Introduction to Environmental Economics
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Lecture – 24
Benefit-Cost Analysis and the Environment-I

Hello everyone, today we will be discussing Benefit-Cost Analysis in the context of the Environment. So, as you understand in the last model we talked about sustainability and two indicator two indices for calculating the sustainability. So, in this context we need to know that if you do not calculate the cost benefit of a policy or a project that is related to environment, then the sustainability will be far fetching term.

So, for this concept we need to understand what is the cost benefit analysis or a tool so, that we can measure, we can assess the project particular project or policy and that can actually lead us to the sustainability in the resource use and the material use as well.

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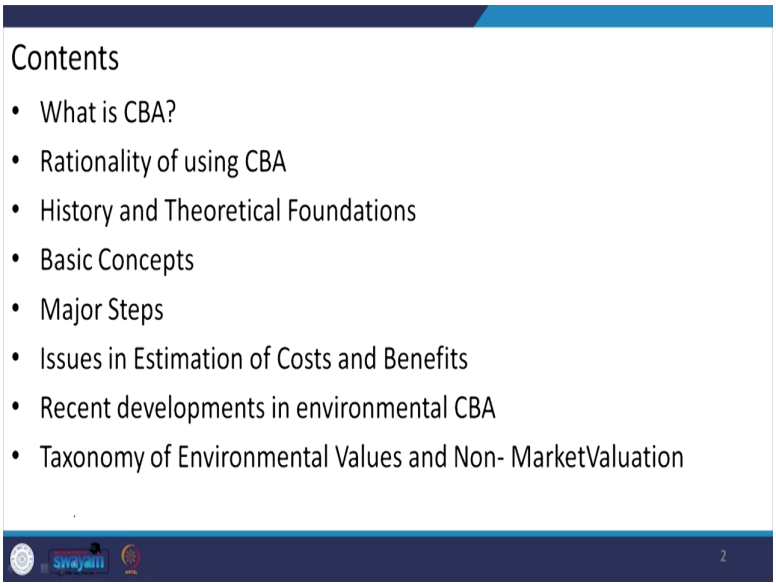

So, in this context we need to discuss the this the cost benefit analysis in details and how it will be helpful in operating the project or a particular policy in the context of environment. So, the broad contents in that will be trying to cover is, what is the meaning of; what is the meaning of cost benefit analysis and why you are using this cost benefit analysis, what is the rationality behind this ah use of this tool.

And then we will be discussing what is the theoretical foundations of cost benefit analysis whether it is just a tool or it has some economic theories back by this tool. Then we will be a discussing what is the major basic concepts and major steps in the cost benefit analysis. And after that we will be assessing that what are the different issues that we may encounter in applying the cost benefits analysis in assessing a particular project or policy.

And then we will be focusing on the recent developments in environmental cost benefit analysis and its application and at last we will be talking about the taxonomy of environmental values focusing on different typology of environmental value and how these are leading to the non market valuation mechanisms.

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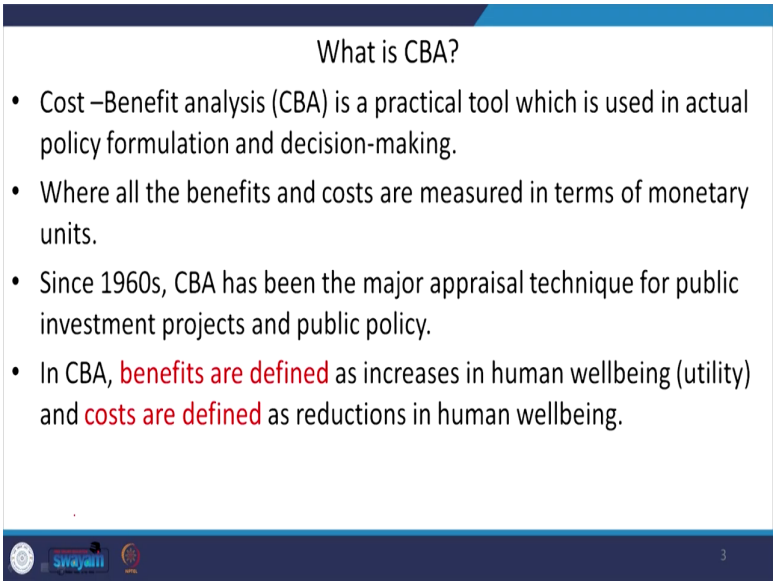

So, let us discuss with the meaning of the cost benefit analysis. So, as you understand that this cost benefit analysis is a tool, that is helpful in finding in average in a particular policy and that will be helpful in taking the policy formulation and making right kind of decision making. And because why we are saying we this tool will be helpful in formulating the right policy or taking the right kind of decision making, because it takes into account all the benefits and cost that will be incurred out of a particular policy or a project. And the thing is that, the all the benefits

and the cost they are measured in terms of monetary units. So, that we can average we can compare between the monetary value of benefits and monetary value of cost.

