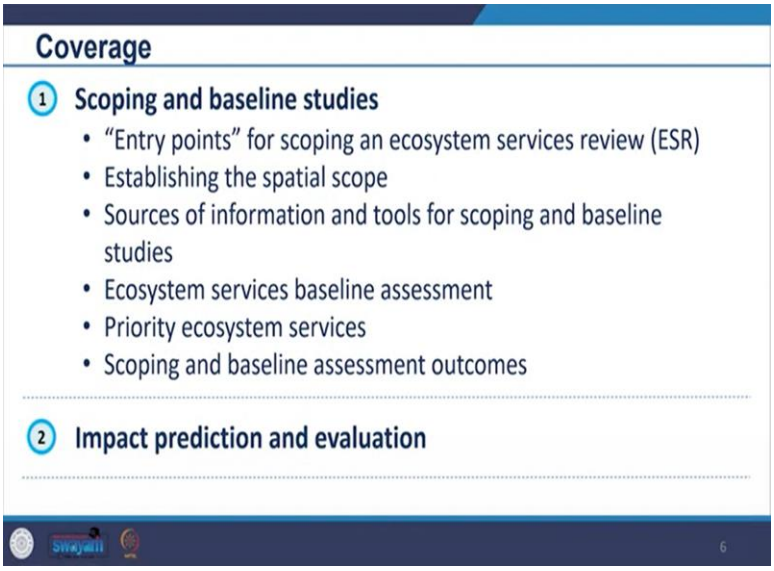
Environmental Impact Assessment
Professor Harshit Sosan Lakra
Department of Architecture and Planning
Indian Institute of Technology, Roorkee
Lecture 41
EIA Methods for Ecosystem Services – Part II

Welcome to the course, Environmental Impact Assessments. In today's session, we will cover ecosystem services. This is part two of ecosystem services in the larger ambit of EIA methods. In part one of ecosystem services, we looked at the challenges of including assessment of ecosystem services in the EIA process and also looked at the definitions and concepts with examples. And then we also looked at the interrelationship between them.

There is much guidance, which are given on how to conduct an assessment, and ecosystem service assessments, which are available from various sources, those sources are given to you for your reference purpose. Today, we will look at methods used at the stage of scoping and baseline studies, as well as at the impact prediction and evaluation stage.

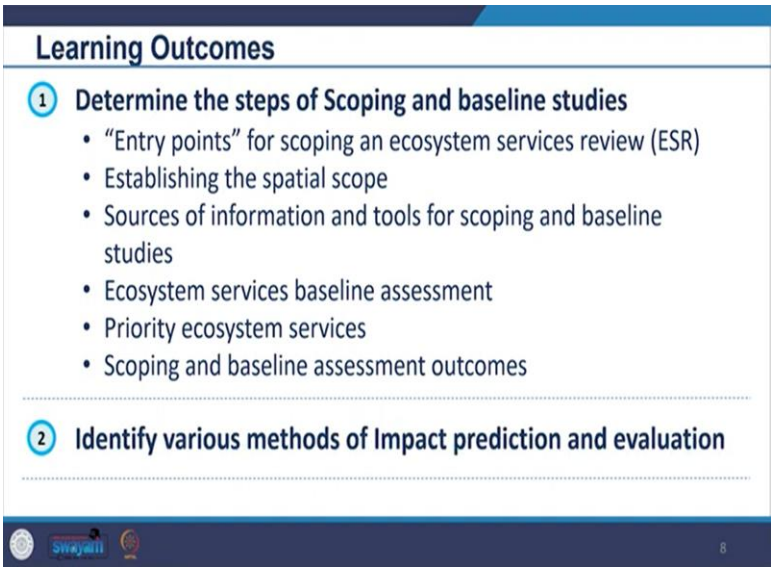
(Refer Slide Time: 01:29)



So, accordingly, our coverage will include a look at the scoping and baseline studies, will look at what kind of entry points are there for scoping, and an ecosystem service review. Then we will look at how to establish the spatial scope for the assessment purpose, then we will look at the sources of information and tools for scoping and baseline studies.

Then we will look at ecosystem services baseline assessments, how do you do that? And then, how do you prioritize identity identifying the priority ecosystem services? And then how do you indicate the outcome of the scoping and baseline studies? Then we will look at the impacts of prediction and evaluation, what kind of methods are available, and what you do in that particular stage.

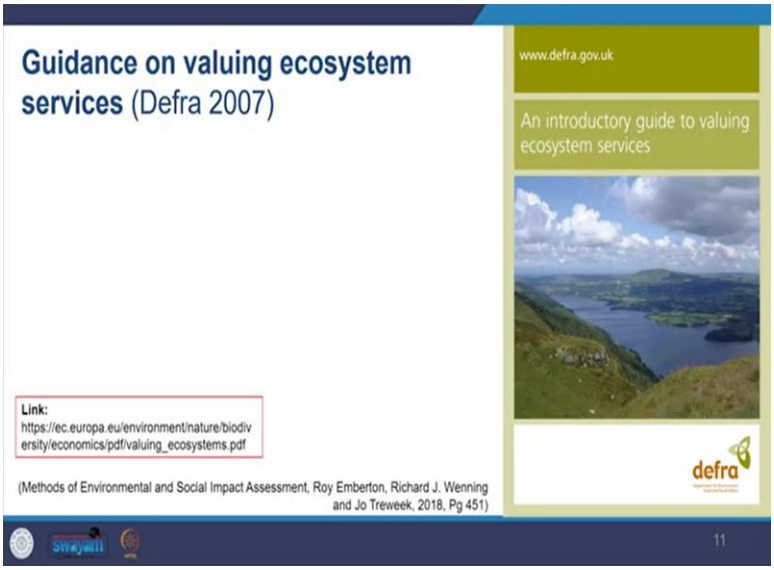
(Refer Slide Time: 02:22)



So the expected learning outcome from you after the completion of the session is that you should be able to determine what else steps would be needed and how to conduct them. So you should be able to tell what the options available to you for entry points, what kind of decisions you should make to determine the spatial scope, and also enlist what kind of sources of information and tools will be available for you for scoping and baseline studies.

Then you should be able to undertake or at least program the baseline assessment for your project. Then you should be able to define the priority ecosystem services and how you undertake that, and then you should be able to organize your assessment outcomes. Further, you should be able to identify different methods used under impact prediction and evaluation. So that is the expected learning outcomes outcome. We are continuing to follow Chapter 8 from our textbook, which we are following.

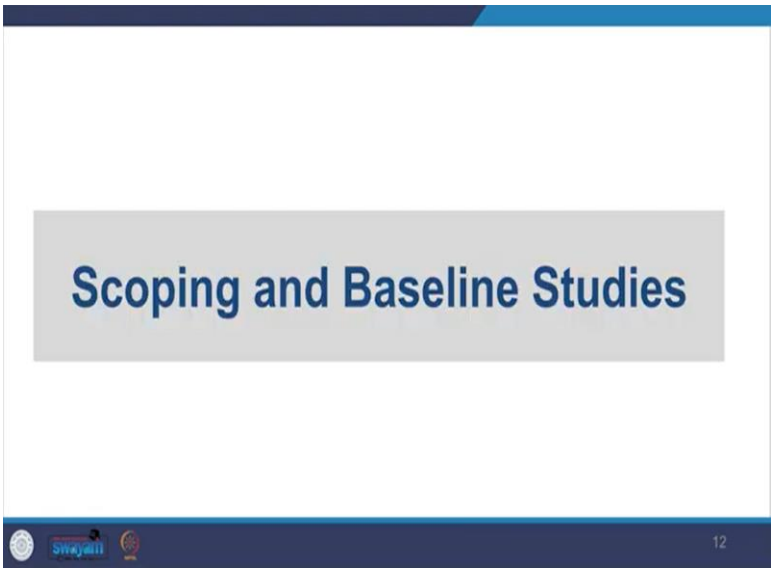
(Refer Slide Time: 03:28)



The guidance suggests the use of benefits-relevant indicators to structure assessments and link ecosystem capacity with use by different beneficiaries. So, we see that the guidance that is available to us, suggests that we should link it with the different beneficiaries. They may be monetary values but can also reflect less tangible non-use values. They can be difficult to quantify and are often excluded from the EIA process, the evaluation process.

In the UK the Department of Environment Food and Rural Affairs published useful introductory guidelines, and guidance on valuing ecosystem services, which explain the strengths and limitations of different economic valuation techniques and give examples of their application to policy and decision-making.

(Refer Slide Time: 04:22)

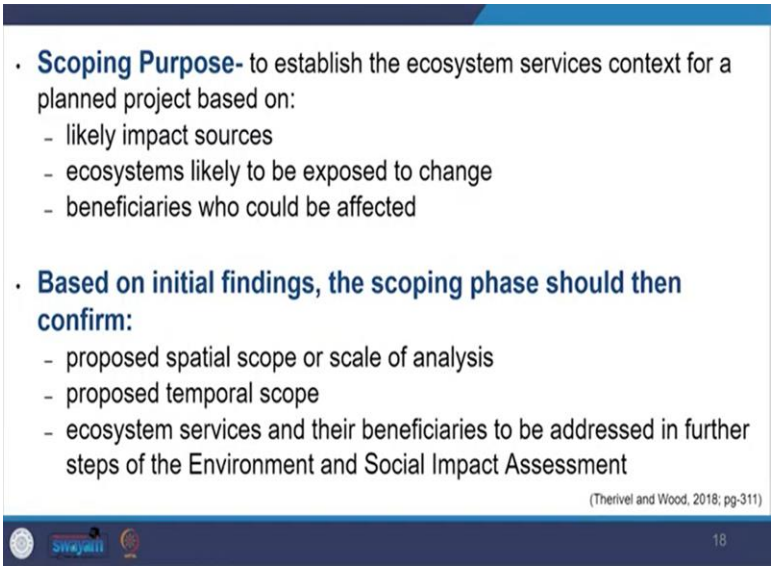


Looking into the scoping and baseline studies stage we will look at how to work out the entry point for scoping. Entry point means how do you get into where from where you start. How to establish the spatial scope? We will look at the sources of information and tools for scoping and baseline studies, how to baseline assessment, and prioritize ecosystem services.

