

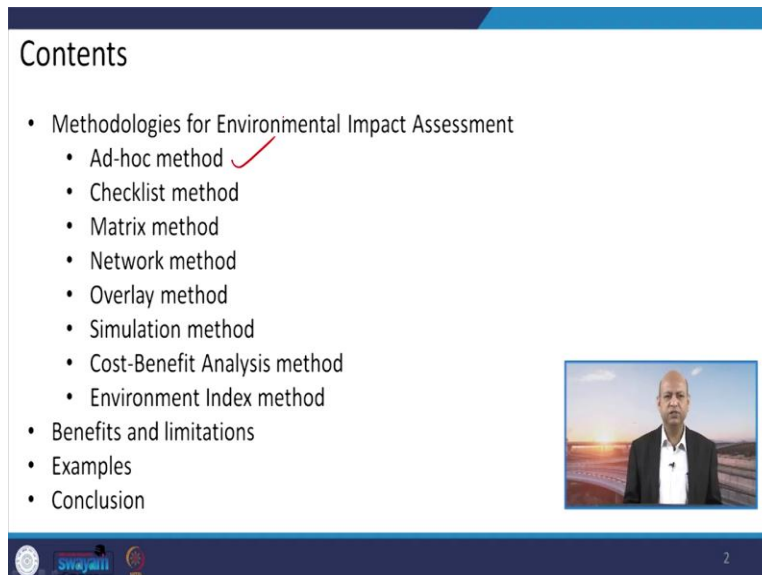
Sustainable Transportation Systems
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Indian Institute of Technology, Roorkee

Lecture 14

Methodologies of EIA

Hello friends, so, we were discussing about EIA, different aspects of EIA. We have seen like what are those concepts like screening, scoping, so, the processes of EIA we were looking into. Today we will discuss about methodologies; means, in that particular process, what are those methodologies which are implemented to carry out those processes of EIA. So, in this particular lecture, we will cover like different methodologies of EIA.

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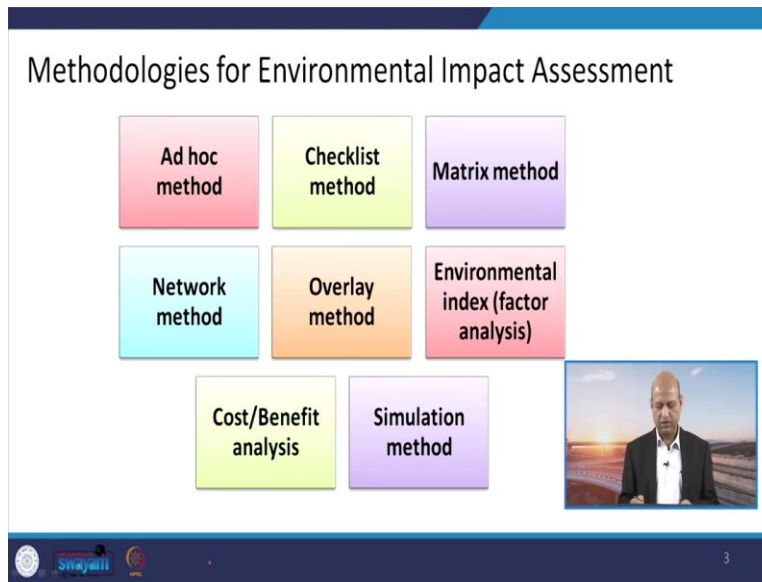
The slide is titled "Contents" and lists the following topics:

- Methodologies for Environmental Impact Assessment
 - Ad-hoc method ✓
 - Checklist method
 - Matrix method
 - Network method
 - Overlay method
 - Simulation method
 - Cost-Benefit Analysis method
 - Environment Index method
- Benefits and limitations
- Examples
- Conclusion

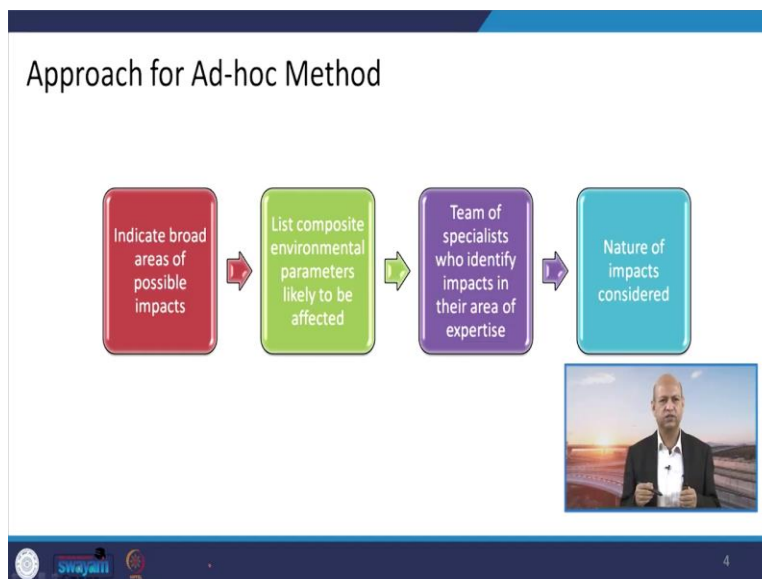
At the bottom right of the slide, there is a small video inset showing a man in a suit speaking. The slide also features logos for IIT Roorkee and Swayamii at the bottom left, and the number "2" at the bottom right.

For example, Ad-hoc method. So, we will see what are the ad-hoc method, checklist method, then matrix method or networking method, overlay method and simulation techniques and then cost benefit analysis and environmental index method. So, at several, occasions different kinds of methods are used. It is not necessarily that every kind of method is applicable everywhere. And at last, we will see like benefits and limitations of different methods and a few examples and then we will conclude it.

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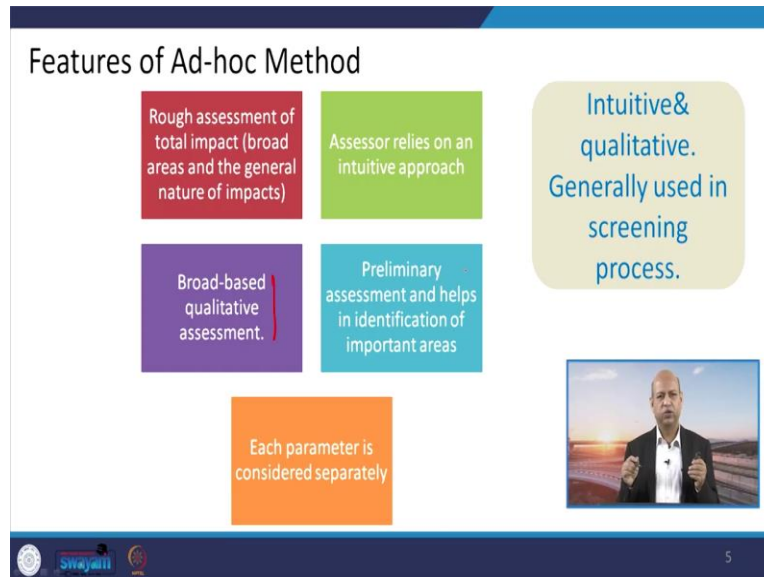


So, as we have seen in the list so, pictorial representation of different techniques like ad-hoc method, checklist method, matrix method this is shown in different boxes. When we talk about ad-hoc method, then basically some indicators are used like broad areas of possible impacts in a completely subjective way you can say and then we also list some composite environmental parameters, which are likely to be affected.

