudices.

Subjective judgments are those which are made on the basis of values, feelings and beliefs.

In the context of the environment the objective judgment describes the impact where-as subjective judgment describes how people feel about the' fact'.

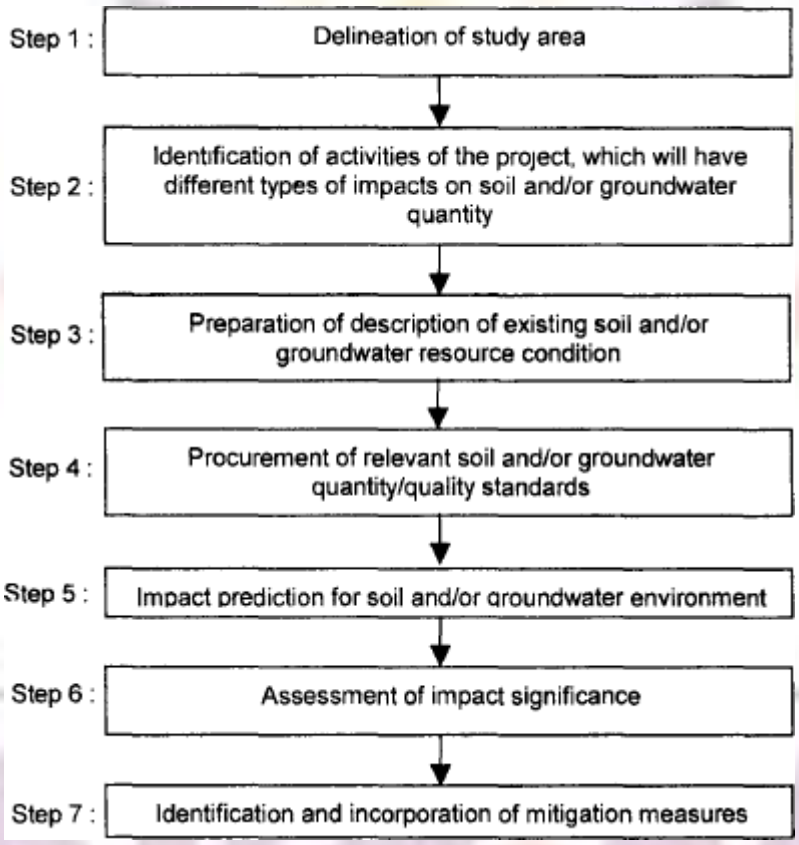

Fig 1: Systematic approach for the study of impacts on soil and ground water.

DELINEATION OF STUDY AREA:

The delineation of the study area for impact assessment will be very specific based on presence of potential impacts.

The study area should reflect the full reach of possible effects within the particular impact discipline that is being considered.

The proposed or future land-use map along with committed land-use policies, zoning, and

development projects should be included in the study area.

The map should clearly distinguish between developed and undeveloped land. Categories shown on land-use map, should be

Residential

Commercial and industrial

Institutional and parks or recreation

Non-urban mixed

The map could include further divisions, such as separate commercial and industrial activity centers and public vacant lands. The categories to be used will depend largely on the type of project or action being evaluated, the characteristics of the local land area, and the geographic extent of the affected study area.

Identification of Activities, Which Will Have Different Types of Impacts on Soil and/or **Groundwater Quantity – Quality:**

Direct Land-Use Impacts on Land:

l. Land Forms: Unique or important physical features that have special importance may be present in the project area. Examples are rock out crops, river gorges, sandy beaches, and lagoons.

Soil profile: The soil profile has a direct bearing on land capability for agricultural or other purpose. Erosion is the principal process which may alter the soil profile and it can have a direct effect on existing or potential land use, and an indirect effect through siltation on water quality, fishing, and land use downstream.

Soil composition: The chemical and mineral composition of the soil influences its engineering and agricultural capability. Changes in soil composition can occur either by acid or alkali leaching or by nitrogen fixation.

Slope stability: Rock slopes are inherently stable. The environmental effects of slope instability are similar to those for erosion.

Seismicity: Renewed or increased activity can have major environmental effects for the project site.

Subsidence and compaction: Subsidence and compaction occur naturally but generally as a

gradual and almost imperceptible process. The process can be accelerated however by underground excavation vibration or loading.

Flood plains and Swamps: Reclamation on natural flood plains or swamps may result in flooding and siltation of other areas during peak flow.

Land use: The existing land use and the compatibility with existing or planned use of adjacent land are important components of the environment. Careful site selection is the principal means of controlling them but many mitigating or abatement measures may also be available.

Mineral or engineering resources: The occurrence of mineral or engineering resources is of strategic and economic importance. Loss of such resources either through wasteful use or through development of incompatible with subsequent mining or quarrying proposal can result in long-term economic or social impacts on the community.

Buffer zones: Buffer zones are spaces which provide natural environmental protection from drainage by external events. They are usually vegetated, depending on the purpose and can provide wind breaks, erosion control, sediment traps, wild life shelter, sound insulation and visual screening.

Environmental Impacts on soil and ground water- A typical Example: Road Construction Project

Impacts and Setting

Soil is an important component of the natural environment, and is a primary medium for many biological and human activities, including agriculture. Its protection in relation to road development deserves considerable attention.

In the road itself, in borrow pits, or around rivers and streams, there are many places where damage might occur. Losses includes farmers losing cropsand land, fishermen losing income because of sedimentation in rivers and lakes etc.,

Loss of Productive Soil

Soil productivity can also be reduced significantly as a result of compaction with heavy machinery during construction.

Erosion

When natural conditions are modified by the construction of a road, it marks the start of

erosion. In some cases erosion might result in cumulative impacts far

beyond the road itself affecting slopes, streams, rivers, and dams at some distance from the initial impact.

Destabilization of Slopes

Slope stability can be upset by the creation of road cuts or embankments - can result in landslides

Side Tipping off Spoil Materials

Spoil material from road cuttings can kill vegetation and add to erosion and slope stability problems.

Water Flow Diversions

Diversion of natural surface water flows is often inevitable in road projects. Engineering Measures

In many cases, vegetation alone may not be enough to prevent erosive damage to slopes and various engineering measures may be needed to complement or replace it. The use of slope retaining techniques may be necessary

Groundwater - Quantity and Quality Impacts:

The consideration of groundwater quantity and quality impacts consist of identifying the types and quantities of groundwater pollutants and/or groundwater quantity changes anticipated to be associated with the construction and operational phases of the proposed project.

This activity should also be performed for any alternatives to the project or proposed plan programs.

Description of Existing Soil and /or Ground water Resources Soil Characteristics

(Background Information on the Soil Environment)

Soil Characteristics of both natural influences and human activities.

The soil and geological environments are typically associated with the physical and chemical environment.

For example, the habitat types and associated vegetation found in an area will be a function of the soil characteristics. Additionally, cultural resources may be related to soil characteristics

or possibly, to unique geological features in an area.

The relationship between shallow, alluvial aquifers and the flow of surface streams and rivers may need to be explored.

The principal anthropogenic activities, which can cause ground- water pollution, are to be summarized.

In describing quantity and quality, the following issues should be addressed:

Description on groundwater systems in the study area, indicating whether they are confined or unconfined. (Unconfined groundwater systems tend to be more susceptible to groundwater contamination.)

Description of karsts aquifer systems since these areas can exhibit unique and rapid groundwater flow patterns.

Description of geographical areas characterized by multiple aquifer systems.

Quantitative aspects of the groundwater resource in terms of potentially useable supplies, which could be extracted.

Uses of groundwater within the study area, with a more detailed study of this subject to be conducted later.

Description of the relationships between local groundwater systems and surface streams, lakes, estuaries, or coastal areas. (Since mutual quantitative or qualitative influences can occur.)

Groundwater pollution vulnerability: Whether the project area is in a recharge zone or not. (There is greater pollution potential in the recharge zone.)

Depth of groundwater. (Greater the depth of groundwater, the greater the degree of natural protection)

Unsaturated - zone permeability should be described. ("unsaturated zone" refers to that segment of the subsurface environment and can influence the attenuation of contaminants as they move away from a source of pollution and toward the groundwater system.)

Aquifer transmissivity should be described. (This parameter represents information on the water carrying capacity of the ground water system.)

Any existing data on groundwater quality should be summarized. If no such data exists, it may be necessary to appropriately plan and conduct a ground water monitoring program.

Unique Soil or Groundwater Problems

Many geographical areas exhibit special or unique problems that should be addressed in the description of baseline conditions for the soil or groundwater· resources in the study area.

Examples of these problems include saline seeps, presence of hazardous waste sites etc,.

Pollution Sources and Groundwater Users

It is appropriate to consider other potential and actual sources of soil and/or ground water pollution which may exist in the study area, and also to consider current and potential future usage of the groundwater resource for purposes of water supply techniques.

Procurement of Relevant Soil and / or Groundwater Quantity / Quality Standards

Land-use restrictions, soil quality standards, soil reclamation requirements, and ground water quantity/quality standards, regulations, or policies are examples of institutional measures, which can be used to determine impact significance and required mitigation measures.

Thus, to determine the specific requirements for a given project area will require contacting appropriate governmental agencies within jurisdiction.

The primary sources of information needed for step 3 (Figure 1) will be pertinent to the governmental agencies, namely, Central government, State government and/or local agencies. In addition, international environmental agencies may have information pertinent to this step.

Impact Prediction:

The prediction of the impacts of project - activity on the soil and/or ground – water environment(s), or conversely, the potential influence of the environment(s) on a proposed project, can be approached from three perspectives.

Qualitative

Simple quantitative, and

Specific quantitative

In general, efforts should be made to quantify the anticipated impacts; however, in many cases this will be impossible and reliance must be given to qualitative trend.

In general, the mixing of sub-soil with topsoil will have an adverse impact in soil fertility and soil structure.

The severity of the impact will depend on the nature of the sub-soil.

Qualitative Approaches-Groundwater Impacts

A qualitative approach for groundwater - impact prediction involves the fundamental subsurface environmental processes.

The fundamental processes in the sub-surface environment can be examined from the information related to physical, chemical, biotic aspects.

Ground water

Water table: The water table elevation is an important contributory factor to engineering and agricultural land capability. It also affects the nature of habitats.

A change in its seasonal fluctuation may result from a reduction in the natural recharge or from increased draw-off from the ground water system

Flow regime: The ground water flow regime, the direction and rate of flow may be altered by surface or underground engineering, especially drainage works. Any such change can have an impact on other users of the ground water source

Water quality: Water quality is important for economic, ecological, aesthetic and recreational purposes.

Changes in water quality may affect water treatment costs or even deny some uses of the water. These changes can be chemical, biological or physical.

Recharge: Impoundment, rearing or compaction of the ground surface and removal of vegetation can alter the recharge of the ground water system.

Recharge should be considered together with water table, flow regime and water quality

Aquifer characteristics: These include all the physical parameters (porosity, permeability etc), which govern the ability of aquifer

Existing use: The uses of ground water system must be for engineered domestic, industrial and agricultural.

Assessment of Soil and Ground Water Pollution

Leaching into Soil and Groundwater

The volume of leachate percolating through a site can be predicted using mathematical models such as the water balance method in sites above the water table. The water balance method calculates leachate flow by balancing flows into and out of a site as follows:

$\Delta S = I-O$

where

I is the inflow volume; O is the outflow volume;

S is the storage volume; and

ΔS is the change in the storage volume.

In the unsaturated zone:

$L=P- R- Evt+ Vd- Evd$

Where

L is the leachate volume;

P is the precipitation volume; R is the runoff volume;

Evt is the volume lost to evapotranspiration; Vd is the volume of liquid disposed; and

Evd is the volume of the liquid disposed lost to evaporation.

