Environmental and Resources Economics
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Daly's Operational Principle of Sustainable Development and Impact of Environment Regulation on Firm's Competitiveness Part - 2

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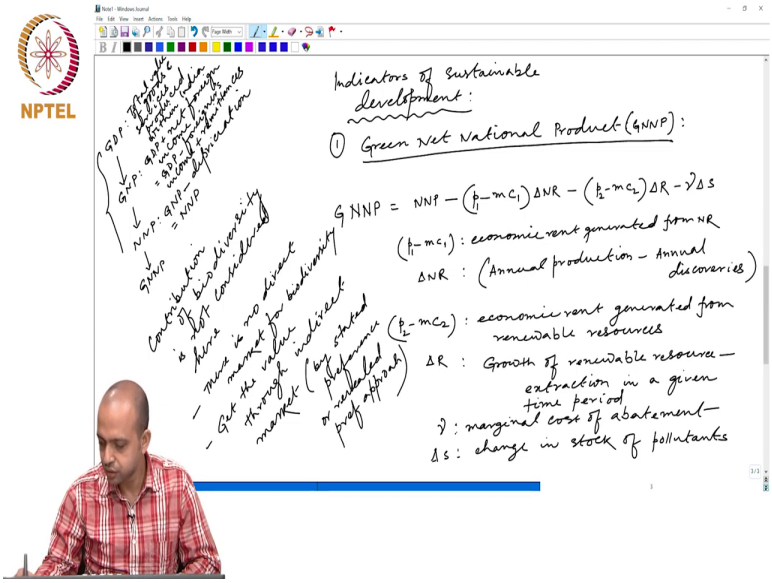

Indicators of Sustainable Development. And the first indicator that is widely used in economic literature, it is called green national product or I would say that green net national product or in the bracket I will say that GNNP. Before we talk about green NNP, let us revise our concept of NNP which is actually coming from GNP, which is actually coming from GDP.

So, this is the, this is how this concept I will give a description here GDP is modified as GNP then that is also again modified as NNP or from here GNNP. Now, what is GDP? GDP is the most popularly used indicators to measure a nation's income. How do you define this? GDP is defined as the total market value of goods and services produced let us say we are talking about India's GDP.

So, then we, how do you define India's GDP? It is defined as total value of marketable goods and services produced within the Indian Territory in a given period of time. So, total value of goods and services produced within India let us say. Now, this GDP includes not only the production of

Indian companies, but also it includes the goods and services produced by the MNC's that means foreign companies which are operational within the Indian Territory.

So, that means, GDP it does not measure actually what is India's income because the foreigner's income is also included in the GDP. At the same time, GDP does not include Indian's income, which is happening abroad, suppose, somebody is working in US and sending remittances then that income is actually not included in GDP. That is why economist they later on revise this idea of GDP and they got a measure which is called gross national product.

So, that means this is equals to GDP plus net foreign income. Why this is called net? Because from GDP equals to GDP minus foreigner's income plus the remittances and then we will get gross national product and then this gross national product it includes, it does not exclude the depreciation of capital, if you deduct the depreciation minus depreciation then you will get net national product.

So, net means after deducting the depreciation. So, this is, this up to NNP we have actually studied so far. Though that standard framework, standard macroeconomic framework to measure nation's income they use any of these three indicators either GDP or GNP or NNP whatever.

But there are certain limitations of this standard measures, what are the limitations, limitation is when we talk about NNP in NNP what we do, we while producing this NNP we extract many resources from the nature, from the environment. But we do not subtract the contribution of those goods and services which we are extracting from the nature or the environment to produce this NNP value.

And then economists are, a group of economists started thinking of revising it, because if we do not subtract the contribution of the environment that is already included in nation's income measure, then that income measure cannot be used for measuring sustainability. Because the amount of resource, renewable resource, non-renewable resource and the pollution what you are generating.

If we do not consider the value of all those. So, that means, you must subtract the contribution of the renewable resource, you must subtract the contribution of non-renewable resource and you

must keep some amount of money available for correcting the pollution what we are generating in the process of making this NNP value, that is why a group of economists started thinking of making this national income measure green and how can we make the national income measure green by subtracting the contribution of the environment that is already included in nations income measure.