And then we look at how the outcomes of the study will be presented. Looking into the scoping and baseline studies stage, scoping is an important stage, in this particularly, for the purpose of assessment of ecosystem services, because you will be able to incorporate ecosystem services into the process. So, when you do it at the very beginning of it, you will be able to incorporate it, and you will be able to integrate it across the domain.

So, you can program it accordingly so that all the domains are integrated, and you will be able to allocate time and resources for the purpose and also plan the stakeholder's engagement. So you will need a lot of stakeholder engagement, so you can plan accordingly. At this stage, you determine the ecosystem services context for a planned project.

(Refer Slide Time: 05:47)

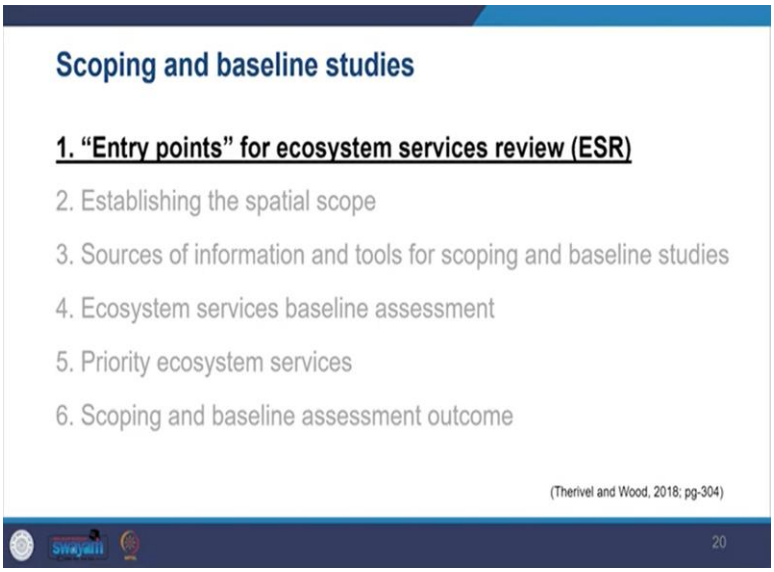


You decide the context based on what is the likely impact sources. So what are the different sources? Like what impact the different project activities would have on your ecosystem services. What are the ecosystems likely to be exposed to changes? So what are the services because of the other activities because of the other sources, and what is the possibility of them getting exposed to change? Who are the beneficiaries? So, you will also look to identify them and who would be affected by the proposed project.

Based on your initial findings, when you do the rapid assessments, based on initial findings in the scoping phase, you would propose spatial scope or determine the scale of analysis to what scale you are going to analyze, which should be undertaken for this particular assessment. You would propose temporal scope as well. So you would look at the period you would, you would suggest for assessment, further detail assessment to take place, the timeline which has to be followed.

Then you would identify ecosystem services and their beneficiary. So what are the services and what are the beneficiaries to be addressed in the further steps of the assessment?

(Refer Slide Time: 07:10)



Looking at the entry point, the entry point for ecosystem service review ESR, ecosystem service review, how you will review the ecosystem service. So what would be the entry point from where you would analyze the system? In the stage of scoping, you will need to determine the entry point for the ecosystem service review. Ecosystem services are a multi-dimensional concept. As we have already seen, discussed that it is a multi-dimensional concept.

So, you can start the assessment from different possible directions. So you can go from different dimensions of it. Therefore, you may determine the entry point for assessing impacts on them. You may select to start by mapping the proposed project activities and associated infrastructure against our ecosystem services. So you might look at various project activities, what are those activities, the different ecosystem services, and how they are being affected.

So you can map them, you can start from there, that could be your entry point. This will help you to identify those activities and ecosystems for which they are likelihood of significant changes. So where there is the likelihood of significant changes, you may identify them while you do the mapping For example, during the construction period, there can be considerable changes in the surrounding surroundings.

You should note the ecosystem that might be affected because of its location within the project infrastructure footprint. So whatever the footprint of your project, those ecosystem services might be located in your project footprint because the project will change the biophysical environment. So it could be beyond the footprint and then your project might be changing those biophysical environments. Or it might be changing the social setup that might change the ecosystem and ecosystem services supply.

For example, there can be population growth and, an increase in population, and then the demand might change. So it might change the supply of it, and it might impact ecosystem services. And it may even change the ability of people to access particular services. So the accessibility aspect which we talked about in a previous class, can

also change their ability to access those particular services. So you might be blocking that or it might be increasing their access.

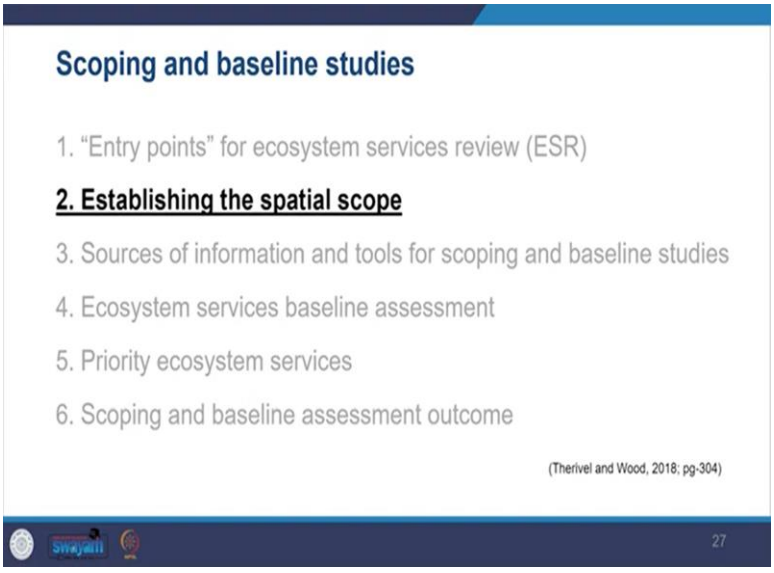
You will be required to identify the potential users of this ecosystem as per the project activities. So you also need to map it, who are the potential users of these ecosystem services based on your project activities. You would be required to take care of the potential indirect effects, and indirect impacts due to all project-related infrastructure and related development.

This will allow, so if you do this, this will allow you to cover the cumulative impacts on ecosystem services very well. Another entry point for your approach, as you have already seen while mapping, so the other entry point could be that you can identify people who use and depend on ecosystem services within a project area of influence. So, your project area could be limited, but the area of influence could be larger. So, your services could be at that place as well.

You can identify the services they use, and then you can consider how their ability to access them might be affected by the project's impact. So, you can also look at the larger scale. This approach has some challenges. So, when you take the second approach we talked about this has some challenges. As users, you may find within the project area of influence, but you may not be able to find users located outside the project influence area.

So, you can take any entry points if you consider all the aspects carefully. So, it does not matter what entry point you take, but if you are careful about all the aspects, so, you can take any entry point to start your analysis work. You must share and integrate information across domains while undertaking the process. And particular, integration at this scoping stage will improve the baseline data collection. So, it will be very beneficial if you do that right away at this stage.

(Refer Slide Time: 11:50)

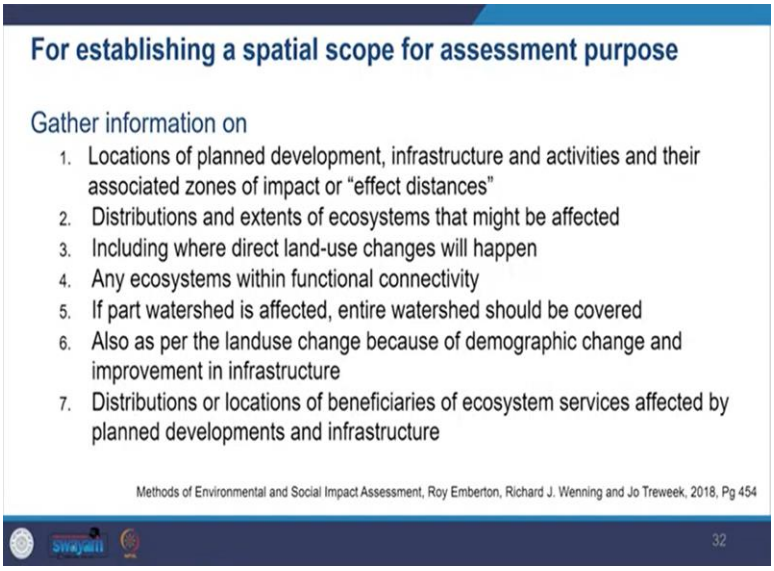


Now, we will look at how to establish the spatial scope. Defining the spatial scope of ecosystem services review can be challenging. So, it can be very difficult because services produced in the study area may be used by people considerable distance away. So, whatever has been produced in your area, there might be users at different other places. So it might be difficult for you to recognize them. For example, the land use upstream can affect the exposure level downstream so whatever you use your create land use here might affect the people downstream.

