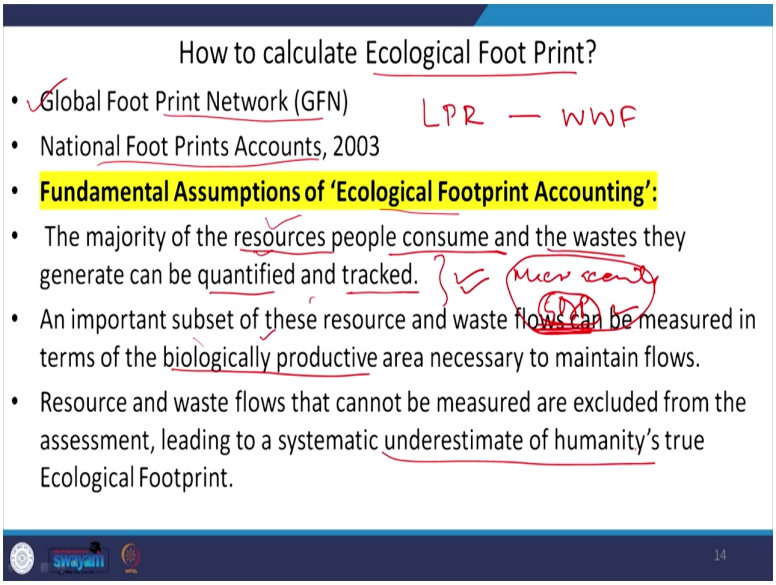
Introduction to Environmental Economics
Prof. Diptimayee Nayak
Department of Humanities and Social Sciences
Indian Institute of Technology, Roorkee

Lecture – 15
Ecological Footprint-II

Hello everyone. So, today we will be discussing the last portion of this Ecological Footprint. So, it is basically a continuation from our lecture 1 ecological footprint itself. We discussed in the previous class we talked about what is the meaning of ecological footprint. Then what is the origin and development of ecological footprint and what can be the indicators to estimate the ecological footprint. And, today we will be discussing what are how to calculate ecological footprint itself.

(Refer Slide Time: 00:55)



So after understanding this now we can also calculate the ecological footprint. Because we have understood what is the, what are the indicators that can be taken to account for finding the ecological footprint. So, who is preparing this ecological footprint? Because it is a tedious job and it takes it needs the data from very minus level micro level to macro level.

So, a first of all we have found this ecological footprint data or the calculation in the living planet report that is published by Wildlife Fund for Nature. And after that this two guys Rich and Wackernagel, they have also founded this NGO's that is known as the global footprint network. And they prepare this network global footprint network. They published National Foot Prints Accounts since 2003. So, for every nation they are preparing, they are calculating what is the ecological footprint of that particular nation.

But however, for finding this ecological footprint accounting that is prepared by a global footprint network; they are making some fundamental assumptions, before preparing this ecological footprint data. So, what are this fundamental assumptions they are taken into account in order to prepare this ecological footprint accounting. So, the first one is it is assumed the majority of the resources people consume and the wastes they generate can be quantified and tracked.

So, this one is again is very useful given the macro accounting concept of GDP. Because again the though we have we are preparing the GDP concept and it has many limitations and it has it is been criticized; because we are not talking about so many accountings like your natural systems oh sorry natural resources accounting. So, in that way ecological footprint accounting can be helpful in strengthening the way we are preparing the GDP even.

So, the assumption here we are making that in GDP we are not take into account this resources that people consume people are consuming natural resources, the people are consuming. As well as the externalities of the waste they are generating. But; however, in ecological footprint this is assumed that this natural resources accounting can be possible and resource calculation that is why can be possible.

And, the number of or the amount of wastes we are producing out of economic activities, it can be quantified as well as tracked from which force, this waste are being produced. The second fundamental assumption that this ecological footprint accounting is making is that an input on subset of this resource and waste flow can be measured in terms of this two concepts. The first one is biologically productive area and the second one is in terms of ecological footprint it even.

