UNIT-I

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Definition:

Environmental Impact assessment is an investigation of the effects on the environment arising from a major Activity (plan/policy/project)

(i) this study proposal means to midigate (or) reducing the significant impacts on the environment.

(ii) In this process the effects of the project undertaken (or) analysed first the effects are recorded in a report followed by a consulting experts on the report and these making a final decision based on the experts comments and informing the public. All these activities Continued to Sestainable development on the environment.

The phrase EIA has been borrowed from section 102(2) of the national environmental policy act 1969 USA. In India the environment was given serious thought with the active involvement of late Smt. Indira Gandhi in the united nations conference on human environment in Stockholm in 1972

A national committee on environmental planning and coordination (NCEPC) was setup in the dept of science and technology.

→ the tiwari committee has proposed the formation of a dept of environment aimed at environmental protection.

→ To carry out environmental impact assessment of proposed development projects and to leave authority for pollution monitoring uncontrolled.

Aims of EIA:

→ Evaluation (or) assessment of environment impacts of a developmental projects. prior to decision making.

→ planning aid for adopting midigating measures (or) reducing adverse impacts of the proposed projects.

→ To support the goals of environmental production and sustainable development

→ To bring out the proposals to decision makers to

→ provide an advice to the decision makers on whether the proposal (or) scheme to be allowed to proceed (or) not

→ to facilitate the sustainable development.

Impact:

A change or deviation of the baseline situation arising from a proposed project/plan.

Baseline situation:

It is an existing environmental condition before a proposed project (or) activity.

Environmental Impact:

It refers to a positive (Beneficial) or negative (adverse) changed to ecosystem (or) human health as a consequence of human intervention in the environment through proposed public and private developmental activities such as projects and programmes.

Beneficial:

Afforestation for coastal management projects.

Adverse:

→ land use

→ Drainage problems

→ loss of trees.

→ loss of historical and cultural monuments for mass transist system.

→ Environmental impact assessment:

An activity carried out to determine and minimise the impact of any project on physical, chemical (or) biological parameters of environmental and also human health is termed as environment impact assessment.

Classification:

Enviromental impact assessment is broadly classified into 3 different ways.

① positive (or) negative impacts

② Temporary (short term) (or) permanent (long term) impacts.

③ Reversible (or) irreversible impacts.

① positive (or) negative impacts:

→ Tourism activities have both beneficial and adverse effects on environment.

→ The impacts from Construction of infrastructure facilities like roads, airports, resorts, hotels, restaurant, shops can have positive impacts by raising awarness of environmental values and save as a medium to finance protection of natural areas and increase their economic importance.

→ uncontrolled tourism can leads to adverse effects like soil erosion, increase in pollution (air, noise, Solid waste,

sewage, oils & chemicals) · Discharges into sea, rivers depletion of water resources.

② Temporary (or) permanent impacts:

→ the short term impacts are the construction, traffic, noise, dust, distruption of vehicles and pedestrain traffic.

→ the long term impacts are the consumption of energy resources, generation of waste, increase in impervious surface leading to increased storm water runoff.

Reversible (or) irreversible impacts:

Based on the severity of potential impact by any proposal project the impact may be either reversible or irreversible.

→ Impact of noise due to the construction activities are reversible.

→ they harm to the environment due to more infrastructural facilities like transport, trade, commerce and service sectors are irreversible.

Elements of EIA:

The key elements in environmental impact assessments are

① Screening
② Scooping
③ Assessment
④ Alternatives
  (i) Feasibility
  (ii) Diverse
  (iii) scheduling
  (iv) public involvement
⑤ mitigating methods
⑥ EIS
⑦ Reviewing & decision making
⑧ Continuous monitering.

① Screening:

Screening of development program is usually done by an EIA authority (or) Govt. agencies constituting a variety of experts as a multidisciplinary team like environment scientist, engineers, ecologist, agricultural scientist, zoologist, economist and sociologist.

② Scooping:

This step recognise the important issues of a concern at a preliminary level of the planning process. It helps in site selection possible technical options and avoid all kinds of delays that arise during

the project. It provides sufficient information to the public about the proposed project and understand this project and issues.

③ Assessment:

The EIA authority must record the Construction operations, maintenance plans of the proposed project and its impact on the ecologist and socio Economic environmental and suggest alternatives for site selection for development solutions, techniques and their impacts

④ Alternatives:

these are included in the EIA to identify and evaluate alternate actions that can be undertaken to achieve similar goals and promote sustainable development. Alternatives in EIA are

(i) Feasibility: The proposed alternatives should be Economically feasible with least negative environment impacts.

(ii) Diverse: the proposed alternatives must have diverse alternatives that include both design and site routes for development.

(iii) Scheduling: the proposed alternative should be timely presented to encourage more environmentally sound and publicity acceptable solutions.

(iv) Public involvement: public participation should be encouraged to integrate citizens into the environmental

decision making process by arranging Public meetings and hearings.

⑤ Mitigation methods:

this step includes the modifications in the proposals to prevent avoid or minimise the potential significant effects of a project. It may also include substitution of an alternative technology.

⑥ EIS:

the findings of the environmental statement assessment are reported as environmental impact statement it is a comprehensive clear and consize non technical summary of the project including location, design, size and mitigation results.

⑦ Reviewing and Decision making:

When the working document of the proposed project reaches the decision making committee (EIA authority or Govt) will consider its simplifications, for projects implementation.

⑧ Continuous monitoring:

Continuous monitoring of the environmental impact by project implementation is essential during the construction and operation stages (or) phases of a project. this phase of EIA ensures effective environment management and protection.

Factors affecting Of EIA:

① Meteorology & Air quality → It deals with atmosphere its phenomean

② Topography → It deals with (or) It Study about shape & features of an area.

③ water → It studies about hydrological studies.

④ Demographics → statical data about population

⑤ land use → For which the land is used.

⑥ Soil condition → type/classifications of soil, properties.

⑦ mineral resources / Activities.

⑧ Ecological studies → Study of flora, fauna.

The study of the EIA process help to evaluate, analys and repot the environmental conditions from the activities. Resulting from several departments / developments An EIA should include details of the above aspects at the proposed site.

① meteorology and Air quality: the science dealing with the atmosphere and its phenomean including weather and climate. It includes

(i) effect of temperature

(ii) precipitation, relative humidity, evaporation and fog conditions.

Evaporat
(iii) wind patterns
(iv) severe weathers such as Hurricanes, volcanoes.
(v) Air quality and odour level.
(vi) sound levels and sources of sound at the proposed project development site.
(vii) These studies are carried out with the help of Computer models, satellite data and climate theories.

② Topography: It is the study of the shape and features of land surfaces. It describes the physical features of an area of land. These features typically include natural formations such as mountains, rivers, valleys, lakes etc., man made features such as roads, Dams, and cities may also be included. It includes the local and reasonal geology studies, major land formations, geology structure and resources, seismic Hazardous.

③ water:

The quality of surface water and ground water along with hydrological studies. It is the study of the amount and quality of water being stored or conveyed on the land surface and in soils and in rocks near the surface.

④ Demographics : (Statical data of population especially) this showing. average age, Income and education etc...,

→ This refers to the population distribution, change in population numbers., population characteristics (such as male to female ratio, Age structure, rate of migration, municipal services (such as demand for social services, hospital beds, school places, housing etc.)

⑤ Land use:

This includes the purpose for which the land is used namely agricultural activities, industrial activities (or) mining activities, Regional planning for future use and zoning etc.,

⑥ Soil conditions: classification of soil, properties of soil and soil mapping.

⑦ Mineral resources/activities:

the mineral resources available at the proposed project, development site, minerals like uranium, coal, oil and gas and other minerals.

⑧ Ecological Studies:

These studies involving data on type and govern
species of flora and fauna, aquatic reptiles, amphibians, threatened species and distribution of species habitant migratory species and species of commercial importance.

All these factors have to be taken into consideration during the EIA process to enable better design buildings to plan heating and cooling systems as well as practising sustainable agricultural activities.

Sustainable development:

the concept of sustainable development aims at improving the quality of life for all the inhabitance of the planet without over consuming the natural resources beyond the capacity of the environment to reproduce them indefinitely. An important aspect which invites serious consideration is the balance between the development and environmental production.

Role of Sustainable development:

Sustainable development is extremely important for the following reasons.

→ ① to manage the resources efficiently.
→ we need to use the natural resources wisely that includes not throwing and away products, they are available use less energy and land fill spaces.

→ To Comeback Climate Change.

The latest report indicates that the Climate change and its resulting effect will continue to worsen in the future. the concentration of green house gases like Carbon dioxide, water vapour, CH_4, N_2O, CFC's have been increasing as a result of human activities such as combustion of fossils, deforestation, overuse of fertilizers, decay of organic matter, accumulation of CFCs all these results in greater warming of earthsurface, rising sea level, changes in precipitation Factors increase in the frequency of severe weather events, melting of glaciers, scarcity of fresh water resources which will collapse the functioning of ecosystems.

* Life cycle Assessment (LCA)

According to the Iso 14040 life cycle assessment is a technique for assessing the environmental aspects and potential Impacts associated with a product. life cycle assessment is also known as ecobalance and cradle to grave analysis

→ Complaining a inventory of relevant inputs and outputs of a product system.

→ Evaluating the potential environment impacts associated with those inputs and outputs.

→ Interpreting the results of the inventory analysis and Impact assessment phases in relation to objectives of

the study.

Aims of the life cycle assesment:

→ It gives an insight to the product inputs related to environmental impacts.

→ It provides an understanding of the independent nature of the state of environment resulting from anthropogenic activities.

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

→ It helps to analyse the origin of the problem related to the product.

→ It helps to design new products that are ecofriendly and greener.

Example: Fruit juices are packed in two possible alternatives (i-e) glass bottle and carton

A glass bottle may be reused many times whereas a carton can be used only once. Additionally the glass bottles need washing and transportation whereas the carton can be disposed of after single use.

But the carton is more example compaie to glass bottles. Thus we can conclude that carton would be the environmentally best choice for pakaging procesed juices.

phases:

The methodology for LCA involves four interrelated phases

① Goal & Scope

② Inventary

③ Impact Assessment

④ Interpretation.

① Goal & Scope:

In this phase, the purpose of study the reason for conducting the study the spatial and temporal scope. The decision taken in support of LCA.

Inventary Analysis:

In this phase the identification and qualification of the inputs and outputs of materials energy, water and pollutants released into the environment.

③ Impact Assessment:

It involves assesment of impacts on resource depletion on human health and ecological impacts.

④ Interpretation:

The inventary analysis and impact assessment results are interpreted by the decision makers to reduce the impact of the products on the environ

Preparation of Environmental Base map:

A Base map is an aerial photograph which simply means the photograph taken from air with the help of air borne camera fitted to a light aircraft to prepare a base map to require two-three experts (or) Specialist, aerial photogrametic camera, field camera, photogrametric scanner, plotter and software (AutoCAD map environmental GIS) the cameras used are film based single lens cameras. The photogrametric scanner enables the conversion of analog images to digital files and represents as pixels.

Environmental Base map is one of the important stages of a project development. It contains the plan of site and final design of the proposed construction in the form of a schematic diagram. It includes the basic information of the project site such as environmental conditions, soil conditions, population distribution, air quality, Quality of surface water and ground water hydrology, land quality and ecological resources.

It provides information on the existing status of the ecosystem potentially threatened by the developmental activities of proposed construction projects.

Environmental parameters:

The environmental data at the site where a particular proposed act on is being considered for an EIA study is collected by the EIA team members as environmental scientist, Biologist, Geologist, agricultural scientist, sociologist, economist and engineers. this multidisciplinary team (or) EIA team considered the following EIA parameters (or) environmental parameters

1. Land
2. climate
3. Air quality
4. water quality
5. Territory
6. Flora
7. Fauna

1. Land:

The following details of the land are necessary for the EIA study. The land details are mainly considered as land owner ship, land tenture, existing land use, crop productivity and natural vegetation. this land data enables less adverse social impacts on the Indigenous people to provide equitable benefits to local communities.

2. climate:

The climatic profile of the site is being

Include the data on the rainfall evaporation, wind speed, relative humidity, minimum and maximum temperatures and barometric pressure.

③ Air quality:

This includes the amount of suspended particulate matter and fall out dust in the concentration of the gaseous emissions like Carbonmonoxide, sulphur dioxide, Noxious flumes

④ water quality:

the study of water quality data includes the quality of surface water and ground water resources temperature, pH, turbidity, total dissolved solids, hardness of the water, total alkalinity, acidity, contents of calcium, magnesium, dissolved oxygen, dissolved carbon dioxide chloride, sulphate, silica, iron, copper, sodium, potassium, phosphate, fluoride, Biological oxygen demand & COD.

⑤ Territory:

The study of terrian analysis at the proposed construction site includes the data of the Geology, classification of the land (Arid land, Grazzing land, wet land & wild land) Drainage, erosion potential and soil classification

⑥ Flora:

The study of the flora at the proposed development site should include the population of different types of different types of vegetation

identification of valuable vegetation species, Identification of rare species and equatic flora.

⑦ Fauna :

The study of fauna at the proposed development site should include the population of different types of fauna, density data of different types of fauna, Data on permanent and migratory population. and data on the rare species.

Role of stakeholders in EIA preparation:

when the draft of the proposed project is ready then it is sent to approval from the Covern-ment agencies. this requires notification in the newspapers and media to lead the general public know about the proposed project. this process involves preparing questions for a survey to be carried out on various aspects of the proposed action. the public decides if the proposed project is beneficial to them Geographically aesthetically and economically the entire process is systematic time bound and carried out in transparent manner. ensuring possible public participation at the proposed sight.

Stages in EIA:

The Complete EIA procedure can be divided into two corresponding functions or stages

Initial environmental examination:

It is the first phase of the EIA process

carried out to review the potential both positive and negative impacts on the environment caused by the proposed development project. It contains a brief information of the major environmental issues based on the readily available recorded information to be used in decision making proces of project planning. the main objective of IEE is to enable the decision makers and project proponents and to compare the alternative project proposals.

It contains a detail information of the proposed project which is reported as environmental impact assessment.

Unit - I

Environmental Impact Assessment & Management ①

Basic Concept of EIA

Definition: —

What is EIAM:-

EIA is an activity designed to identify and predict the impact of a projet on biogeophysical chemical enviopment and on human health so as to recommended appropriate legislative measures, programms and operational procedures to minimize the impact.

(or)

EIA can be defined as an activity or process to identify predict and accers the impacts on enviroment and human health raised by a proposed activity or development activity.

* An impact can be defined as any change in the physical, chemical, biological, cultural, or socio-economic environmental system as a result of any development activity

⊛ Elements of EIA: —

⊛ EIA must be undertaken "early" in the development of proposed projets, plans and programm and must be completed before a decision to proceed is made.

⊛ EIA must be an objective, impartial analytical proces, not a way of promoting or selling a proposal decision makers it must use accepted scientific principle and methods

(*) The process of EIA must be open to government officials at all levels, to potential stakeholders (those with direct interest in the proposed action) and to the public.

(*) Government officials responsible for implementing EIA must be encourage (not just tolerate).

(#) Factors affecting EIA:—

There are six factors that should be taken into account when assessing the significance of an environmental impacts arising from a project activity.

(1) Magnitude:— will the impact irreversible? If irriversible, what will be the rate of recovery or adaptability of an impact area.

(2) prevalence:— Each action taken separately, might represent a localized impact of small importance and magnitude but a no. of actions could result in a wide spread effect.

(3) Duration and frequency:— The significance of duration and frequency is reflected in the following questions. will the activity long term or short term?

(4) Risk:— To accurately access the risk, both the project activity and the area of environment impacted must be well known and understood.

(5) Importance:— This is defined as the value that is attached to an environmental component.

(6) Mitigations:— are solutions to problems available? Existing technology may provide a solution to a silting problem.

** * EIA procedure :—

(*) Initial environmental Examination :— (IEE)

=> IEE is nothing but reviewing the environmental integrity of the projet.

=> In other words, IEE is used to screen and to determine weather the projet require a full scale EIA (or) not.

=> EIA is also ensures Environmental Management.

=> IEE helps to minimize the effort, expanse and Time period to carryout to project and its planning.

=> IEE involves assessing the enviromental effects of a proposed projet with limited budget.

=> If IEE result indicates that a projet is not required a full scale EIA. Then it can be continued without delay.

=> IEE is much helpful in determining & identifying the key issues and merits of EIA with reference to a proje

=> Thus for a development projet is desirable from the economic point of view.

(*) ** Important steps in Full Scale (EIA) :—

Impact assesment methods are Classified into following Analytical ~~situati~~ functions :- Scope, identification, prediction and evolution

=> Methods of identification of environmental impacts can assist in specifying the range of impacts that may occur

=> It can deffeerntiate between various projet Alternative in terms of questions Covering "how much or where" the impact may occer.

=> Method of evaluation determine the groups that may be directly affected by the projet or action.

✱ Preparation of Environmental Base Map (EBM):-

an important requirement is preparation of an environmental Base maps (EBM or Maps) showing the silent information

① The concept of EIA as a planning tool require all phases of projet development, planning, final design, Execution and projet operation.

② The preparation of EBM is an important requirement for EIA to produce the information about planning & final design.

③ EBM provides essential background information about the projet area which can be used to interprete, to report and to conclude the recommendations.

④ Generally an EBM of any projet consists demography landuse, infrastructure, surface and ~~s~~ Ground water resources, soil conditions, ecological resources, metrological conditions and areas of cultural, archilogical, Tourist interest

⑤ The EBM should be very simple and more appropriate than a map drawn stricckling to scale.

⇒ Identification of study Area:-

- The EIA study area should include water bodies, land and population centres where the projet activities will have significant effect.
- General enviromental parameters likely to be affected by development activities include - Ground water hydrology and quality surface water hydrology and quality, air quality, land quality land uses, vegitation forests, fisheries asthetics, public and occupational health and socio economics
- The size of the study area and the metrological conditions would also be considering in determining the study Area

** Classification of Environmental parameters :—

· Environmental resources or values are classified into four General catogories :—

① natural physical resources
② natural ecological resources.
③ Human/economic development resources and
④ Quality of life values including asthetic and cultural values.

(*) Role of stake holders in the EIA preparations :-

In the preparation of Conducting EIA process various groups of stake holders may participate. Some of them are.

① Developpers :— They have direct responsibility for the project to implement (Emp) (Environmental Management program) including mitigation (mitigation means prevention)
- Developpers hire experts to undertake EIA studies on be half of them.

② EIA Experts :— These are experts are professionals to carryout EIA in designing and preparing EIA report.

③ lead Agencies :— Agencies are like govt, ministeries, or department and other people from various industries.
- lead agencies provide Technical information to EIA experts during EIA studies.

④ Public :— public involves various Committies which have like to take part in the EIA process.
- The role of public in the EIA process include contributing the information advising, scooping, during the

the public hearing process.

(5) Academic institutions: — The no. of academic institutions are generally co-opted in Technical Committies of EIA.

(6) International funding organisation: — There will fund the EIA projects.

(7) Print of media organisations and people: — There will help in creating awareness about the project and to bridge the Communities and public with the project development authority.

Silent Features of EIA: —

* EIA procedure identify the all the possible Types of impacts
* EIA provides a plan for reducing the impacts caused by a development activity to control the environmental degradation
* EIA also provides alternatives for impacts to enhance the environmental Quality.
* EIA provides the right to Monitor, to identify also to measure the related impacts
* EIA is not negitively oriented Towards the development of a project but it safe guards the Quality of Environment.

(*) Stages in EIA :—

EIA represents a systematic process that examines the environmental consequences of the development actions in advance. The EIA process involves a no of steps, some of which are listed below.

1. Project screening :— The no of projects that could be subjected to EIA is potentially very large, A screening mechanism seeks to focus on those projects with potentially significant adverse environmental impacts.

Those with little or no impacts screened out and are allowed to proceed to the normal planning and permissions without any additional assessment.

(2) Scoping :— This step seeks to identify, at an early stage, the key significant environmental issues from among a ~~best~~ host of possible impacts of a projects and ~~understand its various characteristics~~ all the available alternatives.

(3) Consideration of alternatives :— This seeks to ensure, that the proponent has considered other feasible approaches including alternative project locations, scales, processes layouts operating conditions and the no-action option.

(4) Description of the environment baseline :—

This includes the establishment of both present and future state of the environment, in the absence of the project taking into account the changes resulting from natural events and from other human activities

⑥ Identification of key impacts :— This brings together the previous steps with a view to ensuring that all potentially significant environmental impacts (adverse and beneficial) are identified and taken into account in the process.

⑦ The prediction of impacts This steps aims to identify the likely change (impact) in the environment when the project is implemented in comparision with the situations when the project is not carried out.

⑧ Mitigation :— This involves the introduction of measures to avoid, reduce, remedy, or compensate for any significant adverse impacts.

⑨ public Consultation and participation :— This aims to assure the quality and effectiveness of the EIA, as well as to ensure that the public views are adequately taken into consideration in the decision making process.

9. EIS presentation :— Environment impact statement This is the vital step in the process. if done badly much good work in the EIA may be negated.

10. Decision Making :— At this stage, decisions are made by the relavent authority of the EIS) and consultancy together with other material considerations as to weather to accept, defer, or reject the projet.