So, again subjective judgment and team of a specialist or experts, they are identified and from them this kind of feedback is taken, and then the nature of impacts of those particular activities

are also discussed. So, basically, there is no particular, step by step methodology, but according to the activity, we take advice of experts and they suggest whether, some negative impact will be there or positive impact will be there.

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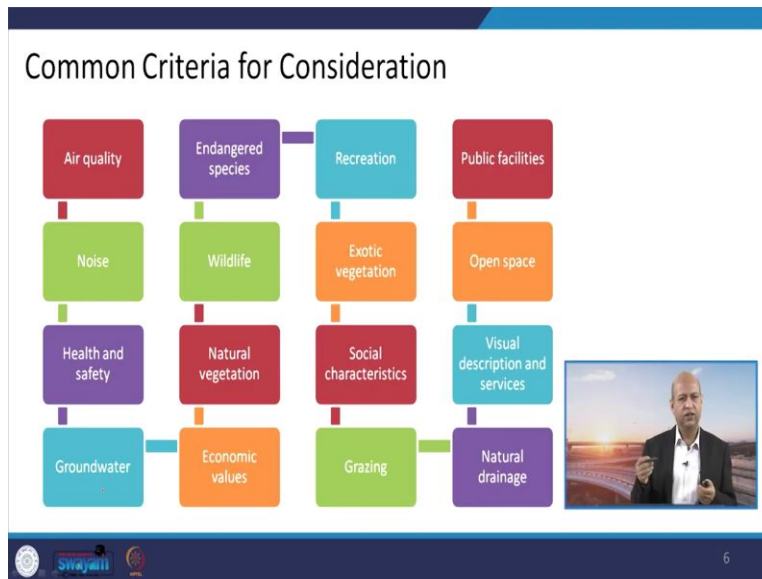


So, means it is a kind of, which we have seen in screening, basically, it depends upon the experience of the expert. So, it is more or less intuitive and qualitative, you do not calculate anything, you just see the situation. So, as per your expert's experience, they will give their decision. So, it can vary from expert to expert basically, that is why it is known as ad-hoc method that there is no much, systematic process in that.

You just need to ask the experts about a particular activity and this is kind of a screening process, which we have seen in the, when we were discussing about different processes. So, the features are like broad based qualitative assessment, it is very less quantitative means or negligible kind of thing, you just see the situations activities, gravity and you decide that this will be very high impactful or moderate impactful or less those kind of things.

So, this is basically preliminary assessment kind of activity and it identify some important areas, some important areas, some less important areas, and each parameter is considered separately. There is no integration, because, there is no feedback available of one factor to another one.

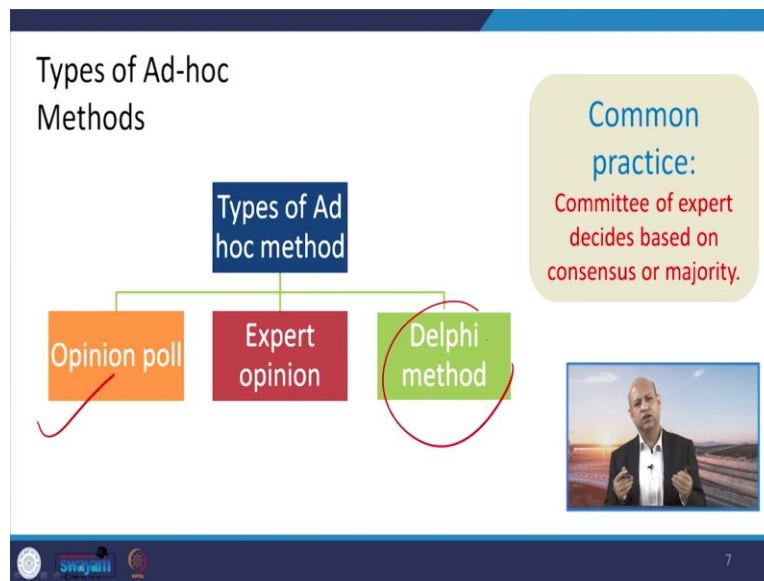
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Well, common criteria for that like air quality. So, you will ask to the air quality expert that because of this activity air quality will decrease, deteriorate or it will improve. For example, some highway is coming nearer to a town. So, you will ask air quality expert that this highway will, how much it will deteriorate the air quality of the town.

So, depending upon the traffic density and the speed and the fuels which traffic will use, expert may give their judgment. Similarly, like noise or health and safety. So, each areas expert you have to consult and, you have to take their feedback or opinion and accordingly combined judgment emerges that whether this activity is good or bad or in which particular sector or criteria, there is more to look into.

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So, like broadly speaking, we can classify them for example, opinion poll based or that means you can do survey you can ask public also and public have their own intuition depending upon their span of the experience. Similarly, the expert's opinion maybe there or Delphi method, means this is both means, you just discuss the expert's opinion with the public, then public may revise their opinion and you give the feedback of the public to the experts, and then experts consider the opinion of the public and then they can revise their judgment or decision.

So, the committee of experts decides based on the consensus or majority opinion and also their own experience. The majority opinion maybe, counter intuitive also or that may be completely perceptive or fearful. So, the facts are discussed with those people and, stakeholders are apprised with more information, then maybe you can remove their own those fearful thoughts etc.

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Ad-hoc Method Practices

U.S.A.

Assemble a team of specialists to identify impacts in their areas of expertise, with minimal guidance beyond the requirements of the NEPA (National Environmental Protection Act)

India

Similar process conducted during Screening process to decide whether to do Impact Assessment or not.
Isn't the example Ad-hoc process? (Yes, It is..)



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Well, for example, in screening process, we have already discussed. So, this is the example of ad-hoc process of course, in screening, we do this that we consult the experts and we take their opinion. Similarly, in the USA also a team of specialists, they identified the impacts of depending upon their expertise area, and then the minimal guidance beyond the requirements of NEPA, those standards etc. they can pass on their judgment.

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Alternative Reservoir: Ad-hoc Method

Parameters	Alternative-1	Alternative-2	Alternative-3	Alternative-4
Air Quality				
Noise				
Wildlife				
Local Population				
Water Quality				

Rank 1/2/3/4 to each alternative on every parameters and assess the best option among alternatives



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Well, when we talk about for example, some alternative approaches like 1, 2, 3, 4, there may be four alternatives available. So, how to judge whether 1 is better or 2 is better. So, according to

these parameters like air quality noise, you will ask the experts, please give some ranking like 1, 2, 3 it is better or worse that maybe you can first choose that one will be for worst or one will be for the best one. So, depending upon then you count and you get to know that, as per experts this is fine, this is not much impactful in that particular area. So, those kinds of alternative approaches can be decided as per the total count of those ranking systems.