And we can take a decision that whether the particular project in discussion or particular policy in the discussion whether it should be accepted or we should actually have need to give a second thought to revise. And so far the history is concerned or the reliability of this cost benefit analysis as a tool appraisal tool is concerned, it has its application since 1960s in most of the public investment projects and public policies.

So, it is one of the popular methods or tool for taking the decision makings. And as you know that we are saying we are only giving emphasis on the two concepts that is benefits we are getting from a project or policy and the cost we are we are expected to incur from that particular policy or project and then how you are measuring? So, we were saying the benefits it is defined as the increase in the human wellbeing or it is increasing the utility of the consumers or human beings.

And when you are saying these are the costs, that needs to be monetized. So, it means the costs are in terms of reduction in the human wellbeing a reductions in the satisfaction or utility level of human beings.

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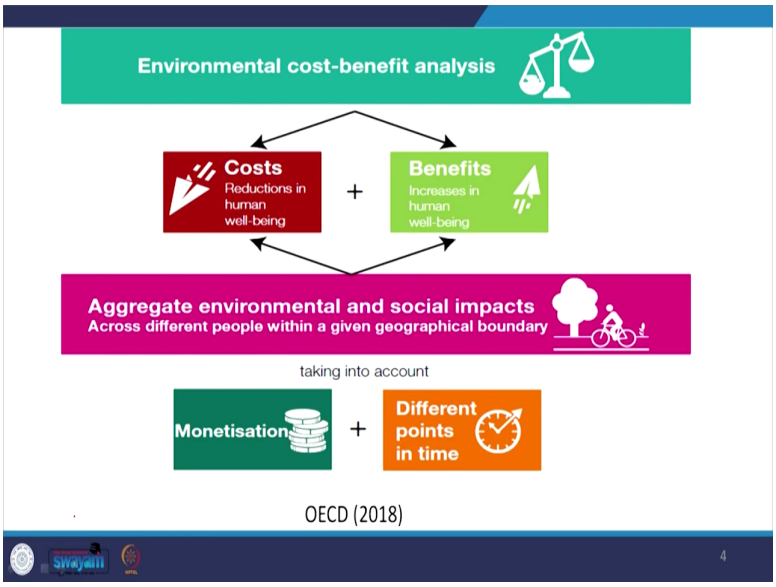

So, in this context once we understood what is cost benefit analysis and we are giving this two words cost and benefit. In the context of in the context of environment how we are going to analyze this cost benefit analysis? That means, the similar the same a logic, same rationality is also applied in case of environmental cost benefit analysis.

And here as you understand we are taking to account all the cost that is that is reflecting, the reductions in the human wellbeing and satisfactions as well as all the benefits that is suppose to increase the human wellbeing and then what we are doing? We are actually a comparing this two in order to find the net of benefits and if the net of benefits we are finding and it is a positive number or positive amount, then we are saying we need to go ahead with this particular policy or particular project.

So, when you are when you are doing this exercise taking all the costs and or taking all the benefits from that particular project or policy, what we are doing? We are actually measuring the aggregate environmental and social impacts of that particular project or of that particular policy and we are collecting this impacts aggregate environmental impacts and social impacts from different sections of the society across different geographical units.

And then after finding this impacts what we are doing? We are monetizing this these impacts this environmental impacts or social impacts in terms of costs and in terms of benefits we are converting it these costs and benefits these impacts in terms of the monetary units. And the another thing that is also important we are not only taking into account the present time and the impacts of these policies on right now on the present, but also in the future time as well. So, that is what is the expected benefits or what will be the expected cost out of a particular project or policy after 3 years, 5 year, 10 years or what will be the duration of project and its impact.

So, here the time factors are also taken into account. So, that is why when you are taking the monetary units for converting the cost and benefits and we are also emphasizing the time factors that is why this cost benefit analysis is one of the best approaches for approaching the feasibility as well as the very acceptance of the project as well.