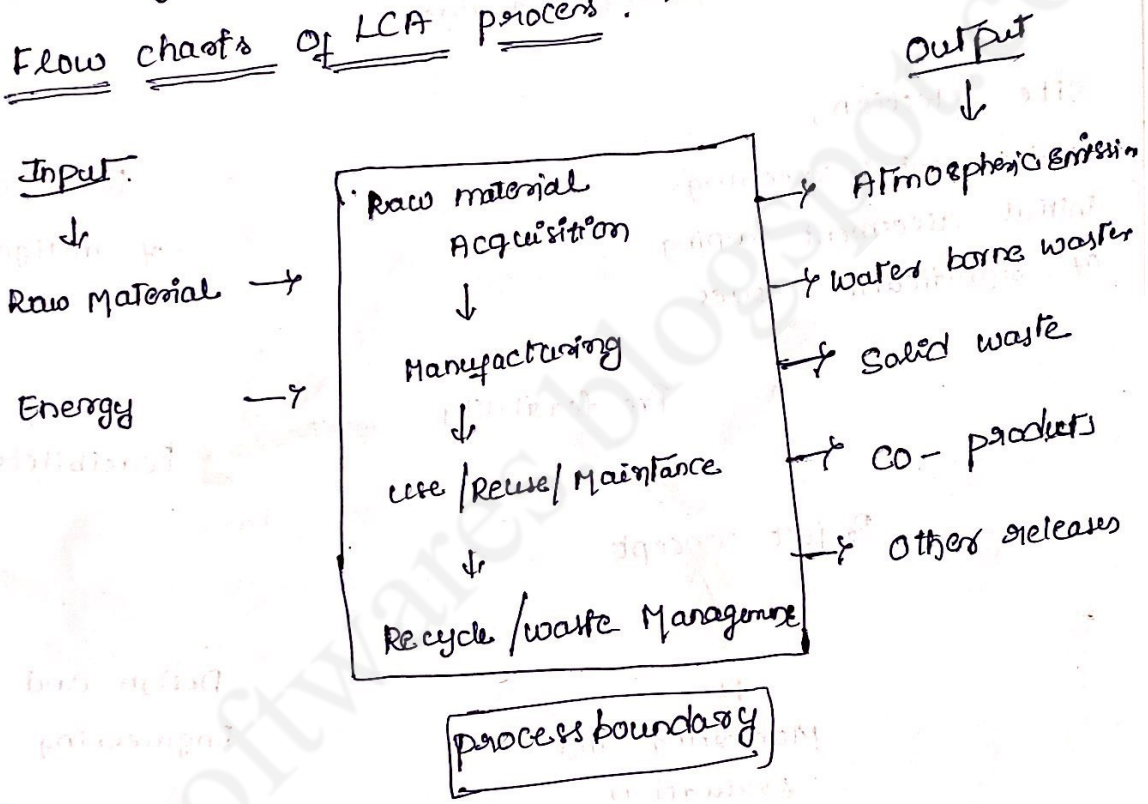
11. Auditing :— This follows monitoring actual outcomes with the predicted outcomes. It is a vital step in EIA

Life cycle Analysis :—

It is a Tool to Evaluate the environmental effects of a product or process throughout its entire life is known as LCA. It is also called as life cycle Assement.

It includes identifying & Quantifying the energy and material used and waste released into the environment and accessing their enviromental impacts.

① Flow charts of LCA process :—



② Stages of LCA :—

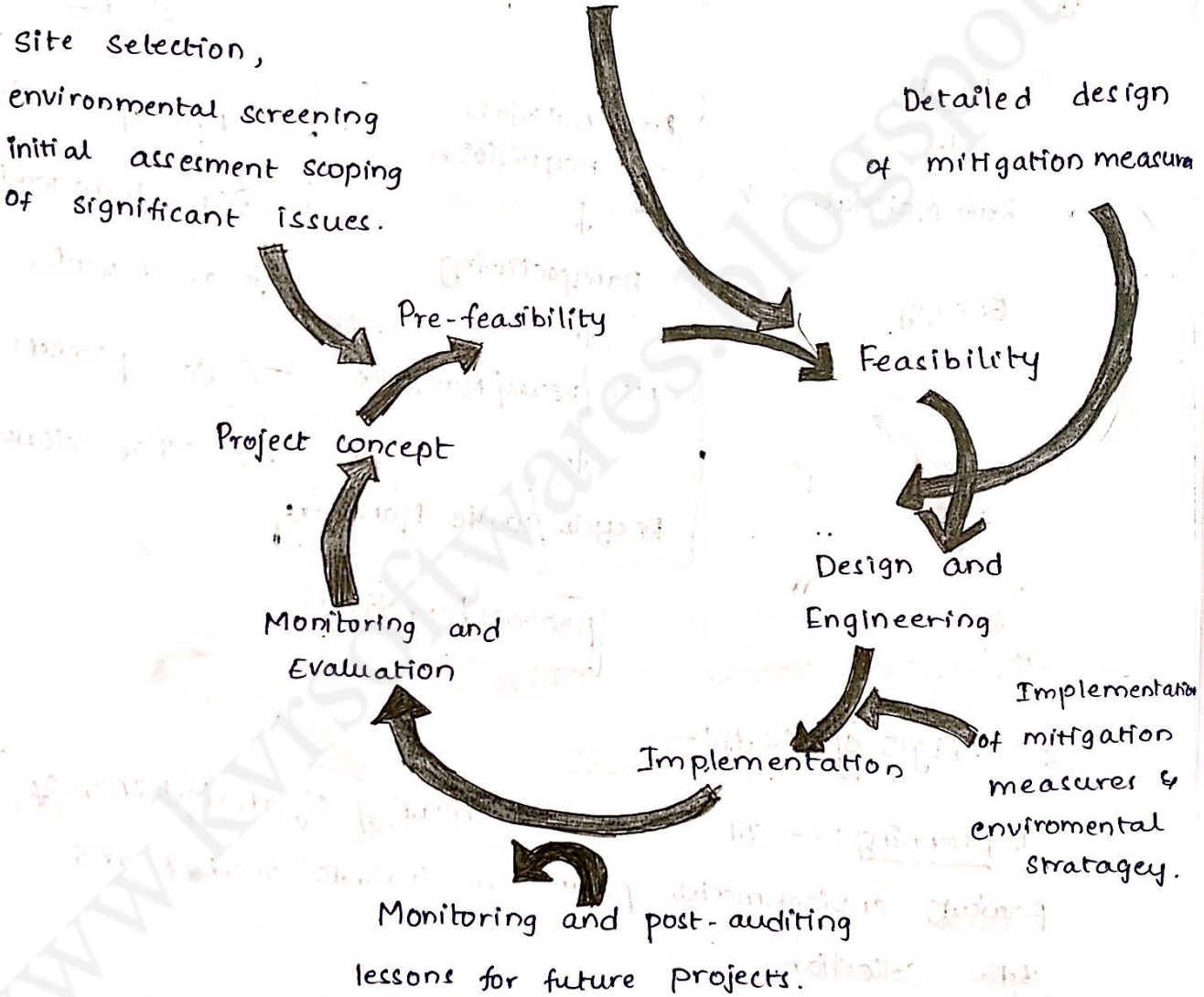
1. Planning :— It includes statement of object, definition of product, environmental parameters, Evaluate method and data collection.
2. Screening :— It includes exhicution of LCA adjustment of plan
3. Data collection and Treatment :— It includes measures interviews, literature search and comperation of the inventory Table.

(4) Evaluation:- It includes classification of inventory data and weighing of different categories.

5. Improvement Assessment :- It includes sensivity analysis of improvement priority and feasibility assesment.

Life cycle analysis preparation of Environmental Base Map :

Detailed assesment of significant impacts, identification of mitigation needs, input to cost / benfit analysis.



** classification of Environmental parameters Explanation

(1) physical Resources: —

(i) Hazard of soil erosion loss without proper resurfacing

(ii) Hazard of soil fertility from physical stresses in clearing and leveling

(iii) loss of rain water infiltrations.

(iv) Micro-effects on increasing Temparature.

(2) Ecological Resources: —

(i) loss of forest resources, which is cleared and associated wildlife habitate

(ii) Hazard from pesticides and other aggricultural Toxics of forest Ecosystems

(3) Human use Values: —

(i) Impairment (means the act of spoiling something or making it weaker so that is less effective) of downstream water Quality.

(4) Quality of life values: —

(i) loss of forest Tourism / aesthetic values

(ii) Disruption (means) of local forest population Socio economics

(iii) Increased Sanitation deases hazard due to increased population

** EIS (Environment Impact Statement)

1. It is a document required by the 1969 National Environment policy Act (NEPA) for certain actions significantly affecting the Quality of Human Environment

2. An EIS is a tool for decision making.
3. It describes the paitive and negitive environment effect of a proposed action.
3. and it resually also lists one or more alternative actions that may be choosed instead of the action described in the EIS.

Unit- 2

EIA Methodologies

Introduction :—

In EIA the methods are used to describe the Quality and characteristics of the effectiveness of EIA process.

Criteria for Selection of EIA Methodology :—

1. General.

⇒ Simplicity :— The method should be very simple and able to grasp background knowledge with the available manpower.

⇒ Manpower time and budget Constraints :— The method should be applied by any group of people with in a given time and budget.

⇒ Flexibility :— The method should be flexible enough for necessary modifications through the entire force of study.

2. Impact Identification parameters :—

⇒ Comprehensiveness :— The method should be sufficiently comprehensive which contains all possible options & alternatives

⇒ Specificity :— The method should be specific to identify specific impacts

⇒ Timing & prediction :— The methodology should be able to identify impacts accurately and the location, extent on a temporal scale.

3. ⇒ Isolation of project Impacts :— The methodology should be able to isolate the impacts raised with specific to project activity

3. Impact measurement parameters :—

⇒ Commensurate units :— The methodology should have similar set of units used to compare the criteria & their alternatives

=> Explicit indicator :— The methodology should suggest Specific and measurable indicator to quantify the the impacts on the relevant Environmental parameters.

=> Magnitude of impacts :— It should be able to provide impact magnitude measurement and the degree of scale of impact and also significance of impacts.

=> Objective criteria :— The methodology should be based on objective criteria related to environmental impact

(4) Impact Evaluation parameters :—

=> Significance :— It should be able to provide impacts ~~magnitude~~ on local, regional and national scale.

=> Explicit criteria :— The assumptions should be explicitly stated to identify the impacts.

=> Risk parameter :— The methodology should be identify the probability of ocurance of impacts with its magnitude

=> uncertainity :— The method should be answer the ① uncertainity of possible impacts.

=> Alternative comparision :— The methodology should be able to provide readily available details on Complete comparision for alternatives on the project.

** EIA Methods :—

1. Ad hock method
2. checklist method
3. Network method
4. Matrice's method
5. Overlay method
6. Cost benific Analysis
7. Environmental media Quality
8. predictive or Simulation method.

① Adhoc Method: —

① Adhoc method involves assembling a Team of specialist to identify the impacts in their area of exp project.

② In this method each environmental area such as air water. is Taken separately and the nature of impacts such as short Term or long Term, reversible or irreversible are Considered

③ These methods are for rough assesment of the Total impact

④ these method serves as a preliminary Assesment which helps in identifying more important Areas.

1. wild life
2. Endangered spcies
3. Natural vegitation
4. Ground water
5. Natural Drainage
6. Air Quality
7. Noise
8. Open space
9. Heath and safty
10. Economic value.

⑤ Adhoc method is very simple and can be performed without any planning

⑥ Adhoc method fails in identifying the actual impact on specific parameters

⑦ Due to Some Drawbacks the adhoc method is not recommended for impact analysis.

② Checklist Method: —

* checklists in general are strong in impact identification and capable of bringing them to the attention and awareness of their audience.

* Impact Identification is the most fundamental function of an EIA and this respect all Types of checklists

namely simple, descriptive, scaling and weighting checklists.

1. Simple checklist :- They are list of parameters without guidelines on how to interpret and measure an environmental parameter :
2. Descriptive checklist :- They includes and identification of environmental parameters and guidlines on how parameter data are to be measured.
3. Scaling checklist :- similar to descriptive checklist with the addition of information
4. Weighing checklists :- Are Capable of Quantifying impacts

3. Matrix Method :-

1. In matrix methods interactions between various activities and environmental parameters will be identified and evaluated.
2. Matrices provide cause effect relationship between proper activities and environmental components.
3. Matrices are strong in identifying impacts, representing the various impacts with their interactions.

Features of Matrix Methods :-

* It is necessary to define the spatial boundaries of Environmental factor
* A matrix is considered as a Tool for the purposes of EIA Study.
* These are useful to display Comparision between different alternatives of the impact
* Colour Codes can be used to display and Communicate information on anticipated impacts of the projects.

Type of Matrix Method :—

1. Interaction Matrix Method 2. Simple interaction matrix method
3. Leopold matrix method 4. Stepped matrix method

(4) Network method :—

Networks are capable of identify direct & indirect impact interaction between the impacts. So, networks are able to identify, measure & incorporate, mitigation measure into the planning stages of a project.

* To develop a network a series of Questions related to each project activity.
* To develop a network the first step is
- Identifying the first order changes in the environment component.
- Identifying secondary changes resulting from first order changes and so on.
- This process will be continued until the network diagram or flowchat is developed as per the development of project

* Network analyze the relationship between Environmental components and their changes resulting to impacts.

* Network displays are useful in Communicating information about Environmental impacts.

(5) Overlay Method :—

Overlay methods involves preparation of a set of Transperent maps. with spatial distribution of environment characteristics

→ for each variable a series of map is prepared. these maps will be overlayed to produce a Composite map

→ This Composite map characterises the areas of physical social, ecological land use with their location of the proposed development.

→ No. of maps to be overlayed in a Transparency is limited to 10 for more clarity.

→ GIS methods are mainly used for assessing the changes in the landscape before and after the project Construction

→ overlay method are also used for analysis of sensitive areas or ecological Carrying Capacity.

→ overlay methods are usefull in addressing size & route selection of the developped project.

→ overlay methods also useful for industrial EIA of any project for Comparing land Capabilities, land uses, route alternatives, for air Quality Conditions and for pollution Control.

→ The overlay method is effective for selecting alternatives and identifying impacts - but it Cant be used to Quantify impacts.

(6) Cost Benifit Analysis: —

The method provides the nature of expanse and benfit acurable from a projet in financial or monitering Terms.

The role of cost benifit analysis or Environmental Economics in an EIA is described into three Catogories.

1. The use of Economies for benifit Cost Analysis
2. The use of Economies in the assesment of Activites.
3. The Economic Assesment of Environmental impacts of the projet.
4. Cost benifit analysis helps in the selection of projects
5. The Cost benifit Analysis in the EIA include the Summery of the projet Cost and Cost Estimates with their changes during the projet development under the EIA process
6. Cost benifit Analysis is not merely Consult with the effects on Environmental Quality but it improves the Conditions for Sustainable use of natural resources in a region.

(7) Environment media Quality index method

*. Classification of Enviromental Quality, pollution, potension of human activites are associated with development of numerical indices

*. The methods include factor identification, assesment impact significance methods of revelouation, field verification, implemuration of appropriate approaches.

* Factor identification Consists delineation of key factor.

* This factor identification should based on enviromental media or pollution source category.

* Development of idex is very important to segregates Environmental media or source Transport factors.

* For the development of media Quality index some of the functions are Evaluated.

They are like

1. linear Scaling or Categorization
2. Designed data Categories
3. Using national Curves
4. pier wise imparition Technic
5. Other pollution Source or environmental media related indexs are
   - Air pollution index
   - water Quality index
   - Rapid Assesment of pollution Source method
6. Regiration Quality or degradation index.

7. Predictive or Simulation methods or media:

* Adaptive environmental Assesment and Management approach Combines varies Simulation models to predict impact.
  - predictive models are used in EIA in Two ways
  - Comparision of model results with enviromental standards
  - The evaluation of proget alternatives predictive methods or model required Connection of information To determine environmental values for a Compared model parameters. In EIA Common Types of models used are

1. Physical model
2. Experimental model
3. mathematical model
4. Conceptual model.

CHAPTER – 2

EIA METHODOLOGIES

2.1 Criteria for selection of EIA Methods

I. 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.

II. Impact Identification

a) 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.

b) Specificity:

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

c) Isolation of project impacts:

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

d) Timing and duration:

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

III. Impact measurement

a) Commensurate units:

It should have a commensurate set of units so that comparison can be made between alternatives and criteria.

b) Explicit indicators:

It should suggest specific and measurable indicators to be used to qualify impacts on the relevant environmental parameters.

c) Magnitude:

It 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 weighing of the degree of significance of the impact.

d) Objective criteria:

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

IV. Impact interpretation and Evaluation

a) Significance:

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

b) Explicit Criteria:

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

c) Portrayal of "with" and "with out" situation:

The methodology should be able to aggregate the vast amounts of information and raw input data.

d) 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.

e) Risk:

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

f) 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.

g) Alternative comparison:

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

f) Public involvement:

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

V. Impact Communication

a) Affected parties:

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

b) Setting description:

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

c) Summary format:

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

d) Key issues:

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

e) 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 controlling agency.

2.2 Objectives of Methodologies

- Understand the nature and location of the project and possible alternatives
- Identify factors of analysis and assessment objectives
- Preliminary identification of impacts and scoping
- Baseline studies and evolution in the absence of projects
- Prediction and assessment of impacts and alternatives comparison
- Mitigation of impacts management.

2.3 Requirements of EIA Methodologies

The EIA Practitioner faces vast varieties of raw and unorganized information that must be collected and analyzed in preparation of an EIA report.

The best methods should be able to

- Organize a large mass of heterogeneous data
- Allow summarization of data
- Aggregate the data into smaller sets with least loss of information
- Display the raw data and the derived information in a direct and relevant fashion
- Target audience should also be considered (if not educated use color codes, size etc.)

2.3.1 EIA Methodology Evaluation

Table 2.1 Summary of current EIA methodology evaluation.

Criteria	Check lists	Over-lay	Net-work	Matrix	Environ-mental index	Cost/ benefit analysis	Simulation modeling workshop
1. Comprehensiveness	S	N	L	S	S	S	L
2. Communicability	L	L	S	L	S	L	L
3. Flexibility	L	S	L	L	S	S	L
4. Objectivity	N	S	S	L	L	L	S
5. Aggregation	N	S	N	N	S	S	N
6. Replicability	S	L	S	S	S	S	S
7. Multi-function	N	S	S	S	S	S	S
8. Uncertainty	N	N	N	N	N	N	S
9. Space-dimension	N	L	N	N	S	N	S
10. Time-dimension	S	N	N	N	S	S	L
11. Data requirement	L	N	S	S	S	S	N
12. Summary format	L	S	S	L	S	L	L
13. Alternative comparison	S	L	L	L	L	L	L
14. Time requirement	L	N	S	S	S	S	N
15. Manpower requirement	L	S	S	S	S	S	N
16. Economy	L	L	L	L	L	L	N

Legend : L = Completely fulfilled, or low resource need.
S = Partially fulfilled, or moderate resource need.
N = Negligibly fulfilled, or high resource need.

2.4 Major Methodologies for EIA

The methodologies can be broadly divided into five types on the basis of impact identification strength.