Darcy's Law is the basis for most models of groundwater flow in sites below the water table.

The method describes the flow of groundwater through a saturated porous medium.

Changes in Groundwater Flow

The effects of physical disturbances and discharge of liquid effluents into groundwater include changes in the availability of soil moisture for soil microorganisms and plants, reducing the available yield for abstraction which

can lead to saltwater intrusion to underground water sources or a change in the hydrology of surface waters.

Changes in Groundwater Quality

Superimposing models can simulate the behavior of non- conservative pollutants. Tracer experiments may be used to predict dispersion of pollutants in groundwater.

Qualitative Approaches-Soil Impacts

One example of qualitative approach for soil impact prediction is acid rain impacts on soils as a result of a proposed project.

Another example is related to pipeline construction. There are four potential impacts of pipeline construction on drainage and soils:

Contamination of topsoil with excavated subsoil

Soil compaction

Soil erosion, and

Disruption of drainage lines or natural drainage patterns.

In most soils, the top several inches are relatively high in organic matter, nutrients, and soil biota. Pipeline construction can result in the mixing of subsoil with top-soil during the excavation and back filling of the pipeline.

Changes in Soil Structure

Changes in soil structure are caused by

agricultural practices,

ground conditions,

surface water conditions and

by removal of subsurface soil or water.

The effects of these changes can manifest on

soil microorganisms,

plants and animals,

crops and livestock,

groundwater and surface water hydrology and quality,

visual landscape and amenity and the integrity of buildings and

other civil engineering works.

Erosion resulting from changes in ground cover, management practices, rainfall and run off, and wind exposure can be predicted by the universal soil loss equation.

Effects on Soil Quality

In order to determine the effects on soil quality of contaminants, it is necessary to establish the chemical composition, quality, and amount of substrate in the various soil strata; absorption and adsorption onto soil particles; uptake by plants; transport through the soil; and the chemical and biological conversion of substances.

Simple Quantitative Approaches-Soil Impacts

Another approach for addressing impacts on the soil environment is to use simple quantitative techniques. One example of a simple quantitative technique is the use of "overlay mapping" which has been developed to delineate various land-use compatibilities in given geographical areas.

Overlay mapping consists of utilizing a base map of the project study area and different soil or geological features of particular impact concerns of the proposed project.

Impact prediction involves identifying where overlaps of particular concerns occur.

GIS can also be used to develop empirical relationships between resource loss and environmental degradation.

Quantitative Models

Models have been developed to:

simulate individual processes occurring in soil;

describe behavior of substances in soil such as nitrogen, phosphorous and pesticides (laboratory experiments using column tests and Lysimeters may also predict the behavior of substances in soil);

predict the behavior of liquids, which are immiscible with water (for example, mathematical models for oil spills on land which simulate the behavior of oil on the surface and in the unsaturated zone and its dispersion above the groundwater table);

simulate the behavior of gases in soil; or

predict dispersion of heat released by pipelines or cables, or discharged in effluents.

Assessment of Impact Significance

There are several approaches which can serve as a basis for interpreting the anticipated project induced changes to the soil and groundwater environments.

One approach is to consider the percentage and direction of change from existing conditions for a particular soil or groundwater environmental factor.

Another approach for impact assessment is to apply the provisions pertinent to Central, State, or Local laws and regulations related to the soil and groundwater environment to be expected with project conditions.

A third approach for interpreting anticipated changes relies upon professional judgment and knowledge. A professional-judgment-based interpretation of anticipated changes may consist of applying rules of the thumb. As an example, concerning soil erosion, the current and anticipated soil erosion patterns from a project area could be compared to regional averages or historical trends.

Environmental Analysis

After the above types of factors are considered, the resultant conclusion may not be absolute. The environmental analysis should yield the best possible prediction of environmental effects based on available information.

Other Secondary Effects

Secondary impacts can occur, however, due to changes in land-use or land-use plans. Many of these secondary impacts are not limited to socio-economic

effects, but can equally affect natural resources, such as, water quality or wildlife habitat.

Assessment Impacts of Induced Development

If induced development is predicted, the environmental impact analysis should consider, to the extent possible, the effects of this induced development.

Perhaps increased density of residential or commercial and industrial land use will, in turn create a need for additional schools, parks, public support programs and facilities, service industries, public water or power supply, solid waste and sewage disposal capacity, improvement in local roads or intersections, or increased emergency services (fire and police)

and health care facilities.

Identification and Incorporation of Mitigation Measures

(Mitigation measures to prevent soil erosion, compaction and ground water pollution during and after execution of any developmental project.)

Use of techniques to decrease soil erosion during either the construction or operational phase of the project.

Where possible gentle gradients should be treated and steep slopes avoided.

Suitable drainage systems to direct water ways from slopes should be installed

Creating large open expanses of bare soil should be avoided. These are more susceptible to wind erosion. If such large areas are created then wind breaks may be a useful mitigation procedure.

If the development is near to a water body, siltation traps may need to be installed to trap sediment and prevent any damage to the fresh water ecosystem

Driving over the soil should be avoided or use wide tyres to spread the weight of vehicles thereby avoiding compaction

Few tracks too should bring vehicles to the working area

Cultivate the area after compaction has taken place. Rotation of land-use practices in the project area can be adopted.

The project can be designed to exhibit greater earthquake resistance if this is a potential concern for the project area.

For projects involving usage of the groundwater resource, groundwater usage could be decreased.

If the potential impact of concern is land subsidence management, techniques to minimize groundwater usage in the area where subsidence is expected to occur could be implemented. These could encompass water conservation measures so as to reduce groundwater requirements.

For projects, which may be of concern because of leachate generation, measures could be taken to immobilize the constituents and prevent their generation.

Prediction and Assessment of Impacts on Surface Water Environment Introduction

Several developmental activities will result in environmental impacts on surface water bodies. Impacts on surface waters are usually caused

by physical disturbances, (for example, the construction of banks, dams, dikes, and other natural or manmade drainage systems),

by changes in climatic conditions, and

by the addition or removal of substances, heat, or microorganisms etc. (for example, the discharge of effluents and deposition of air pollutants into water).

These activities and processes lead to first order effects as manifested by changes in surface water hydrology, changes in surface water quality, and consequently to higher order effects reflected by changes in sediment behavior, changes in salinity, and changes in aquatic ecology.

Projects Which Create Impact Concerns for the Surface-Water Environment

The following are the list of various developmental activities which cause significant impacts on surface water resources for which a detailed EIA is normally required:

Industrial power plants withdrawing surface water for cooling (this may be of particular concern during low- flow conditions).

Power plants discharging heated waste water from cooling cycles

Industries discharging process waste waters from either routine operations or as a result of accidents and spills.

Municipal waste water treatment plants discharging primary, secondary or treated waste waters.

Dredging projects in rivers, harbors, estuaries and or coastal area (increased turbidity and release of sediment contaminants may occur)

Projects involving "fill" or creation of "fast lands" along rivers, lakes, estuaries and coastal area.

Surface mining projects with resultant changes in surface water hydrology and nonpoint pollution.

Construction of dams for purposes of water supply, flood control or hydropower production.

River canalization projects for flow improvements

Deforestation and agricultural development resulting in non-point source pollution associated with nutrients and pesticides and irrigation projects, leading to turn flows laden with nutrients and pesticides.

Commercial hazardous waste disposal sites and/or sanitary landfills, with resultant run-off water and non-point-source pollution; and

Tourism projects adjacent to estuaries or coastal area with concerns related to bacterial pollution.

Methods for Evaluation of Impacts of Various Developmental Activities on Surface Water Environment

For assessing the environmental impacts of various human activities on surface water bodies, a model is suggested which connects six activities or steps for planning and conducting impact studies.

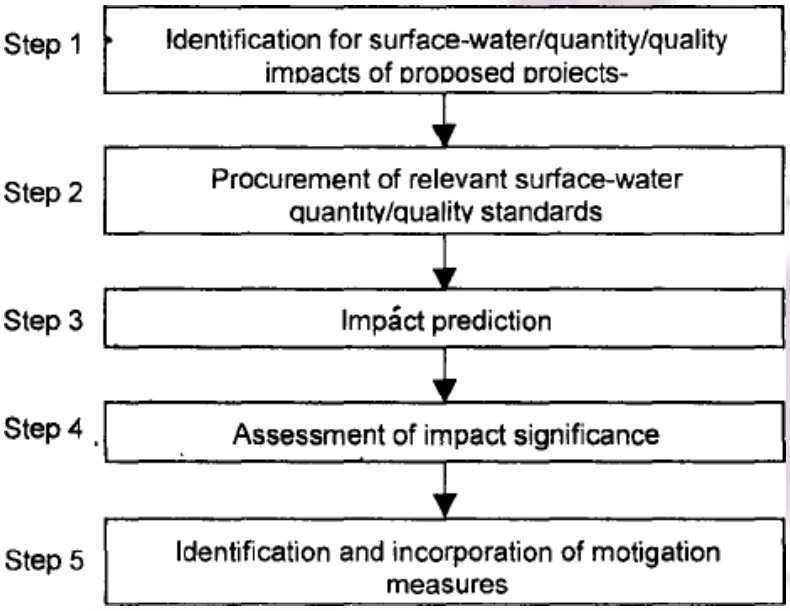

Fig. Conceptual approach to study surface water environment impacts.

Step 1 Identification of Surface Water Quantity or Quality Impacts of Proposed Projects

The first activity is to determine the features of the proposed project, the need for the project, and the potential alternatives, which have already been or may now be, considered.

The key information relative to the proposed project includes items such as

The type of project and how it functions or operates in a technical context, particularly with regard to water usage and waste water generation, or the creation of changes in water quality or quantity,

The proposed location of the project,

The time period required for project construction,

The potential environmental outputs from the project during its operational phase, including information relative to water usage and water pollutant emissions, and waste-generation and disposal needs.

The identified need for the proposed project in the particular location (this need could be related to flood control, industrial development, economic development and many other requirements ;), and

Any alternatives which have been considered, with generic alternatives for factors including site location, project size, project design features and pollution control measures, and project timing relative to construction and operational phases.

The focus of this step is on identifying potential impacts of the project. This early qualitative identification of anticipated impacts can help in refining subsequent steps.

For example, it can aid in describing the affected environment and in calculating potential impacts.

For example, rainfall in highly industrialized regions may consist of acidic precipitation which is introduced to the surface water, and may bring with it natural organics, sediments, and so on;

The discharge of waste water (treated or otherwise) greatly adds to the organic loading of the surface water.

Clearing of land for construction, farming. etc., results in increased erosion and sediment load in the surface water. It is to be noted that highway construction and agricultural operations yield the highest erosion rates, whereas natural land drainage yields among the lowest erosion rates.

The two main sources of water pollutants to be considered are non-point and point sources as shown in Table below.

Non-point sources are also referred to as "area" or "diffuse" sources.

Nonpoint pollutants	Point pollutants
Pollutant from : Urban area, industrial area, or rural run-off *Examples* : sediment, pesticides, or nitrates entering a surface water because of runoff from agricultural farms	*Specific discharge from .* Municipalities or industrial complexes *Example* : Organics or metals entering a surface water as a result of waste water discharge from a manufacturing plant

In a given body of surface water, non-point source pollution are difficult to assess and can be a significant contributor to the total pollutant loading, particularly with regard to nutrients and pesticides.