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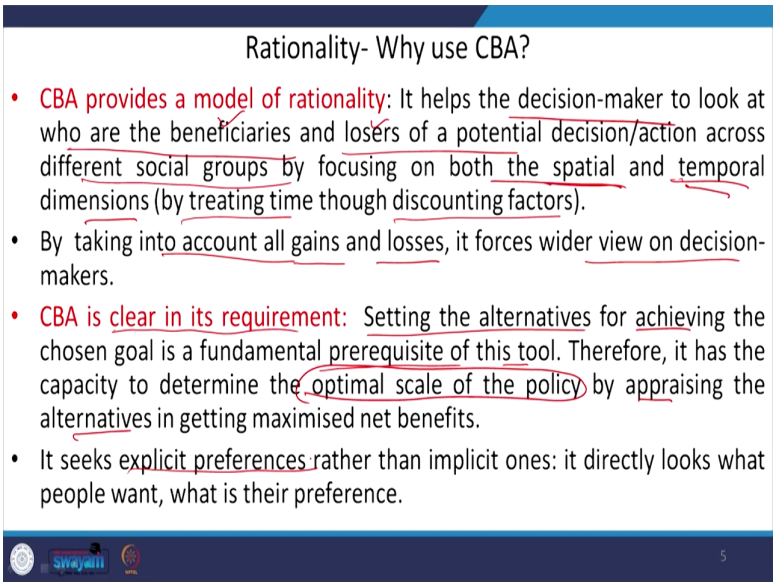

So, now let us understand what is the rationality of this cost benefit analysis, why we are using this cost benefit analysis. So, as we already have been briefed that this cost benefit analysis is a tool, which helps in decision making so; that means, it is helpful in to the decision maker to analyze or to find who are the beneficiaries that they are getting benefits out of this particular project or policy and who are the likely losers and this beneficiaries and losers they can identify across different social groups.

So that means, we are taking into account, we are finding this beneficiary and losers by focusing both this space factors because we are also talking about social groups and they are located they are inhabited in different parts of the world or areas and also the temporal dimensions. So, in that way, it is it is giving the a kind of kind of tool which is representing not

only the present generation state, but also the future generations benefits and cost out of this particular policy or project.

So, when you are saying that it is also taking the time dimensions. So, here the time is treated that what would be the likely benefits or likely cost in the future time by taking into account a concept that is known as discounting factors. So, in converting the time we are taking into account the discounting factors for monetizing the benefits and cost that is to be achieved in future times. And obviously, when you are saying we are taking into account all the beneficiaries and we are also taking into account all the losers potential all the losers of a potential policy or program; that means, we are taking to account all gains and losses.

So, when you are sketching all gains and losses for a particular policy or project, then obviously, the decision maker is having a broader view and that is why he or she can take the right decision based on the alternatives. And the second aspect that why the this tool is to be used or why a this CBA is one of the popular tools and one of the scientific tools of appraisal also. Because it is fulfilling or it is displaying a kind of clear requirement.

So, what is the clear requirement? It is for this cost benefit analysis not only the current project or policy is considered, but also what are the likely alternatives of this policy or project are also taken into account. So that means, here we are setting the alternatives for achieving the same chosen goal, that let us say for a particular objective we need to frame a particular policy and this policy is consider now. But for cost benefit analysis what we are doing? We are also take into account what can be the alternatives for fulfilling the same objectives or same goal.

So, in that way we are weighing the benefits and cost of all these alternatives that can fulfill the same objectives and this is a prerequisite for this cost benefit analysis tool. Therefore, this CBA analysis it has the capacity to determine the optimal scale of the policy because it is appraising so, many alternatives right out of all these alternatives it is it is picking the best one, that is why this CBA analysis is it has the capacity to determine that what is the optimal scale

of a particular policy because it appraises all the a alternatives and that can maximize the net benefits to the consumers or to the party is concerned out of a particular policy or program.

And the third one that may be a the implicit one that also supports their rationality for using this CBA that, it is seeking the explicit preferences rather than a kind of implicit one. Why you are saying that it is it seeks explicit preferences rather than the implicit one? Because it directly looks what people wish to get and that is again what people wish to get is dependent on their preferences. And when the preferences are taken into account so; obviously, the this technique or this tool is actually focusing on the explicit preferences, the consumers their needing for a particular policy or particular program.