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Pros & Cons of Ad-hoc Method

Pros (Red Arrow):

- Simple and can be performed without any training ✓
- No relative weighting or cause-effect relationship
- Suggests only broad areas for possible impacts

Cons (Green Arrow):

- No assurance that all relevant impacts have been studied
- Lacks consistency ✓
- Inefficient as it requires a considerable effort to identify and assemble a panel for each assessment

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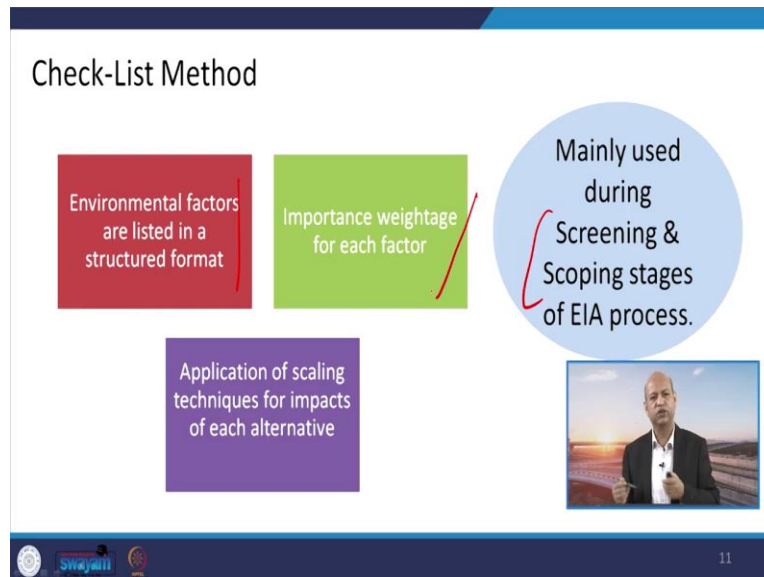
When we talk about what are the good points or limitations or shortcomings of ad-hoc method, then for example pros that means, good points are like it is very simple and it is performed by without any particular hi-fi training, you just go to the expert, you tell about the project, take their opinion and just do the ranking kind of thing.

Similarly, there is no weightage or only this alternative approach 1, 2, 3 kind of ranking maybe there otherwise, there is no weightage or there is no calculation, very complex calculations and it is broadly possible impacts are discussed basically, it is not like you have run some mathematical model and you got some values and according to the values you compare with some standards, and then you pass your judgment, it is not something like that.

It is only the simple opinion based on the experience and the expertise, but there are shortcomings because it is very, very simplistic that is all, but it lacks consistency. The reason is when same project, if you consult 3, 4 experts of the same area, you may get different opinion. So, that means there is no consistency.

Of course, a range may be there, may be like some experts can say, I will give it 1, other can give 2 but of course experts may vary 1, 2 something like that, but they will not assign like 6 or 10 that that gap may not be there, but there will be some sort of range. And it is like inefficient in the sense because you need to consult several times, different groups and consensus sometimes building consensus takes lot of time.

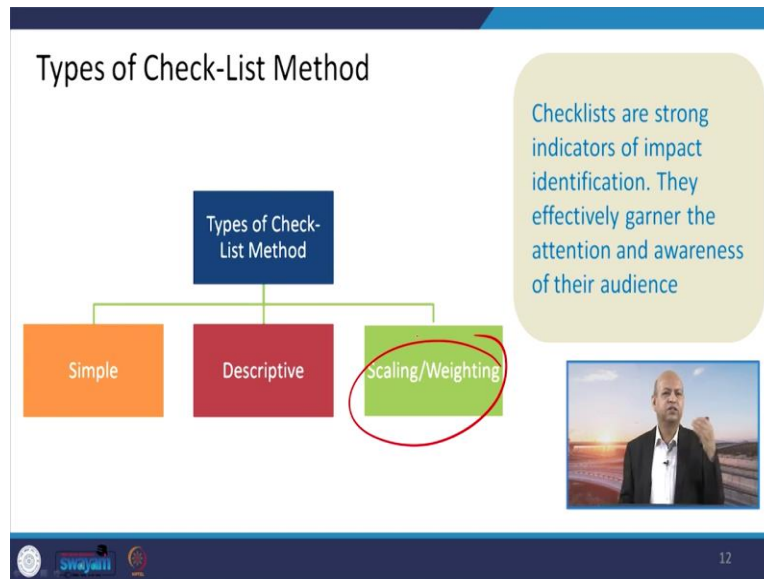
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Another method is checklist method and that is like different environmental factors are listed in a structured format, a checklist, a list is prepared. So, in screening and scoping, again, these things have been used means ad-hoc method also plus this checklist method, this is quite frequently used in this process of EIA, which is a screening and scoping stages of the EIA.

Well, so the importance of weightage of each factor is given to the different parameters which have been listed. And then you do the scaling techniques you use and the impacts of each alternative is arrived at with the basis of those weightage assigned to different activities.

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Again, these types of checklist can be like simple checklist, descriptive means more information, one section, then subsections something like that, otherwise simple means 1, 2, 3 only those activities listed, then scaling and weighting kind of checklist maybe they are. So, three broad types of checklists can be there. Very simple, you just list the activities and you get 1, 2, 3 something like that opinion yes, no, yes, no something like that.

Or descriptive means, you describe those activities little bit more means rather than air quality, you can write NO_x level, SO_x level, particulate matter that way you can further classification can be done. So, that can be descriptive. Otherwise, then third will be like scaling and weightage means you have to give at some scale some weightage will be given depending upon the intensity of the activity and the expert's opinion.

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Simple Check-List

- List of parameters ✓
- Without guidelines regarding either interpretation
- Further needs measurement of environmental parameters or specific data needs or impact prediction and assessment



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So, simple checklist as I said, list of parameters will be there and without guidelines or any further interpretation you can give yes or no something like that, and the further needs measurement of environmental parameters or specific data, and impact of prediction and assessment that is further needed means that is not included in this particular checklist, simple checklist.

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Example of Simple Check-List

Environmental elements	Environmental impact factors	Construction period	Operating period
Social environment	Traffic, development of social economy	○	★
	Land use ✓	☆	☆
	Demolition and resettlement, traffic, irrigation works, social economy	★	○
Living environment	Traffic, exchange, employment, income and safety	★	○
Ecological environment	Water and soil loss ✓	★	○
	Water pollution during construction period and operation period, accident risk	☆	○
Acoustic environment	Traffic noise ✓	☆	★
Air quality	Raise dust, TSP ✓	★	○
	Harmful substances in tail gas (NOx, CO)	○	☆

Solid Star: Obvious effects; Star: Usual effects; Circle: Slight effects

Source: world Bank, 2011

Example of a Simple Check-list for a project of Township




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Descriptive Check-List

- Include list of environmental factors
- Information on measurement, impact prediction and assessment




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So, these are, like social environmental traffic, land use, water and soil loss, traffic noise, air quality raise as those kinds of things are simple. In descriptive, you include some environmental factors and the measurement and impact prediction related information and the assessment.