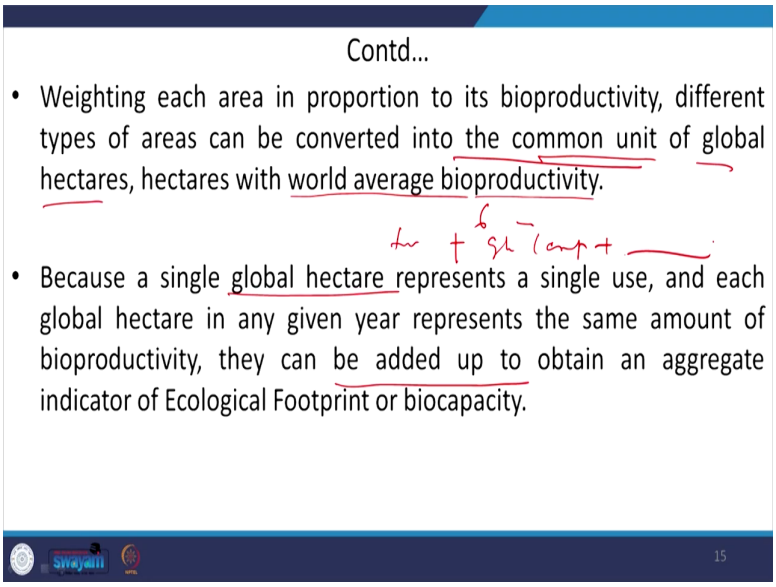
So, the second thing that it is assuming that this resources and wastes; it can be measured in terms of this concept that is biological productive area, that is necessary to maintain the flow of goods and services. And, the third assumption is that resource waste; resources and waste flows that cannot be measured are excluded from the assessment leading to a systematic underestimate of humanities to ecological footprint. And even we cannot say that ecological footprint is giving a kind of perfect picture.

So, for the accounting of resources are concerned it has also its own limitations. So, that is what it assumes that for those resources and waste flow it is not measurable, or the ecological footprint accounting is not in the position to measure, they are systematically excluded.

That is why there is a chance that we may underestimate the humanity's true ecological footprint, but given the data scarcity; so, if this can be a can be taken into account. Then; obviously, in there is a potential that ecological footprint would be a kind of would be giving a kind of perfect picture for accounting.

And another assumption it is making that weighting each area in proportion to its bio productivity, different types of areas can be converted into the common unit.

(Refer Slide Time: 06:27)



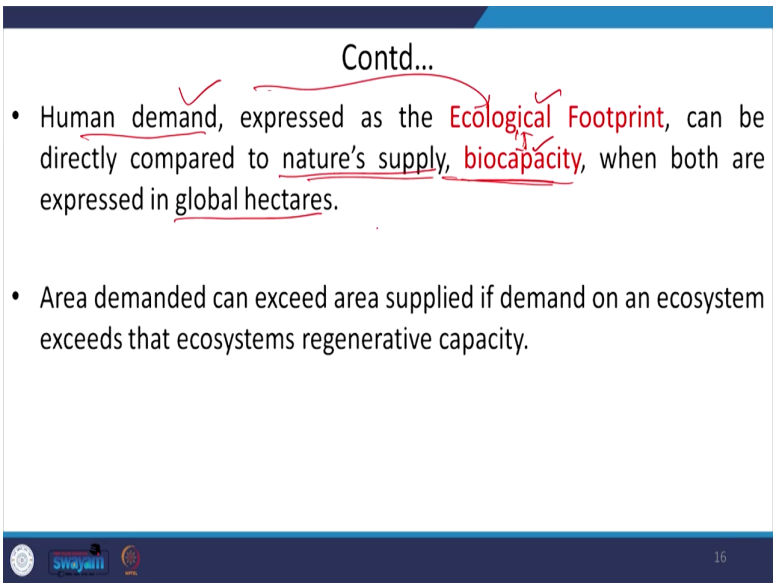
Why you are saying, why you are assuming this common unit concept? Because we have taken to account this 6 subsystems; starting from your crop land to your built up land to the carbon. And, the units expressed would be basically different they are measured in different units. So, in order to overcome this problem, this footprint network; they are using a common unit that is the global hectares which takes the world average bio productivity. So, in our all our example we talked about we need for let us say crop, cropland footprint by taking to account let us say this width.