So, because of this three reasons, a CBA is having huge applications in almost all the public policy appraisal programs or projects.

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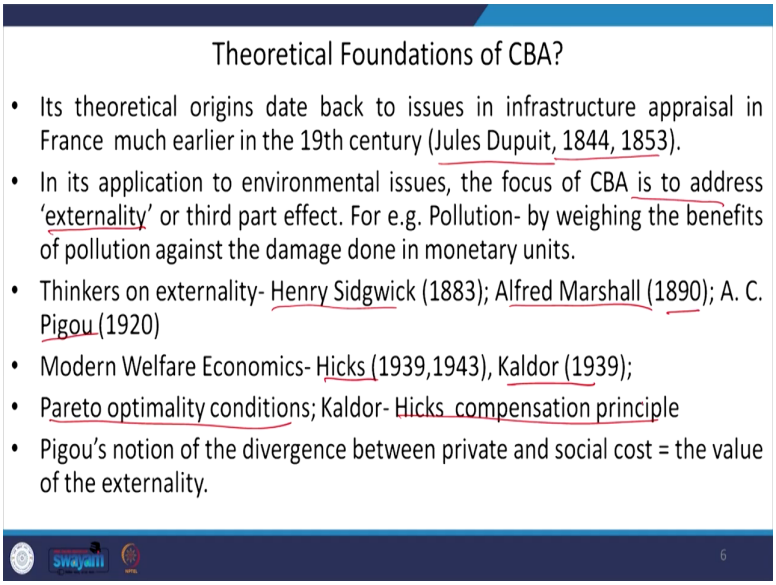

So, now let us have and understanding of the theoretical foundations or theories that are behind this CBA tool. So, what are these theories? Is just is this tool having the recent origin or it is it is having a very deep background in the economic literature even based on the economic logics.

So, if you see the history theoretical history of CBA. So, it is it its application is found most earlier in the 19th century and in the works of Dupuit. So, when you are saying looking for the works of Dupuit. So, he wrote down in 1844, 1853 and that is broadly related to the issues in infrastructure appraisal in France itself.

So, that whether. So, the infrastructures projects like highways or the different kinds of roads should be prepared, should be constructed or not. So, it has it was a kind of project at that point of time and this fellow a civil engineer and economist, he appraise this these proposals or projects that why this infrastructure buildings in terms of building roads and building the networks of roads should be constructed. And he applied this cost benefit analysis as a tool in order to prove this.

And again when you are talking about this CBA is applicable or CBA is applied in case of environmental goods and services or environmental problems or environmental policies even. So, here the focus of CBA is to address the externality. So, in case of environmental policy or program, we are using this CBA as a tool to address the problem of externality or which is also known as the third part third party effect. So, for example, and the pollution.

So, if you want to make some kind of policy on the pollution related problem, let say air pollution that how to what is the why whether the pollution should be decreased or not. Some policy should be there that can address or that can make some arrangements so, that the pollution levels can be decreased. So, for making this policy on the air pollution, we must take into account the benefits of pollution against the damages, that are done because of the pollution. So, you will be surprised to know that why we were taking; why we were talking about the benefits of the pollutions.

So, it is because when you are saying the pollution is there so; that means, some kind of manufacturing or some kind of production is there because pollution is also and a necessary component of your production. So, no manufacturing, no manufacture process or no manufacture can happen without this pollution. So, this is a side output we can say, which is an integrated part. So, when you are stopping the pollution to zero level; that means, you are stopping the altogether the production system so; that means, you are trying to put the economy in a standstill position or to a zero conditions.

So, it is it is not expected; so it is not desirable. So, because of these, we need to find that pollution will be there because some kind of production will be there. So, that is why we need to see what is the benefits behind this pollution; that means, when pollution is there, manufacturing will be there. So, what kind of benefits we are getting by producing more and more of goods and services and because of which the by product is in terms of pollutions.

And the second is that, we need to also understand that what are the different negative effects or impacts or damages the pollution is because of the pollution damages are being created and we need to see or we need to convert all these benefits and all these damages in terms of monetary units. So, in that way in environmental issues we can also take into account the help of this benefit cost analysis basically treating the case of side effects or the third party effects and when you are thinking about the economic history.