1. Adhoc methods
2. Matrices methods
3. Network methods
4. Overlays methods
5. Environmental index using factor analysis
6. Cost/benefit analysis

2.4.1. Adhoc Method

Ad hoc methods indicate broad areas of possible impacts by listing composite environmental parameters (Ex: flora and fauna) likely to be affected by the proposed activity. These methods involve assembling a team of specialists who identify impacts in their area of expertise. Here, each parameter is considered separately and the natures of impacts (long term or short term, reversible or irreversible) are considered. These methods give a rough assessment of total impact while giving the broad areas and the general nature of possible impacts. In this method, the assessor relies on an intuitive approach and makes a broad-based qualitative assessment. This method serves as a preliminary assessment and helps in identification of important areas like:

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

Types of Ad hoc method are:

a) Opinion poll
b) Expert opinion and
c) Delphi methods

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

The drawbacks of this method are listed below:

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

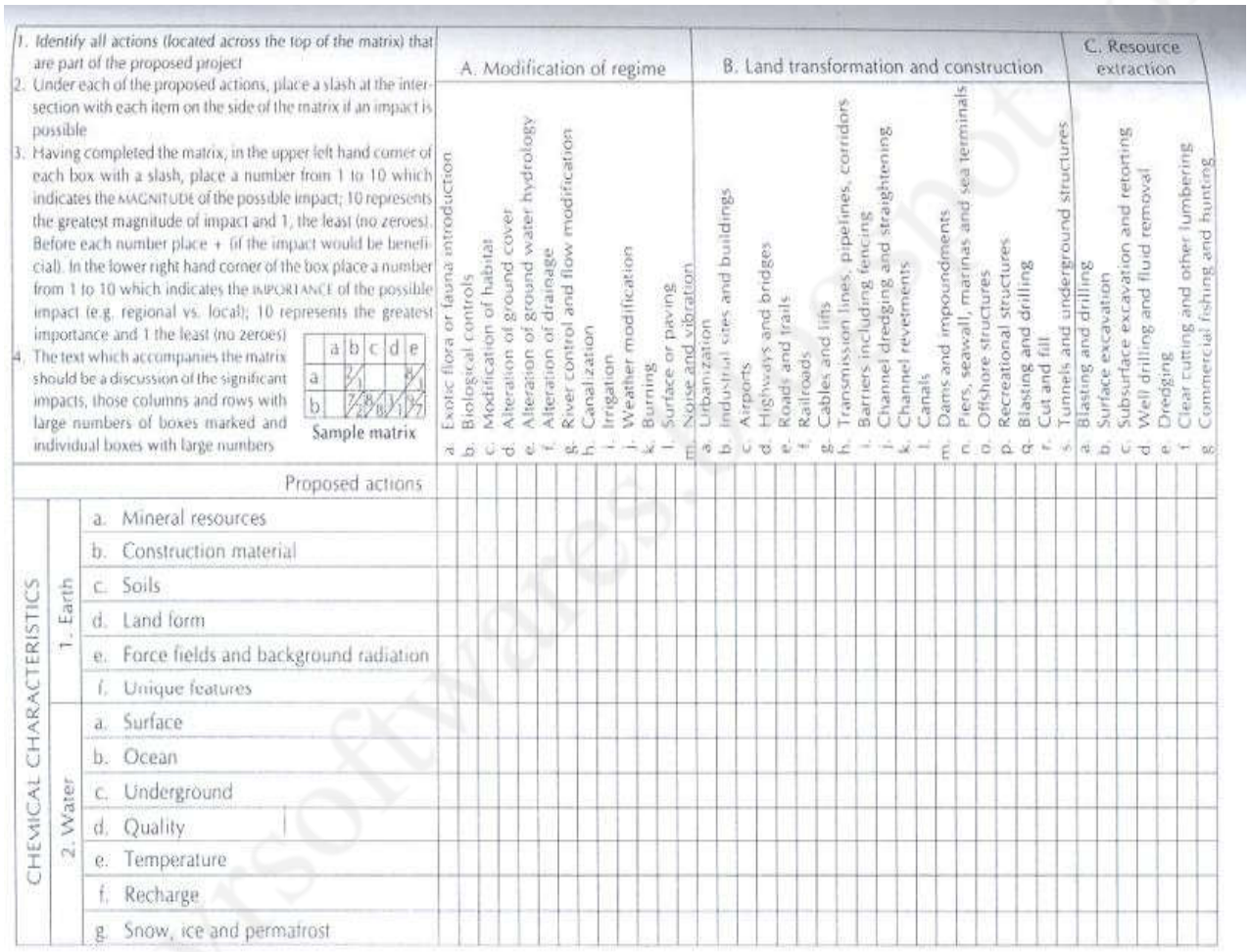
Example

EIA Study for High way Construction Project

Impact Area	Positive Effect	Negative Effect	Adverse	Beneficial	Problematic	Short Term	Long Term	Reversible	Irreversible
Wildlife		*					*	*	
Endangered species		*					*	*	
Natural vegetation						*		*	
Exotic vegetation			*		*		*		*
Grazing									
Social characteristics									
Natural drainage									
Groundwater									
Noise			*		*				
Air quality		*							
Visual description and services		*				*		*	
Open space									
Recreation									
Health and safety									
Paved Surface	*								
Public facilities	*								
Public amenities	*								
Employment Opportunities	*								

2.4.2. Matrices Method

This methodology provides a framework of interaction of different activities of a project with potential environmental impacts caused by them. A simple interaction matrix is formed when project actions are listed on one axis (usually vertical) and environmental impacts are listed along the other axis. This technique was pioneered by Leopold et al in 1971. It lists about 100 project actions and about 88 environmental characteristics and conditions. An example of this matrix is shown below:



1. Identify all actions (located across the top of the matrix) that are part of the proposed project
2. Under each of the proposed actions, place a slash at the intersection with each item on the side of the matrix if an impact is possible
3. Having completed the matrix, in the upper left hand corner of each box with a slash, place a number from 1 to 10 which indicates the MAGNITUDE of the possible impact; 10 represents the greatest magnitude of impact and 1, the least (no zeroes). Before each number place + (if the impact would be beneficial). In the lower right hand corner of the box place a number from 1 to 10 which indicates the IMPORTANCE of the possible impact (e.g. regional vs. local); 10 represents the greatest importance and 1 the least (no zeroes)
4. The text which accompanies the matrix should be a discussion of the significant impacts, those columns and rows with large numbers of boxes marked and individual boxes with large numbers

Sample matrix

A. Modification of regime

a. Exotic flora or fauna introduction
b. Biological controls
c. Modification of habitat
d. Alteration of ground cover
e. Alteration of ground water hydrology
f. Alteration of drainage
g. River control and flow modification
h. Canalization
i. Irrigation
j. Weather modification
k. Burning
l. Surface or paving
m. Noise and vibration

B. Land transformation and construction

a. Urbanization
b. Industrial sites and buildings
c. Airports
d. Highways and bridges
e. Roads and trails
f. Railroads
g. Cables and lifts
h. Transmission lines, pipelines, corridors
i. Barriers including fencing
j. Channel dredging and straightening
k. Channel revetments
l. Canals
m. Dams and impoundments
n. Piers, seawall, marinas and sea terminals
o. Offshore structures
p. Recreational structures
q. Blasting and drilling
r. Cut and fill
s. Tunnels and underground structures

C. Resource extraction

a. Blasting and drilling
b. Surface excavation
c. Subsurface excavation and retorting
d. Well drilling and fluid removal
e. Dredging
f. Clear cutting and other lumbering
g. Commercial fishing and hunting

Proposed actions

CHEMICAL CHARACTERISTICS

1. Earth
a. Mineral resources
b. Construction material
c. Soils
d. Land form
e. Force fields and background radiation
f. Unique features

2. Water
a. Surface
b. Ocean
c. Underground
d. Quality
e. Temperature
f. Recharge
g. Snow, ice and permafrost

Importance of Matrices

- Matrices are two dimensional tables.
- These facilitate the identification of impacts arising from the interaction between project activities and specific environmental components.
- The entries of the cell of the matrix can be either qualitative or quantitative estimates of impact.

i) Simple Matrix

Simple environmental impact matrix for the Phoenix Pulp Mill (*source:* Lohani and Halim, 1983).

Environmental Components	Project Activities								
	Plant Construction	Farming of Kenaf	Use of Pesticide Fertilizer	Transport of Raw Materials	Water Intake	Solid Waste	Effluent Discharge	Emissions	Employ-ment
Surface Water Quality			x			x	x		x
Surface Water Hydrology					x				
Air Quality				x				x	
Fisheries			x				x		
Terrestrial Wildlife Habitat	x								
Terrestrial Wildlife	x								
Land Use Pattern		x							
Highways/Railways				x					
Water Supply			x				x		
Agriculture		x							
Housing									x
Health						x	x	x	
Socioeconomic									x

ii) Leopold Matrices

- Identify all actions that are part of the proposed project
- Under the each of the proposed actions, place a slash at the inter-section with each item on the side of the matrix if an impact is possible.

	a	b	c	d
a	/	/	/	
a				
c				

- In the upper left hand corner of each box with a slash, place a number from 1 to 10 which indicates the MAGNITUDE of the possible impact.

- 10 represent the greatest magnitude of impact.
- 1 is the least magnitude of impact (no zeroes).
- Before each number place + (if the impact would be beneficial).
- In the lower right hand corner of the box place a number from 1 to 10 which indicates the IMPORT ANCE of the possible impact (Eg. Regional vs. Local).
- 10 represents the greatest importance and 1 the least (no zeroes).

	a	b	c	d
a	-1 / 3	+5 / 8		
b				
c				

Methodology - Leopold matrix definitions

NUMBER	MAGNITUDE	DEFINITION
5	Great	The impact is predicted to have a long term positive effect on the environment on a global scale
4	Major	The impact is predicted to provide a leading advantage to the environment and the community
3	Moderate	The impact is predicted to have a positive impact on the ecosystem
2	Slight	The impact is defined to have a mild but positive impact on the changes to the environment
1	Negligible	The impact is defined to have a minor positive impact
-1	Negligible	The impact is identified as modest, almost non-existent
-2	Slight	The impact is minor with a short-term effect on the local environment without changes to the distribution or status of the species.
-3	Moderate	The impact is identified as mild, short-term and reversible without changing overall integrity of the natural habitat and the community
-4	Major	The identified impacts are predicted to result in a primary change to the environment with a long term effect
-5	Catastrophic	The impact is predicted to results in an adverse and irreversible effect on a global scale

NUMBER	SIGNIFICANCE	DEFINITION
5	Great	Impact of cross-border character
4	Major	Impact of national character
3	Moderate	Impact of regional character
2	Slight	Impact of importance for municipality
1	Negligible	Limited impact on location

NUMBER	PROBABILITY	DEFINITION
3	Impact is certain (100% probability)	
2	Impact is probable (probability of over 50%)	
1	Impact is possible (probability of less than 50%)	

NUMBER	DURATION	DEFINITION
2	Long-term/Permanent	
1	Occasional/temporary	

Advantages:

1. The matrix method is that it links action to impact
2. This is a very good method for displaying EIA result.

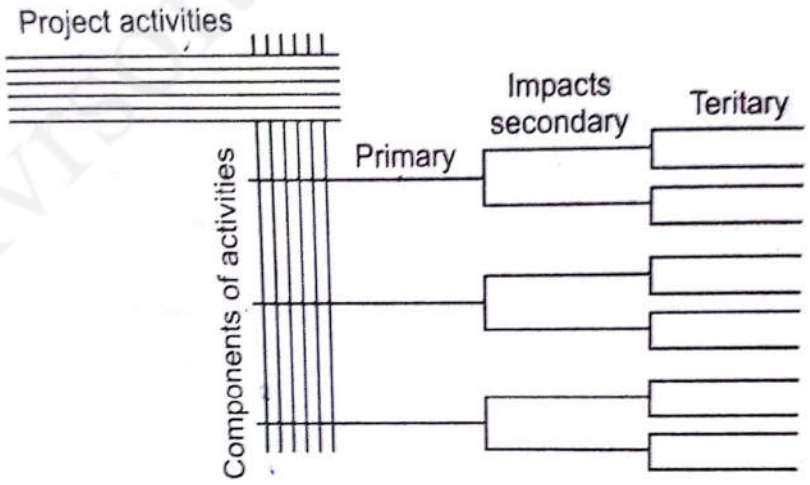
Disadvantages:

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

2.4.3. Network Method

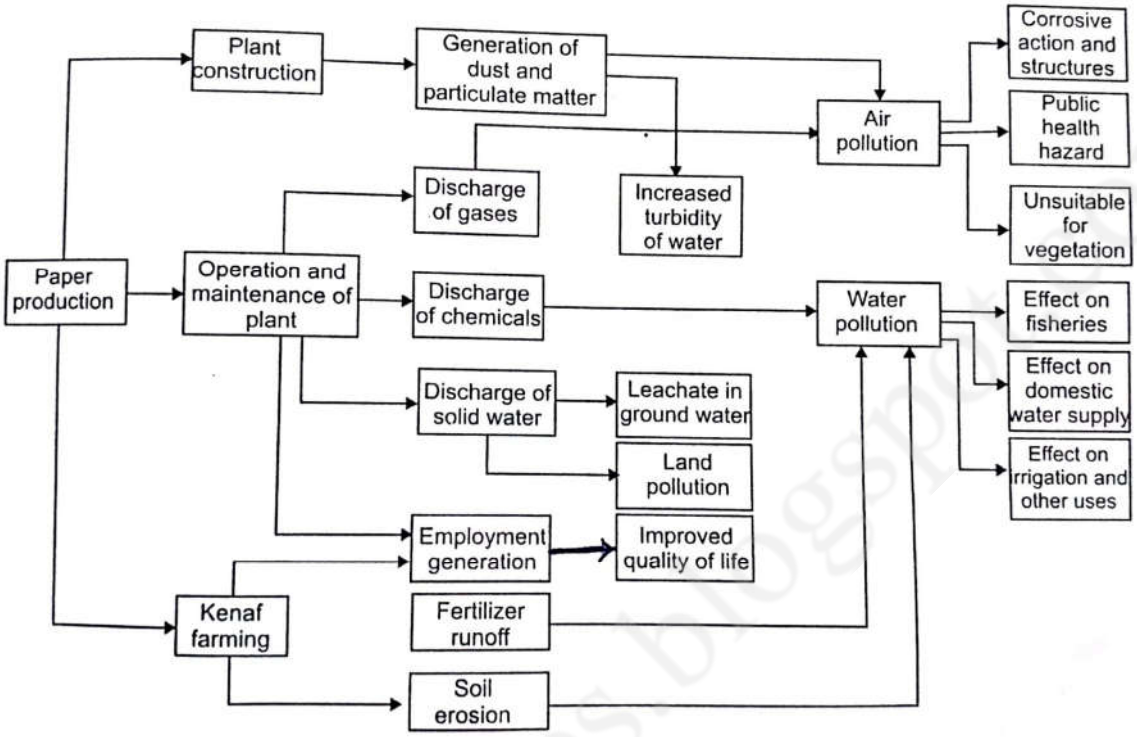
- This method uses the matrix approach and extends it to include both the primary as well as the secondary impacts.
- It is shown in the form of a tree called impact tree. This diagram is also called as reference or sequence diagram.
- Identification of direct, indirect along with short, long term impact is a crucial and basic step of making an impact tree.
- The impact tree is used to identify cause-effect linkages.
- The impact tree is a visual description of linkages.

Network Model



Conceptual model of impact networks.

Example



Network of pulpmill impacts.

Advantages:

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

Disadvantages:

- It becomes overly complex if used beyond simplified version.
- It is completely qualitative in nature.

2.4.4. Overlays Method

1. Overlay methods involve preparation of a set of transparent maps, which represent the spatial distribution of environmental characteristics (e.g., Extent of dense forest area).
2. 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.
3. These maps will be overlaid to produce a composite.
4. 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.
5. 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.

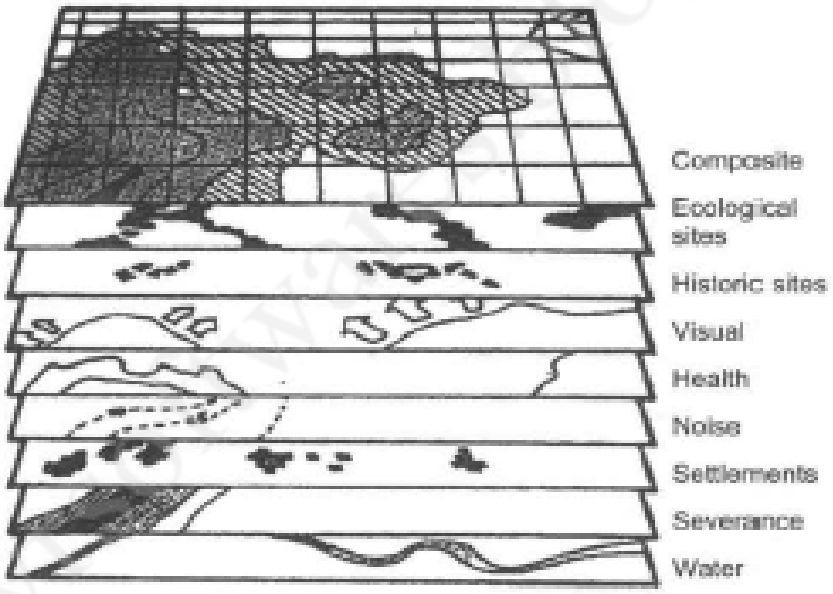


Fig. 2.8 Presentation of array of variables in overlay method.
Source: Wathern 1988

6. Normally to have some clarity the number of parameters that can be over layed in a transparency map is limited to 10.
7. These methods are widely used for assessing visually the changes in the landscape before and after the activity.
8. Secondly it can be used for preparing combined mapping with an analysis of sensitive areas or ecological carrying capacity.

9. As these methods are spatially oriented they can very clearly show the spatial aspects of cumulative impacts.
10. These maps are overlaid to produce a composite characterization of the regional environment.
11. Impacts are identified by noting the impacted environmental characteristics lying within the project boundaries.
12. The approach seems most useful as a method of screening alternative project sites or routes, before detailed impact analysis.
13. Overlays can be useful for industrial EIA of any project for comparing land capabilities existing and projected land uses, road route alternatives and other under parameters, and alternative levels of air quality conditions along with pollution control.

Advantages:

- It is easy to understand and use
- It has a good display
- It is good for setting site selection

Disadvantages

- The overlay method can accommodate both qualitative and quantitative data.
- The weakness of the overlay method is that it is only moderate comprehensive, because there is no mechanism that requires consideration of all potential impacts.
- There is no provision for quantification and measurement of the impacts nor is it assured that all impacts will be covered.
- The overlay approach is generally effective for selecting alternatives and identifying certain types of impacts; however, it cannot be used to quantify impacts to identify secondary and tertiary interrelationships.

2.4.5. Cost – Benefit Analysis (CBA)

1. Cost benefit analysis is a systematic process for identifying, valuing and comparing costs and benefits of a project.
2. It is a systematic approach to estimate the strengths and weakness of alternatives (for ex. In transactions, activities, functional business requirements or project investments)
3. It is used to determine options that provide the best approach to achieve benefits while preserving savings.
4. CBA is a standard tool for evaluating the economic analysis or trade of analysis, investment of development projects.
5. Economic analysis takes into account the opportunity costs of resources employed and attempts to measure in monetary terms the private and social costs and benefits of a project to the community or economy.

CBA Purposes

Broadly CBA has two main purposes

1. To determine if an investment/decision is sound (justification or feasibility) verifying whether its benefits outweigh the costs, and by how much.
2. To provide a basis for comparing projects which involves comparing the total expected cost of each option against its total expected benefits.

CBA Process:

- Define the goals and objectives of the activities.
- List alternate projects /programs.
- List stakeholders.
- Select measurement and measure all cost/benefit elements.
- Predict outcome of cost and benefits over relevant time period.
- Convert all costs and benefits into a common currency.
- Apply discount rate.
- Calculate net present value of project options.

- Perform sensitivity analysis to identifying the key variables that are major influence in the cost and benefits of the project.
- Adopt recommended choice.

**Cost Benefit analysis is carried out for the selected EIA report

- The cost-benefit analysis of the highway road project enables to make a comparison of the individual-projects and give priority to the competing projects on a monetary basis.
- The Road Authority and Transport Department must use the available resources efficiently, keeping in mind the welfare of the environment and its inhabitants.
- Provision for service roads/alternate road connectivity, two-laning/ four-laning/ six-laning, riding quality, bypasses and over-bridges, bridges amenities. Based on these factors, the investment needs can be calculated.

Example:

Highway Road Authority

The road authority costs include

- Expenditure involved in the construction and maintenance of roads.
- Acquiring the land from the land owners and providing appropriate compensation, expenses incurred in setting up fences and land scaping .
- Construction of noise barriers to reduce the sound entering the residential locality by absorbing, transmitting or reflecting the sound.

Highway Cost Components

1. **Agency Cost**

   This includes the expenses incurred by the government or private agency for construction and maintenance of highway roads.

   a) Construction cost includes
      - Expenses incurred in surveying, planning and designing.
      - Purchasing land from the land owners to lay road.
      - Construction of road.
      - Installation of electrical poles, traffic control equipment.
      - Administrative cost involved in supervising the traffic.

   b) Maintenance cost includes
      - Periodic repair of the damaged roads.

- Relocation and rehabilitation of the displaced people .
- Expenses incurred in maintaining and operating the traffic related equipment.

2. **User Cost**
   This includes the cost incurred in vehicle operation and cost due to the unavoidable accidents, cost incurred in vehicle operation, fuel, spare parts, wear out of the tires ,lubricants, registration charges ,insurance expenses, road tax and road permit tax etc.

Benefit components of highway road

- A well maintained highway road provides efficient and safe transportation to the road users.
- The benefits include saving in travel time.
- Improvement in health, education, agriculture, industry trade and various other fields.

Impact Development Activities and Land use

Introduction:— Every type of activities of project can induce changes on the sorroundings of the land.

(*) Some activities of the project will have direct impact or some other may have indirect impacts.

*. Soils and Groundwater:

+ Soil and Ground water characteristics may be affected by physical disturbances like addition or removal of soil, changes in water hydrology, changes in climates discharge of effluence etc.

+ The effects of these vary from first order effects of leaching into soil and ground water to changes in Ground water regime, soil structure (including erosion and subsidence) Soil Quality or Temparature and Groundwater Quality or Temparature.

*. Methodology for the Assesment of Impacts on Soil and Groundwater

(1.) In analyzing environment impacts, both subjective and Subjective Judgements should be taken into Consideration.

(2) objective judgements are defined as those which involve or use facts that are observable or verifiable especially by scientific methods.

(3) Subjective Judgements are those which are made on the basis of values, feeling, and beliefs.

(4) In the Context of the environment the objective Judgement describes the impact where as Subjective Judgement describes how people feel about the fact.

Step 1: Delineation of Study Area.

Step 2: Identification of activies of the project which will have different types of Effects on soil and or Ground water Quality.

Step 3: preparation of description of existing soil and/or Groundwater resource Condition.

Step 4: Procurement of relavent : Soil and/or Ground water Quality / Quantity Standards.

