EIA Methodology

Why do we need EIA methodologies?

- The administrative procedures of EIA Varies from country to country
- Provides uniform standard
- EIA methodologies ensure that the best possible information from EIA procedure is available to decision makers and the public

Some common methods

- Checklists
- EES (Environmental Evaluation System)
- Matrices
- Network
- Cost Benefit Analysis
- SMW (Simulation Model Workshop)
- Overlays/GIS

Checklists

- Checklist means a listing of potential Environmental Impacts.
- This method is done to assess the nature of the impacts i.e. its type such as adverse /beneficial , short term or long term , no effect or significant impact , reversible or irreversible etc.
- Type of Checklist Method:
  - Simple Lists- Qualitative
  - Scaling Checklists- Quantitative
  - Questionnaire Checklists- Qualitative

Advantages	Disadvantages
Simple to understand and use.	Do not distinguish between direct and indirect impacts.
Good for site selection and priority setting.	Do not link action and impact.

Environmental Evaluation System

- Environmental Impact Value

$$EIV = \sum_{i=1}^{n} (V_i) W_i$$

- V_i =Relative change of the environmental quality of parameters (e.g., air quality, water quality, noise).
- W_i = Relative importance or weightage of parameter
- n = Total number of environmental parameters

Equation represents the **Environmental Impact Value (EIV)**, a quantitative method used in Environmental Impact Assessment (EIA) to evaluate the overall significance of project impacts.

EIV

Parameter	Impact Value (V_i)	Weight (W_i)	EIV
Air Quality	-3	0.25	-0.75
Water Quality	-4	0.2	-0.80
Noise	-2	0.15	-0.30
Vegetation Loss	-3	0.25	-0.75
Employment	+4	0.15	+0.60

EIV=(−0.75)+(−0.80)+(−0.30)+(−0.75)+(+0.60)=−3.20

- A **negative EIV** indicates an overall **adverse environmental impact**.
- A **positive EIV** would suggest **net environmental benefit** (rare in physical development projects).

Matrices

- Matrix and its variants provide us a framework of interaction of different actions /activities of a project with potential impacts caused by them.
- A simple interaction matrix is formed where project actions are listed along one axis i.e. horizontally and environment conditions are listed along the other side i.e. vertically.

Advantages	Disadvantages
Link action to impact	Difficult to distinguish direct and indirect impacts
Good method for displaying EIA results	Scoring magnitude and importance often depends on expert judgment, which can introduce bias or inconsistency

Environmental Components ↓ / Project Activities →	Land Clearing	Road Construction	Plant Operation	Waste Disposal
Air Quality	Dust emissions (-2)	Vehicle exhaust (-3)	Smoke (-4)	Toxic gases (-5)
Employment	Temporary jobs (+2)	Construction jobs (+3)	Steady jobs (+5)	waste management jobs (+2)

Network

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

Advantages	Disadvantages
Link action to impact.	Can become overly complex if used beyond simplified version
Handles direct and indirect impacts	Qualitative

Example: Construction of a Dam

Network

Project Action	Direct Impact	Indirect Impact	Cumulative Impact
Dam construction	Land submergence	Loss of forest habitat	Biodiversity decline
Reservoir formation	Change in water flow	Altered sediment transport	Downstream erosion
Population displacement	Social disruption	Economic instability	Cultural loss

Cost Benefit Analysis

- Cost Benefit Analysis (CBA) is a systematic economic evaluation method that compares the total expected costs of a project (including environmental mitigation) with its total expected benefits (economic, social, and environmental).
- It helps determine whether a project is economically viable and environmentally sustainable.