Some general characteristics of Non-point source pollution are as follows:

Non-point-source discharges enter surface waters in a diffuse manner and at intermittent intervals that are related mostly to the occurrence of meteorological events;

Pollution arises over an extensive area of land and is in transit overland before it reaches surface waters;

Non-point source discharges generally cannot be monitored at the point of origin, and the exact source is difficult or impossible to trace;

Elimination or control of these pollutants must be directed at specific sites: and

In general, the most effective and economical controls are land management techniques and conservation practices in rural zones and architectural or hydrological control in urban zones.

In addition to information on pollutant types and quantities, it may also be necessary to assemble information on the transport and fate of specific pollutant materials.

For example, information may be needed on the fate of petroleum products, other organics, nutrients, metals and so on in the water environment.

Table below provides an overview of important surface water contaminants and their impacts

Contaminants	Reason for importance
Suspended solids	Suspended solids can lead to the development of posludge deposits and anaerobic conditions when untreated wastewater is discharged in the aquatic environment.
Biodegradable organics	Composed principail y of proteins, carbohydrates, and fats, biodegradable organics are measured most commonly in terms of BOD (biochemical oxygen demand) and COD stabilization can lead to the depletion of natural oxygen resources and to the development of septic conditions.
Pathogens	Communicable diseases can be transmitted by the pathogenic organism in wastewater.
Nutrients	Both nitrogen and phosphorus along with carbon, are essential nutrients for growth. When discharged to the aquatic environment, these nutrients can lead to the growth of undesirable aquatic life. When Discharged in excessive amounts on land, they can also lead to the pollution of groundwater.
Priority pollutants	Organic and inorganic compounds selected on the basis of their known or suspected carcinogen icity, mutagenicity, teratogenicity, or high acute toxicity. Many of these compounds are found in wastewater.
Refractory organics	These organics tend to resist conventional methods of wastewater treatment. Typical examples include surfactants, phenols, and agricultural pesticides.
Heavy metals	Heavy metals are usually added to wastewater from commercial and industrial activities an may have to be removed if the wastewater is to be reused.
Dissolved Inorganics	Inorganic constituents such as calcium, sodium , and sulfate are added to the original domestic water supply as a result of water use and may have to be removed if the wastewater is to be reused.

Source : Metcalf and Eddy, 1991, p. 58

Step 2 Description of Existing Surface - Water Resource Conditions

This step involves describing existing (background) conditions of the surface water resource(s) potentially impacted by the project. This includes

To gather information on water quantity and quality levels in the area of the project, particularly focusing on quality parameters related to anticipated water pollutants to be emitted from construction and operational phases of the project,

To identify any unique pollution problems that has occurred in the project area. This is necessary in order to describe the environmental setting, to indicate a familiarity with the area, and to focus on environmentally sensitive parameters. Examples of unique pollution problems that should be identified include fish kills, excessive algal growth, and thermal discharges causing stratified flows.

To describe Ground water quantity and quality in the area, if relevant for the project alternatives, noting the depth of groundwater table and direction of ground water flow. This also includes identifying major local uses of ground water, and delineates historical trends for ground water depletion and pollution.

To obtain meteorological data in order to predict and assess air quality impacts associated with proposed actions. In addition climatological factors such as precipitation, evaporation, and air temperature are important in terms of predicting and assessing water quality impact.

To summarize the organic waste load allocation study for the area. Also procure extant information on inorganic, thermal, sediment, and bacterial waste loads. Identify known point

sources of pollution, focusing specifically on unique discharges or wastewater constituents. Also enumerate the types of water uses in the area and the quantities involved.

Step 3 Procurement of Relevant Surface-water Quantity-Quality Standards

To determine the severity of the impact that may result from a project, it is necessary to make use of institutional measures for determining the impact significance.

Surface-water quantity and quality standards, regulations, or policies are examples of these measures. Thus determination of the specific requirements for given surface water will require contacting governing agencies in one or several regions.

The intended use of the surface water with the use as drinking water supply typically results in the most stringent standards.

Effluent limitations regulating the permissible quality of discharged waste water from domestic and industrial sources may also be pertinent, along with regulations concerning non-point discharges from industrial areas. In some cases, there may be limitations on the amount and timing of water usage from a given body of water.

Water quality management policies may also be pertinent; examples of such policies include anti-degradation goals, clean-up or remediation goals, and / or goals for preservation of aquatic ecosystems and scenic beauty.

Typically, state water quality standards represent statewide goals for individual water bodies and provide a legal basis for decision- making.

The standards designated by Central Pollution Control Boards (CPCB) will be based on the use or uses to be made of the water and set criteria necessary to protect the water resources and environment in general. It should be noted that most water quality standards and water-use restrictions are related to low-flow periods in the' river system.

Step 4 Impact Predictions:

"Impact prediction" refers to the quantification (or, at least, the qualitative description), where possible, of the anticipated impacts of the proposed project on various surface water environment factors. Because of the complex and dynamic nature of hydrological systems accurate prediction of impacts is often difficult and there are bound to be some uncertainties which have to be recorded in the EIS.

The following considerations may be relevant to the prediction of surface water quantity

/quality impacts

frequency distribution of decreased quality and quantity;

effects of sedimentation on the stream-bottom ecosystem;

fate of nutrients by incorporation into biomass;

reconcentration of metals, pesticides, or radionuclides into the food web;

chemical precipitation or oxidation-reduction of inorganic chemicals; and

anticipated distance downstream of decreased water quality and the implications for water users and related raw-water quality requirements

Depending upon the particular impact technically demanding mathematical models might be required for prediction.

Other approaches include the conduction of laboratory testing, such as, leachate testing for degraded material and for solid or hazardous waste materials or sludges.

The environmental effects on surface water are given below.

l. Shoreline: The shoreline and the river bank have special economic, ecological, aesthetic and recreational importance. Project development in the vicinity of shoreline may affect these uses. Furthermore any alteration of the shoreline may upset the land / water equilibrium and cause erosion.

Bottom interface: The river bed, lake bed and the sea floor provide habitats, determine flow regimes, influence water quality and can be a source of minerals.

Then disturbance may cause shore-line erosion some distance away, create turbidity and destroy habitats.

Flow variation: Flow regulations can affect transport capacity and water quality and can have a direct effect on economic, recreational and ecological characteristics of the system and adjacent land.

Water quality: Water quality is important for economic, ecological, aesthetic and recreational purposes. Water quality changes can be physical, chemical and biological and may affect water treatment costs or even deny some uses of the water.

Drainage pattern: Any alteration to the drainage pattern can affect the capability of land and

wetland habitats. It may also disrupt the natural flow variation of the catchments.

Water balance: The equilibrium between precipitation, runoff, infiltration and evapotranspiration can be upset by project development. It may also disrupt the natural flow variation of the catchments.

Flooding: Reclamation of natural flood plains or swamps may result in flooding and siltation of other areas during peak flow.

Existing use: The use of surface waterways for new projects can deny existing uses such as for transport recreation water supply by creating turbidity. Constructing barriers or changing the water quality.

It is necessary for professionals to use their best judgment. Impact prediction involves the question whether the pollutants are conservative, non-conservative, bacterial or thermal.

Conservative pollutants are not biologically degraded in a stream, nor are they lost from the phase as a result of precipitation, sedimentation or volatilization.

The basic approach for prediction of downstream concentration of conservative pollutants is to consider the dilution capacity of the stream and use a mass- balance approach with appropriate assumptions.

Non-conservative pollutants refer to organic materials that can be biologically decomposed by bacteria in aqueous systems. Nutrients are also non- conservative, since they can be involved in biochemical cycling and plant uptake.

Predication of impacts resulting from non-conservative and bacterial pollutants and thermal discharges require mathematical-modelling.

Step 5 Interpretation of Impact Significance

For protection and assessment of a significant impact by public opinion collection there are a number of specific numerical standards or criteria. For example, a number efficient discharge standards are prescribed for discharging into lakes or land with professional judgment.

The application of the professional judgment in the context of assessing impacts related to the biological environment; for example, the biological scientist in the study team would render judgments as to the applicability of various laws and the potential significance of the loss of particular habitats.

Step 6 Identification and Incorporation of Mitigation Measures

The next activity is that of identifying and evaluating potential impact mitigation measures. Mitigation measures may need to be added to the project proposal to make it acceptable.

These mitigation measures might consist of decreasing the magnitude of the surface - water impacts or including the features that will compensate for the surface water impacts.

The specific mitigation measures will be dependent upon the particular project type and location.

Examples of certain actions, things which could be considered mitigation or control measures, depending on the type of project, are listed below:

Decrease surface-water usage and waste water generation through the promotion of water conservation and waste water treatment and re-use. Pre-treat waste waters prior to discharge into receptor.

Minimize erosion during the construction and operational phases of the project; this could be facilitated by the use of on-site sediment-retention basins and by planting rapidly growing vegetation.

In projects involving the use of agricultural chemicals, consider measures that could be used to plan better the timing of chemical applications, the rate of application, and the extent of such applications in an effort to minimize erosion and chemical transport to surface-water systems.

"Integrated pest management" (lPM) could also be used to decrease the pesticide loading from agricultural areas.

Manage non-point-source pollution through the application of Best Management Practices (BMPs) as determined by a state or a designated area- wide planning agency.

Develop a non-point-pollution-control program for coastal waters; information is available on management measures for agricultural sources, forestry, urban areas, marines, recreational boating, hydro-modification projects.

Use constructed wetlands to control non-point-source pollution involving nutrients, pesticides and sediments. As an example, a constructed system might include in hydraulic order, a sediment basin, grassy filter, wetland and deep pond.

Consider alternative wastewater treatment schemes to achieve treatment goals in a cost-

effective manner.

For point sources, the treatment schemes could include primary, secondary and / or tertiary processes involving physical, biological and/ or chemical principles of pollutant removal.

For thermal effluents the use of cooling ponds or towers might be appropriate.

Use techniques such as sediment removal and macrophyte (weed) harvesting for restoring lakes and reservoirs from water quality deterioration and eutrophication.

Prediction and Assessment of Impacts on the Air Environment Introduction

Many developmental activities will add air pollutants to the atmosphere or alter the weather and climate which may result in adverse effects on people, plants, animals, materials, buildings etc. These effects can occur at local, regional or even global scale.

Air Pollution Sources

The sources of air pollution can be classified based on the type of activity, their frequency of occurrence and spatial distribution, and the types of emissions, and can be delineated as arising from natural sources or from man- made sources.

Sources like windblown dust, volcanic eruptions, Lightning- generated forest fires and biological activity can be termed as natural sources.

Sources like transportation vehicles, industrial processes, power plants, construction activities, and military training activities can be termed as man- made sources.

Based on number and spatial distribution the air pollution sources are to be classified to include single or point sources (stationary), area or multiple sources (stationary or mobile), and line sources.

Pollutant emissions from industrial process stacks, as well as stacks of different fuel combustion processes are typical examples of point sources, while vehicular traffic, fugitive - dust emissions from resource - material stockpiles or construction, or military training activities over large geographical areas are examples of area sources.

Air Pollution Effect

The air pollution effects can be grouped into:

Examples of effects on human health include eye irritation, headaches, and aggravation of respiratory difficulties. Plants and crops will be subjected to the undesirable consequences of

air pollution, including abnormal growth patterns, leaf discoloration or spotting and death. Animals such as cattle will be subjected to undesirable consequences of atmospheric fluorides.

Materials damage examples are : property devaluation because of odours, deterioration of materials sllch as concrete statuary, and discoloration of painted surfaces on cars, buildings, and bridge structures.

Effects on climatic changes include green house effects, ozone depletion, etc.

The aesthetic effects include reductions in visibility. discoloration of air, photochemical smog - related traffic disruptions at airports, and the general nuisance aspects of odors and dust.

Activities of major concern are the burning of waste, the emission of dust and smoke, and the emission of chemical impurities such as heavy metals, acid or other toxic gases.