So, what do you have taken into account? We have taken into account the average world average bio productivity, or yield of that particular crop and then we compare. So, another assumption is that because of this single global hectare, it represents the single use and each

global hectare in a way, in a given year it will be representing the same amount of bio productivity, they can be added of.

So, the global hectare that is for the forest land, it can be added of with the global hectares with the cropland, with all other parameters that we have taken into account. So, summing up is possible across all these systems and across all the time.

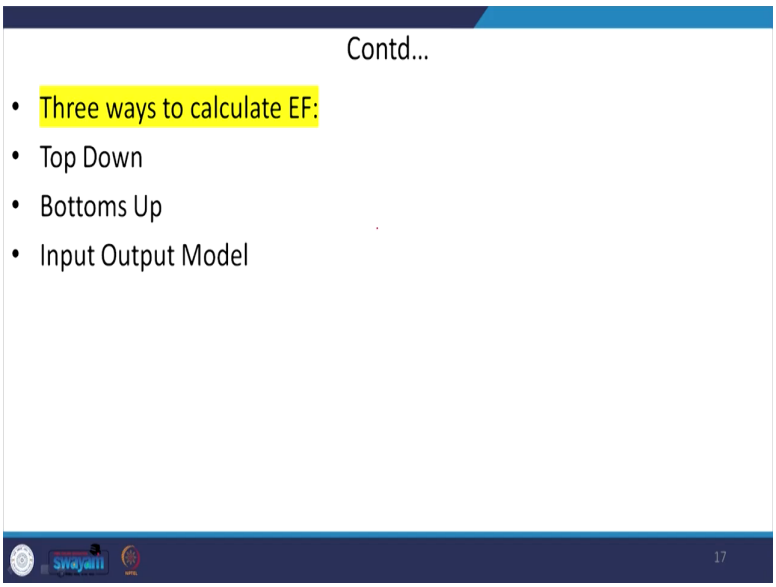
(Refer Slide Time: 08:03)



So, another assumption it has made is as we know this human demand is expressed as the ecological footprint. So, this can be directly compared with nature supply that is bio capacity. So, here we talked about that this human demand is synonymous to ecological footprint and that can be compared with nature supply that is in terms of bio capacity.

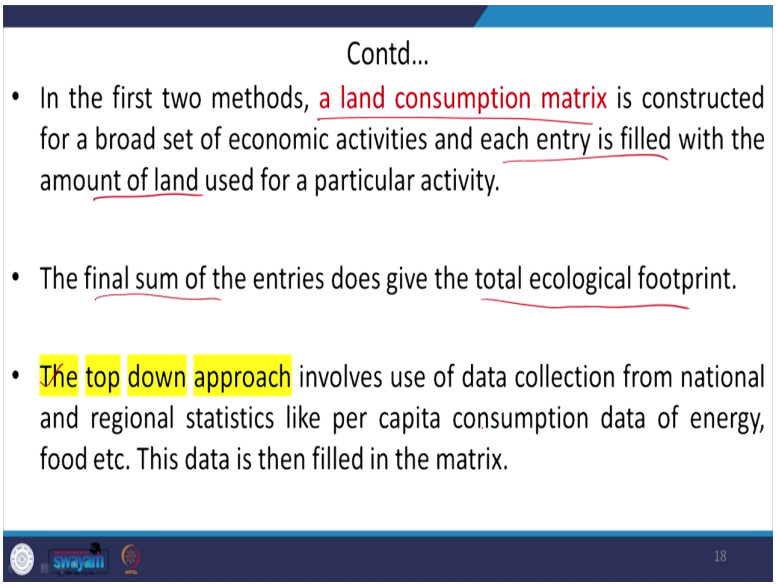
So, these two terms can be compared. When it can be compared? Because, they are expressed in they do have different units of measuring units. But, when this two concept they are measured in same units that is in global hectares that is why they can be compared.

(Refer Slide Time: 08:54)



So, how to calculate this ecological footprint? After understanding this, these are the assumptions we are taken to account for calculating the ecological footprint. Let us understand this. So, generally literature is giving us three different methodology or methods to calculate the ecological footprint. The first one is top down method, second one is bottoms up, and the last one is input output models.