While people within the study area may also benefit from services, so, which may be happening in the other areas like air quality regulation or recruitment of fish stock, which are largely or wholly produced by distance ecosystems, so, something else is happening there and your beneficiaries could be in your project area. So, it makes it very complex. So, to determine the ecosystem's ability to supply services to a particular group of people, you will have to necessarily consider the entire extent or distribution of the project influence area.

So, you might have to look at the larger entire extent here so that you may be able to determine the ecosystem functioning and overall viability. So it is very important at this stage. At this stage, you might need to take a larger area compared to what is taken for other specific domain studies. So when you are studying water, air, and so on, you might meet in very specific areas, when you do ecosystem services, it is advisable to take a larger area, because it might be, it will have a specific advantage while you do the, undertake the entire process.

(Refer Slide Time: 13:53)



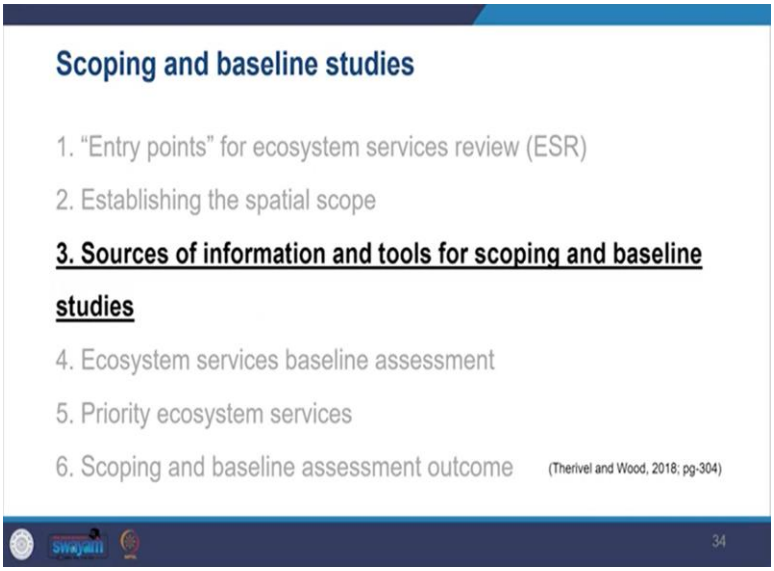
To establish a suitable spatial score for assessment purposes, you will be required to gather information on the location of the planned development. So, the first thing you would like to do would be required to do is to get the location of the planned development or the infrastructure and activities and their associated zones of impact, and effect distance. So that, you need to know, that you need to gather.

Then you need to understand the distribution, the distribution, and the extent of the ecosystem that might be affected, including where direct land use changes will happen. So wherever you want to, because you are going to do the development you want to change the land use. So where the direct land use change will happen?

Any ecosystem with functional connectivity, so how you will connect to those ecosystems, where you have functional connectivity, you need to identify them. If part watershed is affected, you should cover the entire watershed. So, if you see there is part watershed is being connected, there is a functional connectivity, then you should consider the entire watershed.

Also as per the land use change, because of the demographic change that your development might bring end because of, there might be an improvement in the infrastructure, and there might be other impacts as well. So, you need to look at that. So, the distribution or location of beneficiaries of ecosystem services is affected by planned development and infrastructure. So, how are they getting distributed, and what is the scale in which they are getting distributed?

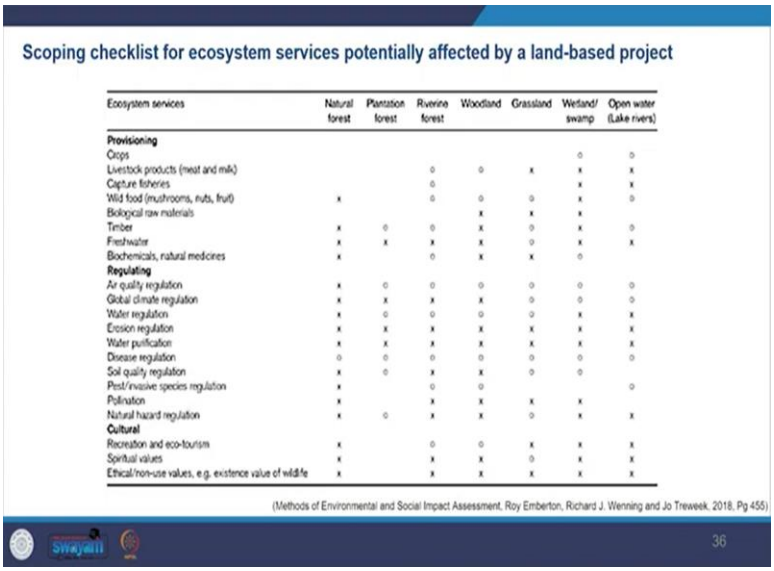
(Refer to Slide Time: 15:22)



Now, looking at the source of information and tools for scoping and baseline studies. So, this is the information you need to get and from where you will get this information. You may usually have to go forward and backward in the scoping and impact assessment. So, it would not be a very streamlined process, but you would be going backward forward. It will be an iterated method for you, the process for you.

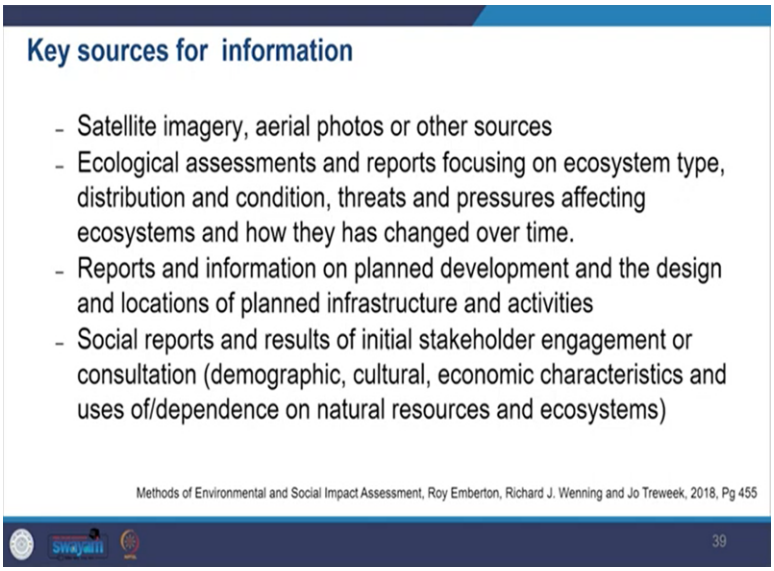
The practical starting point may be to map broad ecosystem types. So, you have, you have seen the types. So it would be advisable to map those broad ecosystem types and settlements infrastructure. You can see here, one of the generic tech lists of ecosystem services, as per the Millennium Ecosystem Assessment categorization that can be used to identify the types of ecosystem services that different ecosystems can be expected to supply. You can take this and you can adapt to your context.

(Refer Slide Time: 16:20)



So you can see here, the checklist. Key sources you can use for information are, so from where all you can get information.

(Refer Slide Time: 16:32)



So you can use satellite imagery, aerial photographs, or other sources showing the distribution location of ecosystems and communities. You can look at ecological assessments and reports focusing on ecosystem types, distributions, and conditions. And you may look at the threads and pressure affecting the ecosystem and how they have changed over time. Information as needed on sustainable production harvest, or yield, if it is possible to get that information.

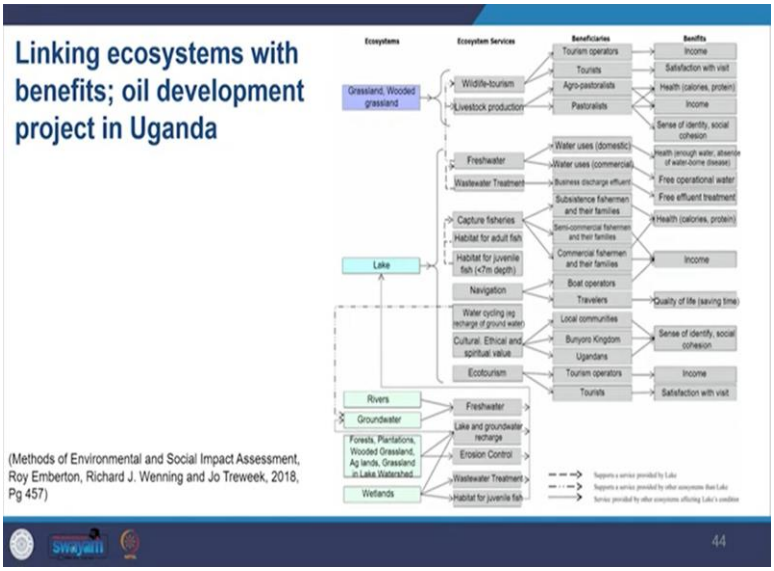
Then you might look at the reports and information on the planned development and the design and location of the planned infrastructure and activities. So there will be already a proposal for the planned activity. So, you need to look at that. Then you need to look at these social reports and the results, of initial stakeholder engagement. So you look at what engagement has been there and what consultation process has taken place.

And then you need to look at the demographic profile, cultural economic characteristics, and uses of dependency on natural resources and ecosystems. So you need to profile that. You have to engage actively with specialists from ecological and social practices and development proponents for good assessment. So it is required that you engage actively with different specialists as well as you need to engage with the proponents and also with the community.

You may have to engage with the other specialist as well. So, not only with your domain from ecology and social practitioners but also from the other domains as well, because you need to require to integrate all the information. You will also have to engage with the stakeholders affected and interested parties through a participatory approach.

This will ensure the ecosystem service review is framed well. So review which you are applying, planning is framed well to address key issues of the concerns of the stakeholders. So when you engage them early in the stage, then it ensures that the agendas are included here. You should engage with stakeholders at the earliest stage possible to obtain essential information and social and ecological surveys else you will be out of time at a later stage.