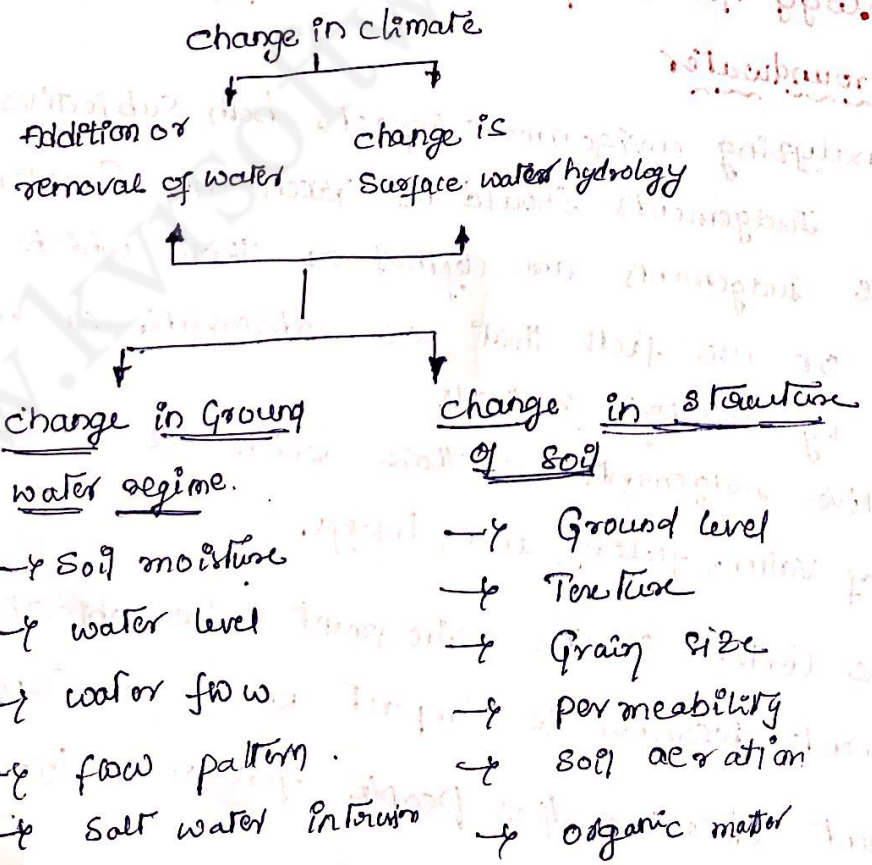
Step 5: Impact prediction for soil and/or Groundwater environment

Step 6: Assesment of Impact Significance

Step 7: Identification and incorporation of mitigation measures.

Soil and

* Soil And Ground water Effects.



- Change in Ground water regime
- Change in structure of soil

↓

Effect on

- Soil biota
- plant and animal
- Aggricultural crop and forestry
- livestock
- Human : health
- Surface water Quality

② change in climate

↓

Change in Groundwat.

↓

Effect on Erosion

- Surface water Quality
- Landscape + visual ecological amenity
- plants and animals
- Aggricultural crops and forestry.

Removal of water

↓

Effect of Subsidence

- building and other work (incl. monuments
- Human Health (safety)
- Landscape - Visual

✱. Delineation of Study Area :

It is very specific based on presence of potential impacts. In the study area the proposed or feature land-use map along with commited land-use polices zoning, and development profects 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.

** Identification of Activities :—

1. Direct landuse impacts on land :—

1. Landforms :— Important few physical features that have special importance as recreational educational or scientific interests may be present in the project area. Examples :- rock outcrops, Sandy beaches and lagoons.

2. Soil profile :— The soil profile is related to the physical and chemical and physical nature of soil. Erosion is the principal process on which may alter the soil profile.

3. Soil Compaction : The chemical and mineral composition of the soil influence in engineering and Aggricultural capability. Changes in soil compaction can occur either by subtraction. Eg. acid and alkali leaching.

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

5. Seismicity :— Stress, vibration, due to explosions and deep well injection operation can have an effect on the stress strain Equilibrium on fault plane.

(6) Subsidence and Compaction :— These are occur naturally but generally as a gradual and almost imperceptible process. The process can be accelerated by underground excavation, vibration or loading.

(7) ~~Flood plains and~~ Land use :— The existing land use and planned use of adjacent land are important components of the environment.

(8) Mineral or Engineering resources :— The occurance of mineral or Engineering resources is of strategic and economic importance.

Mining or quarrying proposed can result in long Term economic or social impacts on any community.

(9) Buffer zones :— Buffer zones are spaces which provide natural environmental protection from drainage. Buffer zone provide wind breaks, soil erosion control, Sediment Traps, ~~sil~~ Siltation Traps, wildlife shelters and visual screening.

* Application of Remote sensing and GIS for EIA :

1. Linear projects :—

Roads affect habitats at a range of spatial scales and usually impinge upon a number of habitats across of habitats. The impact of road is thus difficult to asses using conventional techniques.

2. Coastal zone studies :—

The coastal zone has a similarity to that of roads and pipelines and poses the associated problems with measurement and monitoring.

Remote Sensing can monitor both short and long term changes at the cost. for example historical aerial photograph can be used to measure changes at coastal geomorphology resulting from variation in the long term sediment balance

③ Estuaries: —

Remote sensing is particularly useful in fresh water studies for measuring the extent of coastal zones waters because of their inaccessibility to measurement.

Fresh water ~~bodies of~~ bodies such as lakes reservior, and wastewater stores are similarly difficult to measure.

④ Land use and Land Cover Studies: -

→ The scooping and monitoring wastelands is important and they can be identified with thermal RS in having relatively high soil moisture content and associated low temparature

→ Remote sensing will be ideally suited for mapping and classification of wasteland sites at the regional scale.

⑤ Application of GIS for EIA

Geographical Information systems (GIS) are computer systems that can store, integrate, analyze and display spatial data.

A Geographical Information system uses Geographically referenced data as well as non-spatial data and includes operations which support spatial Analysis.

In GIS, the common purpose is decision-making

for managing use of land resources, Transportation, retailing, oceans or any spatially distributed entities the Connection between the elements of the system. is Geography.

→ In this context GIS can be Seen as system of hardware software and procedures designed to support the Capture, management, manipulation analysis, modelling and display.

Major applications of GIS:—

→ street network based address matching - finding locations given street addresses.
→ Vehicle routing and scheduling
→ location analysis, site selection
→ Environment Impact Analysis
→ View shed analysis
→ wildlife habitat analysis, migration routes planning
→ Zoning, subdivision plan review
→ land acquisition
→ Environment Impact statement
→ water Quality Management
→ Maintance of ownership

4-1 Civil EIAM UNIT-3

CHAPTER 3

Prediction and Assessment of Impacts on Soil and Ground Water Environment

3.1 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 assessment of potential land-use impacts should be comprehensive covering characteristics of the project.

3.2 Soils and Groundwater

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 water, 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. A summary of these effects is presented in Fig. 3.1.

3.3 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. Fig. 3.2. 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'.

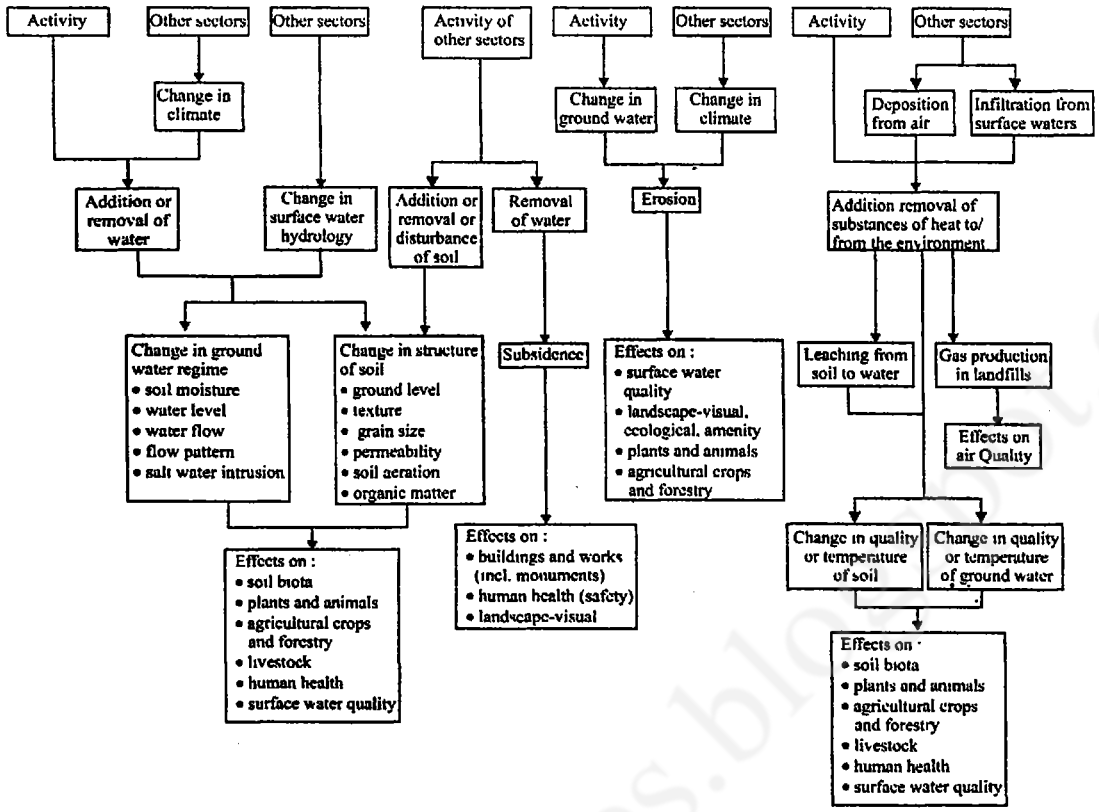


Fig. 3.1 Soil and groundwater effects.

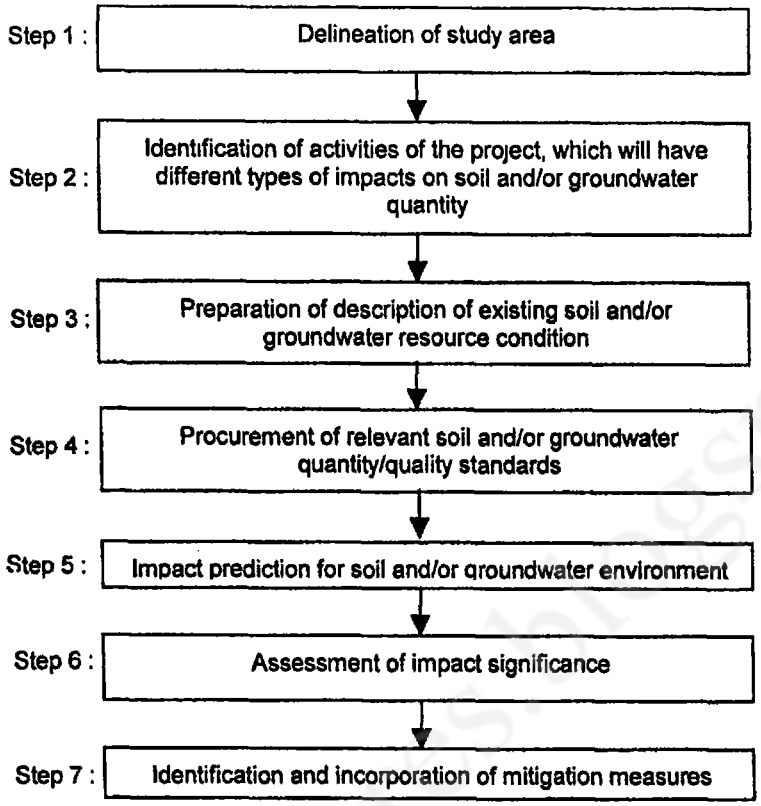


Fig. 3.2 Systematic approach for the study of impacts on soil and ground water.

3.3.1 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.

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

Direct Land-Use Impacts on Land

1. ***Landforms :*** Unique or important physical features that have special importance, as recreational educational or scientific interests may be present in the project area. They may be unique locally or unique in a larger area. Examples are rock out crops, river gorges, sandy beaches, and lagoons. Such features may also influence local climate.
2. ***Soil profile :*** The soil profile is related to the chemical and physical nature of the soil and the prevailing climate and therefore 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, land use downstream.
3. ***Soil composition :*** The chemical and mineral composition of the soil influences its engineering and agricultural capability. Changes in soil composition can occur either by, subtraction e.g., acid or alkali leaching or by addition e.g., cation exchange extraction, nitrogen fixation.
4. ***Slope stability :*** Rock slopes are inherently stable. The environmental effects of slope instability are similar to those for erosion. The scale of the effects are larger in this case.
5. ***Seismicity :*** Stress, vibration, due to explosions and deep well injection operations can have an effect on the stress-strain equilibria on fault planes. Renewed or increased activity can have major environmental effects for the project site.
6. ***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. The major effect is on land capability but drainage, groundwater behavior and landscape could also be affected.
7. ***Flood plains Swamps :*** Flood plains and swamps are an important part of the drainage pattern as they admit peak flows into the drainage system. Reclaimation on natural flood plains or swamps may result in flooding and siltation of other areas during peak flow. Major engineering of a drainage system may either decrease the amount of agricultural land available or may destroy wetland habitats of fish, birds etc.
8. ***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.
9. ***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 incompatible with subsequent mining or quarrying proposal can result in long-term economic or social impacts on the community.

10. *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.

Some projects or actions, by their very nature, have direct and obvious impacts of land use by physically destroying or clearing land and implementing a new use. Here are some examples of this kind of direct land-use revision:

(a) A highway project with a 300 right-of-way width converts whatever the existing land use is to a transportation land- use within that right-of-way width.
(b) A dam constructed to create a reservoir for water supply and recreational use directly converts the previous land use to recreational use.
(c) A regional park constructed on land previously used as pasture directly changes the number of acres of the park into a different use.
(d) A city block of low-income housing structures is demolished to construct a shopping mall, directly converting that land to commercial use.

Examination of Existing and Future Planned Land-Use for Delineating Study Area

The first step is to get the necessary information on existing development trends, planned development projects, and especially the goals and objectives of land-use plans and policies. These existing and proposed committed projects and policies are then factored into the no-build alternative. The result is a definition of future development intensity and policy without the proposed project. The impact of the proposed project is the difference between these future conditions (no - build) and the future conditions with implementation of the proposed project or action (build). There may also be substantive differences among the various build alternatives being considered.

An initial activity is co-ordination with the regional planning organization and with the local planning officials and zoning agencies. This early contact is valuable to

- Determine the existing and planned land- use and zoning for the area of the proposed project,
- Identify any particular problem,
- Identify goals for land- use and economic development
- Initiate continued review and co-ordination throughout the project study phase.

Depending on the expected magnitude of impact of the various activities of the project, the population growth, the study area should be delineated.

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 can be considerable for the road agency and others. This includes farmers losing crops and land, fishers losing income because of sedimentation in

rivers and lakes, and road users being delayed when road embankments or structures collapse. The costs of correcting these problems are often many times greater than the costs of simple preventive measures.

Loss of Productive Soil

The most immediate and obvious effect of road development on soil is the elimination of the productive capacity of the soil covered by roads. Unfortunately, the best sites for road development (flat and stable) also tend to be ideal for agriculture. The narrow, linear character of roads makes the impact of lost land seem minimal, but when the width of the right-of- way is multiplied by its length, the total area of land removed from production becomes much more significant. 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 a race between the appearance of erosion and the growth of vegetation. Disturbance during construction can upset the delicate balance between stabilizing factors, such as vegetation, and others which seek to destabilize, such as running water. 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. Excessive steepness of cut slopes, deficiency of drainage, modification of water flows, and excessive slope loading can result in landslides Fig. 3.3. Some soils, such as shale and "quick clays", are known for being difficult to drain and particularly unstable.

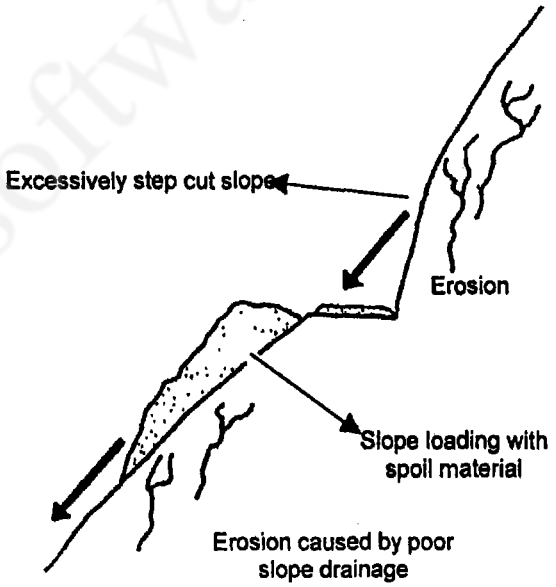


Fig. 3.3 Destabilization of slopes.

Side Tipping of Spoil Materials

Spoil material from road cuttings can kill vegetation and add to erosion and slope stability problems. Large amounts of spoil can be generated during construction in mountainous terrain. Sometimes it is difficult to design for balances between cut and fill volumes of earth at each location, and haulage to disposal sites may be expensive. This creates a need for environmental management of tipped material.

Water Flow Diversions

Diversion of natural surface water flows is often inevitable in road projects. Diversion results in water flowing where it normally would flow.

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 (Fig. 3.4). The use of slope retaining techniques may be necessary when

- Slopes are unstable because they are too high and steep;
- Climatic conditions are such that establishment of vegetation is slow or impossible;
- There is a risk of internal erosion or localized rupture because of drainage difficulties; and
- It is necessary to decrease the amount of earthwork because the road width is limited.

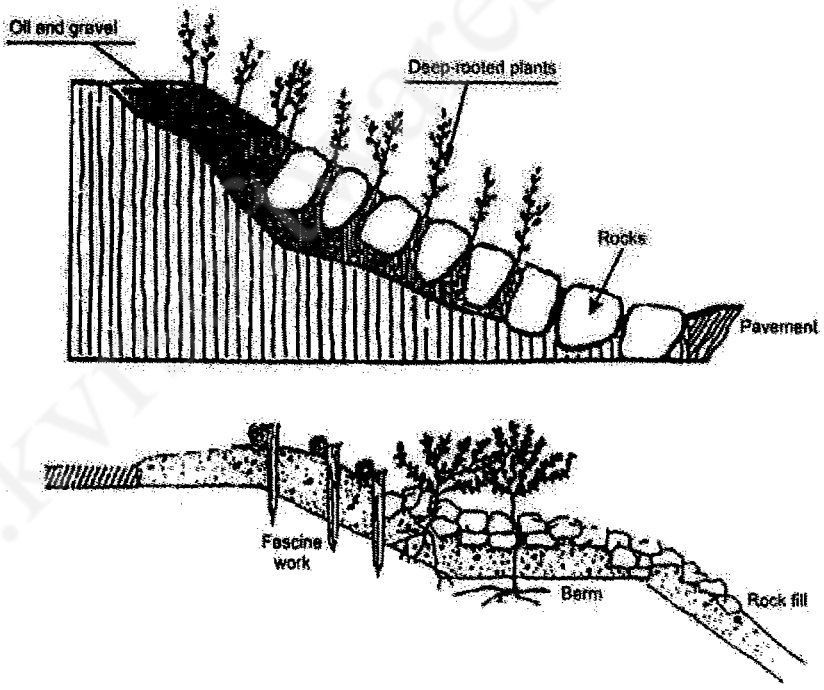


Fig. 3.4 Examples of combined techniques for slope protection.

Well established engineering measures for slope protection include :

- Intercepting ditches at the tops and bottoms of slopes. Gutters and spillways are used to control the flow of water down a slope;
- Terraced or stepped slopes to reduce the steepness of a slope. A berm (or riseberm) is the level section between slope faces;
- Riprap, or rock material embedded in a slope face, sometimes combined with planting;
- Retaining structures, such as gabions (rectangular wire baskets of rocks), cribs (interlocking grid of wood or concrete beams, filled with earth or rock), or other types of wooden barricades and grid work, usually battered back against the slope;
- Retaining walls, more substantial engineering structures able to resist bending, and with a footing designed to withstand pressures at the base of the slope;
- Reinforced earth, embankment walls built up as the earth fill is placed, with anchors compacted into the fill material; and
- Shotcreting and geotextiles, generally more expensive options with specific applications

Preliminary Procedure for General Projects

An appropriate initial activity when analyzing a proposed project or activity is to consider what types of soil and/or geological disturbances might be associated with the construction and/or operational phases of the proposed project, and what quantities of potential soil contaminants are expected to occur.

"Impact trees" or "networks" can be used to delineate potential impacts on the soil and geological environments.

Regarding the identification of potential soil pollutants, a list of the materials to be utilized during the project and those materials which will require disposal could be developed. Examples of materials that may result in soil contamination include fuels and oils, bituminous products, insecticides, fertilizers, chemicals, and solid and liquid wastes. As an initial step, a simple checklist of the types and quantities of chemicals associated with each activity could be prepared and utilized. Transport and effects information on key chemicals could also be included. It may also be appropriate to consider the quality of leachates from waste materials disposed on land.

Environmental problems in land conservation in the following can be analysed using systems analysis techniques:

1. The degradation of soil fertility due to increase in concentration of sodium, caused by water logging and application of chemical fertilisers.
2. Physical loss of soil through accelerated erosion due to the action of water and wind .
3. Impact of the conversion of good farm lands into reservoirs and dwelling areas.

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.

Numerous types of projects could have detrimental impacts on the soil or geological environment, or both Table 3.1 & 3.2.

Table 3.1 Effects of developmental activities on five classic factors for soil formation.

Factors of soil	Type of effect	Nature of effect
Formation		
Climate	Beneficial	Adding water by irrigation; rainmaking by seeding clouds, removing water by drainage, diverting winds, etc.,
	Detrimental	Subjecting soil to excessive insolation to extended frost action, to wind etc
Organisms	Beneficial	Introducing and controlling populations of plants and animation adding organic matter including 'nightsoil', loosening soil by ploughing to admit more oxygen; following, removing pathogenic organisms adding radioactive substances.
	Detrimental	Removing plants and animals; reducing organic matter content of soil through burning ploughing, over-grazing, harvesting, etc, adding or fostering pathogenic organisms; adding radioactive substances
Topography	Beneficial	Checking erosion through surface roughening, land forming and structure – building
	Detrimental	Causing subsidence by drainage of wetlands and by mining; accelerating erosion; excavating
Parent material	Beneficial	Adding mineral fertilizers; accumulating shells and bones; accumulating ash, locally; removing excess amounts of substances such as salts.
	Detrimental	Removing, through harvest, more plant and animal nutrients than are replaced, adding materials in amounts toxic to plants or animals, altering soil constituents in a way to depress plant growth.
Time	Beneficial	Rejuvenating the soil through adding of fresh parent material or through exposure of local parent material by soil erosion; reclaiming land from under water.
	Detrimental	Degrading the soil by accelerated removal of nutrients from soil and vegetation cover; burying soil under Solid fill or water.