(Refer Slide Time: 09:24)

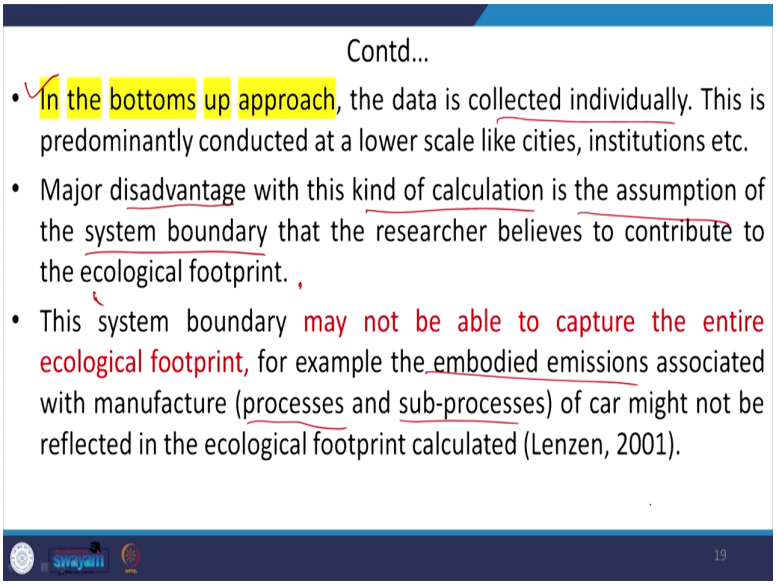


So what are these? So, if you take into account this top down as well as the bottom up approaches. So, for this two methods a land consumption matrix is constructed, for all the all the economic activities and each entry is filled with the amount of land used. So, it is expressed in terms of the land consumption of matrix. How much of land it is required for all this economic activities for performing all this economic activities? And, by summing of the final sum of the entries we are taking to account which will be giving us the picture of the total ecological footprint.

So, in the first approach that is the top down approach, we are involving the data collected from different agencies or statistical units like your national and regional statistics. For example, we can take into account the per capita consumption data of energy, or food, or likewise for preparing this ecological footprint; by take into account all these sub ecosystems or sub ecological systems. And, then all this data collected it will be filled in the matrix

because, it is expressed in terms of what is the area of land that is required for this economic activities.

(Refer Slide Time: 10:57)



So, in case of this second method that is bottoms up approach we are taking the data. But here we are taking the data that is collected by individually. And, in case of top down we are taking to account the data collected by some at a macro level. Let us say for a nation for a country for a state like wise and then we are filling that this is the in the land area required for this, this economic activities. Whereas, in the bottom up approach we are taking to account this data the same level of data, but this data are collected at individual level.

So, that is why while talking about the skills; so, this bottom up data will be focusing more on micro scales like we are taking into account in particular city like Roorkee, and what is their consumptions in terms of crop lands. So, what is the area or what is the land required for

maintaining for sustaining the demand of all residence of Roorkee and likewise. Or, you can talk about what is the ecological footprint of a particular institutions like IIT or all the IIT's; so, that you can measure. So, here we need to take into account the data that is collected individually.