Principal effects are on human health, aesthetic value (sight and smell), adjacent land uses, temperature modifications and humidity changes.

Closely related to the subject of air quality is that of atmospheric visibility which is of both economic and aesthetic importance. Poor visibility due to gas, vapor, smoke or dust emission can have major impacts.

Excessive heat emission at ground level can create katabolic winds and give rise to conditions favoring thermal inversions. Inversion layers can concentrate impurities in the atmosphere at, or close to ground level. Some localities are more susceptible to temperature inversion than others, the topographic character of the area and local wind patterns are important contributing factors.

Highways, tall buildings and major earth works (e.g., contouring) can modify wind patterns locally. Firebreaks in forests can produce a wind tunneling effect. In addition, large paved areas or bodies of water can generate thermal updrafts.

Environmental effects on human communities are of major importance because they have always direct impacts.

Effect of air and water pollution on human health and safety include physical safety, aspects of psychological well-being, parasitic diseases, communicable diseases and physiological diseases.

Predicting Changes in Concentrations

The assessment of air quality impacts usually focuses on determining concentrations of air pollutants.

Predicted concentrations are often compared against national or local air quality standards or objectives. Much of the pre-project air quality data collection is directed at determining pollutant concentrations at different times, at different locations, and the variations in concentration in time and in space.

This information not only determines a baseline for comparison against changes but also provides background information for predictive models. In cases where there is concern for higher order effects, predictions of pollutant concentrations are necessary inputs into predictions of deposition rates, exposure to flora, fauna and man; and changes to local climate and visibility.

Air Quality

Atmospheric changes are generally caused by the release of reactive substances into air by stationary or mobile sources and by changes in surface morphology (for example, the construction of large buildings, and clearance of vegetation, forestation, and creation of water impoundments).

Possible environmental changes range from first order (immediate impact) effects of changes in concentration of substances in the air to higher order (longer-range and secondary impacts) effects of physical and chemical changes on climate (for example, turbulence effects, haze, microclimates over water, heat emission effects, greenhouse effect); to the deposition of substances on soils, water, materials and vegetation; to effects of deposited substances on materials (for example: soiling, corrosion); to effects of changes in climate and air quality on visibility in the atmosphere.

Generalized Approach for Assessment of Air Pollution Impact

To evaluate the impacts on air environment by any project activity, a six- step or six-activity model as shown in Fig. below was proposed for planning and assessment of impact studies.

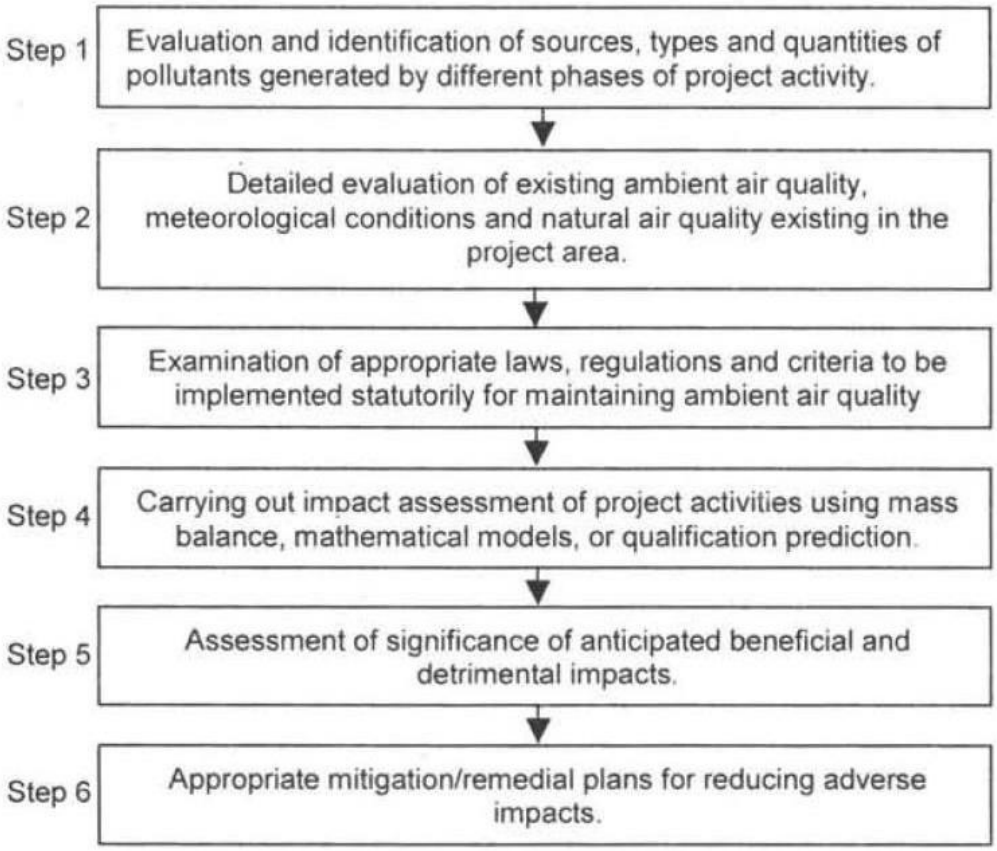

Fig. Six- Activity step model for EIA studies.

Step 1: Evaluation arid Identification of Sources, Types and Quantities of Pollutants Generated by different Phases of Project Activity

In the first step one has to examine what types of air pollutants are likely to be emitted during the construction and / or operational phases of the proposed project - activity, and their quantities.

One can use the emission factor information based on the project type or activity. An "emission factor" is the average rate at which a pollutant is released into the atmosphere as a result of some activity, such as, combustion or industrial production, divided by the level of that activity. Emission factors relate to the types and qualities of pollutants emitted to indicators, such as, production capacity, quality of fuel burned, or vehicle-miles traveled by an automobile.

Compilation of Air Quality Information

All the information on the existing air quality particularly for the pollutants likely to be emitted

from various project activities is to be identified in step. I. Based on this air quality data historical trends are to be integrated.

The collected raw data should be compared in terms of the existing air data and presented in accordance with the averaging times in pertinent ambient-air- quality standards.

Base- line ambient-air quality data will be useful for assessing whether the air quality before the project activity exceeds, attains or does not comply with relevant standards. Some relevant toxic air pollutants also have to be examined in addition to normal air pollutants.

Procurement or Development of Emission Inventory

For evaluating the potential air quality impacts of a proposed project or activity, it is necessary to identify the study area (potential area or region of influence) associated with the air pollution emissions.

The delineation of the study area can be made using the boundaries of the land associated with the project activity, or the delineation can be include a larger area by considering the atmospheric dispersion patterns within the vicinity of the proposed project or activity.

So an emission inventory gives the overall scenario of air pollutant emissions in the existing meteorological conditions of the project area.

Step 2: Detailed Evaluation of Existing Ambient Air Quality, Meteorological Conditions and Natural Air Quality Existing in the Project Area

In terms of ambient air quality data, emissions inventories and meteorological information which relate to atmospheric dispersion the bare time air quality information has to be discussed based on various systematic approaches.

Key Meteorological Data

Categorizations of meteorological parameters which hinder dispersion of pollutants emitted into the atmosphere have to be made on the following lines:

Meteorological data which describe the general air-pollution-dispersion characteristics of the study area. Meteorological data useful to describe the atmospheric dispersion of air pollutants form a project activity quantitatively.

Meteorological data useful and necessary for air pollution dispersion modeling.

The general atmospheric dispersion conditions will provide a fundamental understanding of

atmospheric transport.

Data indicative of the general characteristics of the area with regard to air- pollution dispersion include mixing height, inversion height and mean annual wind speeds.

Wind rose information can be used qualitatively to disclose the atmospheric dispersion of air pollutants from project activity.

Step 3: Examination of Appropriate Air Quality Emission Regulation Laws and Air Quality Standards to be Maintained as Per Local, State and Central Government Notifications.

The basic information on air quality standards, criteria and policies of Local, State and Central Government agencies which have the statutory 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 projects or activities and will aid in deciding between alternative actions or in assessing the need for mitigation measures for a given alternative. Specific air quality management policies or requirements may be in existence for particular areas and the particular requirements of such policies have to be ascertained.

Step 4: Carrying out Impact Assessment using Mass Balance Mathematics Modeling and Single Qualitative Approach

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

Predictions of concentrations and deposition rates are often needed as inputs into other predictive models to determine the potential for secondary and higher order impacts.

Under mass-Balance approach, an emission inventory representing a mass balance of the total air pollutant emissions from all sources for a proposed project or activity entering the atmosphere during the constructional and / or operational phases is prepared.

Then a mesoscale impact calculation has to be carried out based on the expected increase in the existing emission inventory for one or more pollutants as a result of the construction and/or operational phase of the proposed project or activity using the relationship.

$$\text{Percentage increase in inventory} = \frac{\text{project-activity emission inventory information}}{\text{existing emission inventory information}} \times (100)$$

The increase in the percentage inventory for each pollutant for each project activity has to be assessed and the total percentage increase has to be arrived at by adding all the individual values in the inventory.

Box model is a simple atmospheric dispersion model which can be adopted to compute the ground level concentrations of specific air pollutants of concern emitted from the project activity.

Various Air Quality Dispersion Models can be derived to represent specific atmospheric processes of interest to a certain study. The most commonly used models are the Gaussian plume dispersion models which enable one to predict ground level concentrations of pollutants several kilometers from the source.

Mathematical models are also developed in air quality planning and management. These models are used to determine the optimum stack height, optimum emission rate, particulate deposition, distribution of air pollutants from elevated point source.

Using these models not only can the impacts of the project or activity of the project on air quality be assessed but also various modifications of the proposed

project activity be evaluated to assess the effectiveness of mitigation efforts to minimize the impacts of the project activity.

Step 5: Assessment of Significance of Impacts

Evaluation of the significance of anticipated changes related to the proposed project should be carried out through conducting public meetings and/or public participation programs.

Professional judgment based on the percentage changes from baseline conditions in terms of air-pollutant emissions levels and/or exposed human population, or the PSI, should carried out.

These changes should also be considered during both the construction and operational phases of a project.

For certain type of projects or air-pollutant prediction methods, there are numerical standards or criteria which can be used as a basis of interpretation.

Final impact significance can be assessed based on the specific effects of the types of air

pollutants from a proposed project or activity and identification of sensitive receptors in the study area.

Step 6: Development of Appropriate Mitigation or Remediation Plans for Reducing Adverse Impacts

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

The following are some examples where mitigation measures can help in minimizing detrimental effects of air pollution:

I. Regulatory control on the practice of open burning of agricultural crop residues like delineation of specified times for burning to occur and the establishment of distance requirements between residences and open burning areas will help in reducing air pollutant concentrations in sensitive areas.

Development of vegetation cover and watering or use of wind breaks, chemical stabilizers is the most common method for the temporary dust control of nearly 50%.

Planting of rapid growing vegetation in construction areas will reduce dust generation.

For reducing air-pollutant emissions from unpaved roads, paving the surface treating with penetration chemicals, watering, and traffic-control regulations are some of the remediation methods adopted.

In the case of open waste piles and staging areas, dry surface impoundments. landfills, land treatment systems, and waste stabilization measures are adopted as fugitive dust control techniques .

For controlling or reducing air borne pesticide residues resulting from spraying pesticide and other materials, the low-pressure spray nozzles can be used to minimize the generation of fine particles. Further by spraying the pesticide in periods of low wind velocities, dispersion of air borne pesticides can be reduced.

Several alternative fuels, including methanol, ethanol, compressed natural gas, liquefied petroleum gas, electricity, and reformulated gasoline are recommended for reducing air pollution from various combustion process in automobiles.