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Example of Descriptive Check-List

Parameters	Description
Air Quality	Current condition (PM ₁₀ , PM _{2.5} , NO _x , SO _x), area affected, no. of people affected
Water Quality	Current status of water bodies, Dissolved Oxygen level, possible pollutants, Effects on population
Noise	Change in noise level, frequency of occurrence



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So, this is like air quality. So, as I said like PM₁₀, PM_{2.5}, NO_x, SO_x, you can go on depending upon what kind of activity you are looking into and this how much area is affected, number of people affected. So, further classification to sub classification. Water quality again, DO, how much DO will be there, how it will be affected, possible pollutants, then effects on the

population, similarly, noise. So, you can describe means, you can further classify those parameters. So, that is part of descriptive checklist.

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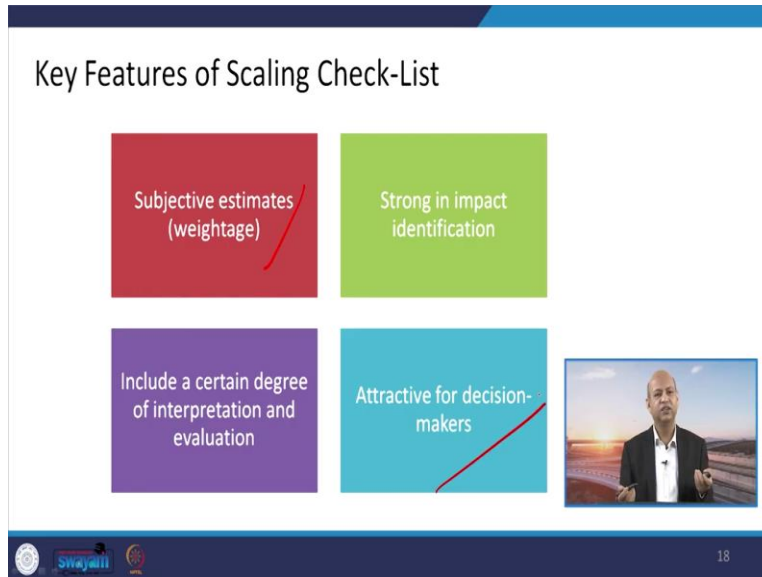
The slide is titled "Scaling/Weighting Check-List" and contains the following content:

- Include list of environmental factors along with importance of factors. ✓
- Weight is given as per importance.
- Require experts for scaling the various environmental factors.

A small video inset in the bottom right corner shows a man in a suit speaking. The slide footer includes logos for "Swayam" and "17".

In scaling or weighting, weighing this checklist, you give some weightage to particular parameters. So, 0.8, 0.9, 1, 2 whatever you decide. So, the environmental factors are included and means, along with important environmental factors, you have further description and the weight is given as per the importance. So, again this will depend upon the expert's experience, but still means, you can assign weightage 0.8, 0.9, 0.1 something like that, and it requires experts experience to on a further scaling.

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The slide, titled "Key Features of Scaling Check-List", features four colored boxes arranged in a 2x2 grid. The top-left box is red and contains the text "Subjective estimates (weightage)". The top-right box is green and contains "Strong in impact identification". The bottom-left box is purple and contains "Include a certain degree of interpretation and evaluation". The bottom-right box is cyan and contains "Attractive for decision-makers". To the right of the cyan box is a small video inset showing a man in a suit speaking. The slide footer includes the Swayam logo, a small circular icon, and the number 18.


Well, different features, if you want to see the subjective estimates, which is weightage but this is subjective, it can vary from person to person. Strong in impact identification, because those high weightage can give you quick idea that, this will be more impactful. Similarly, they can include certain degree of interpretation and evaluation because, when weightage will vary so, a little bit idea will be conceived that, this is the variation of different activities.

And then for decision makers, it is attractive, because, the simple reason, it is very easy for them, because when they see more weightage to a particular factor so, they get to know quickly and easily, this is more important or this is more impactful, something like that.

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Example of Scaling Check-List

Parameters	Weightage	Alternative-1	Alternative-2
Air Quality	40		
Noise	15		
Wildlife	10		
Local Population	20		
Water Quality	15		
Total	100		



The slide features a table with four columns: Parameters, Weightage, Alternative-1, and Alternative-2. The 'Parameters' column lists Air Quality, Noise, Wildlife, Local Population, Water Quality, and Total. The 'Weightage' column lists 40, 15, 10, 20, 15, and 100 respectively. Red circles and checkmarks are drawn on the slide, highlighting the 'Air Quality' row and the 'Weightage' column, and marking checkmarks in the 'Alternative-1' and 'Alternative-2' columns. A small video inset in the bottom right shows a man in a suit speaking against a sunset background.

So, scaling of the checklist can be like weightage for a particular, some project is there. So, in terms of air quality, noise, wildlife local population, water quality, the impact will be in weightage. So, let us say one air quality related, some experts say this is 40 % of weightage I will give to the air quality because this particular project is going to deteriorate air quality very much. So, that with the more weightage can be assigned to that particular parameter.


So, similarly 15, 10 and total should be 100. So, as I said the weightage can be further decided and after that you go to other experts. So, for alternative 1, alternative-2 after this 40, so, within 40 alternative-1 maybe like 30 or 20, because alternative 1 may be better fuel, so air quality may not be deteriorated up to that extent. So, the weightage may vary, alternative 1, 2, 3 something like that, but first of all, this was the perceptive based weightage overall and later on, you can go further classification in terms of these alternatives.

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Limitations of Scaling Check-List

- Pose the danger of imparting equal importance to every impact.
- Numerical values assigned to impacts can be derived based only on subjective understanding.
- Make no provision for assessing dynamic probabilistic trends or mitigation, enhancement and monitoring.
- Can't identify higher order effects, impacts and interactions.

Parameters	Weightage	Alternative-1	Alternative-2
Air Quality	40		
Noise	15		
Wildlife	10		
Local Population	20		
Water Quality	15		
Total	100		



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The limitations mean like this is danger of imparting equal importance to every impact, means when you have assigned one value, so, you do not distinguish like SO_x, NO_x etc. and each is given 40 weightage something like that and then some subjective understanding of course, it requires as per the numerical values, so, there may be some variation.

And there is no provision of dynamic probabilistic trends or mitigation means one value is assigned, it is assigned, there is no variation and no monitoring kind of thing in that, it cannot identify high order effects or impacts or interactions. Once, one this weightage is assigned, then that value is almost fixed and there is no variation or changes.

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The slide is titled "Pros & Cons of Check-List Method". It features a red arrow pointing up and a green arrow pointing down. The green box contains the following text: "It is simple to understand and use" and "It is good for site selection and priority setting". The red box contains the following text: "Doesn't distinguish between direct and indirect impacts", "1. Doesn't link action and impact", and "2. Cumbersome at times". A small video inset shows a man in a suit speaking. The slide also includes logos for "Swayam" and "21" in the bottom left and right corners respectively.