Source : Goudie (3)

Table 3.2 Examples of human-induced effects on soil characteristics.

Soil factor	Beneficial change	Neutral change	Adverse change
Soil chemistry	Mineral fertilizers (increased fertility) Adding trace elements Desalinize (irrigation) Increase oxidation (aeration)	Altering exchangeable ion balance Altering pH (lime) Alter via vegetation change	Chemical imbalance Toxic herbicides and herbicides Salinize Over–removal of nutrients
Soil physics	Induce crumb structure (lime and grass) Maintain texture (organic manure or conditioner) Deep plowing, after soil moisture (irrigation of drainage)	Alter structure (plowing, harrowing) Alter soil microclimate (mulches, shelter belts, heating, albedo change)	Compaction/plow pan (poor structure) Adverse structure due to chemical changes (salts) Removal perennial vegetation
Soil organisms	Organic manure Increase pH Drain/moisten Aerate	After vegetation and soil microclimate	Remove vegetation and plow (less and microorganisms Pathogens Toxic chemicals
Time (rate of change)	Rejuvenate (deep plowing adding new soil, reclaiming land)		

Examples of Types of Projects and Associated Impacts Include

1. Land subsidence which can occur as a result of over- pumping of ground-water resources or oil gas resources in a given geographical area or which can occur as a result of surface or sub-surface mining activities associated with mineral extraction.
2. The impacts associated with the identification and usage of construction material for major projects, with such material coming from identified burrow areas. (There may be changes in local surface water hydraulics and erosional patterns as a result of construction material.).
3. Construction practices in general can create some concerns related to the potential for increased soil erosion in the construction area. This increase in soil erosion could lead to specific mitigation requirements, such as, the creation of sediment retention basins or the planting of rapidly growing vegetation.
4. Landslides, caused by inappropriate slope stability, which can occur as a result of over development on particular soil types within the areas having certain topographic features.
5. The potential concerns associated with constructing and operating nuclear power plants, chemical production plants, waste–disposal facilities. and/or large storage tank facilities in areas characterized by seismic instability and excessive earthquake potential. (This can influence siting decisions and decisions associated with construction and operation activities.)
6. Strip–mining operations for coal extraction, or other mineral resource extraction wherein the land surface is to restore the original landscape, possibly in some type of alternative topographic arrangement.
7. The construction of jetties along coastal areas in order to control beach erosion and littoral drift.
8. Projects which may create acid rain in localized area, with the acid rain, in turn, having an impact on soil chemistry and, potentially, on sub-surface groundwater resources.
9. Projects wherein the site characteristics in terms of soil and geological features are incorporated as components in the selection process examples of such site–selection oriented projects, sludge–disposal projects, and upland locations for dredged–material disposal.
10. Projects that involve developments along the coastal areas wherein coastal erosion problems may either be increased by the project, or may influence the proposed project itself. Examples of such projects include the coastal marins and associated secondary developments, industrial development projects with associated port and boat mooring facilities, and projects, which involve the development of ports and harbours.

11. The construction and operation of surface water reservoir projects, with the purposes of the projects ranging from the single purposes of providing flood control to multiple purposes, including hydro-electric power development, provision of water supply, and so on. There are two key environmental concerns relative to soil and geological issues, the first is related to sedimentation within the reservoir and the provision of appropriate sediment – storage capacity in terms of the project lifetime; the second is related the potential effects of such surface water reservoir projects on the subsurface environment, including changes in soil, ground water, and geological features that lie underneath the water pool of the reservoir.
12. Projects associated with permits for grazing leases or other leases related to agricultural uses, where the subsequent grazing or agricultural developments could lead to changes in soil characteristics such as erosion patterns and soil chemistry. Examples of such changes are in Table 3.2.
13. The potential effects of soil characteristics on buried pipelines, with examples including the potential loss of the physical integrity of the pipeline as a result of acid or corroding soils.

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

Background Information on the Soil Environment

Soil Characteristics

Soil characteristics in a given geographical area at a given point of time are a function 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. Table 3.3 summarizes the principal anthropogenic activities, which can cause ground- water pollution.

In describing quantity and quality, specific indicator parameters can be utilized. For example, the following represent some of the information, which could be compiled, and the issues, which could be addressed, are :

1. Descriptions should be assembled on groundwater systems in the study area, indicating whether they are confined or unconfined, with the obvious pollution relevance being that unconfined groundwater systems tend to be more susceptible to groundwater contamination.
2. Of particular importance would be the description of karsts aquifer systems, since these areas can exhibit unique and rapid groundwater flow patterns.
3. Many areas are characterized by the presence of multiple groundwater systems; accordingly, it would be appropriate to describe those geographical areas characterized by multiple aquifer systems.

4. If information exists on the quantitative aspects of the groundwater resource in terms of potentially useable supplies, which could be extracted, it should be summarized.
5. Information should be summarized on the uses of groundwater within the study area, with a more detailed study of this subject to be conducted later.
6. A description of the relationships between local groundwater systems and surface streams, lakes, estuaries, or coastal areas may be important, since mutual quantitative or qualitative influences can occur.
7. Groundwater pollution vulnerability is associated with the question whether or not the project area is in a recharge zone for a given groundwater system. This should be determined because there is greater pollution potential in the recharge zone. (It should be noted that for confined aquifer systems the recharge area may be located a was long way from the actual segment of the groundwater system being used form purposes of water supply.)
8. Depth of groundwater is a fundamental parameter which could be identified, with the pertinent issue that greater the depth of groundwater, the greater the degree of natural protection.
9. Unsaturated - zone permeability should be described. Here, the "unsaturated zone" refers to that segment of the subsurface environment, which is between the land surface and the water table of an unconfined aquifer system. The unsaturated zone permeability can influence the attenuation of contaminants as they move away from a source of pollution and toward the groundwater system.
10. Aquifer transmissivity should be described. This parameter represents information on the water carrying capacity of the ground water system.
11. Any existing data on groundwater quality should be summarized. If no such data exists, it may be necessary to appropriately plan and conduct a groundwater-monitoring program. In some unique cases, the quality data may need to be described in terms of aquatic ecosystems. For example, several threatened or endangered aquatic species have been found in springs associated with the Edwards aquifer in central Texas.

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, groundwater supplies relative to existing bacteriological or other quality constituents, poor natural quality, and the presence of hazardous waste sites. Dryland farming practices involving irrigation often lead to salt accumulation in surface soils and shallow unconfined aquifers.

Pollution Sources and Groundwater Users

It is appropriate to consider which other potential and actual sources of soil and/or groundwater pollution 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. Quantitative impact prediction is typically associated with the use of look – alike, or analogous projects for which knowledge and information are available, and/or the utilization of relevant case studies.

3.3.4 Procurement of Relevant Soil and / or Groundwater Quantity - Quantity Standards

Land-use restrictions, soil quality standards, soil reclamation requirements, and groundwater 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 with jurisdiction.

The primary sources of information needed for step 3 (Figure 3.2) 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.

3.3.5 Impact Prediction

The prediction of the impacts of a 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.

1. Qualitative
2. Simple quantitative, and
3. 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 and through the spreading of excess sub-soil over the right – of – way during clean-up. 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 sub-surface environmental processes. The fundamental processes in the sub-surface environment can be examined relative to their hydrodynamic (physical), biotic (chemical), aspects. Table 3.3 summarizes processes, which may affect constituents of groundwater.

Table 3.3 Possible sources of ground water contamination.

Category I	Sources designed to discharge substances
Subsurface percolation (e.g., septic tanks and cesspools)	
Injection wells	
	Hazardous waste
	Non-hazardous waste (e.g., brine disposal and drainage)
	Non-waste (e.g., enhanced recovery, artificial recharge, solution mining, and in-situ mining)
Land application	
	Wastewater (e.g., spray irrigation)
	Wastewater by – products (e.g., sludge)
	Hazardous waste
	Non-hazardous waste

Table 3.3 *Contd...*

Category II – Sources designed to store, treat, and/or dispose of substances; discharge through unplanned release
Landfills
Industrial hazardous waste
Industrial non-hazardous waste
Municipal sanitary
Open dumps, including illegal dumping (waste)
Residential (or local) disposal (waste)
Surface impoundments
Hazardous waste
Non-hazardous waste
Materials stockpiles (non-waste)
Graveyards
Animal burial
Aboveground storage tanks
Hazardous waste
Non-hazardous wate
Underground storage tanks
Hazardous waste
Non-hazardous waste
Non-waste
Containers
Hazardous waste
Non-hazardous waste
Non-waste
Open burning and detonation sites
Radioactive disposal sites
Category III – Sources designed to retain substances during transport or transmission
Pipelines
Hazarous waste
Non-hazardous waste
Non-waste
Materials transport and transfer operations
Hazardous and transfer operations
Non-hazardous waste
Materials transport and transfer operations
Hazardous waste
Non-hazardous waste
Non-waste
Category IV – Sources discharging substances as consequence of other planned activities
Irrigation practices (e.g., return flow)
Pesticide applications
Fertilizer applications
Animal feeding operations
Urban runoff

Table 3.3 *Contd*

Percolation of atmospheric pollutants
Mining and mine drainage
Surface mine – related
Underground mine – related
Category V – Sources providing conduit or inducing discharge through altered flow patterns
Production wells
Oil (and gas) wells
Geothermal and heat recovery wells
Water supply wells
Other wells (non-waste)
Monitoring wells
Exploration wells
Construction excavation
Category VI – Naturally occurring sources whose discharge is created and/or exacerbated by human activity
Ground water – surface water interactions
Natural leaching
Salt – water intrusion/brackish water upcoming (or intrusion of other poor – quality natural water)

Source : Office of Technology Assessment, 1984, p. 45.

Groundwater

1. ***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
2. ***Flow regime :*** The ground water flow regime, the direction and rate of flow may be altered by surface or under ground engineering, especially drainage works, by draw-off and by the penetration of cap rocks of confined aquifers, any such change can have an impact on other users of the ground water source
3. ***Water quality :*** Water quality is important for economic, ecological, aesthetic and recreational purposes. Changes in water quality may affect water treatment costs or ever deny some uses of the water. These changes can be chemical, biological or physical
4. ***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
5. ***Aquifer characteristics :*** Sometimes known as "Aquifer safe yield" these include all the physical parameters (porosity, permeability etc), which govern the ability of aquifer, provide water for human use. Over pruning or waste injection can cause a decrease in the "Aquifer safe yield"
6. ***Existing use :*** The uses of ground water system must be for engineered domestic, industrial and agricultural supply or natural agricultural and ecological dependence on the ground water system

Unit - 4

⊛ Procurement of soil Quality

→ Ground water Quality and Quantity standards, soil Quality standards, soil reclamation requirement, & ground water standards, regulations & policies and mitigation measures or the parameters which can be used to determine the impact significance of a proposed project.

→ These details are quality and Quantity standards will be obtained from the govt. agencies.

→ These sources for these water & soil Quality standard can be away from central govt agencies, state govt agencies.

→ In addition to the above agencies international environment bodies or agencies, NGO (Non govt organisations) may have information about the water & soil Quality standards.

⊛ Impact prediction :—

The prediction of impact of a project activity on the soil and or ground water ~~environment(s)~~ conversely the can be approach in three ways.

1. Qualitative
2. Simple Qualitative
3. Specific Maintanance

(1) Qualitative approaches on Ground water :—

⊛ Qualitative impact prediction using look-alike (The prediction of acid rain impacts)

⊛ The Qualitative approach for soil impact prediction irrelated to soil pipeline construction

⊛ There are of potential impact of pipeline construction on soil & Ground water.

1. Contamination of Top soil
2. Soil Compaction
3. Soil Erosion
4. Disruption of natural Drainage pattern

(*) . Soil structures changes can be caused by aggricultural practi ground water conditions and by removal of surface soil or water

(*) Erosion of wind explosure may damage soil profile and it can be predicted by the universal soil loss equation.

Qualitative impacts on Ground water : –

* Qualitative approach for ground water impact prediction involve the examination of their hydrodynamic (physical) Biotech, chemical aspects.

* possible sources for Ground water impacts are

1. Subsurface percolation
2. Injection well
3. various types of land applications
4. various land fills
5. Radio active disposals
6. Irrigation practices
7. pesticide & fertilizers applications
8. Urban runoff
9. Mining & its drainage patterns
10. Construction Excavation activities
11. Surface Ground water Interaction
12. Natural leaching
13. Salt water Intrusion

2. Simple Quantitatives for impacts on Soil & Ground water:

* There are different simple Quantitative techniqu are they impact prediction.

① overlay Mapping ② Quantitive models.

③ Specific Quantitatives :—

* The changes in Ground water flow and Ground water Quality assesment with mathematical Conceptual models

* Ground water Table, flow regime, water Quality, Ground water recharge, acquifer characterstics, use of Ground water systems and there monitoring, Evaluation and management and the key process in specific Quantitative impact significant.

③ Assesment of Impact Significance :—

*. Several approaches are available for interpreted in anticipated impacts by a projet on Soil & Ground water Environment.

*. 1. Approach is Considering of & direction of change from existing Condition for a particular Soil / Ground water

*. Another approach is to apply the provisions pertinent. To local, state, national laws & regulations related to Soil and Ground water Environment.

3. Third approach is professional Judgment & knowledge Based on the anticipated changes of projet.

4. The environment analysis of the projet should yeild best.

(*) Effects of Air pollution :—

The damage caused by air pollution is enormous. It damages our health in many ways. The pollutants in the air have a negative impacts on humans, animals, and plants and the environment as a whole.

⇒ Acid deposition :—

During the combustion of fossil fuels, the emmision of sulphur-dioxide and nitrogen oxides react with water to form sulfuric acid and nitric acid. This high acidity causes metals to dissolve in water thus polluting the surface water.

⇒ Smog :— Eutrophication :—

The main contributors to this phenomenon are the nitrogen pollutants such as nitrogen oxides and ammonia. The increased plant nutrients in water cause some water plants such as algae, and duckweed to grow extensively. This extensive growth blocks the supply of sunlight to water.

⇒ Smog :—

The word smog is a combination of the word smoke and fog. a term coined by a Glasgow public health official, Desveaux the smog in the atmosphere comprises of over 100 chemicals from different sources like automobiles, fires, waste treatment, oil production, industrial solvents, plants and coatings car engines.

⇒ Loss of Ozone layer :—

The ozone layer is present in the stratospheric layer of the atmosphere. It help to shield the UV rays from reaching the surface of the earth.

$$O_2 \underset{\text{Radiation energy from the sun}}{\rightleftharpoons} 2O$$

$$O_2 + O \rightleftharpoons O_3 \text{ Ozone}$$

⇒ The Greenhouse effect :—

As a result of human activities, a no. of gases being put into the atmosphere which trap the energy that comes to the earth as sunlight.

(iv) Identification and Incorporation of Mitigation Measures - (3)

(1) Use of Techniques to decrease soil erosion during either the construction or operational phase of project Various Types of grasses and vegitations have relatively Greater Heavy or less potential for minimizing soil erosion

(2) Where possible gentle gradients should be Favored and steep slopes avoided.

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

(4) creating large open expanses of bare soil should be avoided. These are more susceptible to wind erosion

(5) If the development is near to water body silt ation Traps may need to be installed to Trap Sediment and prevent any damage to fresh water ecosystems.

(6) Driving over the soil should be avoided or use wide Tyres to spread the weight of vehicle thereby avoiding Compaction

(7) cultivation the area after Compaction has Taken place

(8) The project can be designed to exhibit greater earth quake resistance if this is a potential concern for the project area.

(9) For projects involving useage of Ground water resources Ground water usage Could be decreased

(10) 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.

(d) EIA with reference to Surface Water :—

(1) Methodology for the Assesment of Impacts on Surface water environment,

Surface water bodies like rivers, streams, canals, ditches, ponds reservoirs, lagoons, estuaries, Coastal waters, lakes etc which play very important role in the sustainability of any ecosystem and it is very important to assess the impact of any development activity on these surface water environment.

Impacts on surface water are usually caused by physical disturbances [for example, the Construction of banks dams, dikes and other natural or man made drainage systems and by changes in climatic conditions, and by addition or removal of substance, heat or micro-organism.

These activities and processes lead to first order effects as manifested by changes in surface water hydrology, surface water Quality, changes in salinity, and changes in aquatic ecology.

Methodology :- for the Assesment of Environmental impacts on surface water bodies

The following approach or methodology is determined.

Step 1: Identification for surface water/Quantity/Quality impacts of proposed projects

↓

Step 2: procurement of relavent surface water Quality/Quantity standards

↓

Step 3: Impact prediction

↓

Step 4: Assesment of Impact significance

↓

Step 5: Identification & Incorporation of mitigation measures

Metho. Generalized approach for Assesment of air pollution impact :

* Many developmental activities will act air pollutants to the atmosphere which may effect people, plant, animals, materials, buildings & climates.
* To Evaluate the impacts on air Environment by any proper activity, a six step model approach was proposed

Step 1: Identification of Sources, Types, Quantities of pollutants by different activities of the projects.

Step 2: Description of existing ambient air Quality, metrological Conditions & natural air Quality exist in the project area

Step 3: Examination of relavent laws, and regulations for maintaining air Quality

Step 4: Impact prediction.

Step 5: Assesment of Impact significance

Step 6: Identification & Incorporation of mitigation remidiation plans to maintain air Quality.

(1) Causes of Air pollution :—

=> Increase in the level of atmospheric carbon dioxide. The different gases in the atmosphere are nitrogen (78%), oxygen (21%) argon (0.9%) Carbondioxide (0.03%)

=> Use of harmful chemicals like pesticides, insecticides, herbicides etc in agriculture

=> The domestic sewage is discharge into water bodies like the rivers and oceans

=> The industrial effluent are discharged into the environment

=> The discharge of radio active substance into the rivers and seas

=> use of aerosol spray propellants containing chdoroflurocarbons (CFC) depletes the ozone layer, hence the harmful rays of the sun, strike the earth and may lead to skin cancer in humans.

=> Air pollution also occurs naturally within the Tolance limits in the atmosphere when

(a) Gases are released in the the atmosphere due to Volcanic eruptions

(b) Smoke arising from the forest fires

(c) Dust arising due to storm and strong winds

(d) Evolution of methane gas from bags, marshes, and from decomposing bodies and plants and animals excidus

=> The smoke arising from kitchen chimneys factories automobiles aeroplanes, and railway engines pollutes the atmosphere with soot and gases like Carbon monoxides and carbon dioxide

=> The major cause of air pollution in india was the release Methy Isocynate (MIC) gas from the union carbide India Ltd. It is also known as the Bhopal gas Tragedy.

4.1 Procurement of relevant soil quality

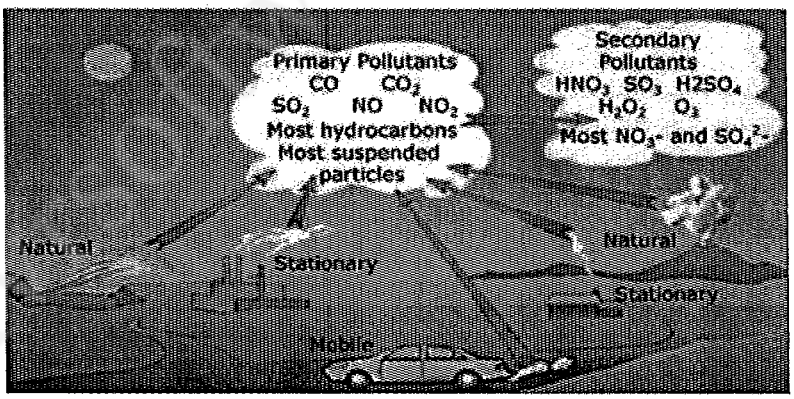
Description of the following components of environment must be included in the EIA study.

1. Air Environment
2. Water Environment
3. Noise Environment
4. Meteorology and Climate Data
5. Vegetation found in the Study Area

4.1.1. Air Environment

* Existing air quality
* Wind Speed
* Wind Direction
* Humidity
* Pollutants in Air

[Particulate matter (PM10 & PM2), Ozone (O3), Nitrogen dioxide (NO2), Carbon monoxide (CO), Sulphar dioxide (SO2)]



4.1.2. Water Environment

* Existing water resources

  [Ground water, tube wells, dig wells, hand pumps, aquifers].

* Surface water resources

  [Tanks, rivers, reservoirs, lakes, ponds, and coastal waters]

* Quality of water

* Quantity of water

* Impact of proposed construction activity on water resources

Water pollution load in different states.

States	Pollution load	States	Pollution load
Bihar	32194	Tamil Nadu	84384
Madhya Pradesh	243125	Gujrat	78354
Maharashtra	234360	Kamataka	58705
Orissa	204240	Haryana	36939
Andhra Pradesh	131536	Rajasthan	23530
West Bengal	130444	Delhi	12387
Uttar Pradesh	103205	Pondicherry	9655
Punjab	96050	Chandigarh	9294
		Assam	7861

* Around half of all ocean pollution is caused by sewage and waste water.

* Each year, the world generates 400 billion tons of industrial waste, much of which is pumped untreated into rivers, oceans.

4.1.3. Noise Environment

* Noise levels of study area.

* Predicted noise levels during construction activity.