(Refer Slide Time: 19:00)



You will also have to identify possible links between ecosystems and users. So you need to look at the links. This will allow you to identify particular benefits that users take from these sources. So that link would help you to identify the benefits and the beneficiaries. You can take this information from the secondary sources.

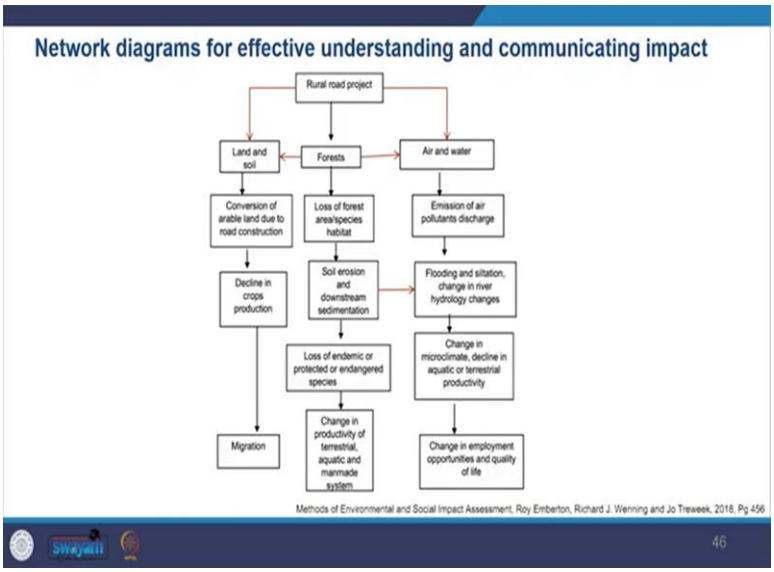
So looking at the other reports might help you to process this information. You may also have to undertake specific baseline investigations if required. So if secondary data is not enough, then you might have to take a baseline investigation.

In the figure, you can see examples of many intra and inter-relationships that may exist between ecosystems, services, and benefits. Each ecosystem might provide many benefits to many different users. Equally, one group

of people may use multiple services to derive all the benefits they need. So, they must be using, and accessing lots of other services as well.

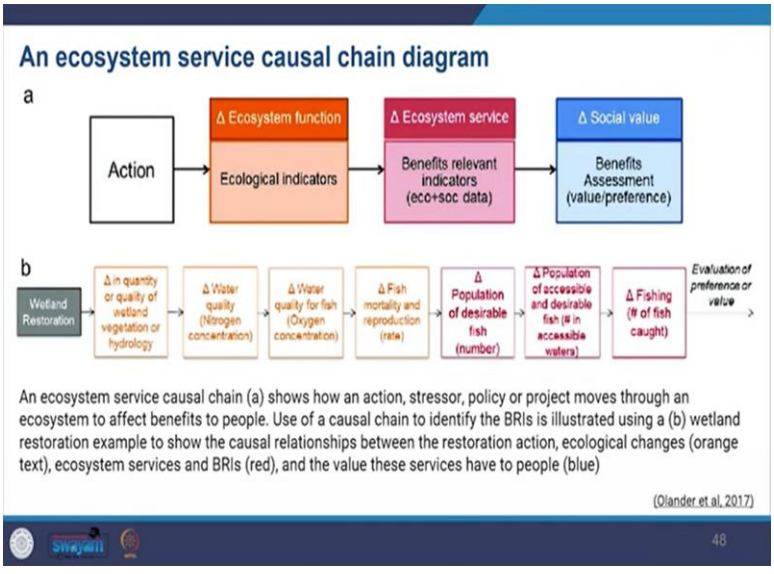
So, you look at this linkages ecosystem with benefits and this is taken from the oil development project in Uganda. You can see how complex the interrelationship is. So, you can see the network diagram there, how complex the interrelationship is, and how complex it will be to access and manage information.

(Refer Slide Time: 20:32)



For this purpose, you can draw flowcharts or network diagrams for effective understanding and communicating impact.

(Refer Slide Time: 20:40)



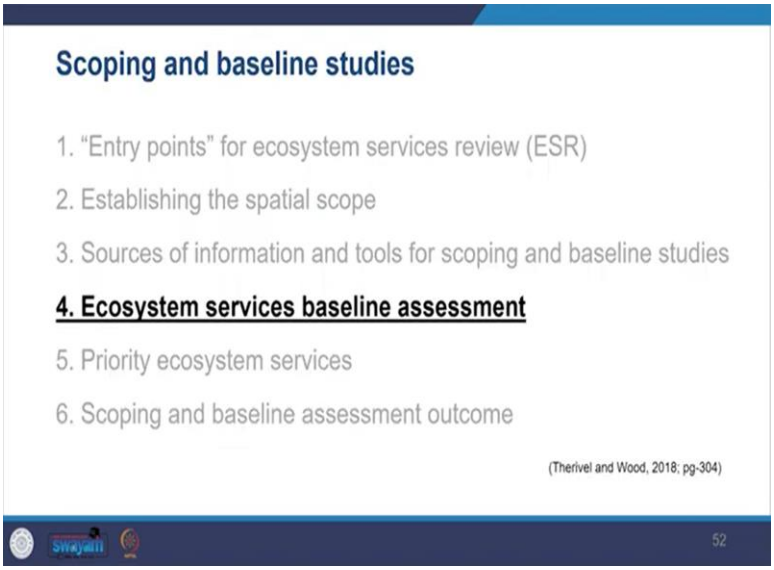
You may also construct a causal chain diagram, also known as a path model or means-end diagram. This will help you to track how a project's action or impact can propagate through ecosystems. Eventually, after changes in the provision of ecosystem services and benefits to particular beneficiary groups, causal chain commonly used ecological assessments, it is very commonly used, a causal chain in an ecosystem service assessment will

show, in the end, the effects of changes on our well-being or the benefit we get. So, that should be the end product that we are looking at.

During the scoping and the baseline studies, it is also necessary to understand the pattern of supply and use without planned development. So, you look at without the planned development, so that it is possible to predict how these can be expected to change as a result of development in the impact assessment. So, you would be looking at both the scenario with the development and without the development, how the future would look like. Sometimes sufficient baseline understanding is available at the scoping stage, but often there are important gaps.

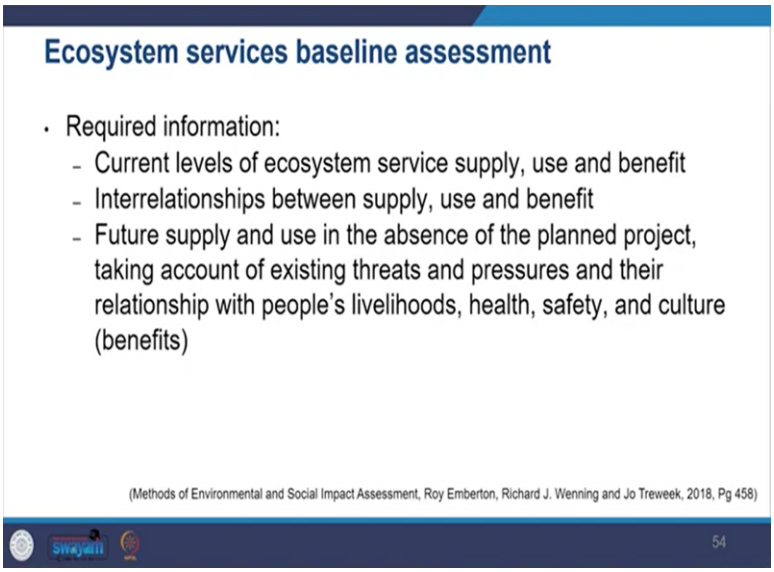
So, then you need to come back to that stage, risk from unplanned events or accidents should also be considered while you are doing the scoping.

(Refer Slide Time: 22:21)



Now, looking at the ecosystem services baseline assessment, you will find it challenging to develop a reliable baseline for ecosystem chart services because of the need to obtain information on several aspects.

(Refer Slide Time: 22:35)

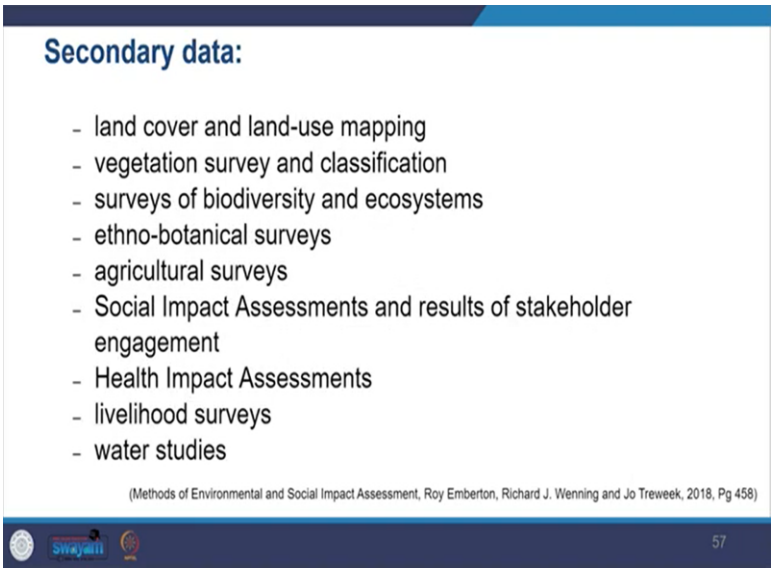


Such as, well, you would be required to obtain information on current levels of ecosystem service supply, use, and benefits. You would be required to identify the interrelationship between supply use and benefits. Then you also look at the future supply and use in the absence of a planned project. You would be looking, taking account of existing threats, pressures, and their relationship with people's livelihoods. Like, you would be also taking care of the health, safety, and cultural benefits.