So, checklists pros and cons if you discuss means strong points or limitations or shortcomings. So, again it is simple to understand and use checklist list is there, you know everything, good for site selection and priority setting and very quick also, different parameters are there, weightage is given or those kinds of things and you can decide, but it does not distinguish between direct or indirect impacts.

Means like in terms of air quality, we do not know whether ozone production will be there or not indirect, smog will be possible are not, only very simple assessment air quality we have just discussed. It does not link action and the impact. So, cause effect is lacking in this particular thing. And sometimes it is cumbersome because the list can be very exhaustive also, when you go for descriptive list kind of things.

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The slide is titled "Matrix Method" and contains the following information:

- Red box:** Framework of interaction of different activities
- Green box:** Project actions are listed on one axis & environmental impacts are listed along the other axis
- Purple box:** Assess potential environmental impacts
- Light blue box:** This technique was pioneered by Leopold et al. in 1971
- Orange box:** Lists about 100 project actions and about 88 environmental characteristics and conditions

A small video inset in the bottom right corner shows a man in a suit speaking. The slide footer includes logos for Swayam and the number 22.


There is another method which is matrix method. So, in matrix method, we have a framework, interaction of different activities, a framework is developed, and then different actions of the project listed on one axis and the environmental impacts on the another axis. So, this is a matrix. This vertical and horizontal, you list activities and their impacts or impacts and activities, either way.

Then, potential environmental impacts are assessed according to that matrix and this technique was of course, in '71 it was developed and for different projects, it has been widely used, and different characteristics of the environment are judged by, or assessed by this matrix method.

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Example of Matrix Method

Environmental Components	Project Action				
	Construction	Operations			
Flora	Utilities	Buildings (Residential + Commercial)	Residential	Commercial	Parks & Open Space
Fauna					
Air Quality					
Water Quality					
Population Density					
Employment					
Traffic					




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So, you can see flora and fauna, this is flora and fauna, air quality, water quality, population density, employment, traffic, these are the environmental components. How it will be affected? Project action, like utilities, construction activity due to utilities, what will be the effect on the flora, fauna or air quality? Building like residential, commercial kind of activities. So, how they will affect. Similarly, operations residential, commercial parks or open spaces. So, they will be another kind of ranking system.

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Pros & Cons of Matrix Method



- links action to impact ✓
- Better displaying EIA results
- Difficult to distinguish between direct and indirect impacts
- Chances of double-counting of impacts
- Doesn't refer to quantity of impact



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Example of Matrix Method

Environmental Components	Project Action			
	Construction	Operations	Operations	Operations
Flora	Utilities	Buildings (Residential + Commercial)	Residential	Commercial
Fauna				Parks & Open Space
Air Quality				
Water Quality				
Population Density				
Employment				
Traffic				

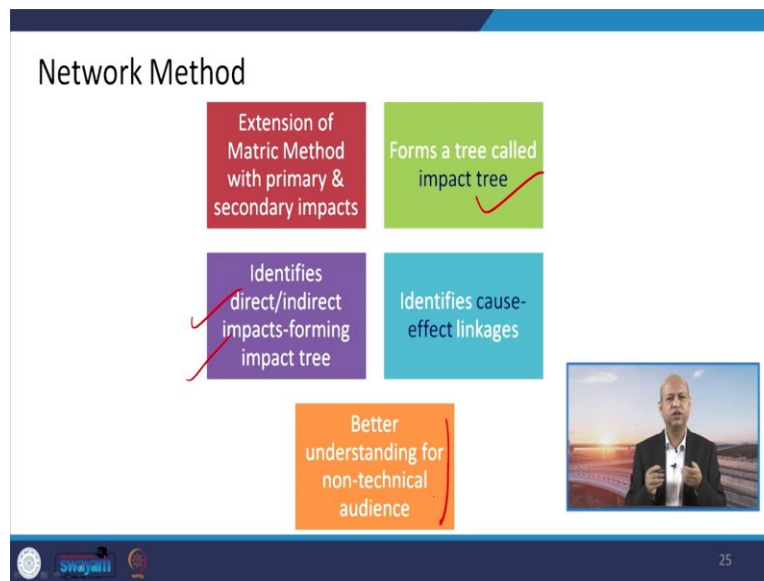


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So, for matrix also there are like some good points or some shortcomings, like it links the actions to the impact as you can see, some actions like utilities are there, then water, wastewater will be generated, and which we have to deal with. Similarly, residential complexes are there, if multi-story building coming. So, population density will increase, so, that kinds of impacts and activities are related to each other.

Better displaying EIA results of course, in comparison to other techniques it depicts in a better way, but again, the same shortcoming like direct and indirect impacts are not distinguishable in here. Chances of double counting of impacts maybe there because once we have discussed about residential and there also commercial activity. So, double counting maybe there, whereas we should take them separately. Does not refer to quantity of the impact again, it is qualitative as other techniques are there.

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Then there is network method. So, in network method extension of this matrix method with primary and secondary impacts. So, this is further evolution of the matrix method you can say. So, it is a kind of tree, branches are there and this impact tree is like flowchart becomes and the cause-and-effect linkages are particularly emphasized upon.

Then identities, direct indirect impacts and forming the impact tree for this tree formation, better understanding for non-technical audience because this will give different branches, one will lead to the another impact and one impact will lead to another kind of activity. So, this cause and effect is there.


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Example of Network Method 1/2

Possible Adverse Impacts			Corrective Action	Control Mechanisms
Initial Condition	Consequent Condition	Effects		
Increase surface runoff (E)	Flooding (H)	Gully and Erosion (K)	Place intermittent flower beds	
Pollution of Ground Water (F)	Degradation of Water Supply (I)	Health Hazard (L)		
Removal of Topsoil (G)	Decreased Fertility (J)	Death of Flora (M)	Plant Shrubs	Plant Shrubs

Action	Impacts			Branches
A	(F)	(I)	(L)	1
B	(E)	(H)	(K)	2
C				
D	(G)	(J)	(M)	3

Source: Esraz Z., 2017




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Example of Network Method 2/2

Impacts	Impact Score (1-10 Interval Scale)		Probability of Occurrence	
	Magnitude	Importance		
E	5	3	B → E(0.8)	D → E(0.7)
F	2	5	A → F(.5)	
G	3	4	C → G(.3)	D → G(.4)
H	4	5	E → H(.7)	
I	2	9	F → I(.6)	
J	2	5	G → J(.8)	
K	3	7	H → K(.7)	
L	2	10	I → L(.9)	
M	1	6	J → M(.8)	

Branch 1 $(2)(5)(.5) + (2)(9)(.6) + (2)(10)(.9) = 33.8$
 Branch 2 $(5)(3)(.8) + (5)(3)(.7) + (4)(5)(.7) + (3)(7)(.7) = 51.20$
 Branch 3 $(3)(4)(.3) + (3)(4)(.4) + (2)(5)(.8) + (1)(6)(.8) = 21.2$
 Grand Network Index $33.8 + 51.2 + 21.2 = 106.2$



For example, it is clear from here, like initial condition increase surface runoff. So, flooding may be there, impact may be there. Similarly, so A activity will have impacts F, I, L and the B may be similarly, D may go to E also. So, networking means from one point to another nodes it can go. So, it can be cross functioning also. So, this is one another example of network method. So, different branches are taken and the magnitude like 5, 2, 3, 2, 1 something like that is given and accordingly some quantitative values are taken.