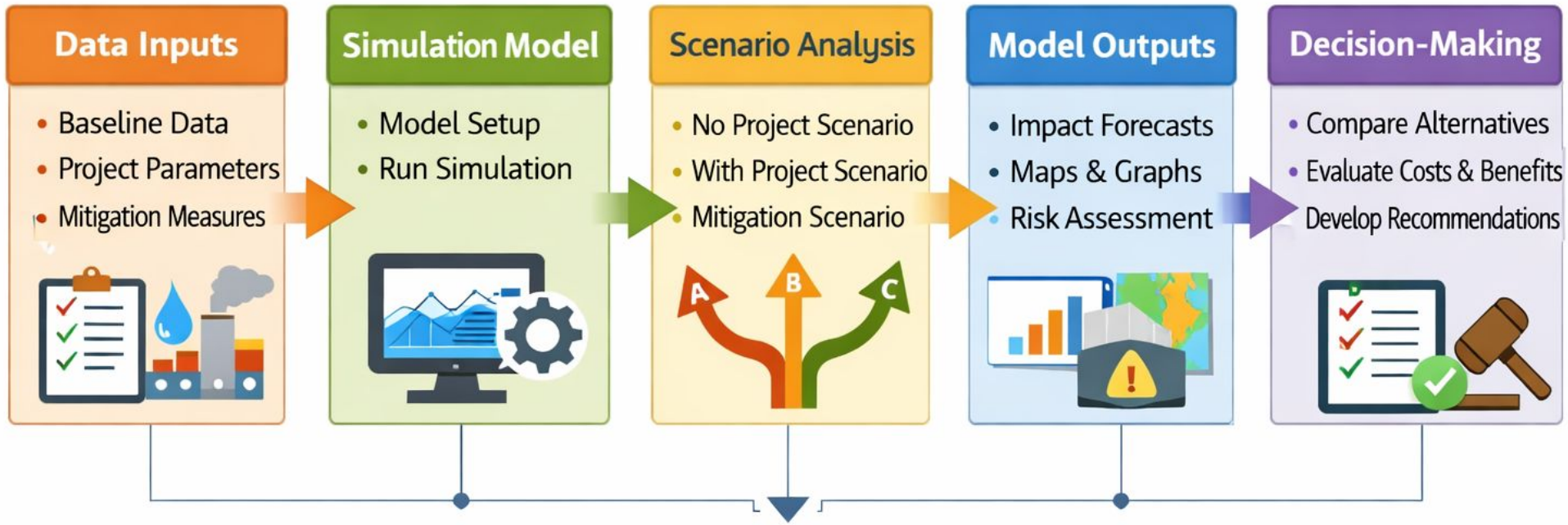
Advantages	Disadvantages
Provides quantitative justification for environmental investments.	Difficult to monetize intangible benefits (e.g., biodiversity, cultural value).
Facilitates comparison of alternatives.	Sensitive to choice of discount rate and assumptions.
Integrates economic efficiency with environmental sustainability.	

Simulation Model Workshop

A Simulation Model Workshop in the context of Environmental Impact Assessment (EIA) is designed to help participants to understand how computer-based models can be used to predict, evaluate, and visualize environmental impacts under different scenarios.

Advantages	Disadvantages
Enables forecasting of environmental changes (e.g., air pollution dispersion, groundwater contamination) before project implementation	Requires large, high-quality datasets; poor data can lead to unreliable results
Provides quantitative outputs (maps, graphs, risk indices) that help policymakers make evidence-based decisions.	Results depend heavily on assumptions and parameter settings; small errors can cause large deviations.

Simulation Model Process Flow



Legend

Data Inputs

Simulation Model

Model Outputs

Simulation Model Workshop

Example: Simulation of Groundwater Contamination from Industrial Effluent

- **Inputs:** effluent discharge rate, soil permeability, rainfall data.
- **Simulation:** contaminant plume spread over 10 years.
- **Outputs:** maps showing contamination zones, concentration levels.
- **Decision:** whether to install treatment units, change discharge location, or redesign project.

Overlays/GIS

- Rely on a set of maps of a project area's environmental characteristics covering physical , social, ecological, aesthetic aspects.
- Separate mapping of critical environmental features at the same scale as project's site plan e.g. wetlands, steep slopes, soils, floodplains, bedrock outcrops, wildlife habitats, vegetative communities, and cultural resources...
- Older Technique: environmental features are mapped on transparent plastic in different colors.
- Newer Technique: Geographic Information Systems (GIS).