You will face the challenge of finding data on relevant information and information may vary between projects. So what applies to one project might vary for the other project. You have to ensure that all assumptions are stated well, in the assessment report all the assumptions and data limitations are mentioned. This information informs about certain limitations of the conclusions you are drawing about the database.

So, it is very important that you clearly state the entire process, assumptions, and what data limitations you are encountering. Any oversight may have serious implications for livelihood and well-being. You might have to even design studies if existing information studies are limited. So if you do not have substantial study, what secondary sources are telling you then you might have to design a study to undertake a baseline study here.

(Refer Slide Time: 24:11)



Many secondary data you can collect include, which include like you can collect, land cover and land use mapping, then you can do vegetation survey and classification. You can undertake surveys of biodiversity and ecosystems, ethnobotanical surveys, you can take agriculture surveys, social impact assessments and results of stakeholders which might be available, health impact assessments, livelihood surveys, and water studies, so you can access the secondary data.

When you design a baseline study, if you need to undertake this, you should consider how environmental impact significance will be interpreted in terms of human well-being. So you need to see whatever impact is coming, and how are we going to interpret it in terms of human well-being. If you plan to use indicators, if you decide that you are going to use indicators for assessment and also to review the significance, then it is advisable to identify them early at the stage of scoping so that all information is aligned accordingly to the indicators.

So you ensure your indicators are in place and accordingly, you gather information and then organize it to present the outcome. With this, you will be able to readily link results with the significance as well. So, after impact assessment, you would be also able to evaluate the significance of it, as well as provide a potential framework for monitoring. For example, suitable indicators to establish the significance of wetlands' contribution to the health of people depending on it for accessing clean water might include the volume of water the wetland can treat.

So that could be one indicator. Quantity of water people abstract for drinking and or cooking, the incidence of waterborne disease. So these are the indicators. So if you might be looking for these indicators, you collect data accordingly. While you select indicators, so when you are selecting indicators for this purpose, you should see that indicators should reflect the key aspects of ecosystem supply, use, and benefit. You should focus on ecological changes that are relevant to the provision of specific services.

So whenever you get indicators, you might have to include certain indicators and exclude certain more, include certain indicators because you need to contextualize them to your area of study. Further, you also need to ensure that the indicators that you have taken are relevant and meaningful for the potentially affected people whom you are studying. You may choose indicators that are benefit-relevant because they directly indicate the benefits of the study group. So you have indicators that are benefit-relevant. So it directly shows how it benefits the users or the end group.

For example, what kind of indicators you can take several fish consumed, and sold, that can be caught without undermining future cats? So this is a much clearer statement to compare in the end than, compared to total fish stock, and fish stock diversity. So I do not know when I say, see the fish stock, I do not know what impact it will have on humans. So, compared to this, the number of fish consumed, and sold that can cut without undermining the future cat is a much preferable indicator.

You may also avoid impacts on the ecosystem through mitigation. That will avoid complete damage to ecosystems by a project. To find out the scope for avoidance, so there are certain things like mitigation that you can avoid. So, you, as a professional and as a person who is undertaking the process of assessment should avoid those kinds of damage to the ecosystem. In order to find out the scope of avoidance, like where all you can avoid, you may model the alternative scenarios.

(Refer Slide Time: 28:38)

So, you can do modeling, you can develop scenarios by using tools such as InVEST, which has Integrated Valuation of Environmental Services and Tradeoffs. So you can use them. These tools largely focus on mapping ecosystems and estimating ecosystem service supply. So, they have also been making considerable advances in mapping demand.

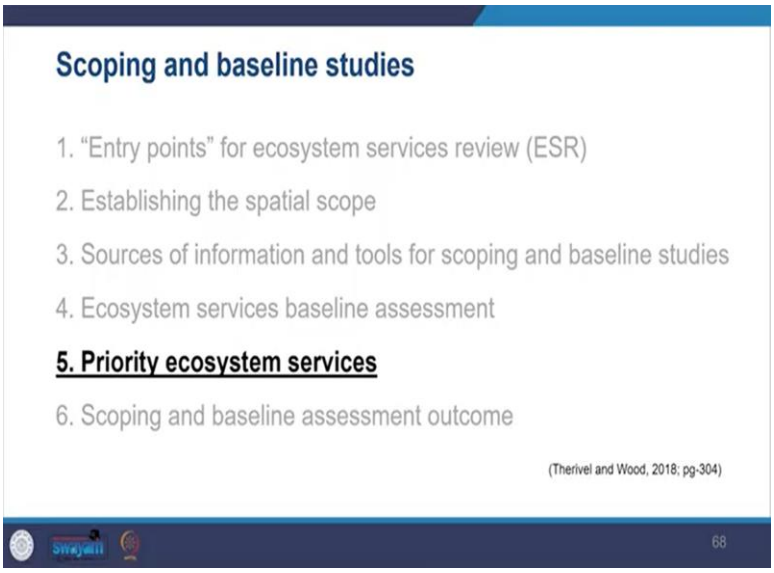
You may apply such tools depending on the availability of the scale-relevant spatial data. So, if you have data of that particular scale, then you can use this particular tool. It is advisable that if you use such a tool from the

very beginning of the assessment process that allows, it allows you a much more robust and spatially clear approach.

You can identify options that minimize impacts on vulnerable groups, who depend heavily on a particular service and have limited alternatives by modeling alternatives for specific beneficiaries. So, beneficiary-wise also you can look at alternatives through modeling. You can identify them in the scoping phase and with a better understanding engage with them further.

To avoid impact on ecosystem services, early consideration of alternatives is necessary. It is better to have a front-loaded process, meaning that at the beginning of the process, you can allow much more time and activities of the assessment which can take care of the later stages. So this will allow timely stakeholder engagement and data collection.

(Refer Slide Time: 30:22)

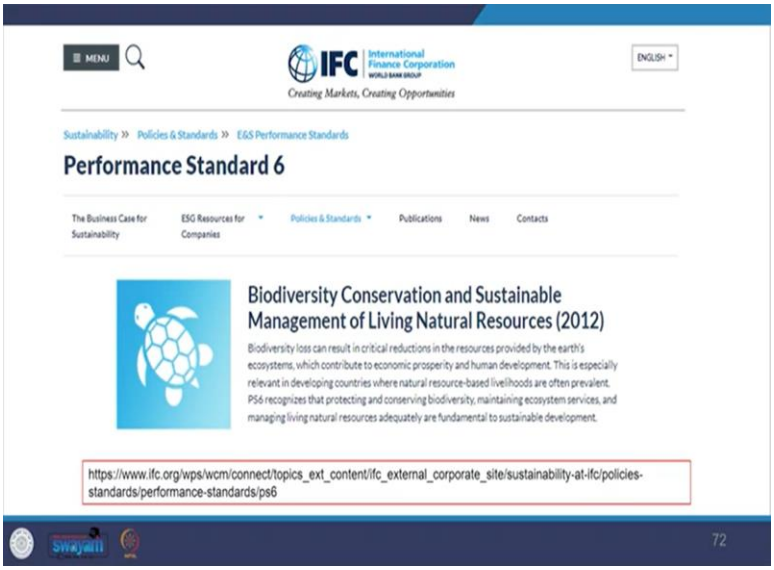


Now, we look at how to identify priority ecosystem services. Priority ecosystem services, you may find it challenging to address project impact on all ecosystem services. So you saw how complex things are and beneficiaries within the timeframe, so you have a certain time frame in which you have to execute the work. Therefore, you may be required to focus on priority ecosystem services.

(Refer Slide Time: 30:49)

Priority ecosystems are those for which changes due to a project are most likely to affect the well-being of the beneficiaries. So where all the changes will happen and where will impact the beneficiaries? So those are the areas that are a priority, plus the beneficiaries probably would have limited or no alternatives. So, those kinds of ecosystem services become your priority ecosystems.

(Refer Slide Time: 31:24)



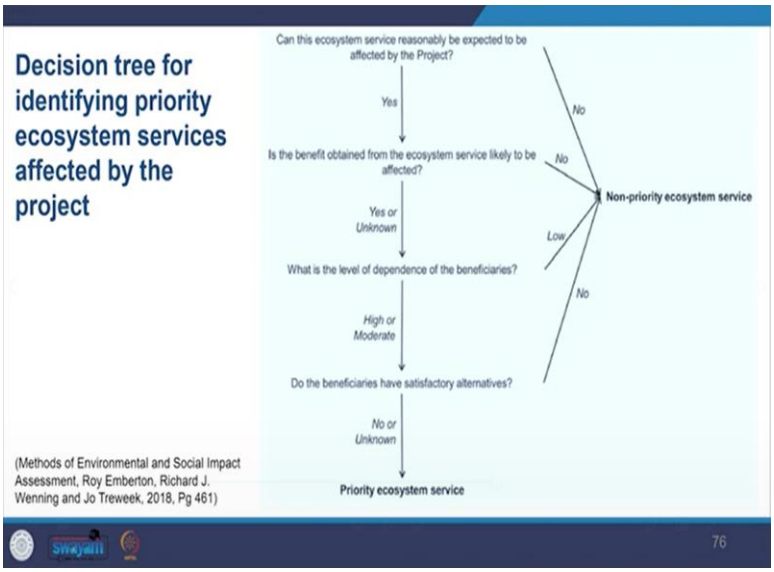
You may refer to the approach suggested by IFC Performance Standard 6. It will be important for you to identify a variety of ecosystem services as some people may depend on many of them to meet their needs. Therefore, you may not screen out services too early in the state. So at the scoping stage, you might retain some of the services.