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Pros & Cons of Network Method

Pros:

- Links action to impact ✓
- Check second order impacts in a simplified form ✓
- Handles both direct and indirect impacts ✓

Cons:

- Overly complex if used beyond simplified version ✓
- Appears to be quantitative but qualitative in nature ✓

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So, the again pros and cons if the network method we discussed. So, it links action to the impact. So, this is again like matrix, one more advantage for this. It checks second order impacts varies in matrix it was not there, because this impact can lead to another impact. So, the secondary or further impacts can be linked with the previous one.

Handles both direct and indirect impact. So that is a good point. But still there are some, limitations or shortcomings like it is overly complex, if used beyond some simplified version, because one tree becomes from one point it will go there here then, other point will go here and it will go this point also this may lead to this one. So, becomes very, very complex after a certain point.


And it appears to be quantitative because, you can see here some magnitude importance, so, some numbers are given. So, it looks like it is quantitative here also some calculations are there, but still, it is qualitative in nature, because from expert to expert from people to people, these values can vary. It is not like one absolute value is there in the standards and we have to follow the same value. It is not something like that.

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Overlay Method

Set of maps of a project area's environmental characteristics covering physical, social, ecological and aesthetic aspects.

Separate mapping of critical environmental features at the same scale as project's site plan (Ex: wetlands, steep slopes, soils, floodplains, bedrock outcrops, wildlife habitats, vegetative communities, cultural resources, etc.)



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Another method overlay method. So, this is based on mapping basically. So, maps are used and maps are different color schemes, they can give your idea of impact of the density of the colors may vary and like slopes and wetlands, soils, floodplains, bedrock, all these can be shown in different colors, so, visually it is much easier to understand.

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Pros & Cons of Overlay Method

Easy to understand and use.

- Good display.
- Good for setting site selection.

Addresses only direct impacts.

- Doesn't address impact duration or probability.



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But still there are good and bad points or limitations you can call, easy to understand, good display, colorful visuals always give us more understanding as you know and then it is very nice for setting site selection because contours are there some like pond is shown here, those kinds of

topographical representations can give us better idea that where one project will be launched or established, it is good site or bad site, there is floodplains or not, what are other, activities may be there.

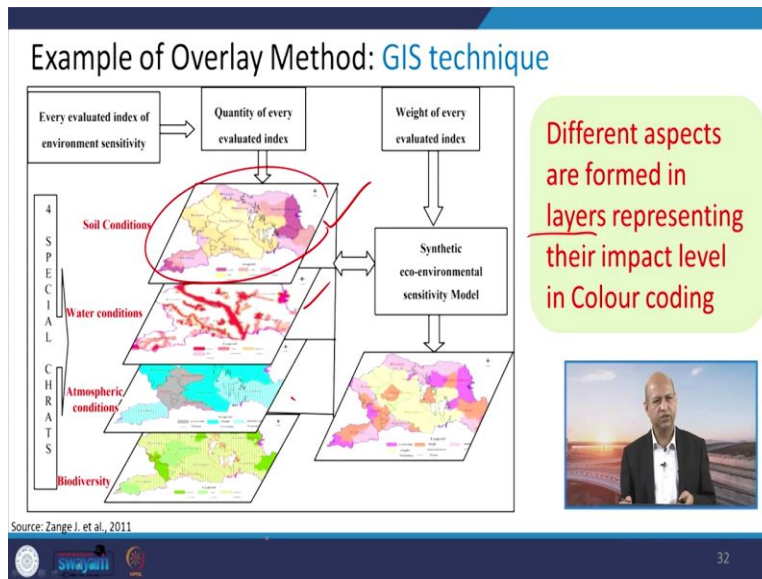
But only direct impacts because in that color scheme if you are having slopes, so, you will find that this will give much water and during rainy season it can feel some pond here. So, those kinds of direct impacts only visible. And it does not address impact duration or probability as it was earlier in network or matrix related methods, where some values are given. So, those kinds of things are not available in that, in this particular technique.

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The slide is titled "Old Vs. New Technique for Overlay Method". It features two main text boxes connected by a red arrow pointing from left to right. The left box, titled "Old technique:", contains the text "Environmental features were mapped on transparent plastic in different colors." The right box, titled "Modern technique:", contains the text "It is done using GIS (Geographic Information Systems) with help of skilled personnel." The words "GIS (Geographic Information Systems)" in the modern technique box are circled in red. Below the text boxes is a small video thumbnail showing a man in a suit. At the bottom of the slide, there are logos for "Swayam" and "31".

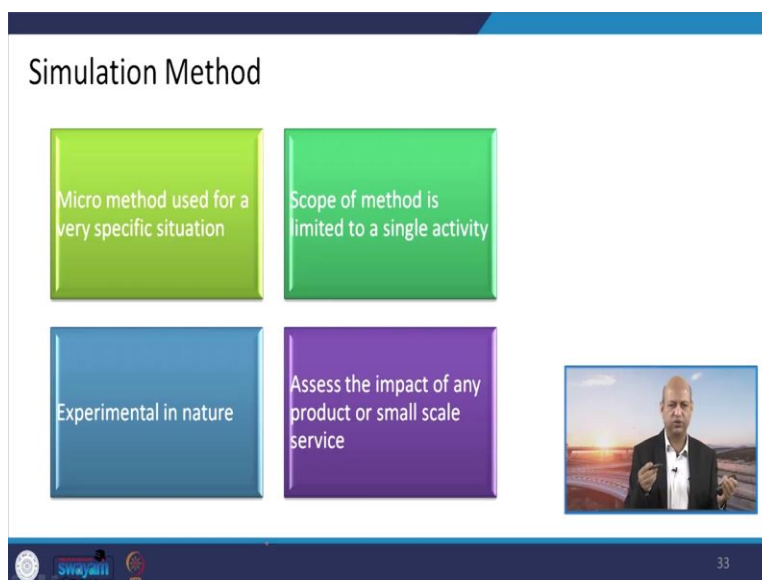
And old versus new techniques are also there, part of overlay method because now this GIS Geographic Information System is there. So, computer-based map preparations, these are much easier, but easier in the sense much quickly and computer-based techniques are there, but you need a skilled personnel for that, nobody means everybody cannot prepare those maps some expertise must be there. Earlier it used to be like transparencies we used to create and some color scheme of different colors we used to give.

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So, the soil condition map maybe they are like here water condition mapping, atmospheric conditions. So, different color schemes give different values of air quality or something biodiversity is shown again dark green, light green something and then all these different aspects, different layers are there 1, 2, 3. So, you can combine also them but then it will be a little bit complex. Otherwise, separately you can study and come to certain conclusions.