Advantages	Disadvantages
Easy to understand and use	Address only direct impacts
Good display method	Do not address impact duration or probability

GIS Overlay in EIA Methodology

Thematic Layers



Forest Cover



Soil Erosion Zones



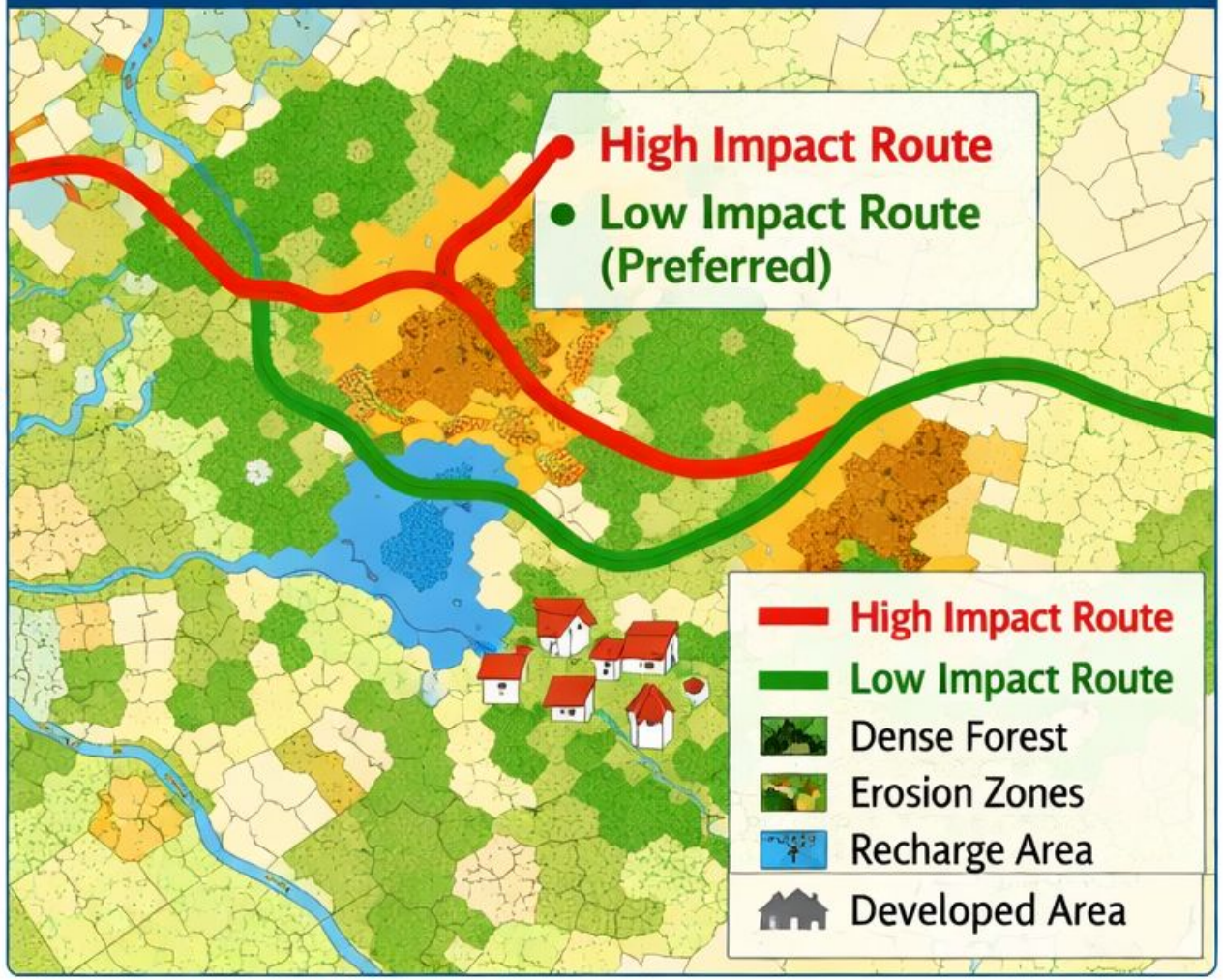
Groundwater Recharge



Human Settlements

Overlay & Analysis

Overlay Analysis Map



- Identifies Sensitive Areas
- Evaluates Alternative Routes