A number of advanced exhaust emission control technologies for gasoline and diesel fueled

cars, trucks, and buses are available to minimize the air pollutant from transportation sector.

For purifying gas from various point sources a number of control systems like cyclones, scrubbers, fabric filters, and/or electrostatic precipitators for control of particulate emissions are now available.

UNIT-4

EIA NOTIFICATION BY MINISTRY OF ENVIRONMENT AND FOREST

Environmental Auditing

Introduction:

The term "environmental audit" derived its name from "financial audit", and bears some similarity with the latter.

Financial "auditing" is a systematic examination of the Books and Records of a business or an organization, in order to ascertain or verify and to report upon the facts regarding its financial operations and the results thereof: auditing is thus considered to be the means for detecting frauds.

Similarly, an "environmental audit" is an independent, systematic method of verifying that environmental regulations, internal policies and good operating practices are being followed.

The concept of an environmental audit had its beginning in late 1970s in the USA, when the dire consequences of mismanaging environmental responsibilities prompted several companies to develop audit programmes of their own, as a preventive tool. Since then, the interest in environmental audit has increased tremendously in all developed countries and such auditing has now become a specialized field.

In India, a notification under the Environment (protection) Rules, 1986, has been issued in 1992,requiring industries to submit annual report of environmental auditing of their activities/operations, each year, beginning with 1992-93. The term audit report has been changed to "statement" in a subsequent amendment in the year 1993. The industries are now supposed to submit their "environmental statement" for a financial year ending on 31st March, to the concerned state pollution Control Board, on or before 30th September every year. As per the provision of the rule, practically none of the industries are exempted from submitting the above "environmental statement".

An environmental audit (EA) is a systematic, independent internal review to check whether the results of environmental work tally with the targets. It studies whether the methods or means used to achieve the goals or ends are effective.

EA involves studying documents and reports, interviewing key people in the organization, etc., to assess the level of deviations between targets and results.

Environmental audits are being used as a tool and an aid to test the effectiveness of environmental efforts at local level. They can be carried out for a number of reasons including the following:

To verify compliance.

To review implementation of policies.

To identify liabilities.

To review management systems.

To identify needs, strengths and weaknesses.

To assess environmental performance

To promote environmental awareness.

Environmental auditing thus has got far reaching benefits to the industry, to the society, and to the nation at large.

It should be appreciated that an audit is different than an "assessment" while assessment implies an overview with less details and direct checking, audit essentially implies statistical verification and direct checking with greater details. An effective audit must collect its own sample and verify the existing sampling data.

Environmental auditing thus may be viewed as a "management tool" internally, and "liaison" externally with the public and the regulatory bodies. It helps in pollution control; improve production, safety and health and conservation of natural resources by way of:

ensuring waste prevention and reduction,

assessing compliance with regulatory requirements,

facilitating control of environmental practices by the company's management, and placing environmental information to the public.

Objectives of Environmental Audit:

The objectives of an environmental audit are

to safeguard the environment and substantiates the compliance with the regulations

to determine the status of performance of the process/system, as well as that of the pollution control system.

to evaluate the efficiency and efficacy of resource utilization (i.e., people, machines and materials),

to provide the technical data base for use in plant modification, emergencies, etc.

to identify the areas of risk, environmental liabilities, weakness in management systems and problems in complying with regulatory requirements and

to ensure the control on waste/pollutant generation.

To identify potential cost savings by way of waste minimization or reuse/recovery/recycle of the wastes.

Types of environmental audits

The two main types of environmental audits areobjective-based andclient-driven.

Objective-based types

Environmental audit covers assessment of any activity that impinges on the environment.

The scope and objectives of the audit more usefully distinguish different audit categories and how the audit results are to be used. However, the objectives and scope are often a combination of several audit types and are usually defined on a case-by-case basis. Organizations have developed audit programmes to fit their particular needs.

Based on objectives, environmental audits can be further categorized as under:

Environmental Audit Types- Objective-based types		
Liabilities Audits	Management Audits	Activities Audits
Compliance Audit	Corporate Audit	Site Audit
Operational Risk Audit	Systems Audit	Waste Audit
Acquisition Audit	Policy Audit	Product Audit
Health & Safety Audit	Issues Audit	Cross-boundary Audit

Table: Environmental Audit Categories- Objective-based types

Liabilities audit:Compliance audit, operational risk audit, acquisition audit and health and safety audit form liabilities audit. These are often conducted as a prelude to gaining insurance cover and as a means of demonstrating the regulatory compliance.

Compliance auditing is probably the most common form of environmental audits; it is a verification process whereby the facility establishes the extent to which it is complying with environmental legislations, regulations, emission limits, etc.

Operational risk concentrates on the potential frequency and consequences of environmentally damaging activities in the raw material and product storage/handling and manufacturing process. Compliance with regulations does not necessarily reduce liability due to operational risks.

Acquisition audits assess the liability due to contaminated land and building remediation costs.

Health and safety audits normally form part of health, safety and environment (HSE) audit and involve assessment of adequacy of personal protective equipment (e.g., safety shoes, goggles, helmets, etc.), emergency preparedness and disaster management plans.

Management audit:Corporate audit, system audit, policy audit and issues audit form management audit. These pay considerable attention to management systems as they guide the efficient and effective running of the operations.

A corporate audit is initiated by the main Board of a parent company and is concerned with organization structure, roles and responsibilities,

policy implementation, awareness and communications with a subsidiary. This is carried out as a reassurance to the main Board that its aims and objectives are being implemented throughout the corporate structure.

Management system audits are carried out to check the systems against the policy and standards such as British Standard 7750 or ISO 14001.

Policy audit is carried out to review and reassess the relevance of policy in light of developments (legal, technical, financial) within the organization and outside.

Issues audit is carried out to establish environmental management plan and targets.

Activities audit: Site audit, waste audit, product audit and cross-boundary audit form activities

audit. These cover auditing of select technical and management issues.

Environmental site audit examines all aspects of the facilities performance with respect to the environment. It combines most of the elements of other types of EA and, when undertaken in depth, involve considerable time and cost.

The waste audits are of two types. The first identifies and quantifies waste streams and is a precursor to waste minimization programmes. The second type assesses waste management practices and procedures.

Product audits cover several aspects of their environmental impacts through design, manufacture, use and disposal. Such audits are pre- requisites for identifying environmentally friendly products for "Green Labelling".

Cross boundary audits assess activities, which cut across departments or business units (e.g., transport and supply chain audits).

Client-driven types

The different types of audits are based on the client, who has commissioned or ordered the audit procedure:

Environmental Audit Types-Client-driven types		
Category of Audit	Ordered By	Desired Result
Regulatory External	Regulatory Authority	Enhanced oversight
Independent External	Buyer, bank, customer, insurance firm, etc.	Objective information
Internal	Top management,	Reduced risk
	Members of Board	
Third Party	Top management, Members of Board	Certified environmental protection system

Table: Environmental Audit Types: Client-driven

Regulatory external audit: This often entails an examination carried out by or for an

environmental regulatory agency, with the goal of ensuring that a facility is meeting the relevant legislation and regulations. The regulatory agency can use the methodology of audit as a tool to systematically enhance its overview, including the possibility of verifying the accuracy of any reports, which a company is required to submit to the authority.

Independent external audit: This is conducted by external auditors entitled to perform audits. As the environmental factors have gained importance for a firm's market relations, shareholders such as banks and investment funds, insurance companies, environmental groups, potential buyers, customers, local government and environmentally-aware citizens are demanding independent external audits to assess how the firm deals with environmental issues.

Internal environmental audit: This often involves an inquiry commissioned by management. In practice, such audits are commonly ordered by senior management located at some distance, in both physical and operational senses, from the factory or site of environmental concern. In such cases, the environmental audits are internal in that the results will remain within the organization. However, for the facility under investigation, the internal audit will have the same effect as an external audit. One reason why firms conduct internal environmental audits is to diminish their liability to pay fines, damages or clean-up costs as the result of breaking the law (e.g., releasing more emissions than permitted).

Third party audits: These represent the audits certifying organizations carry out to verify as to whether internal/ external audits meet the standards set.

General Approach to Environmental Auditing

Environmental auditing essentially consists of three main phases:

Programme planning, or pre-audit preparations,

On-site activities, or site visit, normally involving interviews with personnel, inspection of facilities, data sampling, etc., and

Post-visit activities, involving evaluation of audit data and reporting of findings.

Programme planning or Pre-audit Preparations:

An environmental audit programme, particularly the compliance audits, can not be successful without the clear commitment of the management. Theprogramme should be initiated by the management and must provide all the resources necessary for the programme. The plant personnel should be directed to provide access and to cooperate with the auditors during their

work. The management should also have explicit commitment to follow-up an audit finding and correct the irregularities the audit will uncover.

Once the objective of the audit is finalized, preliminary information about the industry is obtained through a questionnaire. The information should include:

location of the plant and surrounding land use, climate condition, products manufactured, raw materials used, details about the manufacturing process, details about the water utilization, wastewater generation and disposal, gaseous emissions, solid/hazardous waste, organizational set up of the company, and Policies of the company in respect of environmental management.

The review of the above information helps in identifying the areas of concern and thus in the selection of members of the audit team. The team members should be selected carefully, and might include corporate staff, operating staff and even experts from outside. Each of these categories of persons has advantages and disadvantages in their approach to various issues. But a comprehensive audit team should have knowledge or "expertise" inenvironmental regulations, in plant operations and processes, in pollution control technologies—but essentially should be independent. A team member from the industry should not hesitate to criticize owing to obligations to his employer; he also should be convinced about the objective and the benefit of the audit.

Once the audit team is formed, the scope of the audit should be formalized, and specific tasks are to be allocated to each member. The team would plan their visit to the industry—and should ensure that such visits are not treated as "raids".

On-site Audit:

Primary purpose of the visit is to review documents maintained at the plant, to interview the operating staff, and to inspect all relevant operations conducted in the industry. Once the audit team becomes familiar with the manufacturing process, layout of the plant and process operations, and with possible impact on the environment, they should be able to work out the material balance in each unit operation, in respect of raw materials, water/air, power, etc. From the material balance, the sources and quantities of generation of wastewater, gaseous emissions and solid waste should be identified. A visit to the plant also allows detection of locations of potential leakages, spills or overflows. The "attitude" and "technical capability" of the associated staff should be observed critically for the accomplishment of safer environment.

Parameters to be monitored for pollution control can be determined from the material balance.

Not only the effluent and emissions, but also the ground water, ambient air, as well as other surface water in the vicinity and agricultural land around should be monitored to determine the impact due to the industry. In any event, the audit team should collect the sample of their own—and not depend upon the industry to do it.

Subsequently a draft report should be prepared which should include:

material balance in each unit operation, identification of locations generating the wastes, analyses of various samples, field observations, and Findings and possible recommendations.

The above draft should be placed before the Management for their observations, and recommendations.

Post-Audit Activities: The mass balance of the materials in each process should be compared with the stoichiometry requirements, and the excess usages of the materials are to be brought to the notice of the management and a norm should then be fixed for performance in each unit. Similarly the data in regard to the performance of pollution control devices should be analyzed and the reasons of failures, if any, should be diagnosed. Suggestions, in respect of segregation, neutralization, equalization, detoxification, etc., might also be given to minimize the pollution.

Finally, all the aspects as discussed above are to be documented and compiled, along with recommendations, in a formal "Final Report". The recommendations might include measures for best practicable environmental management, annualized capital cost of the pollution control measures and their operating cost, and action plans with time frame and priorities therein.