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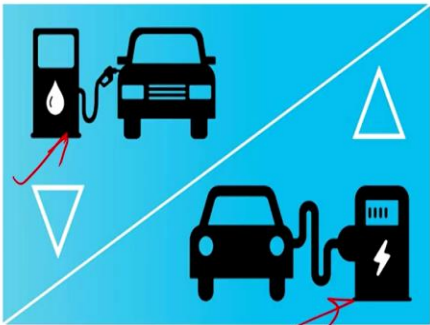


Another method is simulation method that is like quantitative and some models are run, mathematical models are run and for example CFDs are there or some Gaussian model you can

use for air quality assessment. So, at micro or macro level, you can have different kinds of boundary conditions and you can do modeling work, due to modeling you get some values and you those values you can compare with some standards. And you can then pass some judgment that it is good or bad.

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Example of Electric Vehicles Vs. Fossil Fuel Based Vehicles



- Electric & fossil fuel based vehicles compared in standard conditions for exact emissions and cost per km.
- Simulations are done to compare the environmental impacts by both type of vehicles




Image Source: noodoe.com

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So, then if we compare this simulation of for example, if petrol cars are replaced by electric cars, so in models you can put those values how many cars are there, how much fuel will be reduced from burning. So, air quality improvement, how much we can achieve those kinds of things means, different scenarios, you can create in model or you can get some values.

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Cost-Benefit Analysis (CBA) Method

Based on simple comparative analysis of positive and negatives of any particular activity or project

Every impact is valued in monetary terms

Economic & social valuation of benefits of the projects are also considered

Assess the impact of any product or small scale service



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Then there is cost benefit analysis, because every activity has certain cost and some impacts maybe negative. So, negative externalities, this will be a kind of negative cost, but there may be some for example, job creation or health infrastructure is developing, developed there in a particular locality, then some benefit is also there. Economic and social valuation also done. So, the impact assessment of any product or small-scale service that can be done with cost benefit analysis, very simple. But again, it has certain limitations that we will see.

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Social Cost-Benefit Analysis (SCBA)


Assessing the desirability of projects in the public as opposed to the private sector

Identification of costs and benefits (social, environmental & economic)

Generally used by international institutions such as World Bank

Measurement of costs and benefits in monetary terms

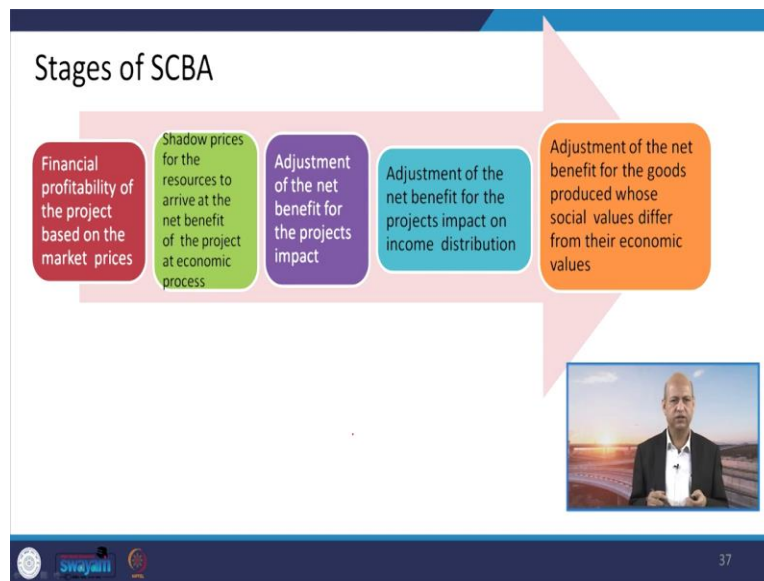
The effect of (risk and uncertainty) during project life cycle



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Then there is social cost benefit analysis, because some project has one or other kinds of benefits, as I said employment generation maybe there or like time saving is there if we are, we are having some road between a village to city, otherwise people used to travel in bullock carts also now, they can travel with bus or other methods. So, those kinds of benefits maybe there, social positive impacts will be there, but as I said negative externalities are known as negative cost.

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So, in totality this SCBA, Social Cost Benefit Analysis is done more recently, like through World Bank or other international agencies, they are giving more emphasis to these kinds of activities because they try to combine broader impacts in society and in other aspects of those projects.

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The slide is titled "Limitations of SCBA" and lists four points:

- Measurement of social costs and benefits are formidable.
- Costs and benefits are intangible and their evaluation in terms of money is bound to be subjective.
- Comparison with future projects is difficult.
- Impact on the ecology and people of the particular region and the country as a whole are bound to be differing from case to case.

A small video inset in the bottom right corner shows a man in a suit speaking. The slide also features logos for Swayamii and a page number 38.

Well, there are certain limitations of SCBA or Social Cost Benefit Analysis like it also measures social cost and benefits, but it is not so easy because converting everything into monetary things, it is very difficult, there are many things which are intangible, only tangible things you can convert into monetary things, but there are many things which are intangible, and it becomes difficult.

So, everything like for example, suppose, because of a project some accidents happen. So, how, how will you value the life, life's value, whether it is 1 lakh or 1 crore or something, insurance have some way of evaluating those values, but still if single person, bread earning person is died in an accident so it is a loss of whole family, how can you convert that monetary loss in that way.

So, those are the issues in fact, many schools of thoughts, they discuss and debate on these particular aspects. Then future projects, comparison is difficult because we do not know what kind of technology technologies will be there to intervene at after, 15 years or 20 years, those kind of things. For example, right now, we have been doing many things online even during pandemic but 50 years back, this was not possible, this was not possible.


Impact of the ecology and people for a particular region and country as a whole are bound to be different from case to case, as I said different socio-economic groups have different value system and it is not necessary that they will agree on a particular monetary value which has been assigned to a particular activity.

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Environment Index Method

- Standards are predefined.
- Raking is done for various parameters against set standards
- Based on overall score, alternatives are given ranks.

Based on this method, EPI (Environment Performance Index) is developed to rank countries.



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Environment Performance Index (EPI) Ranking

International ranking mechanism for accessing countries' efforts against climate change

The EPI uses the distance-to-target technique for indicator scoring, which situates each country relative to its targets for best and worst performance corresponding to scores of 100 and 0.