You may also identify services that are on the decline and may increase levels of dependency on the other ecosystem. So if that goes away then there might be other ecosystems that will have higher dependency. You

should importantly consider overall resilience to change among beneficiaries. So how is the overall resilience, and how would they, how resilient they be towards the changes?

So as a beneficiary might be dependent on a wide range of services, they might be accessing a lot of services. So therefore, you may have to conduct prioritization iteratively, like you have to move forward, or backward mode, and as you gain more knowledge on the dependency on the ecosystem services, you can improve the process.

(Refer Slide Time: 32:44)



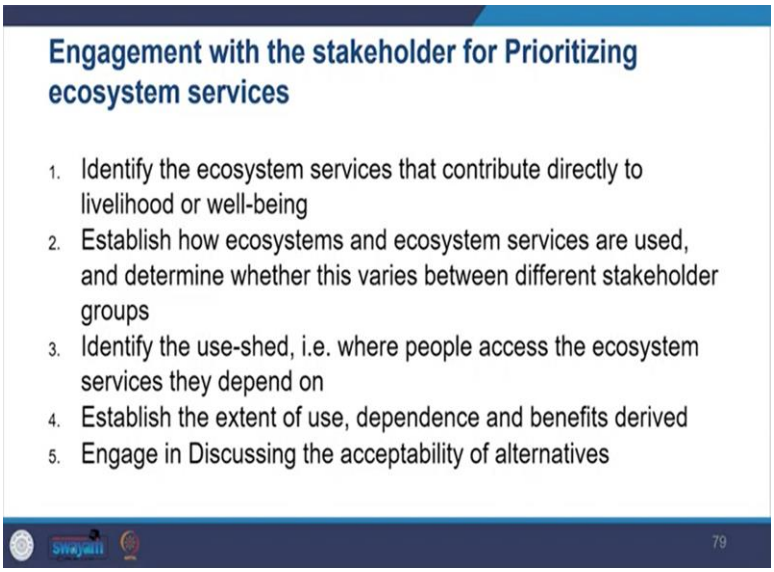
You can see the decision tree shown here which reflects the criteria that might be used to identify the priority ecosystem services. The supply or use of ecosystem services is affected by the project, whether it is supplied from ecosystems that are located in areas exposed to land use change as a direct or indirect result of the project, or maybe because the presence of the project will affect the ability of the users to access it.

So you might be blocking their access by the kind of development you are doing or you are giving access to many other people. So that can also happen. Project impact on the ecosystem services might lead to a change in the benefits it provides to the people. So how many benefits it provides, can also change. The benefits derived from the services are important to the overall well-being of its beneficiaries.

So what benefits they are deriving, is important for you to evaluate. The beneficiaries have no or limited viable alternatives to the services to maintain their well-being. So you need to be sure that they have alternatives or they do not have alternatives to the services. If one of the services is blocked, do they have alternatives to the, have access to other alternatives? So that is all you need to see.

For prioritizing ecosystem services, you have to engage with the stakeholders. So you need to talk, you need to talk, you need to learn about their requirements.

(Refer Slide Time: 34:21)



You identify the ecosystem services that contribute directly to the livelihoods or the well-being. You establish how ecosystems and ecosystem services are used and determine whether this varies between different stakeholder groups. So you undertake those engagements with the stakeholders. You will identify the use-shed. So you have learned this term use-shed. So you would be identifying this used shed, which is where people access the ecosystem services they depend on.

You will establish the extent of the use. So you will be defining the space, dependencies, and benefits derived from the services. You will then engage in discussing the acceptability of the alternative. So whatever alternatives are given to the beneficiaries, how, what is the acceptability of the alternative? So that can all only come through engagement with the stakeholders. Your engagement format and timing will be context-specific.

So how you adopt, what timing you adopt, and how you go about engaging with people will all depend on the context in which you are working. Engaging with representatives of the organization, and departments which are involved in these natural resources is advisable in the process. You would also be required to engage with the affected communities.

Use tools such as focus group discussions. So that all you can do is gather together people from similar backgrounds or specific user communities to discuss the levels, views, and dependency on ecosystem services, and their likely trends in the absence of those projects, so what is happening right now without the project and what is likely to happen with the project.

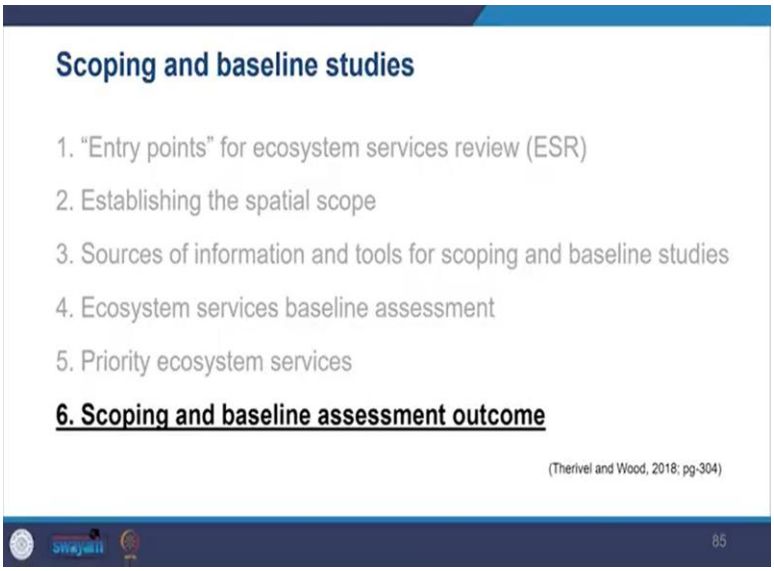
And you need to ensure that you engage with different groups within the affected groups. For example, if you engage with the women, they may have different concerns and observations. For example, women in fishing communities might have different perceptions about benefits associated with and dependence of their families on fishing compared to men, and men who fish might have a better understanding of changes in the supply of fish over time than do people who purchase fish for consumption.

So you need to be aware of with whom you are talking about what you are talking. Then you would link the priority ecosystem services. So now, you have, you would identify the priority ecosystem services, and then you would link the current socio-economic benefits derived by the affected stakeholders to current or baseline levels of use.

So you would be identifying all these priority ecosystem services' current socio-economic benefits derived from the affected stakeholders, and then link them to the baseline levels of use. So during impact predictions, once you do these linkages, during the impact prediction and evaluation, changes in ecosystem services benefits results from the project-related changes in ecosystem services supply and or use can then be estimated and compared against this baseline.

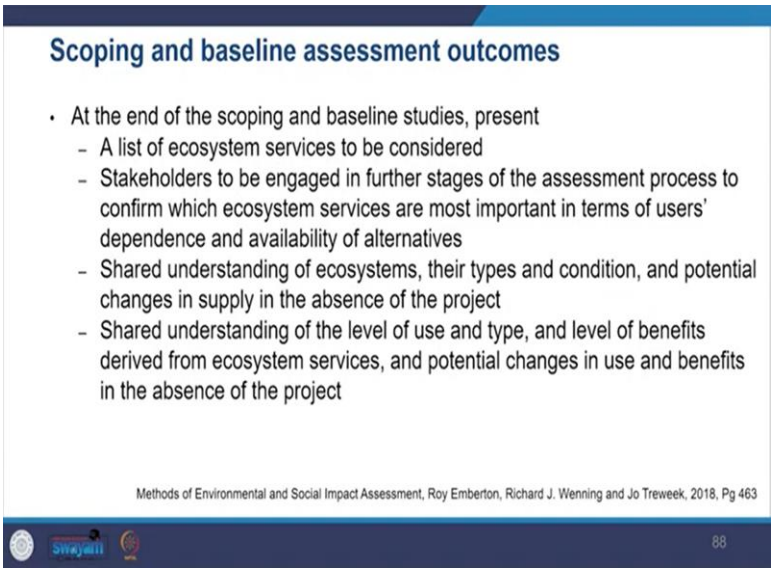
So once you link that through your baseline, then you would be able to compare the two scenarios.

(Refer Slide Time: 37:59)



So now, we will see the scoping and baseline assessment outcomes. So you have done all these assessments and how you are, what will be your outcome like? At the end of scoping and baseline studies, you should present, so what you are going to present?

(Refer Slide Time: 38:14)

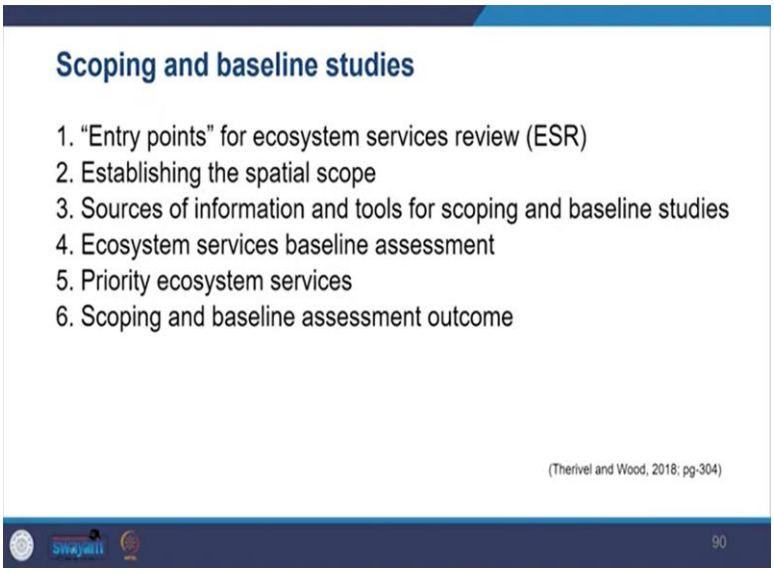


You are going to present a list of ecosystem services to be considered by the decision-maker. So you will provide a list. And stakeholders to be engaged in further stages of the assessment process, like who all will be engaged including results of any explicit prioritization. So you might decide which groups have to be prioritized to confirm which ecosystem services are most important in terms of users, dependence, and availability of alternatives. So there you might have prioritized groups here.