Action plans can best be developed by the management after the finalization of the Final Report. The management should ensure implementation of recommendations of the audit. The "environment division" of the industry could take the responsibility of reviewing the progress and of resolving the discrepancies.

Statutory Environmental Statement (i.e., audit report)

Under the provision of the Environment (Protection) Amendment Rules, 1993, the mandatory environmental statement (i.e., audit report) is to be submitted in a specified format, and consists of the following nine parts:

Part A, in which the particulars about the industry, in respect of ownership, industry category, production capacity, etc. are required to be furnished,

Part B, in which information about water and raw material consumption is to be furnished. The water budgeting and product wise or unit wise material balance is not essential for filling in entries in this part—but would help while filling in entries in this part but would help while filling other parts. The water budgeting is however difficult but not impossible to work out. Quite often actual requirement at site becomes necessary for this purpose.

Part C, in which information in regard to pollution discharged to environment from each unit is to be furnished. Both quantity and concentration of air and water quality parameters are to be included. The discrepancies, if any, should be highlighted—and the reasons explained.

Part D demands information about hazardous waste generation, if any, both from the process and the pollution control facilities.

Part E deals with solid wastes from processes and pollution control facilities: information about quantities recycled or reused or sold have to be furnished.

Part F Once again deals with hazardous as well as solid wastes, and seeks information about the disposal practices adopted for both the above categories of wastes.

Part G partially attempts to get information about the cost of pollution control and its effect on the cost of production.

Part H invites proposal for additional measures or investments for environmental protection and pollution control.

Part I is intended to include any other information not included in any other parts, which might improve the quality of the environment.

UNIT-5

THE ENVIRONMENT ACT, 1986

Environment (Protection) Act, 1986. (No 29 of 1986).

It is an Act (based on four chapters) that provides for the protection and improvement of environment, and the related matters.

This chapter gives the short title of the Act, and details of the extent and commencement of pollution, hazardous substances etc.

Section 2 of the chapter, defines environment, environmental pollutants, environmental pollution, hazardous substances, etc.

The Act has a broader spectrum and includes water, air and land and their inter- relationship which exists among and between water, air and land and human beings, other living creatures, plants, micro-organisms and property.

(General Powers of the Central Government)

Section 3 is related to the power of Central Government to take measures for the protection and improvement of environment.

Section 4 and 5, discuss the appointment of officers, their powers and functions and power to give directions.

Section 6 is very important as in accordance with this section, Central Government may by modification in the official Gazette, make rules in respect of all or any of the matters referred to in Section 3.

Section 15, is related to the penalty to be imposed for contravention of the provisions of the Act, and the rules, orders and directions issued from time to time.

For failure to comply with or contravening any of the provisions of the Act attracts the punitive clauses; for each failure or contravention the punishment is imprisonment for a term which may extend to five years, or imposition of fine which may extend to one lakhs rupees, or both. If the failure or contravention continue even after this punishment is meted out, additional fine which may extend to five thousand rupees per day has been provided for. However, if failure or contravention continues beyond the period of one year after the date of conviction, imprisonment for a term extendable to seven years is proposed.

This chapter makes a provision for any pollution caused due to any action taken in good faith, cognizance of offences, bar of jurisdiction, effect of other laws, etc.

As per the powers conferred by Section 6 and 25 of the Environment (Protection) Act, 1986 the Central Government has made the Environment Rules under modification No. S.O. 844 (E) of 19-1 1-86.

The Hazardous Wastes (management and handling) Rules 1989 under modification No. S.O. 594 (e) of 28-7-89 were also made by the Central Government with reference to Sections 6,8 and 25 of the Environment (Protection) Act, 1986.

Similarly, the Rules for the Manufacture, Use, Import, Export and storage of hazardous microorganisms /generally engineered organisms or cells were made under modification No. G.S.R. 1037 (E) of 5-12-89 as per the provision made in the Environment (Protection) Act,1986.

THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

This Act was promulgated for the purpose to provide for the prevention and control of water pollution and for maintaining or restoring of wholesomeness of water. It also provides for the establishment of Boards both at the Central and State level with a view to carrying out the purposes aforesaid.

There are in all eight chapters in this Act.

(Preliminary): This chapter mainly gives definitions of the terms used in the Act. Pollution, Sewage effluent, Sewer, Trade Effluent, etc,.

The Central and State Boards for Prevention and Control of Water Pollution :This chapter aims at establishment of Central and State Pollution Control Board at the central level and also at state level for each state and giving powers to the members so as to enable them to carry out the purposes of the Act.

Board is having 17 members to carry out the said purposes and the functions of the Board.

The Central Board shall consist of the following members, namely:- a full-time chairman, officials to represent the Government; persons from amongst the members of the State Boards, non-officials to represent the interests of agriculture, fishery or industry or trade or any other interest, persons to represent the companies or corporations owned, controlled or managed by the Central Government, and a full-time member-secretary, possessing qualifications,

knowledge and experience of scientific, engineering or management aspects of pollution control.

Similarly Act provides for the constitution of State Boards.

(Joint Boards): Section 13 and 14 give the constitution and composition of joint boards.

A Joint Board constituted in pursuance of an agreement entered into by two or more Governments of contiguous States

(Powers and Function of Boards): This chapter deals with the functions of Central Board / State Boards. This section is important to environmental engineers. The Boards may perform all or any of the following functions, namely: --

to plan a comprehensive programme for the prevention, control or abatement of pollution of streams and wells in the State and to secure the execution thereof;

to advise the State Government on any matter concerning the prevention, control or abatement of water pollution;

to collect and disseminate information relating to water pollution and the prevention, control or abatement thereof; to encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution;

to collaborate with the Central Board in organizing the training programmes relating to water pollution and to organize mass education programmes relating thereto;

to inspect sewage or trade effluents, works and plants for the treatment of sewage and trade effluents.

lay down, modify or annul effluent standards for the sewage and trade effluents and for the quality of receiving waters (not being water in an inter- State stream) resulting from the discharge of effluents and to classify waters of the State;

to evolve economical and reliable methods of treatment of sewage and trade effluents.

to evolve methods of utilization of sewage and suitable trade effluents in agriculture;

to evolve efficient methods of disposal of sewage and trade effluents on land.

to lay down standards of treatment of sewage and trade effluents to be discharged into any particular stream.

to make, vary or revoke any order

for the prevention, control or abatement of discharge of waste into streams or wells;

requiring any person concerned to construct new systems for the disposal of sewage and trade effluents. or to modify, alter or extend any

such existing system or to adopt such remedial measures as are necessary to prevent control or abate water pollution;

to lay down effluent standards to be complied with by persons while causing discharge of sewage or sullage or both and to lay down, modify or annul effluent standards for the sewage and trade effluents;

to advice the State Government with respect to the location of any industry the carrying on of which is likely to pollute a stream or well;

to perform such other functions as may be prescribed or as may, from time to time be entrusted to it by the Central Board or the State Government.

(Prevention and Control of Water Pollution)

It has several sections outlined as under:

Section 19 of this chapter describes the power of State Government to restrict the applications of the Act to certain areas only whenever necessary.

Section 20 describes power to obtain information by surveying or by stream gauging.

Section 21 gives powers to take samples of effluents, and lays down the procedure to be followed in this connection.

Section 24 is related to prohibiting the use of a stream or a well for the dispersal of polluting matter, etc. into these water bodies.

Section 25 restricts a person so as not to establish new outlets and new discharge points without the previous consent of the State Board.

Section 27 makes the provision for refusal or withdrawal of consent by the State Board.

Section 32 gives the details of the emergency powers of the State Board to take suitable measures in case of pollution taking place in a stream or well.

(Funds, Accounts and Audit)

The provisions relate to the smooth and efficient administration of the Boards.

(Penalties and Procedure)

Section 42 relates to penalty for certain prohibited acts.

Section 43 gives the penalty for the contravention of provisions of section 24.

Section 44 includes penalty for contravention of certain other provisions of the Act as a whole.

Sections 47 and 48 relate to the offences committed by companies and Government Departments.

This chapter describes functions of the Central Water Laboratory, State Water Laboratory, annual reports; and, the power of Central Government to supersede Central Board, power of State Government to supersede the State Board; and, outlines powers of Central and State Governments to make rules.

THE AIR ACT. 1981

Air (Prevention and Control of Pollution) Act, 1981. (No. 14 of 198 1)

It is an Act that provides for the prevention, and control of air pollution, and for the establishment of Boards, with a view to carrying out the aforesaid purposes. The Act also provides for assigning and conferring necessary functions and powers, respectively, to these Boards. This Act consists of seven chapters.

This chapter defines the various terms used in the Act.

(Central and State Boards for the Prevention and Control of Air Pollution)

This chapter lays down the constitution of these Boards. (Powers and Functions of Boards) Section 16, is related to the functions of Central Board. Section 17, gives the functions of State Boards.

(Prevention and Control of Air Pollution)

Section 19, empowers the authorities to declare air pollution control areas.

Section 21 (as added by Act 47 of 1987) outlines restrictions on the use of certain industrial plants.

Section 22, prohibits the emission of air pollutants in excess of the standards laid down by the concerned State Board.

Section 22 A (added by Act 47 of 1987) gives power to the Board to make applications to the appropriate court for restraining persons from carrying out air pollution activities.

Section 24, relates to the power of entry into and inspection of a pplace, etc., by a person empowered by a State Board; whereas Section 25 gives power to obtain information.

Section 3 1 A (inserted by Act 47 of 1987) gives power for giving discretion to theBoard to close, prohibit or regulate any industry; it also empowers the Board to stop or regulate the supply of electricity, or handle any other service in a similar manner.

(Funding, Accounts and Audit)

This chapter discusses the budgetary provisions and related issues.

(Penalties and Procedures)

Section 37, 38 and 39 discuss the penalties for failure to comply with the provisions of Section 21,22 or 31 A, and penalties for certain acts, and for the contravention of certain provisions of the Act.

(Miscellaneous)The chapter discusses the powers of State Government to supersede the State Board; special provision to supersede Central Board or the State Boards constituted under Water (Prevention and Control of Pollution) Act, 1974, and powers of Central Government and State Government to make rules.

Wildlife Protection Act, 1972

Introduction

Wild Life, which is a part and parcel of the environment, constitutes wealth of the nation. It included wild animals, birds, plants etc. However, man, in the process of progress and development and also for his selfish ends, is causing much damage to the forests and wild life. Wild life is nature's gift and its decline has an adverse effect of ecology and hence there is an urgent need to protect the wild life. Therefore, in order to protect the wild life from destruction, the Indian Parliament passed the Wild Life (Protection) Act in the year 1972.

Object

The main object of the Act is to provide protection to the wild animals' birds and plants. The Act empowers the Central Govt. to declare certain areas as Sanctuaries or National Parks. The Act prohibits hunting of wild animals; birds etc. and impose punishment for violating the same.

Salient Features

The Act contains 66 Sections divided into seven chapters and six schedules. (Secs. 1 and 2) contains short title and definitions.

deals with Authorities under the Act.

deals with the protection of Specified Plants.

provides for declaration of sanctuaries, National Parks and Closed Areas.

A deals with Central Zoo Authority and Recognition of Zoos.

deals with Trade or Commerce in Wild Animals, Animal Articles and Trophies.

A deals with prohibition of Trade or Commerce in Trophies, Animal Articles etc.

relates to Prevention and Detection of offences and finally contains Miscellaneous Provisions.

Authorities

Sec. 3 of the Act empowers the Central Govt. to appoint the Director and Asst. Director Wild Life Preservation and other officials and employees. Further, Sec. 4 empowers, the State Govt. to appoint Chief Wild Life Warden, Wild Life Wardens and an Honorary Wild Life Warden in each District and other officers and employees as may be necessary.