So, this externality is not a new concept it is we can also find in the writes writings of Henry Sidgwick. So, he talked about this externality in 1883 work, we can also find in the work of Marshall his work is 1890 and also the in the work of Pigou. So, in all this works we can find out the how externalities there or some kind of treatment to the externality has been addressed. And if you are looking to the modern times that is welfare economics we are saying. So, again the theoretical underpinnings is having its root in the writings of Hicks and Kaldor.

And again we are very familiar about the Pareto optimality conditions in the welfare economics and also the Hicks compensation principle Kaldor Hicks compensation principle in

the welfare aspects. So, all these theoretical underpinnings it talks about somewhere the problem of externality and we can actually link to this cost benefit analysis to this externality problem.

So, what exactly is the externality and how you will be finding from all these theories? So, when you see this Pigous writings A. C. Pigous writings in 1920 a literature, then you can find that he highlights the private benefit and private cost and the difference between the public benefit and public cost which we are saying the social cost. So, that means, here we need to have a divergence between these two concept; one is private cost and the public cost or social cost.

So; that means, what the private benefit is, it is not the benefit accrued to the society or this is not reflecting the social societal benefit this is not the same. So, societal benefit is somewhat different from private benefit and likewise obviously, the societal cost is something different between the something different from the private benefits as well so; that means, they are exist a difference between this private benefits and social benefits private cost and social cost.

When you are doing this divergence between these two, then this is nothing this is capturing the value of the externality. And when you are saying that this private benefit there is a divergence between private benefits and social benefit. So, it may lead to the concept of positive externality and when you are saying that there is a divergence between the private cost and social cost and here the social cost is out going is more than the private cost, then it is leading to the concept of negative externality. And again when you are saying that how to measure, how to put a value, how to put a monetized tag to this externality.

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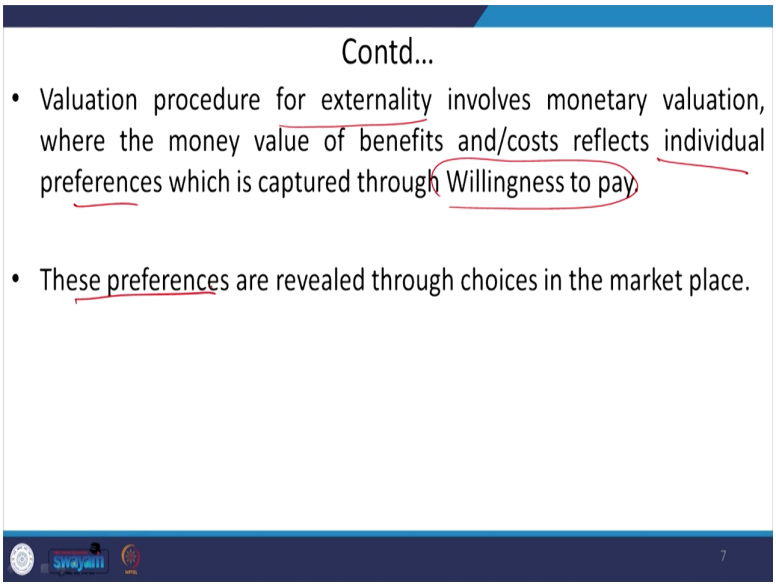

So, this valuation process for the externality is involving the same procedure for monetary valuation of all the rest of the financial assess. So, where the money value of the benefits and cost, it reflects the individual preferences and this individual preferences are captured by captured through this concept which is known as the willingness to pay. So, what is this willingness to pay?

So, willingness to pay means, here what the consumer or a human being is interested to pay in order to get a particular benefit or what a particular individual is interested to forgo some kind of costs and that is why he needs to pay something? So, this is what the concept of willingness to pay. So, this preferences again they reveal through different choices in the market price.

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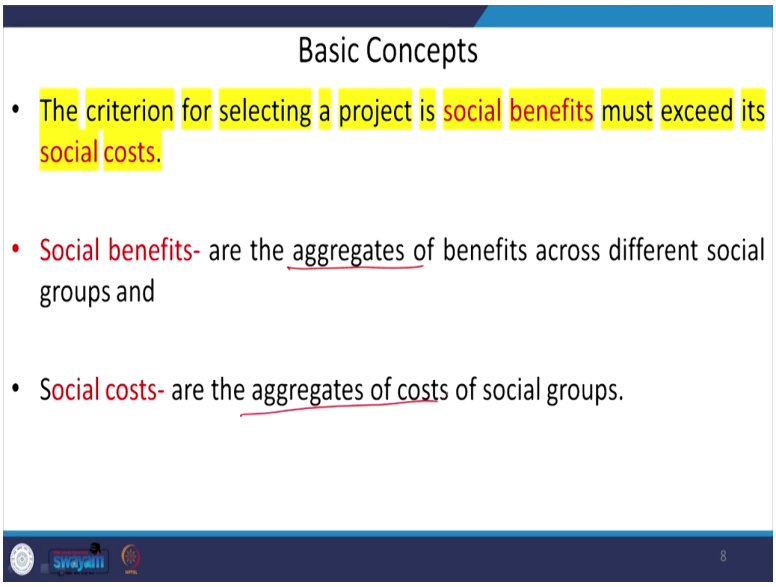