Further, you should present a shared understanding of the ecosystem. So what understanding you have developed about the ecosystem that needs to be shared? Their types and conditions and potential changes in supply in the absence of the project. Further, you should present a shared understanding of the level of use and types and level of benefits derived from the ecosystem services and potential changes in use and benefits in the absence of the project.

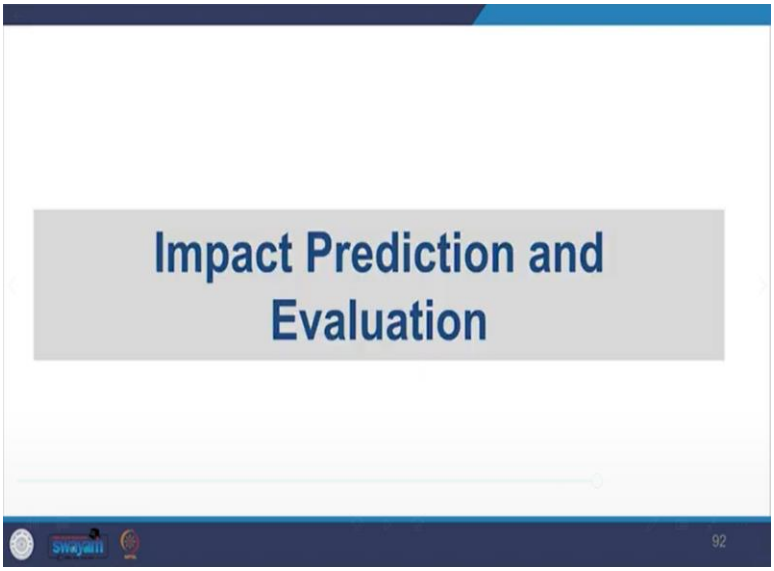
You need to revisit scoping and the baseline as more information is known about the project, its potential impacts, the affected people, and the dependence on the ecosystem for their well-being. So as more and more you understand about these things impact the people, their dependence, about their well-being you need to revisit the scoping and the baseline.

(Refer Slide Time: 39:43)



So we have completed the section.

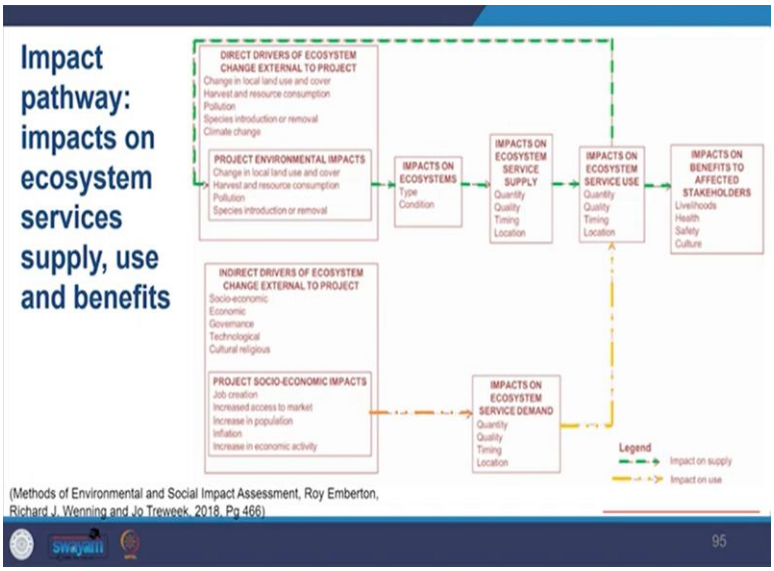
(Refer Slide Time: 39:48)



Now, moving on to the next segment impact prediction and evaluation. Impact prediction and evaluation, during impact prediction you need to consider the effects of the planned development on the supply and use of ecosystem services and their implications. So you are going to look at all these effects of the planned development.

You have to look at any changes in people's livelihoods, health safety, and culture, you will establish the situation in the presence of planned development as compared with the baseline and generally build on information from other specialist topics areas in the impact assessment. So we talked about it that you have to initially frame it and then here you will get information from the other domain as well. So you need to build and integrate upon that.

(Refer Slide Time: 40:46)



A project may affect beneficiaries' well-being in two ways as seen in the figure. So it will be affecting in two ways. In the image, you can see the impact pathway, impacts on ecosystem services supply, use, and benefits. So in the image, you can see that. In the green dash arrow, you can see the impact and supply, and in the yellow arrow, you can see the impact on use.

The upper segment shows the direct drivers of the ecosystem change, and the lower segment shows the indirect drivers of ecosystem change. So you can look at this diagram here, how you would be analyzing the impact. You may see impact and supply shown by the green dash arrows. It might contribute to existing direct drivers of ecosystem change or introduce new ones. So you might get new drivers.

For example, by polluting waterways over-harvesting water, or drainage draining a wetland, you might be reducing the capacity of an ecosystem to supply services. So that can be influenced. Information on the state of ecosystems and their capacity to supply is likely to build on ecological studies. So you need to refer to that. A project may also speed up or slow down ecosystem change by affecting indirect drivers of change. So your project can bring changes.

It might speed up or slow down the ecosystem changes that are happening. For example by increasing the local population, so if your project comes, the local population increases and the rate at which services are used because, now there are more people so the rate of consumption also increases, potentially in access to their sustainable supply.

Further. we see that impact on use shown by the yellow dash dot arrow, it might affect beneficiaries' well-being and therefore, their demand for ecosystem services. Information beneficiaries are likely to build on the results of social studies. For example, a project may provide an alternative source of income that makes people less dependent on ecosystem services.

So now your project has come and people have other sources of income. So they will depend less on the ecosystem services for meeting their aspect of well-being, thereby diminishing the use of those services. So no longer that services be required. It might also affect indirect drivers of ecosystem change, such as governance and cultural norms, which can affect the legal and social enforcement of ecosystem protection news.

So you would be required to predict how human well-being will change as a result of the project's impact on ecosystem services which will require information on current levels of use and benefits about the supply and the future trends which you would project for the place. Further, you need to recognize that the level of supply and use might alter without affecting levels of benefits.

So you might, those changes might happen and there might be no change in the level of benefits. It is therefore necessary to consider use relative to accessible supply. So you must learn this term, accessible supply. So you need to look at whether whatever supply is happening that access is maintained or not. If supply comfortably exceeds the use of the service before development is implemented, it may be possible for users or beneficiaries to tolerate a reduction in supply without experiencing significant loss of well-being.

So if it was substantial beforehand, and if there is a minor reduction, you might be also looking at how much reduction is happening, so if the users do not have issues with that then it might not be of that much concern., on the other hand if supply is already trending towards unsustainable levels, so if it is already going at a higher rate and increase in local workforce, so more and more people coming there might increase levels of use causing an ecosystem service to crash.

For example, the availability of water in the area and the population increases and the water availability goes down. So that might lead to the crashing of the ecosystem services. If you used to close to being unsustainable, if certain things are very close to being unsustainable level, then every, very slight decrease, any decrease which happens in supply might cause the relationship between the use and supply to become unsustainable.

So it might affect that as well, and an extreme case might lead to the collapse of the ecosystem services. So you need to be careful about that whether it's very, very close to the unsustainable use. Impact significance depends on the extent to which predicted changes in well-being can be accommodated by the beneficiaries. So it also depends on the beneficiaries who are going to take the impact, so to what extent they can take it.

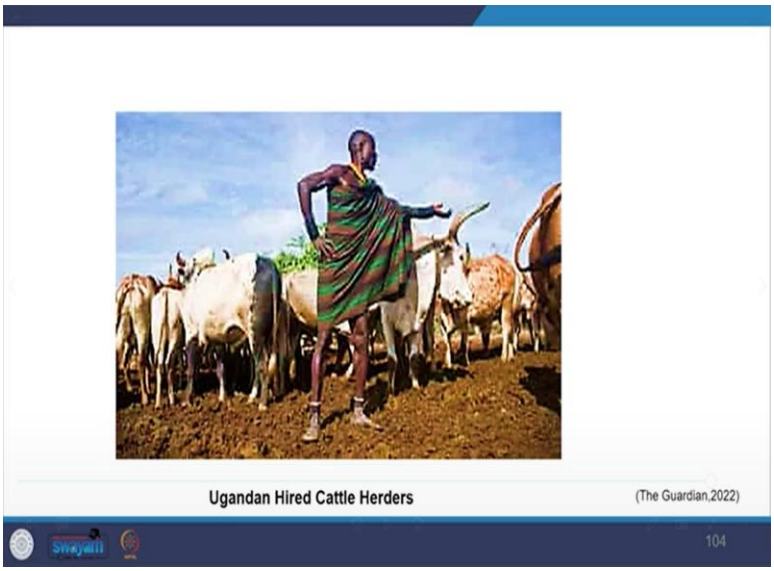
If they are living in poverty and are already suffering from malnutrition, any loss of food supply will be significant. So, you need to take care. On the other hand, if a project provides income or builds local capacity to improve food production, small changes in access to wild food may not be significant. So that way you have to evaluate.