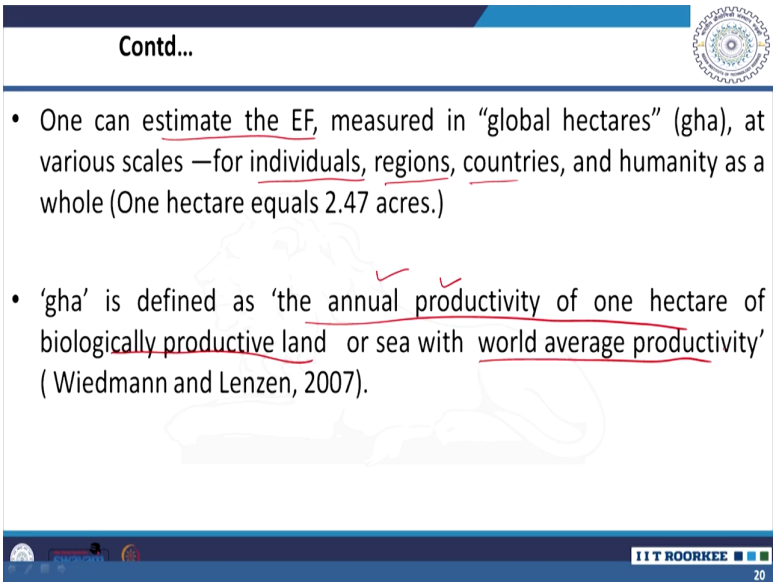
And however, the kind of limitations or disadvantages that we are having with this kind of calculation that we are say that we are a making is the system boundary is the assumption of system boundary. So, if there is no designed or no defined system boundary then it will be difficult to find out the ecological footprint of the concerned. And many times it is a, many times it is actually difficult to find out this system boundary to define the system boundary right.

So, for example, we can take the case of the embodied emissions that are associated with car manufacturing right. So, then in that case how to calculate this? And, it will be so this is a kind of problem we will be facing; if you are preparing this bottom up approach. Are you guys following this method? So, here you simply say that this system boundary may not be able to capture the entire ecological footprint.

Here for example, this embodied emissions associated with manufacturing of car might not be reflected in ecological footprint that is calculated. So, again why? Because, in this when you are talking about this embodied emissions in the manufacturing; so, it talks about not the final car that that we can use right and that is why you can prepare this ecological footprint.

But, also it needs to be taken into account the very processes and sub processes. The emissions associated with the very processes and sub processes for manufacturing a particular car, that may not be actually taken into account for preparing this ecological footprint, if you are following this approach.

(Refer Slide Time: 14:31)



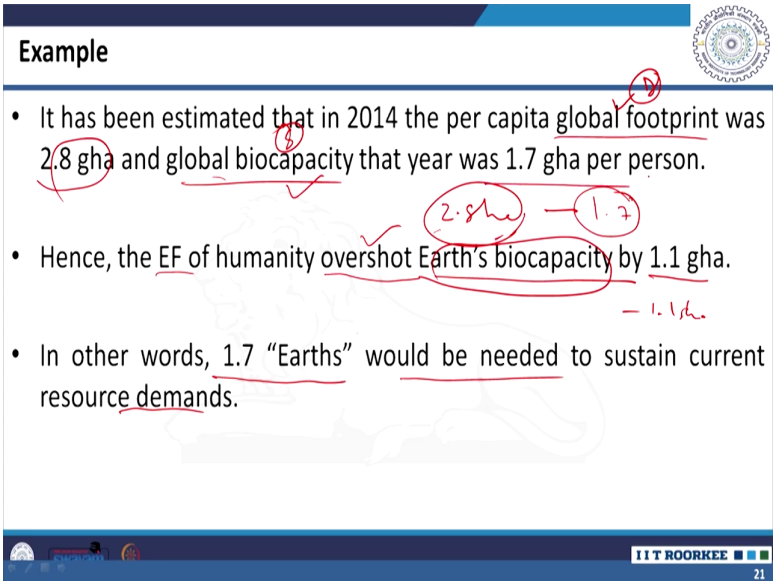
And, the last one last method that is relatively new method in terms of in comparison to the bottom up and top down approaches that is the input output method. And, here in input output method it systematically follows that what are the different inputs we are taking to account for preparing this ecological footprint. And, what are the different outputs that we are finding because of this.

And by taking all these methods what we can estimate? That we can estimate this ecological footprint and generally we are saying that it is expressed in terms of global hectares. That is why it is expressed in terms of common unit and it will not be difficult to compare the footprints across the systems. And, from my study it has been found that this the global hectares that is gha unit, it can be of various scales.

For individual level, it is having different scales, for regions it is different, for countries as well as for this planet itself it is different. So, here one hectare is equal to 2.47 acres. So, accordingly you can find out what is the global hectares. So, precisely you can say that this gha is defined as the annual productivity of one hectare of biological productive land, or in terms of sea with world average productivity. So, here we are taking to account the productivity or one hector of land or one hector of sea area per annum which needs to be expressed in terms of world average productivity.