Because we are again comparing between the market price which is revealed preference and the second one is in terms of willingness to pay and there would be some difference between willingness to pay and the market and the market price itself which is leading to the concept of a surplus.

So, based on these understanding that these are the historical backing or you can say the theoretical underpinnings, in order to understand this benefit cost analysis let us understand what is the criteria or basic concepts that we are using in this benefit cost analysis.

So, the first criteria or the first concept is that if you need to select a particular policy or project, we need to see that social benefits must be greater than the social costs. And again here we are we are using the social benefits and social costs from the Piguos concept itself.

So, what is the social benefits? So, these are the summation of the benefits across the society. So, if you were having like n number of individuals. So, we are aggregating their benefits of first person, second person up to the nth person which is giving the picture of social benefit. So, we are following this aggregation rule for getting the social benefit and likewise for social cost we are also take into account the aggregate costs to the society.

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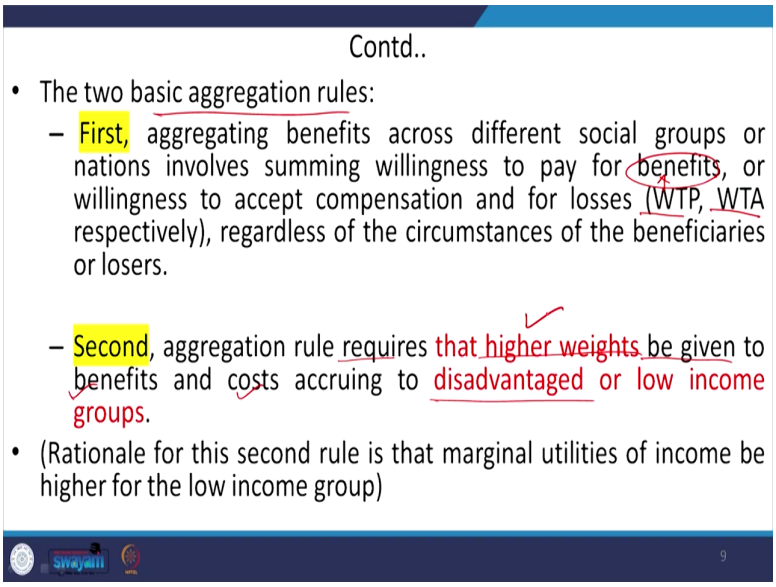

And because of this understanding social cost and the social costs and social benefits, we are also finding also having in this cost benefit analysis two basic aggregation rules. How to aggregate this social cost or how to find this social cost and how to find the social benefits because we are saying we are following the aggregation rule. So, what are these two basic aggregation rules we are following? The first thing is that when you are saying this

aggregating benefits across different social groups or social strata. So, here we are summing up the willingness to pay for benefits or willingness to accept for compensation.

So, that is you can say that we are using these two concept willingness to pay and willingness to accept, if we have to or if the consumers or the a particular person is interested in getting a benefit and he needs to secure this benefit, then he will be paying something that is known as the willingness to pay. And if someone is loosing or he is a victim and he has to tolerate and that is why he needs to be paid. So, that is expressed in terms of willingness to accept.

So, this willingness to pay and willingness to accept is helpful in finding the aggregation of benefits and aggregation of costs, that is reflected in social benefits and social costs. And the second principle that we are we are also take into account in order to find this aggregation rules of cost and benefits is that, for this rule aggregation rule we are giving higher weights to the benefits and costs, that is accrued to the disadvantage or low income groups who are not privileged then obviously, weight should be given more..

For less privileged society or for less privileged group so, far the aggregation rules are cost and benefits are concerned then we are paying more weights to these less privileged groups and then we are aggregating all the costs and all the benefits here in this estimation of cost benefit analysis.