* Actions needed to reduce the noise levels.

* Sound intensity : 40-60db

* Sound < 80db, safe for ear

Event	Noise levels(dB)
Volcano eruption	190
Thunder	120
Jet plane	120
Factory boiler	110
Trains	110
Cars and bikes	90(approx)
Barking of a dog	70
Loud conversation	70
Typewriting	50
Whispering	15
Breathing	10

4.1.4. Meteorology and Climate data

The following meteorology and climate data collected before and after project activity for EIA study.

* Temperature
* Air pressure
* Water vapour
* Humidity
* Precipitation
* Wind movement

4.1.5. Vegetation Data

The proponent of planned construction activity should include a description of all types of vegetation.

- Vegetation ecotypes

  [Forested, agricultural, wetland, riparian]

- Old growth forests
- Rare plants
- Medical plants
- Non-native species

4.2. Environmental Status of Ground Water

1. Chemical Composition of Ground Water

- Chemical composition of ground water depends on several factors such as
  - ✓ Frequency of precipitation
  - ✓ Quantity of salts leached
  - ✓ Duration of rainwater in the root zone
  - ✓ Presence of organic matter in soil

2. Description of Ground water

- The description should include the type of aquifer present in the study area
  - ✓ Whether it is confined or unconfined
  - ✓ The levels of pollution in the ground water resources

3. Description of underground drainage System

- Description of underground drainage system includes the
  - ✓ The rain water infiltrates rapidly through sink holes.
  - ✓ Fractures in the karst landscapes

[The karst landscapes are very fragile and vulnerable to various anthropogenic activities.]

4. Description of multiple aquifer systems

- ✓ Wherein two or more aquifers are interconnected.
- ✓ The quantity of groundwater flow between two different aquifers.
- ✓ The quality of groundwater flow between two different aquifers.
- ✓ Multiple aquifers are possibly separated by the aquitard at the project sites.

5. Quantitative data on the extractable groundwater resources.

6. Information related to uses of groundwater within the study area for many industrial processes, agricultural and municipal use, or public services.

7. Understand the factors influencing the likelihood of ground water contamination.

8. Information of the depth of usable quality ground water.

9. Description of the unsaturated zone where the pore spaces are not filled with ground water.

10. Description of ground water quality characteristics.

11. Emphasis on ground water problems in study area.

- ✓ Leaks and spills at factories and commercial facilities.
- ✓ Improper hazardous waste disposal.
- ✓ Disposal of pesticides.
- ✓ Animal wastes.
- ✓ Pipe line breaks leading to pollution from sewerage.
- ✓ Petroleum products.

4.3. Environmental Status of the Soil

- ➢ The assessment of current state of in-situ soil by laboratory analysis was done before & after project activity.
- ➢ The soil at the proposed construction site should be given maximum importance of EIA because,
  - ❑ Any developmental activity causes disturbance to the soil.
  - ❑ The agricultural land may be disturbed or loss due to project activity.
  - ❑ Contamination of land is likely to occur.
- ➢ The Condition of soil at the project site can be assessed by three ways.
- ➢ **1) Desk Study**
- ➢ Collection information by literature review related to the soil characteristics and geological information at the proposed construction.
- ➢ **2) Field Work**
- ➢ Observation of the color and texture of soil at the proposed project site.
- ➢ **3) Laboratory Tests**
- ➢ The physical and chemical properties of soil such as moisture content, density, pH, minerals, heavy metals, soil productivity, hydrological function (infiltration and permeability).

4.4. Impact Prediction

* The role of impact prediction of a project activity is to understand the consequences of the proposed development.
* The extent of changes that can affect the environment, so it will help the decision makers to identify the most important issues.
* Impact prediction involves the scientific characterization of the cause and effect of impacts on the environment and the local community.
* While predicting an impact, the physical, biological, socio-economic aspects, anthological data and techniques are taken into consideration.
* When a toxic liquid effluent is discharged irresponsibly into the environment, the potential impacts with regard to surface water hydrology include the following.
    * Reduced water quality parameters of the receiving streams.
    * Change in the ecology of banks of the water bodies.
    * Loss of land resources and livelihood due to allied developments.
    * Effects on the economy of the fishing community.
    * Socio-cultural effects as indigenous people, living in and around the proposed project areas are rendered homeless due to invasion by land speculators.
    * The Potential earnings from ecotourism market may suffer.

4.4.1 Impact Prediction Method

Impact prediction methods are broadly classified into two methods.

1) Box – Model Approach for prediction
2) Mass Balance Approach

1) Box - Model Approach for prediction

i. Box model is the simplest approach commonly used for prediction of various environmental impacts for engineering projects in a city.

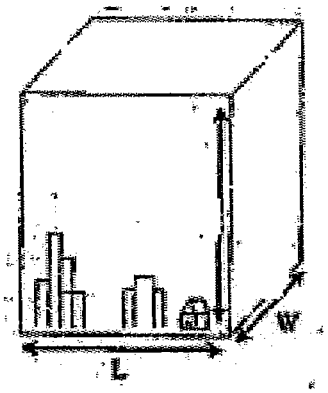
ii. The following assumptions were made in this model.

a. It assumes that the city under study is in the shape of a rectangular box with dimensions such as width W), Length (L), and Height (H).

b. The direction of wind flow is parallel to one side of the box.

c. The air pollutants are dispersed homogeneously inside the box.

d. The instability in the atmosphere produced must not cross above the height of the box.



iii. The dispersed pollutants have uniform concentration in the whole volume of air and do not change with time.

iv. The wind blows at constant velocity in the direction of the length or width of the box.

v. The concentration of the pollutant must be constant anywhere within the box and should not leave the box from any side.

vi. The average concentration of the gas or particular matter dispersed in the box is given by the following equation.

vii.

$$C = \frac{R \times T}{L \times W \times H}$$

Where

C = Avg. Concentration of the gas/particulate matter
R = Release role of pollutant (µg/sec)
T = Time period needed for uniform distribution of pollutant (sec)
L = along wind side / Length of the box (m)
W = Cross-wind dimension / Width of the box (m)
H = Vertical dimension of the box (m)

2) Mass Balance Approach

- The mass balance model (Material balance) for prediction of environmental impacts of engineering projects is a technique for assessing the potential risks on the environment owing to a developmental activity.
- It needs detailed knowledge of the inputs and outputs of several components during the construction and operation phases of the project activity.
- It helps to evaluate the situation and identify the options according to the principle of conservation of mass.

- The mass of the body remains the same throughout a process or an operation.
- The same principle is applicable to the mass balance concept.
- The rate of change of mass is given by the formula proposed by McKay, Peterson

$$\frac{dt}{dM} = (I+D+F+J) \div (X+R+T)$$

Where

I = Rate of mass inflow into the compartment
D= Rate of discharge into the compartment
F = Rate of mass formation due to activity
J = Rate of transfer from other compartments.
X = Rate of outflow from the compartment
R = Rate of the degrading reaction.
T = Rate of transfer to other compartments

4.5. Assessment of Impact Significance

A widely used environmental Evaluation system developed by a research team at the Battle Columbus Laboratories in the United States in 1972 called the Battelle Environmental Evaluation System (BEES) is used for the computation of environmental impacts. It consists of seventy-eight environmental factors (Parameters) arranged into Seventeen compounds and four categories.

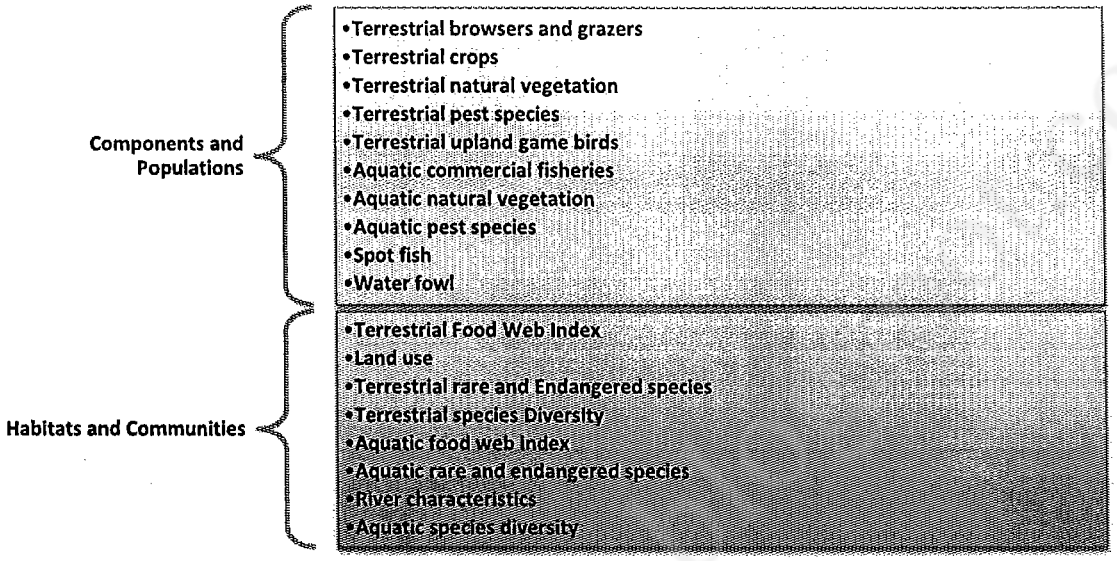
The four main categories of environmental impacts are,

1. Ecology
2. Physical/Chemical
3. Aesthetics
4. Human interest and social

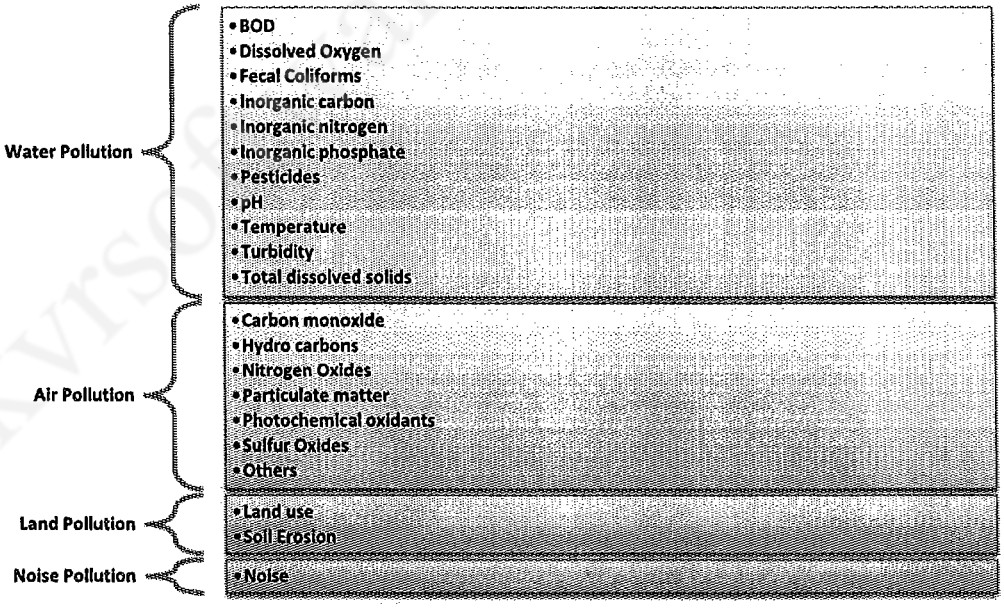
Each category is further subdivided into many environmental components and each environmental component is braked down into several parameters. Each environmental quality is given value in a scale ranging from 0 to 1.

The frame work for the BEES is given below.

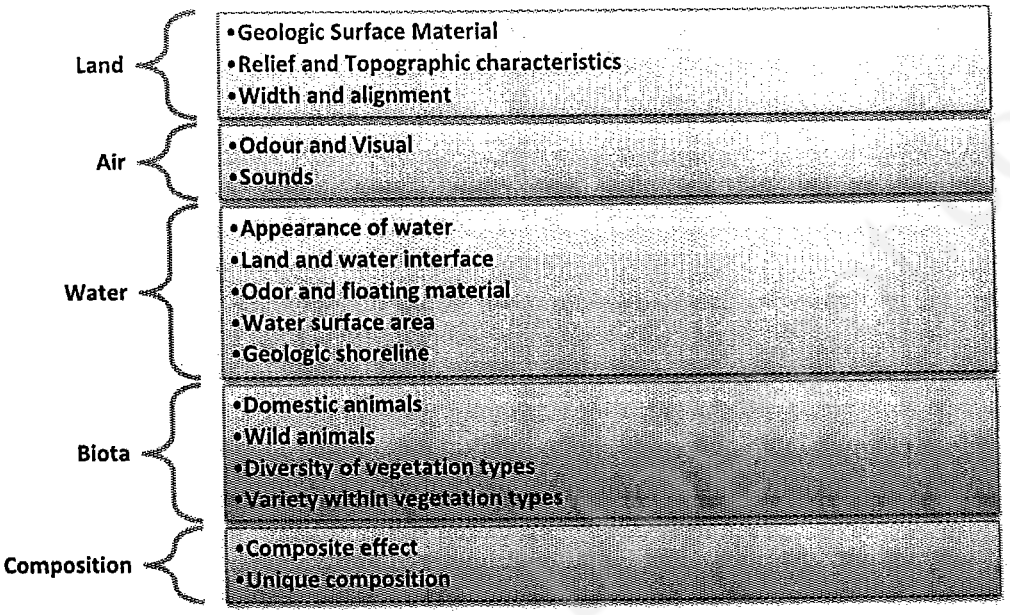
1. Ecology (Category – 1 : Ecology)



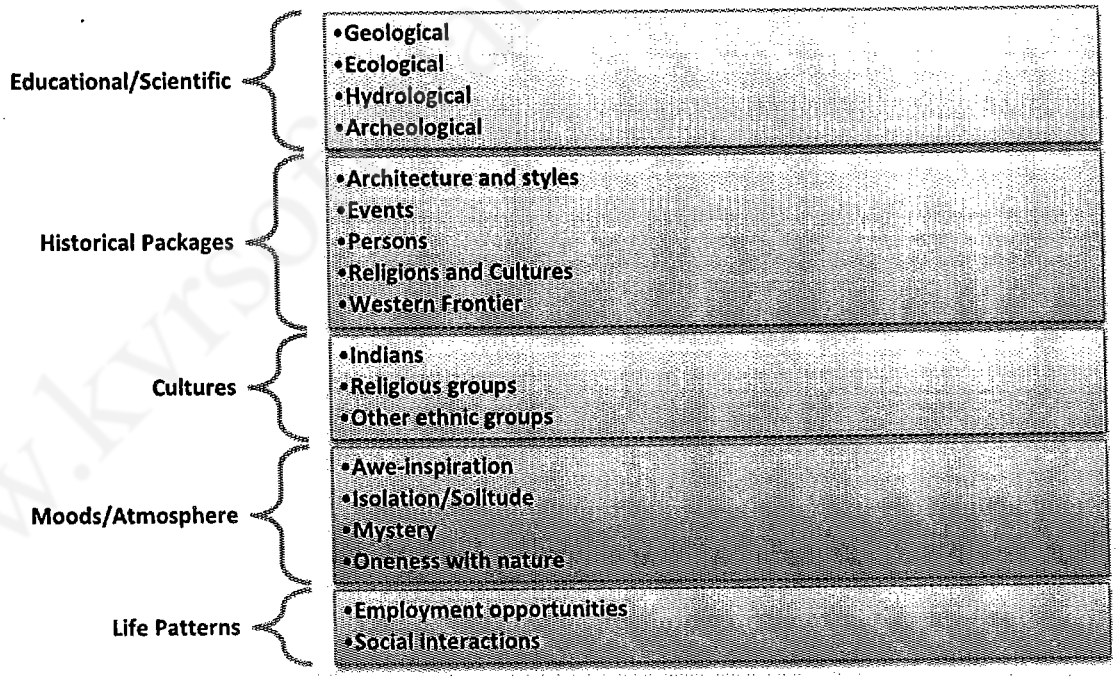
2. Environmental pollutants (Category – II : Environmental pollutants)



3. Aesthetics (Category – III : Aesthetics)



4. Human Interest (Category – IV : Human Interest)



4.6. Identification and Incorporation of Mitigation Measures

Different mitigation measures that can be employed for different adverse conditions that can affect the environment based on the type of developmental project activity.

4.6.1 Mitigation measures to counteract the adverse effects of a natural calamity

The different types of measures that can be employed for mitigation of adverse environment are,

1. Loss and damage to soils from erosion, compaction and pollutions can be mitigated by good practice techniques. Erosion of soil by various agents can be reduced by minimizing the amount of soil bared through reduced vegetation, by retaining the stubble of the crops in the soil, by promoting the growth of macroscopic and microscopic soil organisms, by promoting the use of anthropogenic chemicals in the soil, by encouraging extensive plantation of trees.
2. Restrictions on the cutting of plantation at the site.
3. Development of green belt on the surrounding periphery of project site.
4. Watering the ground before the excavation process begins.
5. Soil contamination from oil and material spills by adopting spill control procedures.
6. Restoring the vegetation on barren lands by landscaping with fast growing grass cover, plants, flowers, bushes and trees.
7. Implementing appropriate water conservation measures to meet the increased demand for electricity.
8. Implementing appropriate energy conservation measures to meet the increased demand for electricity.
9. Use of safety procedures and personal protective equipment to prevent adverse human health from dust and noise.
10. Prevent the entry of construction material into surface water to prevent the adverse impacts on drinking water supplies, irrigation systems and river ecology.
11. Prevent the entry of sediment into surface waters by implementing runoff control measures, mechanical sediment control measures, grassed filter strips, and soil bioengineering practices.
12. Regulation on the open building of solid waste/garbage.
13. Use of air pollution control techniques such as electrostatic precipitation, cyclone scrubbers, thermal oxidation, bio filtration, adsorption, wet scrubbing, condensation, and chemical treatment for reducing pollutant levels from point sources.
14. Modification in the project with changes in the design patterns.

4.6.2. Mitigation measures of adverse environmental impacts during operational phase of Engineering Project

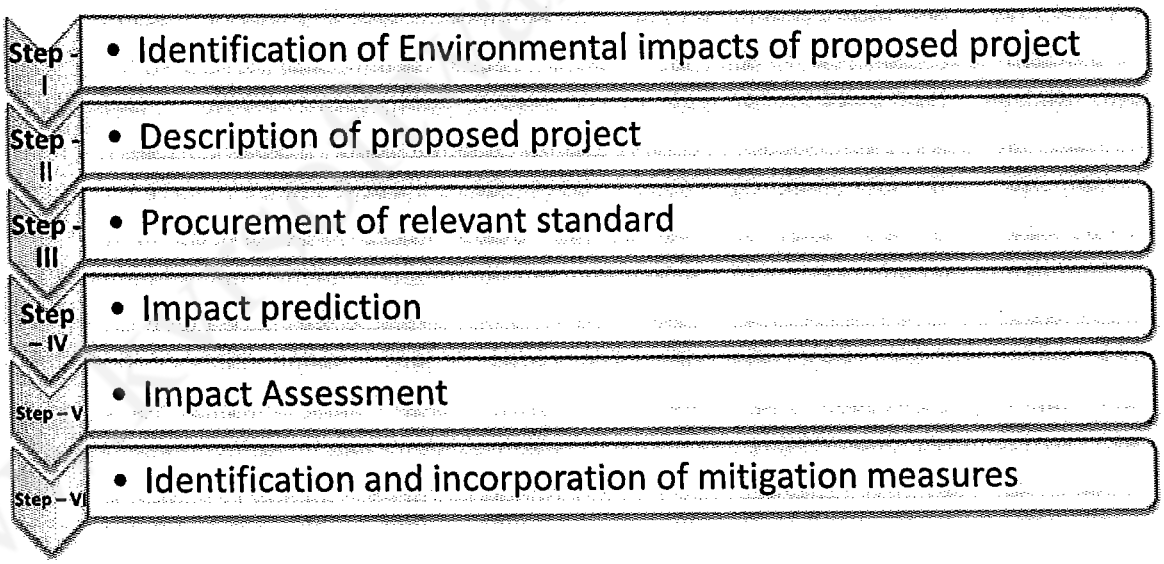
The measures to be taken for mitigation of adverse environmental impacts during operational phases of an engineering project are,

1. Decrease in the height at which the construction material is loaded or unloaded.

2. Influencing the ground vehicles to reduce emissions.
3. Use of silencers on construction equipment for noise abetment.
4. Use of noise barriers to prevent the noise emanating from the construction equipment from the sensitive receivers.
5. Energy management systems to monitor and reduce overall energy use includes,
    a. Use of renewable energy sources such as solar photovoltaic panels or wind turbines.
    b. Burning of municipal solid waste to produce electricity.
    c. Encourage the use of low-emission rental cars, taxis, shuttles.
6. Implement water conservation measures such as installation of automatic shut off and low-flow plumbing fixtures, water reuse programs.
7. Preventing soil compaction caused by the weight of vehicles and machinery by restricting the vehicular movement to defined tracts and avoid its use outside the construction zone.
8. Preventing the entry of construction material into surface water to prevent the adverse impacts on drinking water supplies, irrigation systems, river ecology, etc.
9. Prevent the entry of sediments into surface waters by implementing runoff control measures, mechanical sediment control measures, grassed filter strips, and soil bioengineering practices.

4.7. EIA with reference to Surface Water

A schematic diagram for a conceptual approach to the study focused on environment impacts is depicted below:



4.7.1. EIA study with respect to Surface water

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

1. Identification of Surface Water Quantity or Quality Impacts of proposed Projects.
2. Analysis of the Potential impacts of the development project on the surface-water conditions.
3. Collections of Significant Information Related to Quantity and Quality of Surface Water.
4. Evaluation and Prediction of Impact on Surface Water.
5. Analysis of Impact Significance.
6. Mitigation Measures.