Wild Life Advisory Board

It is constituted in each State or Union Territory to advise the State govt. in selection and declaration of Sanctuaries, National Parks, Closed Areas etc. for protection and conservation of wild life.

Hunting of Wild Animals

The Act prohibits hunting of wild animals. No person shall hunt any wild animals as specified in the Schedules. However, there are certain exceptions. The State Govt. may order to kill or wound in good faith any wild animal for self-defense or to protect or save another. Any animal so killed or wounded is not an offence and shall be govt. property. The Govt. may permit killing of certain wild animals for academic purpose.

Sanctuaries

The State govt. by notification, may declare any area within the reserved forest or territorial waters as a sanctuary if it considers fit the area for protection and conservation of wild life.

National Parks

The State govt. by notification may declare an area whether within a sanctuary or not, by reason of its ecological or other technical grounds needed to be

constituted as a national, park for the purpose of protection, propagating or developing wild life.

Recognition of Zoos

No zoo shall be operated without being recognized by the authority. The person intends to operate a Zoo shall apply to the Authority in such form and pay such fee prescribed. Every recognition shall specify the conditions, if any, subject to which the applicant shall operate the zoo. Such Zoo shall acquire or transfer any wild animal specified in this Act with the previous permission of the Authority. No person shall tease, molest, injure or feed any animal or cause

disturbance to the animals by noise, or otherwise or litter the grounds in a zoo.

Trade or Commerce in wild animals, animal articles and trophies

All the wild animals, animal articles and trophies shall be the property to the State Government. No person is entitled to hunt any wild animals. After the commencement of this Act no person shall acquire, receive, keep in his control, custody or possession sell, offer for sale or otherwise transfer or transport any animal specified in the Act or any uncured trophy or meat derived from such animal or the skins or musk or horn without the previous permission in writing of the Chief Wild Life Warden or the Authorized person. Dealings in trophies and animal articles without license are prohibited.

Purchase of animal:

The person who obtains wild animals with the previous permission of the Authorities shall not sell it. He shall keep it in a habitat and healthy conditions.

Power of entry, search, arrest, and detention:

Any authorized person under this Act is entitled and has power of entry, search, arrest and detention of any premises. He can stop vehicle or vessel. He can enter any premises. He can seize any captive animal - wild animal, animal article, meat, trophy or uncured trophy or any specified plant or part of derivative thereof forms the possessor.

Penalties: (Section 51 of Wild Life Protection Act)

Any person who contravenes any provision of the act [except chapter V-A (prohibition of trade or commerce in trophies or Animal articles) and section 38 J (prohibition of teasing of animals)] or any rule made there under, or who commits a breach of any conditions of any license or permit granted under this act shall be punishable with imprisonment for a term which may extend to Three years or with fine may extend to Twenty Five Thousand rupees or both.

MOTA (Forest Rights Act) Act

Introduction

The Forest Rights Act (FRA) or Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 is a result of the protracted struggle by the marginal and tribal communities of our country to assert their rights over the forestland over which they were traditionally dependent.

After the enactment of the Act now tribals and other forest dwellers will have the right to cultivate forest land to the extent under occupation, the right to own, collect, use and dispose of minor forest produce, rights inside forests which are traditional and customary like grazing.

The notification of Rules for the implementation of the Forest Rights Act, 2006 on 1st Jan 2008, has finally paved the way to undo the 'historic injustice' done to the tribals and other forest dwellers.

The Act is significant as it provides scope and historic opportunity of integrating conservation and livelihood rights of the people.

Salient features of the Act

The Act provides for recognition of forest rights of other traditional forest dwellers provided they have for at least three generations prior to 13.12.2005 primarily resided in and have depended on the forest or forest land for bonafide livelihood needs. A "generation" for this purpose would mean a period comprising of 25 years.

The cutoff date for recognition and vesting of forest rights under the Act will be 13.12.2005.

The Act provides for the ceiling of occupation of forest land for purposes of recognition of forest rights to the area under actual occupation and in no case exceeding an area of four hectares.

The Act provides for conferring rights in the National Parks and Sanctuaries also, renamed as 'critical wildlife habitat' on regular basis.

The Act provides for the right to hold and live in the forestland under the individual or common occupation for habitation or for self-cultivation for livelihood by a member or members of a forest dwelling Scheduled Tribe or other traditional forest dwellers.

The Act recognizes the right of ownership access to collect, use, and dispose of minor forest produce which has been traditionally collected within or outside village boundaries.

The Act has defined the term "Minor Forest Produce" to include all non- timber forest produce of plant origin, including bamboo, brush wood, stumps, cane, tussar, cocoons, honey, wax, lac, tendu or kendu leaves, medicinal plants and herbs, roots, tubers and the like.

The Act recognises the right to in situ rehabilitation including alternative land in cases where the Scheduled Tribes and other traditional forest dwellers have been illegally evicted or displaced from forest land of any description without receiving their legal entitlement to

rehabilitation prior to 13.12.2005.

The Act provides for the forest right relating to Government providing for diversion of forest land for the purpose of schools, hospitals, anganwadis, drinking water supply and water pipelines, roads, electric and telecommunication lines, etc.The rights conferred under the Act shall be heritable but not alienable or transferable and shall be registered jointly in the name of both the spouses in the case of married persons and in the name of the single head, in the case of a household headed by a single person and in the absence of a direct heir, the heritable right shall pass on to the next of kin.

The Act provides that no member of a forest dwelling Scheduled Tribe or other traditional forest dwellers shall be evicted or removed from forest land under his occupation till the recognition and verification procedure is completed.

As per the Act, the Gram Sabha has been designated as the competent authority for initiating the process of determining the nature and extent of individual or community forest rights or both that may be given to the forest dwelling Scheduled Tribes and other traditional forest dwellers.

The benefits that will accrue from the Act

sThe Act results in recognition of forest rights of forest dwelling scheduled tribes and other traditional forest dwellers over the forest land under their occupation and their habitat for self-cultivation of the land for their livelihood.

They will have access to, use or dispose of, minor forest produce

They will not face the threat of eviction or removal from forest land under their occupation.

They will be entitled to the benefits of various schemes of the Government after vesting of the clear cut title of land in their favour.

Since the Gram Sabhas have been designated as the competent authority for initiating the process of determining the nature and extent of individual or community forest rights that may be given to the scheduled tribes and other traditional forest dwellers, this would empower the local communities in management of their natural resources in tune with the provisions of the PESA Act, 1996.

The recognition and vesting of forest rights in the forest dwelling scheduled tribes and other traditional forest dwellers also includes the responsibility of protection, conservation and

regeneration of wild life, forests and biodiversity.

The Act envisages registration of the title of the forest land jointly in the name of both the spouses, where married, and in the case of single person headed households, in the name of the single head. This would also benefit the women dwelling in the forests.

ENVIRONMENTAL IMPACT OF MINING IN INDIA

The mining industry in India is a major development sector. Some of the major minerals, which are mined in India, are listed below:

Coal, Iron ore, Limestone, Zinc, Lead, Copper, gold, Pyrites, dolomite, Manganese, Apatite and Rock Phosphate, Bauxite, Gypsum, fireclay, Silica-sand, Kaolin, Magnesite, Barytes, Steatite, Chromite and Mica.

The mining of mineral resources, whether by opencast or under ground methods, has adverse environmental impacts. The magnitude and significance of these impacts, however, vary with the type of mineral mined, the method of mining and beneficiation, scale and concentration of mining activity in conjunction with the geological and geomorphological setting of the area, the nature of the mineral deposits, the land-use pattern before the commencement of the mining operations, the natural resources existing in the area etc. Out of a total number of 5097 mines in our country, about 55% of the mines are coal mines and the rest are non-coal mines. Thus environmental impact study can be made by broadly dividing the mining industry into two sectors, viz, coal mining and non-coal mining.

COAL MINING: In 1979-80, the total coal production was 104 million tonnes, out of which 31 million tonnes were produced by opencast and the rest by underground mining methods. In 1983-84, Coal India Limited, the major state owned company, produced 142.44 million tones of coal. Considerable technological transfer action is going on for conservation, increased safety, economy and improved productivity. For making an assessment of the environmental problems associated with coal mining, the various activities in the coal mining industry can be categorized as given below:

Mining of coal

Coal preparation and beneficiation of coal,

Surface coal handling and transport, and

End use like power generation, railways, steel and other industries.

NON-COAL MINING:

The non-coal minerals can be divided into metallic and non metallic minerals. 96% of 49 million tones of metallic minerals and 99.5% of 40 million tonnes of non-metallic minerals produced in 1979 were from the open cast mines. Iron ore and limestone are produced exclusively from open cast mines.

ENVIRONMENTAL ISSUES IN MINING:

In 1983, the Environment Division of the Department of Science and Technology, Government of India, which has since been transformed into the Department of Environment, formed a working group of Mining and the environment. This working group, after considering in detail the various spheres of activities in the mining industry identified the environmental problems of serious nature and prioritized them as given below:

Land degradation by the opencast mining operations,

Deforestation during mining operations in the forest areas,

Soil erosion and land sledges,

Subsidence of land due to underground mining operations.

Disposal of tailings and effluents in case of beneficiation plants,

Wash-off of overburden wastes and fine mineral particles into the nearby water bodies and agricultural lands, Acid mine drainage,

Dust generation in the opencast mines, coal and ore handling operations and beneficiation plants,

Pollution of air due to noxious fumes released into the atmosphere by blasting and soft coke makes operations and mine fines.

Disruption of water regime due to mining operations, and

Noise and ground vibrations resulting from heavy blasting and operation of heavy machinery.

ENVIRONMENTAL POLLUTION PROBLEMS IN MINING

Environmental pollution from mining activity can be broadly classified into the following four categories, viz, (1) water pollution, (ii) air pollution (iii) despoliation of land, and (iv) noise pollution. In addition, health and safety of workers in mining needs special attention.

Water Pollution: Mining operations contributes, in two ways, towards water pollution. (i) Through the discharge of acid mine water into the streams or other water bodies, and (ii) By adding toxic substance like selenium, nickel, fluorine, and other radio active elements to the water bodies. Acid mine water is produced, as a result of pyritic minerals found in coal, ore bodies and over burden. Inaddition to effecting biota in surface water, acid mine waters corrode metal structures and destroy concrete, and heavy metals get dissolved in acid mine water rendering it unusable for domestic and industrial uses. Due to under ground mining operations, the ground water table is lowered. In most of such cases, the acid mine water infiltrates into the unconfined aquifers and pollute the water in the aquifers.

Air Pollution: Gaseous pollutants like sulphur dioxide, oxides of nitrogen and carbon dioxide, and dusts are the major air pollutants generated in mining operations. Gaseous pollutants in mining are generated during surface mining through ore/coal handling, blasting and during movement of automobiles on the quarry roads.

Sulphur dioxide, carbon monoxide and oxides of nitrogen are discharged into the atmosphere by mine fires associated with underground mining. Improper solid waste disposal results in waste dump fires, which in turn emit gaseous pollutants. Mine fires keep on burning uncontrollably for years together. Jharia coal fields in Bihar are ravaged by these fires.

Despoliation of Land: Despoliation means spoiling. Despoliation of land occurs due to subsidence of land in underground mining and large scale excavations in surface mining. Subsidence of land begins as soon as the supports or pillars left in the underground mine are no longer able to support the overlying rock. Substantial damage to life and property is caused by surface subsidence which affects the buildings, the surface drainage pattern and sometimes even highways, bridges, water and gas lines which may get twisted and sheared.