And if we do so, then that green measure of nation's income can be considered as an indicator of sustainable development that is the idea. So, that means, what we need to do from the NNP measure, net national product. So, that means GNNP green NNP equals to I would say that NNP minus the contribution of the non-renewable resource, how will you measure, I will first write the formula and then I will explain.

Now, I will explain what I am doing what is this p1 minus mc1, p1 is actually the price per unit of non-renewable resource, mc1 is basically the marginal cost of extraction for the non-renewable resource. So, the difference between the price and marginal cost is defined as if you recall we have already introduced this concept, what is it called? This is called economic rent, economic rent generated from non-renewable resource.

And what is delta NR? Delta NR is basically the change in the stock of non-renewable resource and how do you measure the change of non-renewable resource, it is annual production minus annual discoveries that means, if in a particular year we extract 100 kg of coal, then the entire 100 kg of coal's value should not be deducted.

Because in that given time period in that year, the economy might have discovered some new sources of coal as well that is why when you are trying to measure the change in the stock of non-renewable resource it is defined as annual production how much you have produced minus actually what is the new discoveries. If in that particular year, you have already discovered let us say 40 kg's of new coal, then the change in NR is actually 100 minus 40 equals to 60 that is the change in non-renewable resource.

Similarly, p2 minus mc2 let us say that this p2 is the price per unit of renewable resource, mc2 is the cost of extraction then this is actually economic rent generated from renewable resources and delta R is again the change in stock of renewable resources and how do you do that, it is actually

growth of renewable resource minus extraction in a given time period and what is in gamma here this is actually marginal cost of abatement and delta S is basically change in stock of pollutants.

This is how we can actually modify the net national product definition and we can come up with a measure which is green in a sense, which is sensitive towards the environment. Because, we are accommodating the fact that we are deducting the contribution of the environment that we derive in the process of making this gross national product or net national product.

So, these are the different channels by which we can actually consider making the national product green. But there are certain problem of course, for example, here aggregation problem will always be there because there are different types of renewable resource there are different type of non-renewable resources.

And then when you talk about change in stock of pollutant, which pollutant you are talking about. Here we are using only one single marginal abatement gamma, but marginal abatement cost for CO2 is quite different from SO2 or NOx and it also varies from one place to another. So, utilising one single marginal abatement cost, this is marginal cost of abatement for all sort of pollutants is quite problematic.

Similarly, when you try to measure the change in stock, stock for which particular pollutant you are talking about, is it CO2, is it NOx or is it SO2 that also makes this measurement problematic, but at least this is some rough idea of making the net national product and this is how we can actually get some idea about a particular economist's performance towards the sustainability.

Which is not included in the formula is basically the contribution of biodiversity. So, contribution of biodiversity is left out. So, here basically the contribution of biodiversity is not considered here, why this is so, because there is no direct market for biodiversity.

Since we are talking about a measurement, which is NNP or GNP, these are all as I define total value of marketable goods and services, but biodiversity is also one very important ecological services that we extract in the process of making GNP or GDP. We cannot include this in this formula, because there is no direct market.

So, we do not know what is the value and when there is no direct market, what is the solution, the solution is you get the value through indirect market by contingent valuation by stated preference or revealed preference approach.

So, there is some alternative that is why this is not included in the formula, but this formula can be also modified to include the contribution of the biodiversity by indirect market through stated and revealed preference approach, which we will study in detail in our next topic, where we will be discussing about economic evaluation of environmental goods and services. So, this is one indicator that is widely used to measure sustainable development.