The significance of a project's impact will be how do we look at the significance? The significance of a project's impact will be a function of beneficiary sensitivity. So how sensitive they are to the change, to the predictive impact on ecosystem services, benefits, and the magnitude of loss in these benefits.

So what kind of, range of loss is happening, and the sensitivity of the beneficiaries here? So the significance would depend on that. These, in turn, depend on beneficiaries, human, social, physical, financial, and natural capital. So all these capital the beneficiaries, how much human resource the beneficiary has, social, capital the beneficiary has, and physical, financial, and natural capital the beneficiary has.

So it will depend on those. And the prediction duration, to what duration you are predicting frequency, and whether that is reversible or not. So we are going to look at this at a later stage as well.

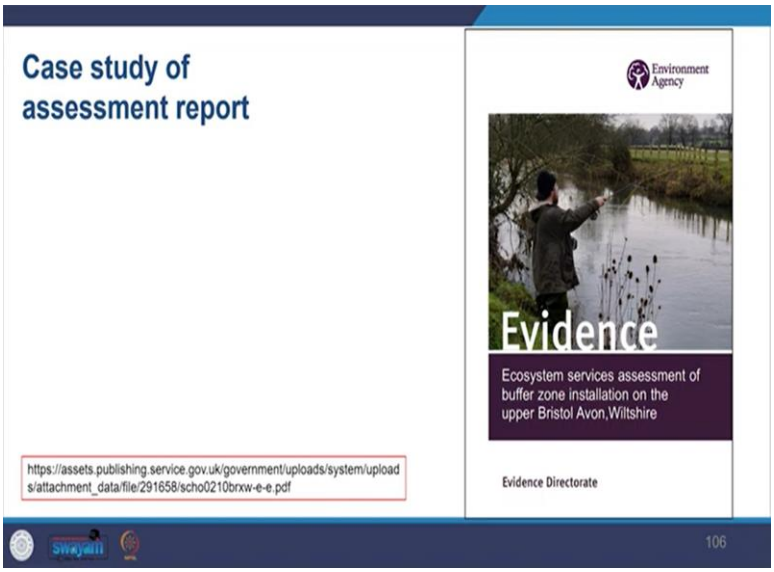
(Refer Slide Time: 47:43)



For example, referring back to the example of Uganda, hired cattle herders, those for whom herding is their sole source of income are likely to endure a significant impact. So if that is the only source of income for them, they will have a significant impact from the enclosure of the open access grazing.

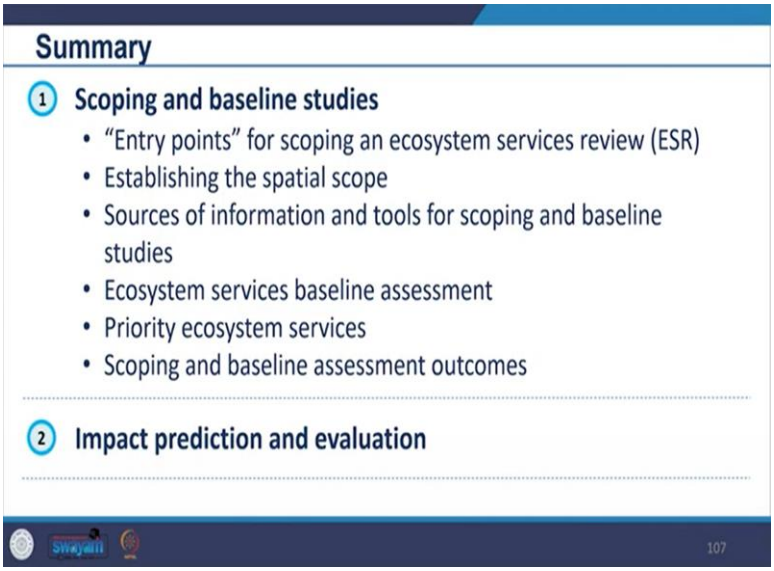
So if the grazing area is enclosed then they would have, they would accessibility will be close to that supply, compared to other herders who might have alternative lands to access. So all those things have to be taken care of.

(Refer Slide Time: 48:20)



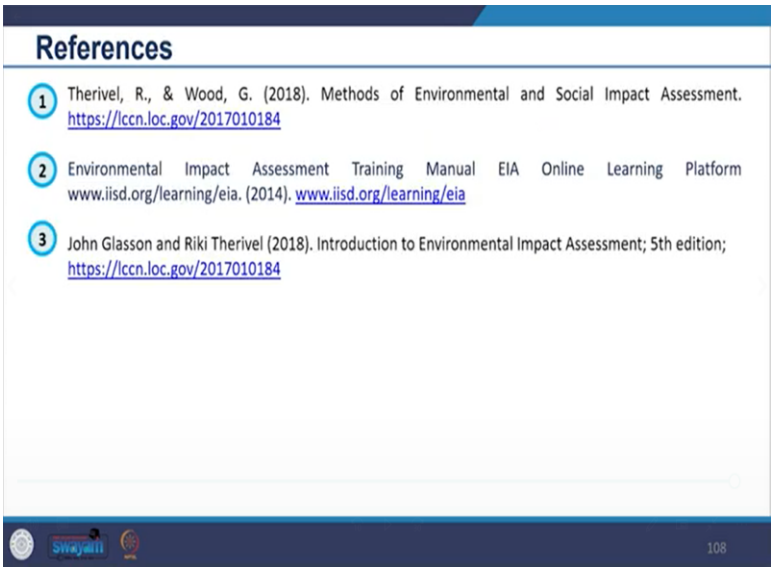
For your purpose, we have given you an additional case study to read along with this, which gives you ecosystem services, and how the evaluation has been done. You may look at the case study. It is the complete report attached for your review of the methods for evaluation of changes in ecosystem services. It is taken from the UK Government Environment Website.

(Refer Slide Time: 48:45)



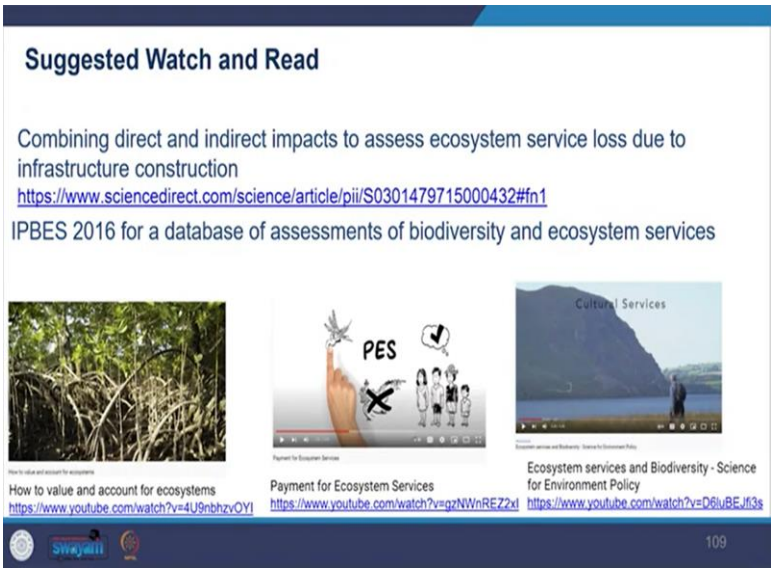
So summarizing what we have covered today, we looked at the methods, that are available to us, and step by step here in the area. We looked at the scoping and baseline studies, we looked at the entry point, how we established spatial scope, sources of information ecosystem service baseline assessment, how we undertake that, what is the priority ecosystem services, how we decide, and then how we present the outcomes. And then we looked at the impact prediction and evaluation.

(Refer Slide Time: 49:21)



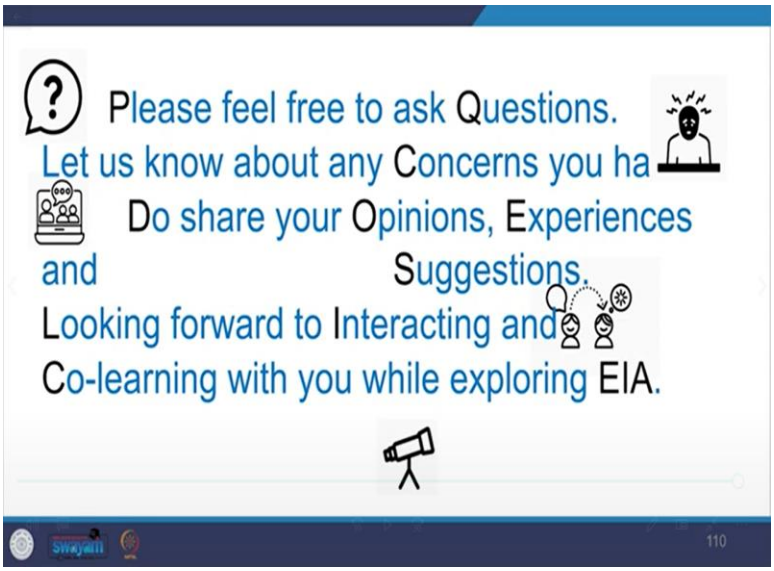
So this was the key reference for our particular session today.

(Refer Slide Time: 49:26)



Then there are the suggested readings and watch for other typical terms which you looked at.

(Refer Slide Time: 49:33)



So winding up, please feel free to ask questions. Let us know about any concerns you have. Do share your opinions experiences and suggestions. Looking forward to interacting and co-learning with you while exploring EIA. So that is all for today. Thank you.