STEP - 1*: *Identification of Surface Water Quantity or Quality Impacts of proposed Projects

* The physical parameters of water include the temperature, color, conductivity, turbidity, total suspended solids, total dissolved solids, oil and grease, etc. The chemical parameters of water are broadly categorized into

a) Organic content of water

- ✓ It includes the biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Oxygen Demand (TOD).

b) Inorganic content of water

- ✓ It includes the salinity, hardness, acidity, alkalinity, pH, cations such as Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Hg, k, Mg, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sr, Th, T, V, U, Anions such as CI,F, SO4, CN.

c) Biological Components of Water

- ✓ They include total coliform count and fecal coliform count. Source of pollutant in water are categorized as

1. **Non-Point Sources**
   Pollutants come from many different sources, for example: Urban runoff, poor, irrigation practices, poorly managed construction sites, abandoned mines.
2. **Point Sources**
   The Pollutants come from one source, for example: Factory/ industrial plants, direct dumping of toxic waste into water. The water quality parameters are intrinsically linked to water quantity due to the fact that changes in water quantity are likely to affect the dilution of pollutants.

* The potential water quality impacts due to construction phase include.
  (a) Runoff general construction activities related to the project at the site.
  (b) Construction runoff and drainage.
  (c) Production of sewage effluents from the on-site construction work force.
  (d) Increased load of suspended solids and contaminants from site surface and drainage channels.
  (e) Pollutants such as fuel, oil, diesel, lubricants and solvents generated from vehicles and equipment used for construction activities, can enter the surrounding water bodies.

STEP – 2: Analysis of potential impacts of the development project on the surface-water conditions

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

a) Some mathematical models commonly used in EIA are mentioned below Fundamental runoff formula for predicting surface water runoff.

b) Rational formula — this is used to compute the peak discharge flow rate.

c) Naiver-Stokes equation -This is used to determine the water-flow patterns.

d) Streeter-Phelps equation :-(also known as the "dissolved oxygen sag" equation). This is used for evaluating dissolved oxygen in water.

e) Advective transport formulation

f) Dispersive transport formulation

g) Surface heat budget formulation

h) Dissolved oxygen saturation formulation

i) Hydrological transport model.

STEP - 3: *Collection of significant information related to Quantity & Quality of surface water*

* The Bureau of Indian Standards Specifications ISO: 10500-1991 governs the quality of drinking water supplies in India.
* This is based on international standards for drinking water quality issued by the WHO.
* A number of government agencies are responsible to foresee the availability of drinking water of adequate quantity and potable quality.
* The government agencies include the ministry of water resources, the ministry of Urban Development and poverty Alleviation, the Ministry of Rural Development, the Ministry of Environment and forests, the Ministry of Health.
* The water quality standards in India recommended by the Bureau of Indian Standards

S.No.	Characteristics	Permissible limit
1	Color	5-25 Hazen units
2	Odour	No objectionable odour
3	Taste	No objectionable taste
4	Turbidity	5-10 NTU
5	pH Value	6.5-8.5
6	Total Hardness	300-600 mg/l
7	Iron	0.3-1.0 mg/l
8	Chlorides	250-1000 mg/l
9	Residual free cholrine	0.2 mg/l
10	Calicum	75-200 mg/l
11	Magnesium	30-75 mg/l
12	Copper	0.05-1.5 mg/l
13	Manganese	0.1-0.3 mg/l
14	Sulphate	200-400 mg/l
15	Nitrate	45-100mg/l

16	Fluoride	1-1.5 mg/l
17	Phenolic compounds	0.001-0.002 mg/l
18	Mercury	0.001 mg/l
19	Cadmium	0.01 mg/l

STEP – 4: Evaluation and prediction of impact on surface water

* The potential surface water impacts that are likely to occurs as a result of the proposed developmental activity depends on several factors

(a) Direction of the Impact

- ✓ The types of impacts may have positive, negative or neutral effect on the environment.

(b) Magnitude of the impact

- ✓ The magnitude of impact may be categorized as none/negligible, low moderate or high.

(c) Duration of Environmental Impact

- ✓ The duration of the environmental impact may be transient, short term, medium term, long term or permanent.

(d) Geographical Extent

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

(e) Probability of Impact Occurrence

It refers to the chances of occurrence of impact. It can be of the following types,

i. Least probable / impropable (<5% chance)

ii. Low probability (5% to40% chance)

iii. Medium probability (40% to 60% chance)

iv. High probability (60% to 90% chance)

v. Definite (Impact will occur definitely)

- ✓ The potential impact during the construction and operation phase of proposed project with regard to surface water hydrology includes the following.
  1. Increase in the erosion and sedimentation due to stripping of vegetation in and around the proposed construction site.
  2. The construction of river crossings would alter the ecology of river bank and river beds.
  3. Increase in erosion and sedimentation due to the construction of diversions channels for directing the river water in another direction.
  4. Increase in polluted discharges affect the water quality of the receiving streams.

STEP – 5: Analysis of Impact Significance

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

STEP – 6: Mitigation Measures

Some general mitigation measure should be practiced/ followed,

a) Re-Vegetation and tree plantations near the proposed construction site.

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

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

d) Increasing water infiltration into soil.

e) Controlling excessive storm runoff.

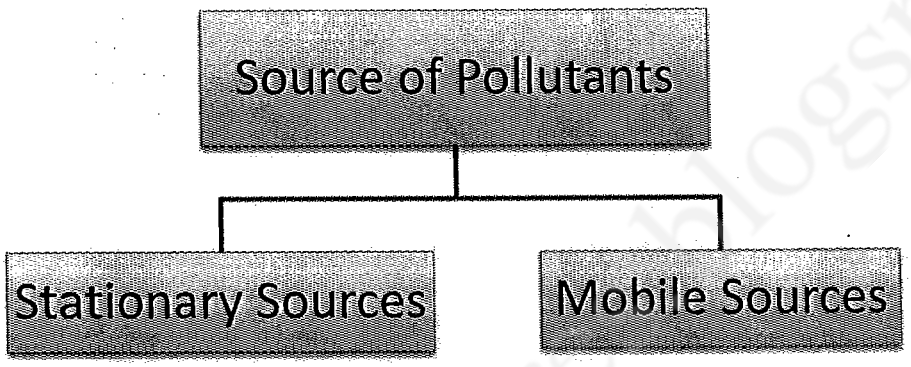
f) Controlling soil erosion.

4.8. The evaluation of impacts on environment by any project activity

The evaluation of impacts on environment by any project activity can be structured in the following steps,

STEP - 1: ***Examination of Types of Pollutants, Quantities and sources Generated during the Construction and operation phase of Proposed Activity***

The first step for evaluating a proposed project activity is to consider the type of air pollutants released during the construction and operation phase of the proposed activity and their expected quantities. The air pollutants are added to the atmosphere from various sources, as mentioned below.



Examples:

- Electric power plants
- Fuel combustion facility stacks
- Domestic heating and cooking
- Dry cleaners
- Paint shops
- Phosphate processing plants
- Pulp and paper mills
- Solid waste disposal
- Municipal incinerators

Examples:

Vehicle emission from road transport
Railway inland navigation
shipping, Aviation.
Dust emission from stock piles Gas stations
Industrial plants airports
Dock yards
Rail Yard

STEP – 2: ***Evaluation of project site for the Ambient Air Quality, Emission Inventory and Metrological data***

The ambient air quality at the proposed project site is established through intensive of ambient air quality with the help of automatic techniques such as TEMO (TAPERING ELEMENT OSCILLATING MICROBALANCE) beta gauge instruments, light scattering systems and manual techniques such as filter paper samples and impinges.

The pollutants in air are analyzed by the following methods,

(i) Gravimetric analysis
(ii) Volumetric analysis
(iii) Spectrophotometric analysis
(iv) Turbidimetry, Nephelometry
(v) Flurometry , Atomic absorption Spectrometry
(vi) Infrared spectroscopy, HPLC, Electro chemical techniques.

The information in this section should include the following

(a) Types and concentration of hazardous gaseous chemical emissions.
(b) Concentration of particulate matter.
(c) Offensive odors.
(d) Various climatic conditions. The data on meteorological variables to be included are - rainfall, temperature, air pressure, wind speed, direction of wind, relative humidity.
(e) It should also contain a summary of the pollutants in the vicinity of the proposed project site.

STEP - 3: ***Examination of Air Quality Standards criteria, polices of the local, state and central government agencies***

This section has the documentation of existing air quality at the regional, sub regional and local level, the desirable air quality must be in compliance with the prevlling government regulatory standards, guidelines, codes of practices and permit conditions.

STEP - 4: ***Impact*** **prediction** ***of new project on ambient air quality***

The most popular approach for impact prediction is,

(i) The Mass -Balance Approach The mass balance approach is for the total air pollutant emission during the construction and operation phase of proposed project activity.

(ii) Use of arithmetical models

(a) Box model

(b) Dispersion or craussian model

(c) Computer simulation model

STEP – 5: Assessment of impact significance

In this stage, the beneficial and detrimental impacts of the proposed development are assesed.This is accomplished by conducting public meetings and / or public participation programmers. If no significance impacts are likely to occur, then the agencies involved in environmental impact assessment study issues a finding of no significant impact.

***STEP – 6:** Mitigation Measures*

Some of the many mitigation measures during the constructional phase of the project include,

1. Decrease in the height at which the construction material is loaded or unloaded.

2. The excavated material at the construction site should be enclosed, covered or dampened, especially during the dry and windy conditions.

3. The construction areas should be dampened using appropriate water sprays.

4. The vehicles carrying the construction material should travel controlled speed to reduce traffic included dust dispersion.

5. The vehicles carrying the construction should carry properly.

6. Implementation of technology to the fuel efficiency of automobiles.

7. Reduction in the tail pipe emissions by adopting technology to control the emission of evaporative exhaust gases.

8. Manufacture of vehicles with alternative fuel options.

9. Use of air pollution control techniques such as electrostatic precipitators, clone scrubbers, mist filtration, thermal oxidation, catalytic oxidation etc.....

10. Regulation on the open burning of solid waste.

Unit -5

* Assesment of Impact development activities on vegitation and wild life

① Many development activities like deforestation, Construction of dams, industries etc, can cause impacts on flora & fauna

② Bio-diversity refers to Various species & Ecosystems in a given region

③ prediction & Assesment of impacts on biological Environment involve a no of Technical & professional Considerations related to the effects.

④ For the assesment of impacts on biological Environment a six step methodology or approach was proposed.

Step 1 : Identification of the activities of biological impacts

Step 2 : Description of Existing biological Conditions status of bio-diversity with their habitates.

Step 3 : Procurement of relavent laws, regulations related To impacts / Condition of bio-diversity.

Step 4 : Impact prediction

Step 5 : Assesment of Impact significance

Step 6 : Identification & Incorporation of mitigation measures.

* Causes of Deforestation :—

① Urbanisation ② Industrialization

③ population explosion ④ Mining

(5) Construction of dams and reservoirs

(6) Modern aggricultural practices etc.

Effects:—

1. Causes global warming & Green-house effect
2. Raise of Sea Levels
3. Submergence of Coastal lands
4. Lack of rainfall
5. Enhanced Soil Erosion
6. Glowering aggricultural protectivity
7. Reduction in ground water level Tables
8. Preventing drought Conditions
9. Enhanced degradation of natural resources
10. loss of marine bio. diversity
11. Prevailing epidemics
12. Raise in Environmental pollutions. etc.

(*) **Environmental Risk Assesment & Managment :—**

Environmental risk Assesment can be defined as an Emerging Technique which involves structured gathering of available information about the environmental risk and information of the Judgement about them (ERAM) with reference to issues relating to the human health and ecological issues is a rapidly growing field which can provide information to decision makers about the freqency and and magnitude of adverse environmental Consequences arising from human activities or planned interventions

Some of the Terms used in Risk Assessment as given below:

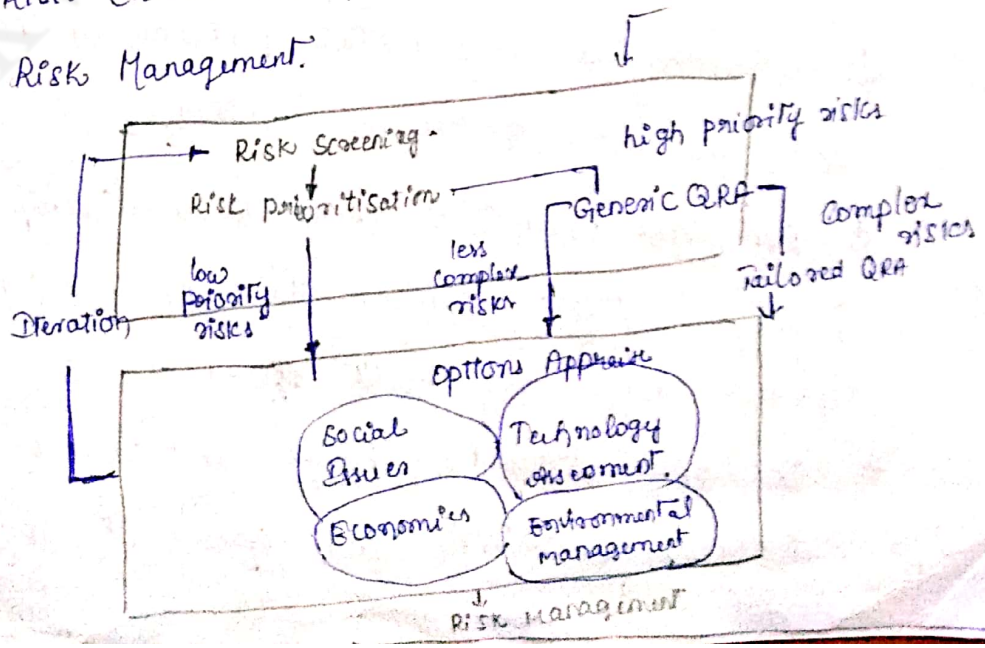
1. **Hazard**: a property or situation with the potential to cause harm.
2. **Risk**: a combination of the probability or frequency of the occurance of a particular hazard and the magnitude of the adverse effect or harm arising to the Quality of human health and environment.
3. **probability**: The occurance of particular event in a given period of Time or as one amongest a no. of possible events.
4. **Risk Management**: The process of implementing decisions about accepting or altering Risks.

Key steps in performing an Environment Risk Assessment:

(*) To Analyze uncertainities with reference to human health and ecological issues in ERA Process, the following 5 - steps are performed.

1. Hazard Identification
2. Hazard Accounting
3. Scenario of Exposure
4. Risk Characterization
5. Risk Management.

A Frame work for Enbironment risk Assessment



1. Hazard Identification :

* In EIA this step is related to the Qualitative prediction of Environmental impacts.
* This is preliminary risk Assessment of Environmental hazard.

2. Hazard Accounting / Analysis : —

(*) In this step many of hazard accounting will be Covered which is useful for the scoping of EIA.

(*) During hazard accounting flow cycle for hazardous Chemicals to be included in the ERA.

(*) Hazard Analysis should include the Social and natural systems of a project including pollution studies.

(*) Fault tree analysis method should be used to Evaluate failure in Engineering systems of a project as part of the hazard accounting

(3) Scenario of Exposure : —

(*) This stage of ERA&M is used to known how the hazard might be encountered.

(*) To understand and to analyze exposure of hazard some of the constructive models are used

(*) To understand environmental pathway of hazard. body and dose response is Calculated.

(*) ERA Seeks information about the relationship between Quantity, emitions, Environmental Considerations, human exposure doses and health effects.

(*) In ERA different Techniques and units of measurement degree of reliability and specificity is used.

Risk characterization :-

* It is likely hood and seriosity of impact damage due to environmental hazards or hazardous chemicals is known as Risk Characterization.
* Risk characterisation facilitate the Judgement of risk acceptability
* Typically risk is characterised in Terms of
  1. Exposure period
  2. potency of Toxic chemicals
  3. no. of persons exposed
  4. Quality of models used.
  5. Confidence and uncertainity in the assesment
  6. Comparision of appropriate risk
  7. probability of frequency of event
  8. Reduction in life expectancy due to exposure.

5. Risk Management :

* It is a methodology to mitigate or reduce unacceptable environmental risks
* due to hazards is known as risk Management.
* Risk Management depends on identifying limited resources whose they actually needed
* Comparing Risks with their Cost reduction is a valuable decision tool in the Risk Management.

Advantages of Environmental Risk Assessment:

1. ERA provides greater assurence in hazard Management
2. ERA is used to inform clarify about preparation and study of the project and its impact
3. ERA promotes Efficiency in the EIA process
4. ERA Ensures all the levels of Investigations are proportionate to the environmental risk
5. ERA can play a significant role in managing uncertainity as part of an EIA process.

Disadvantages: —

1. Risk tolerance is relative to different perceptions and acceptence.
2. Isolating the risks associated with a decision can be difficult.
3. ERA as a practical and valuable addition to the management of hazards for EIA.

Risk Treatment of uncertainity: —

- Risk assesment is a scientific method of Identifica and expressing uncertainity in predicting the future of the risk
- Risks may vary based on degree of damage for unit of time, probability and frequency of Occurance
- Environmental risk management is the process of Evaluating the likely hood of adverse Effects in the natural Environment.

(3) uncertainity is the activity of understanding the regulation of the environmental systems

* Ecological uncertainity is of Two Types
  1. Qualitative uncertainity
  2. unanticipated uncertainity

(4) In EIA the source for uncertainity is basis resulting from measurement & sampling error.

(5) A familiar source of uncertainity is natural variation

(*) Environmental Impact of Deforstation:-

(1) The Carbon cycle:-

The Tree absorb Carbon dioxide from the atmosphere to produce Carbohydrates, fats and proteins in them. This Carbon is released as Co_2. when the Trees are either burnt or rot, causing an increase in Co_2 Concentration in the atmosphere.

(2) The water cycle:-

The underground water is drawn up by the root system of the Trees and released into the atmosphere by the process of Transpiration.

(3) Erosion of Soil:-

The root system of the Trees holds the soil particles firmly. with the removal of Trees, erosion of soil Takes place

(4) Natural Conflicts with wildlife:-

as the green cover droplets the wild animals are forced to move out of their Traditional homes into areas inhabitated by humans, causing dredful encounters with wild animals like elephants, poisonous snakes etc.

(5) Social Effects of Deforestation:-

Case studies have document that, the indegeneous people

people living in the forests have been rendered homeless due to invasion by cattle ranchers, loggers, and land speculators.

Remedial actions for deforestations:—

=> Prevent overgrazing of forest lands

=> overexpoliation of timber should be prevented. which is maintained by the branch of forestry. i.e Silviculture.

Silviculture - development and reproduction of Timber like Teak Sal, Sheesham etc.

=> Recycling of forest products like paper should be practiced

=> Burning of forests should be strongly prevented so as to develop into pasture lands.

=> Forest should be conserved by growing plants tolerent to deaseses, fire and pests.

=> plantation of seedling of forest Trees with crop plants enables the Trees of the forest to grow better

=> we should buy foods (eg. bananas, peppers clover, coffee) that are grown in a substainable way.

=> Encourage the use of environmentally friendly paper

=> Encourage the use of recycled paper

=> Forest Departments and other Communities involved in Conserving Trees have Taken to plantation of eucalyptus Tree, Cassia Trees, Teak Trees, Tammered Trees etc, in the govern ment waste lands, along roadsides, railway line, This has met the basic demands of wood for rural people, prevented the erosion of soil, maintained ecological balance and provide Shade along the roadside

4-1 civil EIAM 5th UNIT

UNIT :- V

IMPACT ASSESSMET ON VEGETATION AND WILD LIFE

KHIT – CHOWDAVARAM

CIVIL ENGINEERING

5.1. Assessment of Impact Development activities on Vegetation and Wild life

5.1.1 Biodiversity

The term biodiversity is a contraction of biological diversity, which is the variability among living organisms inhabiting the different ecosystems (Ex. Terrestrial, aquatic ecostyems.)

In general terms, the word "biodiversity" can be defined as the concentration of various entities such as general ecosystem, different species and organisms confined to a particular region.

Types of Biodiversity

1. **Genetic Diversity:**

Genes are the basic units of hereditary information transmitted from one generation to other. Diploid organisms contain two sets of chromosomes and thus two copies of each gene (called alleles). Genes are composed of DNA and are present inside living organisms. They have the instruction to provide all the information necessary for a living organism to grow and live. DNA is combined with specialized proteins to form a complex called as chromatin which organizes into chromosomes during the process of cell division. The information contained in DNA is determined by the sequence of the nitrogenous bases (adenine, cytosine, guanine and thyme) along the chain. The nitrogenous bases are in a different number and order in every living organism on this earth. Different number and order in every living organism on this earth. Differences in the nitrogenous bases result in production of varied sequence of amino acids and the resultant protein. These proteins are responsible for the development of anatomical, physiological and behavioral characteristics of living organism.

Genetic diversity or simply put, variation in the genetic constitution in living organisms is introduced either through mutation in living organisms is introduced either through mutation of one of the alleles, or as a result of sexual reproduction. Mutation is a change in the nitrogenous base sequence of DNA that may cause a change in the product encoded by that gene. During sexual reproduction, the off springs inherit genes from both the parents, which can be exchanged in a process called sexual recombination.