Large scale excavation in surface mining results in spoiling the landscape. Huge voids are created in surface mining. Removal of overburden to reach the actual ore site, results in dumping of large amounts of waste materials. Normally mine owners will be indifferent in not filling the excavations with waste materials, even after the mining operations are over. Surface mining also leads to rapid erosion of land because of slope stability problems and denudation of vegetation. Rapid erosion of land further results in silting and degradation of streams and waterways.

Waste dumps from both underground mining and surface mining, if not controlled properly, could lead to slip or erosion. Neively Lignite Corporation in Tamilnadu, is one of the

companies in India, which has not only filled up large voids in their mining area, but has grown thousands of trees on the filled up areas.

Noise Pollution: Usage of heavy machinery and explosives in different activities of drilling, blasting, transportation etc., results in high levels of noise pollution.

Noisy environment causes nervous irritability, strain, deafness, blood pressure etc. It would, therefore, be appropriate if a concerted effort is made to establish the noise levels and to take suitable control measures to reduce noise pollution in mining activity. A worker should not be allowed to enter, without appropriate ear protection, an area in which the noise level is 115 dBA or more. No worker shall be allowed to enter an area where the noise level exceeds 140 dBA.

Health and safety: The Indian workers in mining activity are under triple burden of malnutrition and poor health, occupational stress and polluted environment. Parasitic diseases like hook-work infection, and communicable diseases like tuberculosis or said to be rampant and among the mining population. Significant prevalence of occupational respiratory diseases like pneumoconiosis, silicoisis, asbestoisis etc. amongst the underground mine workers occupational diseases like nystagmus (abnormal movement of the eye ball caused amongst underground workers who work under inadequate light), dermatitis (skin diseases), anemia, ankylostumasis and occupational loss of hearing due to noise and vibration etc., occur in mining workers if adequate precautions are not taken. Most of these occupational diseases are compensable diseases.

Mining accidents also take a heavy toll of the miners. Mining accidents may occur due to material factors like geological conditions, equipment, method of working, work planning etc. or due to human factors like physical, psychological, and physiological components existing both within and outside the work. It is more often a combination of several factors which contribute to an accident. Analysis of several mine accidents have shown, that a better living environment for the workers, which is bound to improve their physical physiological and intellectual state, will ultimately result in the reduction of number of accidents.

ENVIRONMENTAL PROBLEMS IN SELECTED MINING ACTIVITIES:

Khetri Copper complex has got a concentrator plant and a smelter. Spillage of tailings from concentrator plant to the surrounding land and water ways was prevented by construction of a tailing dam. Recycling of spillages and re-pumping systems have been installed to arrest plant spillages and to pump them back to respective process circuits. The liquid effluents from

treatment plant of smelter, which are alternatively acidic and alkaline, are being sent to baffle type neutralization pit before being sent out to drain. The liquid effluents from sulphuric acid plant and fertilizer plant in Khetri Copper complex are treated properly. Gypsum and fluorine are recovered from the fertilizer plant effluents.

Dust problems from both mining activity and the concentrator plant are regularly analyzed. Limestone mining is carried out in 8 districts of Andhra Pradesh. All lime stone mines totaling to 44 in AP are open cast. Only 3 are mechanically operated, one is semi mechanically operated and the rest are manually operated. Production of all lime mines put together was 31.66 lakh tones in 1978. Environmental problems are created mostly by abandoned quarries and disturbance of land surface due to these pits and removal of the top soil thereby resulting in economic devaluation of the land excavated. Land vibrations and shocks from blasting effect permanent structures.

Lead and Zinc mines contribute to air, water and other types of pollution resulting from solid waste disposal. Noise is mostly generated by drilling and blasting, mucking and transporting ore and waste. Air pollution is generated by drilling, ore or waste handling, blasting or crushing operations. Remedial measures which have been adopted to control air pollution include water spraying, water injection and providing adequate ventilation.

Sub-surface water percolates through cracks and fissures in the surrounding rock and becomes the main source of mine water. During its flow, the mine water dissolves the soluble matter in the rock which finally contribute to its hardness and acidity.To minimize exposure of workmen to ground vibration and noxious fumes connected with blasting of mines with explosives, blasting times are regulated.

Dust extraction system is provided in the 4000 tonnes per day beneficiation plant, to prevent air borne dust caused by crushing of ore. Dust is also generated from where tailings are generated. Tailings are discharged into old tailing dam from where water is allowed to drain out through decantation towers constructed in the tailing pond. Frequent power tripping results in overflows in the beneficiation plant. These overflows and washings of the plant are collected in a small pond near beneficiation plant where solids are allowed to settle and water is pumped to tailing dam.

ENVIRONMENTAL IMPACT OF POWER PROJECTS

Energy is required for many domestic, industrial and transport activities. Mega thermal, hydroelectric, and nuclear power projects have till recently been looked as symbols of progress

in every society and India no exception to this. In thermal power plants large use of coal will result in pollution of the air, water and land. Hydro electric power projects result in the submergence of ecologically rick forests, and rehabilitation of native people. Accidents in nuclear power plants and complications involved with handling and safe disposal of nuclear wastes are the major problems connected with nuclear power generation. Examples of Chernobyl connected with nuclear power generation. Examples of Chernobyl in the east while USSR and three Mile Island in USA are quoted for nuclear power plant accidents. Case studies of three major controversial hydro-electric projects, viz., Salient Valley, Narmada and Tehri Dams are presented in this chapter. Before presenting the case studies, a general review of environmental impacts of power projects is presented.

In any hydro electric project, a number of environmental impacts, both primary and secondary may be associated with the inundation of land for developing reservoir area. They include; effects on downstream water quality and subsequent problem for downstream waste water quality standards, loss of freely flowing streams, loss of flora and fauna, changes in aquatic life, loss of agricultural land, loss of forest land, loss of wetlands, and loss of wildlife including endangered species. A few of the impacts, which can be expected to occur in the project area surrounding the proposed reservoir include; increase in traffic, noise and air pollution, increase in waste management problems, impacts on local aquifers', and development of additional growth and related environmental affects. The greatest long term land use impacts of an impoundment will be felt in the entiregeographical area of the power project. The impacts include increased pressure for industrial, commercial, residential and recreational development. It is difficult to isolate the contributing influence of these secondary impacts from general economic and social stimuli for development.

Potential water quality and ecological impacts are basically related to direct and indirect environmental changes caused by the project. The effects of temperature, dissolved oxygen, dissolved and suspended solids, water flow, and bacteria are usually the most important impacts with respect to water uses and ecology. Impacts upon water quality and ecology can be associated with construction, inundation of land area, creation of artificial reservoir, operational procedures and any changes which influence both the water source itself and downstream water. Sediment, pesticides, petroleum products and other materials are potentially significant water pollutants at a construction site. Sediment at a construction site is primarily transported by water and to a lesser extent, by wind. A few examples of potential sediment sources include; site preparation, earth moving, dredging, access and haul road

construction and use, rock blasting, drilling, turnneling or channeling, dam foundation preparation and construction, landscaping and cleanup operations and concrete mixing.

Thermal stratification, sedimentation, expected land use around the reservoir, and inflowing water quality all affects the physical, chemical and biological properties of the impounded water. The water quality impacts resulting from the flooding of land are determined by the nature and composition of vegetative cover and soils within the reservoir area. Over the years, substantial changes in water quality like decrease in dissolved oxygen, organic enrichment, increase in iron, manganese, nutrients, dissolved substances and algal growth etc., will take place in the reservoir water. These changes in water quality result from: ion exchange through the clay and humic colloids in the soil under water saturatedconditions, microbiological degradation of organic materials which releases dissolved materials and carbon dioxide, leaching or organic and mineral substances from the soil and vegetation, and microbiological activity at the soil water interface which depletes dissolved oxygen possibly causing anaerobic conditions and a change in the products of depletion.

Longer range impacts upon water quality include the alteration of a water course's ability to assimilate oxygen-demanding upstream and downstream wastes. Under stratified conditions water quality may affect the aquatic biota. A low oxygen level hypolimnion may be uninhabitable for fish. Nutrient or wate rich inputs may also lead to entrophication of the impoundment. Increases in water salimity, usually occurring in arid or semi-arid regions as a result of high rates of evaporation, may alter downstream use of released water.

Land flooded by an impoundment is lost as habitat for terrestrial wildlife. Inundation may destroy wildlife or plants or special significance because of the rarity or uniqueness.

Hydro-electric power plants usually cause very large fluctuations in downstream flow, the quality of water released and the hydraulic characteristics of the river will influence water quality. Impounded water may be depleted of dissolved oxygen, particularly if power penstocks draw water from deep hypolimetic levels. Downstream water quality, waste assimilative capacity, species diversity and life cycles may be affected when this water is released.

Case studies of two major hydro-electric projects of India are presented below:

Narmada Dam Project:

There is a plan to build 30 massive dams on the river Narmada, two major dams of which are

the Sardar Sarovar Project in Bharuch district in Gujarat and the Indira Sagar Project in Khandwa district in Madhya Pradesh. The Sardar Sarovar Projet will have a dam height of 128 m, a reservoir storage capacity of 7.7 million acre feet, 2 power houses and an installed capacity of 1,450 MW. A canal net work of covering a length of 7800 km will meet irrigation and water supply requirements. This project is estimated to cost around Rs.6400 crores as per 1985- 86 costs. The construction of the Sardar Sarovar and Indira Sagar Projects would mean that over three lakh people of the Narmada valley would be evicted from their native places. The projects will submerge about 1,30,482 hectares of land and 56,066 hectares of land will be forest area. Apart from this district submergence, there is timber for displaced human population and for grading by the massive numbers of livestock. The cost of loss of forests due to the Indira Sagar Project is estimated to be Rs.30,923 crores and the cost of loss of forests due to Sardar Sarovar Project is estimated to be s.8,190 crores. The forest Conservation Advisory Committee of the Ministry of Environment has identified that the ecological balance of the area would be seriously affected due to the cutting down of 80 million trees at one go. The climate in the area will change, the rain cycle will be upset and the vital oxygen content in the air in and around the area will decrease.

Tehri Project:

Tehri dam being constructed on the Bhagirathi in the Garhwal-Hymalayas will be of 260 m height. It is expected to generate 2400 MW of powr, it is expected to provide 300 cusecs of water to meet the water supply needs of Delhi and it is expected to irrigate 2.7 lakh hectares of land in Western Uttar Pradesh. The cost of the project is expected to be around Rs.4,142 crores as per 1990 rates. Seismologists have warned that there are chances of an earthquake of a magnitude beyond 8 on the Richter Scale in the region, where Tehri Dam is being constructed. Prof. James N.Burne of Nevada University, USA has said “the proposed Tehri Dam location is one of the most hazardous from the point of earthquakes. There is little question that in terms of the hazard rating of the International Commission on Large Dams, it’s hazard rating is extreme”. Prof. VI Kellis-Borak of the International Institute of Earthquake Predication Theory and Mathematical Geophysics, Moscow said “I discussed the Tehri Dam problem with our experts here and we unanimously believe that it requires serious reconsideration”.

Forests in the Tehri region have vanished over the last 150 years due to commercial exploitation and conversion into timber mines – monoculture stands of pines, which are soil depleters and water suckers. This instead of holding the soil, has accelerated soil-erosion and

acidification. The acid pan in the root system of the pines breaks the rocks paving the way for landslips, common in the hills.

Many environmentalists like Baba Amte, MeghaPhatkar, Sundarlal Bahuguna, Chandi Prasad Bhatt have organized strong peoples agitations against the construction of big dams. State governments are agitating for the construction of big dams. A careful analysis of cost-benefit ration and environmental impacts has to be made before sanction is given for the construction of big dams and other power projects.