32 indicators into 11 issue categories and two policy objectives, with weights shown at each level as a percentage of total score

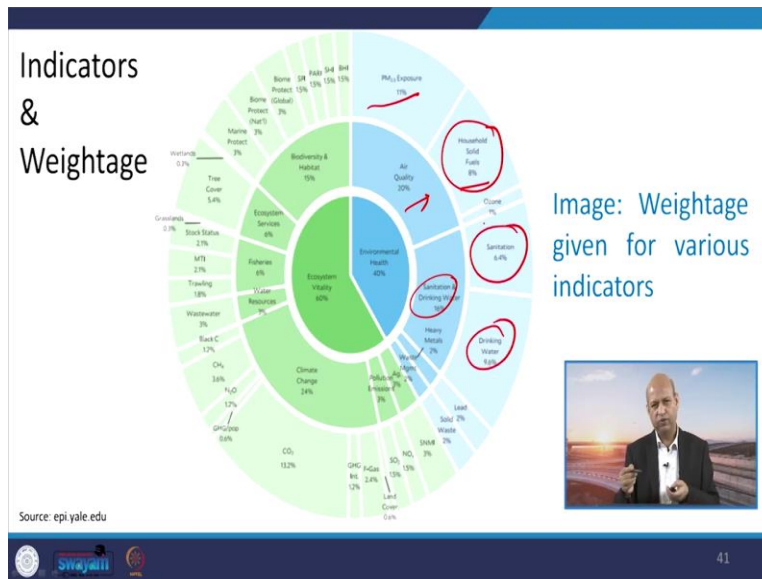


Source: epi.yale.edu

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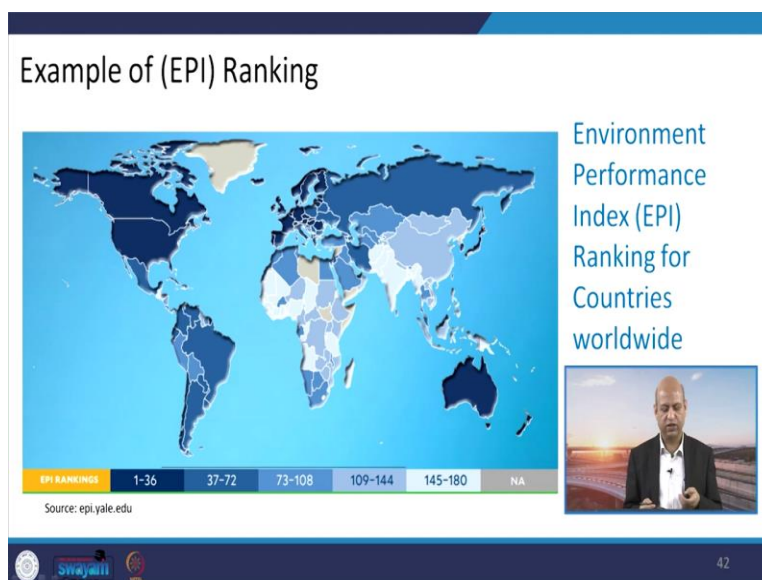
Then another method is environment index method. So, in this particularly basically ranking is done and performance basically based on the performance, the indexing is done and then judgment is passed. So, for example, there are certain parameters and indicators. So, 32 indicators and 11 categories are there.

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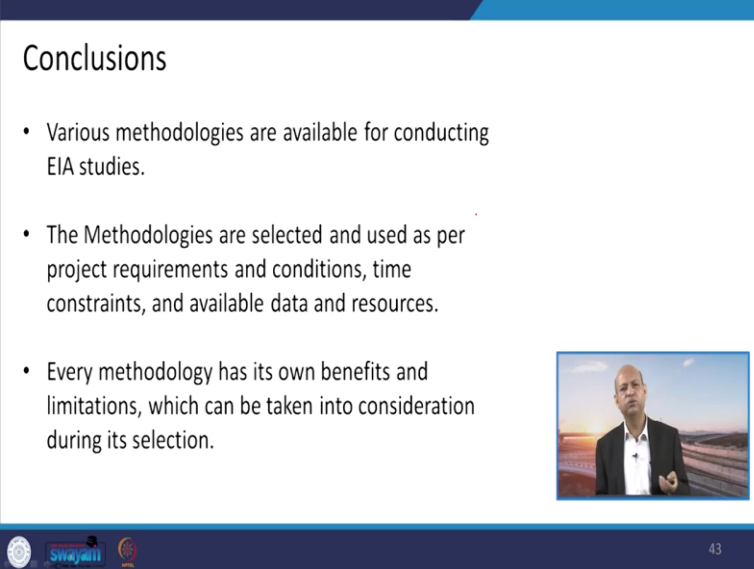
So, there are 11 categories and 32 indicators, different kinds of indicators may be there depending upon what kind of thing we are looking into. So, in within environmental for example, air quality is there. So, within air quality, we can discuss about PM10 or the fuel type or other parts like sanitation, then sanitation, drinking water or the sanitation part what is their proportion, that can be seen.

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So, depending upon this performance EPI some countries have been given some values and accordingly they have been ranked by their performance for the environment whether it is good or bad.

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The slide is titled "Conclusions" and contains three bullet points. To the right of the text is a small video inset showing a man in a suit speaking. At the bottom of the slide, there are logos for "Swayam" and "43".

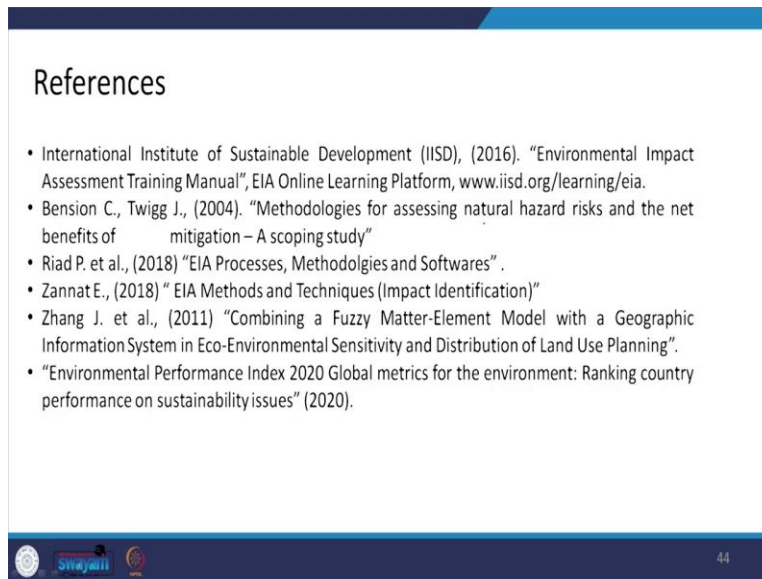
Conclusions

- Various methodologies are available for conducting EIA studies.
- The Methodologies are selected and used as per project requirements and conditions, time constraints, and available data and resources.
- Every methodology has its own benefits and limitations, which can be taken into consideration during its selection.

So, in nutshell we can conclude that different methodologies are there for environmental impact assessment and they have their own good points or some limitations and we have to use a particular method depending upon the context. It is not necessary that every method is applicable for all the situation.

So, depending upon the situation like screening, scoping, we use some simple checklist or those kind of things, but for let us say power plant is there, so, then we have to use some Gaussian dispersion model to look into what will be the impact on the air quality. So, we have to see what kind of activity is there and what kind of impact assessment we need to carry out. So, depending upon that, methodologies are selected and used for carrying out this impact assessment.

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- "Environmental Performance Index 2020 Global metrics for the environment: Ranking country performance on sustainability issues" (2020).

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So, for today, it is all these are the reference lists you can go through to learn more about if some particular topic you found, you find more interesting or you feel more inquisitive, you can look into additional references. So, thank you again for your attention and we will carry on all other aspects of the EIA or Environmental Impact Assessment in future classes. Thank you.