So, if you are talking about the fish, fishery area of fish land. So, we need to take into account what is the world average productivity of land right for this one hectare, per annum and accordingly we can calculate. So, as this gha is giving a very the same unit measuring unit then it is not difficult to find out or to sum up the footprints across this sub 6 sub ecosystems.

(Refer Slide Time: 17:08)

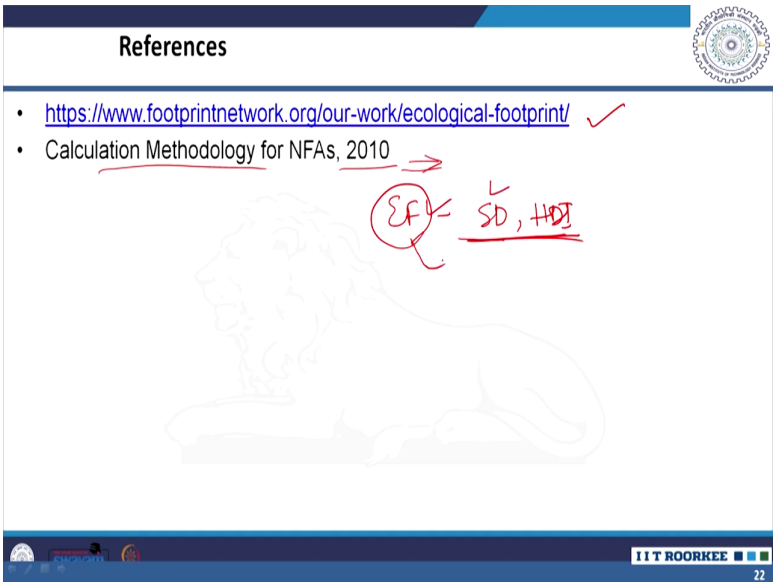


So, here you can take an example on this ecological footprint and ecological reserve, or deficit, or how this can be this data can be used in order to understand the sustainability concept. So, for example, it has been estimated that in 2014 as per this EF report; the per capital global footprint was 2.8 gha and the global bio capacity in 2014 it was 1.7 gha per person. So, from this two data that is giving one is giving the per capita global footprint and the second one is giving the global bio capacity data. So, the first one is giving the demand side factor and the second one is giving us the supply side factor.

So, from these two data set what we are finding or what how you are interpreting? So, here you can say that the ecological footprint of humanity in this case overshot earth's bio capacity. By how many units? That is; obviously, 2.8; that is your demand, your demand is 2.8 from for the humanity total humanity. And, the supply that is supply in terms of this of sub ecological systems or in terms of biological, global bio capacity which helps us providing the demand or fulfilling the demand that is 1.7.

So, if supply is less than demand then; obviously, so the we are actually finding a scarcity or a deficit ecological deficit we are saying. Or in other words you can saying we can say that this ecological footprint it overshot the earth's capacity by 1.1 gha, or in terms of deficit it is minus 1.1 gha. So, the same thing can be interpreted as that here it may also mean 1.7 earth's would be needed to sustain the current resource demand, because we are recurring 1.7 gha per persons. So, for further clarifications you may follow this reference.

(Refer Slide Time: 19:41)



So, this is the original you know web page of this NGO footprint network which prepares the ecological footprint data since 2003. And also you can follow this calculation methodology of NFA, National Footprint Account 2010. So, it recently it very simply explains that what kind of methodology, we can we are applying for calculating this ecological footprint data for the nations, and across the nations of the world.

So, that is all that is how we have, we are computed with the two indicators that explains the sustainability. And, now your task is to explore more that how this ecological footprint can be related to sustainable development concept as well as the other indicators of sustainability like you are human development index, you can explore more.

So, now, you can further analyze or explain that what is the relationship between ecological footprint and sustainable development and what kind of correlation might be there among

these ecological footprint, sustainable development and other sustainable indicators like human development index. So, you can just explore more by understanding this ecological footprint as an indicator of sustainability.

Thank you.