Let us consider a very simple example of genetic diversity. Human beings look very similar to each other as opposed to being like other living forms. All of us have two arms, two legs, two eyes, ten toes, soft skin etc. but all of us have certain genetic trails that which we have inherited from our parents and ancestors(such as facial features, color of hair, eyes, height, behavior, needs) that distinguish us as unique individuals. These genetic traits have been carried from one generation to the next generation in varying degrees.

2. **Species Diversity**

Species diversity refers to the number of species in a habitat or a region or an area along with their relative abundance. The number of species, kinds of species and the number of individuals as per species vary in an ecosystem. For example, a rain forest consists of many thousands of species of different animals and plants where a as a boreal forest may support fewer number of species.

It has been estimated that more than 1.7 million species have been discovered while ecologists are of the view that there are millions more which we do not know about.

Components of Species Diversity

The different components of species diversity are,

(i) ***Species Richness***

The species richness refers to the number of different species present. For example, a biologically diverse community such as a marine ecosystem with a large number of species has high species richness, while a temperate forest may have few species of plants or low species richness.

(ii) ***Species Evenness***

Species evenness refers to the number of individuals of each species present. For example, a tropical forest having the same number of individuals from each of many different species is said to have high species evenness, while a desert containing a large number of individuals of one particular species and relatively low number of individuals from the other species has low species evenness.

3. **Ecosystem Diversity**

Ecosystem diversity refers to the variety of ecosystems in a given area wherein, a community of organism interact with their physical environment (climatic, geological and chemical constituents including temperature, precipitation and topography of the ecosystem). In a simpler sense, ecosystem diversity includes both biotic (living) and abiotic (non-living) components.

An ecosystem can occupy a large are of thousands of kilometers (Ex. Great Barrier Reef) or a whole forest or a small area such as a pond.

Humans and their activities have a considerable effect on species and ecosystem diversity causing.

a) Destruction, modification and/or fragmentation of habitat.
b) Introduction of exotic species.
c) Overharvesting and overexploitation.
d) Global climate change.

Sufficient measures should be undertaken for conserving biodiversity by saving habitants and ecosystems.

5.1.2 Systematic approach for evaluating Biological Impacts

Studies related to the assessment of impact of any proposed projects or floral and faunal species that are components of biological environment include the following steps.

1. Qualitative identification of the potential impacts of the proposed projects on biological environment in the core and buffer areas. The biological environmental refers to the flora and fauna of a particular area which includes species of trees, gases, fishes, reptiles, birds and mammals.
2. Description of the biological environment (including flora, fauna, natural resources and habitats) along with community types and geographical description.
   - The description of flora environment involves a five level classification of vegetation. The different levels are:
     Level – 1: Vegetative structure
     Level – 2: Dominant plant types
     Level – 3: Size and density
     Level – 4: Size and habitat
     Level – 5: Special plant species
   - The description of the faunal environment should include different species of animals of various groups, such as amphibians, reptiles, birds, mammals, rare faunal species etc.
3. Obtain information on legislation regulations criteria or guidelines related to the biological environment.
4. Prediction of impact of the proposed project on the biological environment. The methods used in these steps are **Habitat Evaluation System (HES)** and **Habitat Evaluation Procedure (HEP)**.
5. Interpretation of predicted impact on the overall ecosystem.
   - This steps include the following aspects
     a) The importance of individual species in the food web to maintain stability in the ecosystem.
     b) Assessment of the implication of project activity on species diversity.
     c) Effects of the proposed projects on ecological succession.
     d) Evaluation of effects of the proposed project on the economic importance of some species.
     e) Impacts of a proposed projects (or activity) on threatened or endangered species.
6. Identification of mitigation measures followed by their implementation. This includes prevention, reduction, rectification, and restoration, and conservation, compensation in relation to project location, construction and operating procedures.

5.1.3. Significance of Vegetation and Wild Life

- Regulation of atmospheric chemical composition.
- Regulation of global temperature, precipitation and other climatic processes.
- Regulation of hydrological flows.
- Storage and retention of water.
- Retention of soil within an ecosystem and prevent it from eroding into water bodies.
- Nutrient cycling in the food chain.
- Food production from the plants and animals of the natural ecosystem.
- Rich source of raw materials such as wood, fibers, biochemical / biodynamic compounds, fuel wood, organic matter and animal feed.
- Genetic resources.
- Cultural and Recreational activities.

5.1.4 Mitigation measures

The significant measures for mitigation against biological impact by development activity are,

(i). Restrictors to rights-of-way and limiting the cleared areas.
(ii) Implementation of vegetative stabilization to protect the soil from erosion, water logging and salinization.
(iii) Creation of alternative and accessible habitats within the proximity of the existing population of the species of interest.
(iv) The disturbed areas must be revegatatted to reduce habitat fragmentation.
(v) The area of land that is being disturbed must be reduced.
(vi) Collection and storage of top soil for future use to ensure conservation of exiting seed bank.
(vii) Conducting surveys by ecologists on the different species inhabiting the project area. Clearance of vegetation should take place outside the breeding season.

5.2. Environmental Impact of Deforestation

5.2.1. Significant Impacts due to Deforestation

Forest supports divert life forms as they can provide three basic ingredients for survival of the species-water, food and shelter.

- Timber products are in high demand almost worldwide. This encourages harvesting, transporting processing buying or selling of timber against the national laws, thus making illegal logging a lucrative industry.
- The main cause of deforestation is illegal logging due to which half of the original forest cover has already disappeared several species of animals like tiger, rhinoceros, elephants are almost nearing extinction due to loss of their habitats.
- Transportation of timber from the forest to the places in demand adds to the greenhouse gases in the atmosphere leading to a global warming trend, where the average temperature becomes higher. The sawing and sanding of the wood products adds dust to the atmosphere.
- The term deforestation refers to destruction of forests and woodland. The tribal hunter gatherers depend on the forests for their livelihood. They rely on the forests for fuel wood and other resources. The forest provides domestic use and hydroelectric power.

Some of the medicines derived from the forests are enlisted below:

- Quinine- cure for malaria
- Curare-anesthetic and muscle relaxant used in surgery
- Rosy periwinkle-cure for Hodgkin's disease and leukemia
- Other drugs-arthritics, hepatitis, insect bites, fever, coughs and colds

The forests are destroyed for the following purposes:

a) To convert forest into agricultural land to feed the increased number of people and for cattle rearing.
b) To earn money by growing cash crops.
c) Logging of commercial wood.
d) Cutting down of trees for fire wood paper and building material.
e) Urbanization.
f) Mining and oil exploration.
g) The acid rain and forest fire too contribute to deforestation.

5.2.2. Problems associated with exploitation of Forests

Some of the Problems associated with exploitation of forests are as given below:

1. ***Change in Local and Global Climates through Disturbance of***

   a) ***The Carbon Cycle:***
   The trees absorb carbon dioxide from the atmosphere to produce carbohydrates, fats and proteins in them. This carbon is then released as co2 when the trees are either burnt or not, causing an increase in CO_2 concentration in the atmosphere. CO_2 contributes to the greenhouse effect.

   b) ***The Water Cycle:***
   Underground cycle is drawn up by the root system of the trees and released into the atmosphere by the process of transpiration. The felling of trees will render a drier climate in the region. Felling of trees also effects rainfall pattern.

   c) ***Erosion of Soil:***
   The root system of the trees holds the soil particles firmly. With the removal of trees erosion of soil takes place.

   d) Owing to soil erosion, silting of rivers, lakes and dams takes place.

   e) ***Extinction of species***
   Forests are home to more than half the world's species. Cutting down of trees leads to extinction of thousands of species of birds and animals. Some of them are the orangutan mountain gorilla, manatee, jaguar and puerlo Rican parrot. The orangutan feeds on various plant parts like, leaves, figs, and fruits bark nuts and insects. The old trees in the forest support the growth of woody vines that serve as aerial ladders, thus enabling the animals to move around, build nests and hunt for food. Thus loss of forest leads to endangering the lives of plants and animals.

2. ***Natural conflicts with wild life***

   As the green cover depletes, the wild animals are forced to move out of their traditional home into areas in habited by humans, causing dreadful encounters with wild animals like elephants, poisonous snakes etc.

3. ***Desertification***
   Deforestation contributes to the desertification of the green canopy.

4. *Effect of ecotourism*

The potential earnings from market suffer due to deforestation. Tourists would be unwilling to travel to see the polluted rivers carcasses of wild animals, stumps of the trees and unused wastelands.

5. ***Social effects of deforestation***

Case studies have documented that the indigenous people living in the forests have been rendered homeless due to invasion by cattle ranchers, loggers and land speculators.

5.2.3. Reasons for Deforestation

The major causes of deforestation are:

1) Rapid urbanization is leading to deforestation as the land is not available.
2) Forests are overexploited so as to develop them into agricultural lands.
3) Overgrazing of forest lands is also leading to deforestation.
4) Shifting of rammers from the production of cocoa exports to growing of cash crops is leading to felling of trees so as to develop agricultural lands.
5) Cutting down of trees for fire wood paper timber and other building materials.
6) Mining of minerals and their ores have also led to destruction of forest extensively.
7) To generate hydroelectricity for irrigation dams are built which have led to felling of trees.
8) Projects undertaken for building of roads, lying of pipelines, construction dams etc. have led to deforestation.
9) Mining and exploration of oil also leads to deforestation.
10) The acid rain and forest fires too contribute to deforestation.
11) Forests are being cleared for the purpose of cattle ranching.

5.2.4. Remedies

Measures taken to mitigate deforestation are as follows:

1. Prevent over grazing of forest lands.
2. Overexploitation of timber should be prevented which is maintained by the branch of forestry, i.e., silviculture. This branch is responsible for the establishment, development and reproduction of timber trees like teak, sal, sheesham etc. Illegal logging should be prevented. The forest officials should cooperate in protecting the forests.
3. Recycling of forests products like paper should be practiced.
4. Burning of forest should be strongly prevented so as to develop into pasture lands.
5. Forests should be conserved by growing plants tolerant to diseases, fire and pests.

6. Plantation of seedling of forest trees, with crop plants, enables the trees of the forests to grow better.
7. Forest departments and other communities involved in conserving forests, have taken to plantation of eucalyptus trees, cassia trees, teak trees, tamarind trees etc, in the government waste lands, along road sides, railway lines, marginal lands of the farms thereby contributing to social forestry. This has met the basic demands of wood for rural people, prevented the erosion of soil, maintained ecological balance and provided shade along the roadside.
8. We should buy foods (Ex: banana, pepper, cloves, coffee) that are grown in a sustainable way.
9. Encourage the use of environmentally friendly paper.
10. Encourage the use of recycled paper.
11. Practice of silviculture helps to replenish the forests.
12. Plant an equal amount of saplings so as to compensate for the fallen trees. Thus, equal balance should be maintained between the growth rates and falling of trees.

5.2.5 Major impacts on forests due to Water Resources Project and Mitigation Measures

Water resource projects are the multi-purpose river valley projects and major irrigation projects / canals. These are concrete structural barriers constructed across rivers and streams to block or control the flow of water in them.

They serve the following major functions,

(i) To store water to compensate for the fluctuations in the discharge by rivers.
(ii) To increase the hydraulic head (difference in the heights of water levels in the upstream of the dam and the downstream river).
(iii) Generations of electricity.
(iv) Supply water for irrigation, industrial and household activates.
(v) Control the effect of flood waters.
(vi) Encourage river navigation and recreational activities like swimming, fishing and boating.

Construction of water resource projects in the prime forests lands may cause flooding, thereby leading to total destruction of the entire forests. The environmental effects associated with such constructions include both the physical and social aspects.

The forests are degraded and devegetated to carry out construction activities related to the water resource projects such as offices, approach roads, residential quarters as well as building for the storage of construction material.

The process of deforestation leads to,

(a) Loss of fruit-bearing trees, loss of timber and scarcity of firewood.
(b) Destruction in the habitats of wildlife.
(c) Hampers the precreation activities of people.
(d) Involuntary displacement of large number of people, causing widespread traumatic psychological and sociocultural consequences.

The alternatives to dams is rainwater harvesting. It is one of the most important and economic tools for water conservation at a time of rapid dwindling of fresh water resources. The different types of harvesting structures that may be used are farm pond, percolation / recharge pits, recharge wells, check dams, and lagoons / lined ponds.

5.3. Environment Risk Assessment and Risk Management in EIA

- According to International Standard ISO 31000, risk is defined as the change of something happening, that will have an 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 natural environment medium (including air, water, land, plants and wildlife.)
- 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 such as,

- Natural events (flooding, drought, extreme weather events)
- Agents (ex: chemical, biological, radiological)
- Technology(ex: unconventional drilling technologies)
- Practices(Ex: silviculture)
- Processes
- Products
- Industrial activities.
- Environmental conditions(Ex: chemical contamination in air, soil, surface water, sediment, biota, changes in climate, introduction of native species)

A simple and classic example of environment risk assessment is that of source – pathway- receptor. Let us consider the source to be hazardous source (such as a source of contamination), the receptor to be ecosystem. The link between the source

and the receptor is the pathway. In the absence of the pathway, no risk exists. But if the source and the receptor are linked by a pathway then the consequences of this is assessed.

5.4 Risk Assessment and Treatment of Uncertainty

5.4.1. Main advantages of Environmental risk assessment with an EIA

1. ***Environmental Risk Assessment(ERA) helps with the scoping of EIA investigations:***

The scoping phase is an early phase of the EIA process that typically recognizes the important issues of concern at a preliminary level of the planning process. It helps in site selection, possible technical options and avoids all kinds of delays that arise during the project.

Hazards are determined by taking into consideration the different ways the proposal might interact with the environment. The priority hazards are identified and assessed during the scoping phase while the other issues are given less attention. The advantages of ERA during the scoping phase are as follows:

i. It contributes to a feeling of satisfaction that the hazards that need thorough inspection have been determined.
ii. It advises the preparation of the proposed study program.
iii. It confirms that the level of inspection is proportionate to the risk.
iv. It encourages efficient processing of EIA.

2. ***ERA Enables prioritization of risk***

If an organization encounters various types of potential environmental risk. Then ERA can be used to setup the risks according to their importance, and prioritize the risks that should be deals with first.

3. ***Site specific risk evaluation***

ERA helps to establish the location of the risks that affect a particular site and enable proper risk treatment.

4. ***Comparative risk assessment***

The relative risk of different types of actions can be compared. For instance, the risk produced by untreated water versus the risk produced by the chemicals used in treating water.

5. ***Quantification of risk***

The risks are quantified to setup controls on the risks (ex: the acceptable concentration of chemicals in drinking water).

6. *ERA manages uncertainty as part of an EIA process*

Thus ERA is very important as it conveys the outcome of environmental decisions. It helps to overcome the potentially negative features of a project to prevent harm to the ecological assets, social values and economic uses.

5.5 Key Stages in performing ERA

Environmental risk assessment (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 the organization and for quick and easy identification of risks.

2. ***Risk identification (Also known as problem formulation)***

   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. Further, this step should ideally be carried out in a workshop in the presence of stakeholders, trained facilitator and recorder.

3. ***Risk analysis***

   This step involves the following aspects:

   - Identification of consequences produced during risk identification.
   - The effectiveness and dependability of controls.
   - Information about the statement of context.
   - Additional information about statistical data, predictive modeling or expert judgment.
   - The risk involved in establishing the context.

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

4. ***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 risks, criteria and if it requires any treatment.

   Usually the managers of the organizations are given instructions/advisories about the type of action to be taken for a specific type of risk and the time allotted for their completion.

5. ***Risk treatment***

   This step involves making changes to the risk by changing the consequences that is likely to occur.

Risk treatment involves three basic methods:

(a) ***Avoid the risk:***

An activity that can lead unacceptable risk can be avoided altogether or adopt an alternative activity that causes less risk to meet the aspirations and purpose of the organization.

(b) ***Transfer the risk***

This step involves the transfer of the organization's risk to an outside party (insurer). Generally the method involves the purchase of insurance and indemnity. The expenses in occurred in the process depends upon the extent of assurance the organization can give to the insurer with regard to recovery of claims. The insurer needs information about the type of risk an organization can encounter the robustness of the organization's system and the updated claim history.

(c) ***Risk control***

This is considered as the ideal method to lower the likelihood of the risk occurrence of the impact of the risk or both. The best method of risk control is to modify the systems and processes so that the potential for adverse impact can be lowered.

The risk treatment plans should consider the following aspects,

1) Proposed actions
2) Resource requirements
3) Individuals responsible for action
4) Time frames.

Unit- 6

EIA notification by Ministry of Environment & Forest (Govt of India)

① MOEF notification —

Govt of India related EIA notification in the year 2006 which clearly explains the procedures and objectives process, formats of EIA.

In this notification the procedure and formats for Environmental clearance, Environmental impact statement, environmental audit were clearly explained.

② objectives of EIA notification: —

*. To formulate a Transparent decentralized and Efficient regulatory mechanism to —

* Incorporate necessary environmental safe guards at planning stage
* Involve stake holders in the public Consultation process
* Identify the development project based on impact potential instead of the investment criterion

③ procedure for Environmental clearence: —

* There is a great need to establish project clearence procedure. The 1st step was to define the EIA process
*. The EIA process in India made up of with the following stages. 1. Screening & Scoping
3. Impact Identification & prediction
4 Assessment of Impact significance
5. public hearing
6. Environmental Management plan
7 decision Making
8. Monitoring the Clearence Conditions.

* What is Environment legislation? —

The Term Environmental legislation refers to the managem of the environment under a strong legal framwork to help or protect the environment.

An Internation Conference on human ~~health~~ environment was organized in stockholm from 5th June to 16th June 1972 as UN Conference on Human environment to bring awareness to peopl to exert efforts for preservation of the environment for all the well being and prosperity of all.

*. Objectives of Environmental audit: —

- To Minimize the resource Consumption in order to Conserve the resources as there are the valuable assets of any nation
- To Minimize the waste Generation by abatement and reduction in waste.
- To promote the use of Green Technologies to reduce the damage impacts on the environment in an efficient and cost effective manner.
- To promote good pollution Control practices to help in pollution Control.
- To identify the deficiencies and problems with the operations and ~~lessons~~ processes to lessen the risk of future problem
- To improve the health and safety of individual during the production process in industrial units.

* Advantages of Conducting Environmental Audit: —

=> The amount of waste production is Considerably reduced
=> Environmental audit help Conserve resources and thus the input costs are significantly reduced leading to financial benifits
=> It helps to prevent and Control pollution of the environm
=> It helps the project proponents to take Corrective actions wherever necessary

- It helps to provide warning about the the possible future problems the project may face.
- Risks from environmental hazard is reduced
- Increases in environmental awareness among customers workers staff and consumer
- Improvement in the Quality life of peoples

(5) post audit activities :—

once the on-site activities are completed. The post audit activities follows where in the collected data is Translated into meaningful information to enable better decisions.

The Team leader of audit Team prepares a draft report of the on site observations with in 2 weeks of the on site activity.

- this step is followed by the review of the report by the environmental department, law department etc.
- A final report is prepared by the same audit Team assisted by the respective specialists
- It Contains the statements of facts and proposals on how to improve the environmental performance.
- The audit report is to be Circulated to all the members of audit Team including the audit management Committee Senior site auditors, site facilitators, audit personnel for endorsement. The environmental audit report generally includes the following items

(i) An executive Summary
(ii) Introduction and background information to the audit
(iii) Scope and objective
(iv) Description and methodology of audit
(v) Summary of observations, findings and recommendations
(vi) Conclusions
(vii) Annexes.

* Draft and final Environmental impact statement.

Environmental impact statement: — (EIS)

The findings of the environmental assessment are reported as Environmental impact statement (EIS). It is a Comprehensive, clear and concise non Technical summery of the decision of the project, including location, design, scale, size, mitigation measures, to minimize or avoid the potentials adverse impacts of a project and a more detailed selection on the Technical aspects of the assesment.

The statement contains specific information describing the effect on the environment due to the proposed development along with the impacts on humans flaora and fauna, soil water, air, climate, and cultural heritage.

The EIS is prepared in two stages - draft and final

A draft Environmental impact statement (DEIS) refers to the report on the environmental impact of proposed alternatives.

Draft Environment impact statement: —

⇒ Analyses of environmental issues related to a proposed actions and its alternatives

⇒ Comparative actions of all proposed alternatives and their potential environmental impacts which include aesthetic, historic, cultural, economic, social, health and ecological impacts

⇒ purpose and need for the proposed action.

⇒ Contains input of public and agency of their consultants so that the decision maker takes the public's environmental concerns into considerations during the decision making process.

- Explanation of the EIS's framework and methodology
- Identification and evaluation of significance environmental impacts as well mitigation measures related to a proposed action

- Final Environmental impact statement:—

FEIS contains information necessary, agency officials to make decisions based on the environmental consequences of proposed actions. FEIS is a revised version of the Draft EIS as viewed by most people. But the contrary, a DEIS and FEIS may contain very different information unless and until the FEIS includes the DEIS.

There are other agencies who prefer to rewrite and republish the changes made in Draft EIS and final EIS in order to make it easy to refer to just one document after the completion of the EIS process.

(7) Environmental audit notification:—

The environmental audit notification was laid down by the constitution of India on 13th march 1992. According to the notification. it is mandatory that the every industrial organization should prepare an annual report on environmental matters by the end of financial year 31st march in prescribed format.

This report should provide information about the pollutant generated measures taken to control the generation of hazardous substance, and additional steps taken for the Environmental protection if any.

Types of Audits :—

① Objective based Type of Auditing

- Liability Audit
- compliance audit
- operational Risk audit
- systems Audit
- Issues Audit
- Site Audit
- Health and safty Audit
- Management audit
- Corporate Audit
- Policy Audit
- Activity Audit
- waste Audit