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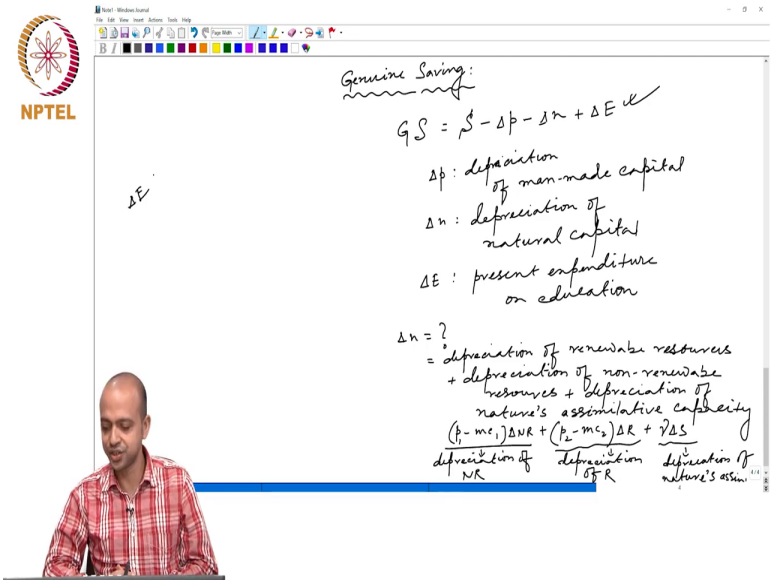

Then economist's they use another indicator which is called genuine saving. So, what the idea is from the total saving this is GS is equals to total saving minus delta p minus delta n plus delta E, what is delta p here, delta p is basically depreciation of manmade capital delta n is depreciation of natural capital and so depreciation of manmade capital, depreciation of natural capital and delta E is the present expenditure on education.

This is how we can actually measure we can actually change the national saving into another indicator called genuine saving. Now, the question is how do you measure delta p depreciation of

manmade capital which is very easy. So, measuring the depreciation of manmade capital is very easy.

But the question is how do you measure delta n, how do you measure the depreciation of natural capital? Can you think of how to measure natural capital, depreciation of natural capital? Now, depreciation of natural capital can actually happen in three ways, in the process of economic development, what you do, we derive or we extract renewable resources, we derived non-renewable resources and we generate pollution.

That means, natural capital depreciates in the form of depreciation of a renewable resource, depreciation of non-renewable resource and depreciation of nature's absorptive capacity or the assimilative capacity. That means, if we consider these three form of depreciation, then we can actually consider delta n.

So, this is actually equals to depreciation of natural capital plus depreciation of sorry this is depreciation of renewable resources, sorry, this is depreciation of renewable resources, depreciation of non-renewable resources plus depreciation of nature’s assimilative capacity. So, that means, we need to deduct the value of all this depreciation and that is exactly what we did in the context of getting green national product, green NNP.

So, that means basically we need to consider p1 minus mc1 into delta NR, then p2 minus mc2 into delta R and plus gamma into delta S. So, this is the value p1 minus mc1 into delta NR, this is the value for depreciation of non-renewable resource, p2 minus mc2 into delta R this is the value for depreciation of renewable resource and this is the value of depreciation of nature's absorptive capacity indirectly we can say.

So, that means, we have already discussed how to consider or how to accommodate the depreciation of different forms of natural capital depreciation. So, this is basically depreciation of non-renewable resource, depreciation of NR, non-renewable resource this is depreciation of R and this is depreciation of nature's assimilative capacity.

Then the question is how, why should I add delta E so, that means additional expenditure on the education because the expenditure made on education it actually creates when the economy is

spending money on educational infrastructure building that actually helps accumulating human capital.

So, that actually adds to human capital and that human capital should be added not to be subtracted. So, that is why a group of economists they consider up to delta n so, that means, they deduct only depreciation of manmade capital and natural capital. But World Bank they say that no in the process of calculating genuine saving, we should actually add the present expenditure on education because that is going to add the human capital.

So, this is the way by which you can actually measure genuine saving. So, that means, this is how the entire topic of sustainable development we have completed our discussion, what do we did basically, we discussed about the definition of sustainable development then we also discussed economist's way of measuring sustainable development, then we discussed what are the why should we bother about sustainability that means future generation.

We discussed about two versions of sustainable development, weak and strong sustainability. We discussed the relative merits and demerits, what are the problems of weak sustainability measures that is why strong sustainability rule came in and then we also discussed how to operationalize those theoretical ideas by Daly’s operational principle and then lastly, we discussed about the indicators for measuring sustainable development and two most important indicators are green NNP and genuine saving with this, we are closing our discussion on sustainable development. Thank you.