So, what is the rationality that why we are giving higher weights to the preferences of the low income groups or less privileged groups? Because the rationality is that, this we know that this marginal utilities of income will be higher for the low income group in comparison to the marginal utilities of income that is ah for the higher income group.

So, because of this reason that marginal utility is differ based on their income levels. So, we take into account this low income groups and we are giving more weightage to the low income groups and whatever the cost and whatever the benefits they will be getting out of a particular policy or a project. And as you understand that we have already defined what is willingness to pay. So, systematically you can say that an amount of money an individual is

willing to pay for obtaining a benefit or even to avoid a particular loss. So, this is termed as the willingness to pay.

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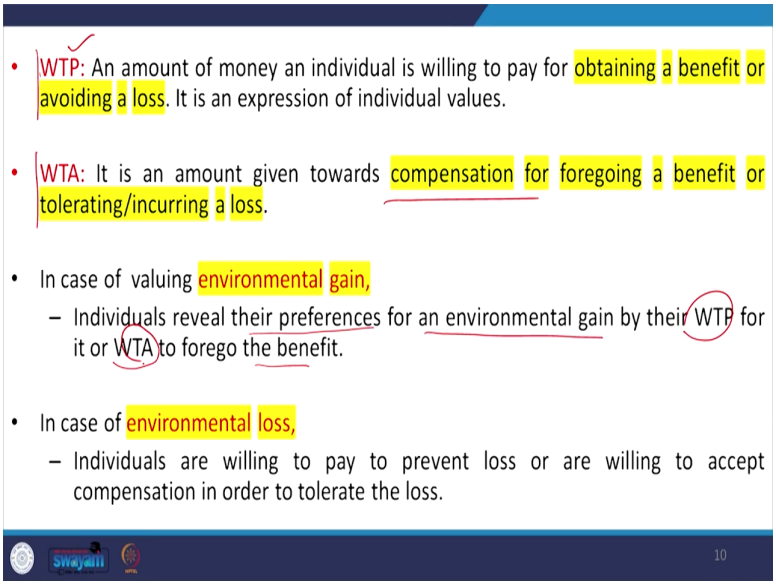

So, again this willingness to pay will be differ will be different it can differ from person to person, based on the individual values how a particular person is valuing the benefit or valuing the loss. So, that he wants to avoid. So, based on these the willingness to pay will be different and what is willingness to accept? So, again this is a particular amount which is given for compensation in order to forgo a particular benefit. If you have to forgo a particular benefit, then you must be given some compensation.

So, that is expressed in terms of your willingness to accept that particular compensation so, that you can forego avoid these benefit out of that policy or program or if you have to tolerate some kind of loss because of a particular policy or program, then you must be given some

compensation that is also named as the willingness to accept. And in case of valuing this environmental gain or loss because we are appraising this environmental policies and program, let us talk about in case of gain environmental gain we are valuing or how to value environmental gain.

So, here in order to measure this environmental gain, the individuals they will be revealing their preferences for this particular environmental gain by expressing their values in terms of willingness to pay or if they do not want it or if they allow it to ah if they just allow it to forgo, forgo that they do not require it the particular benefit then it is expressed in terms of willingness to accept. So, now see that the basic meaning of willingness to pay and willingness to accept and how for a particular environmental gain how these two terms are exercise.

So, both terms can be exercise this willingness to pay terms can be exercise or used and also willingness to accept can also be used in case of this environmental gain. So, likewise if you are saying that because of a particular policy or program if it is to be implemented, then some kind of environmental loss will happen. So, if the if this is so, then how to value this environmental loss? Because of this particular project or particular program or policy.

So, here the individuals are willing to pay to prevent the loss that obviously, when the policy is there that it is to be it is it is to be implemented and because of which we are the individuals they are anticipating for a loss then obviously, they will be they will be trying to prevent this loss. Or the second thing is that they will be willing to accept the compensation in order to tolerate the loss and let the policy begin or let the particular policy be implemented.

So, these are the two scenarios that in case of suppose say a policy happens and we are finding this environmental gain, then how the how people are valuing this environmental gain in terms of their preferences by this willingness to pay concept and willingness to accept concept and if there is there is likely to be some environmental loss because of a particular policy or particular particular program, then how they are going to tackle it or showing their preferences in terms of the same concept willingness to pay and willingness to accept.

So, another thing that is also taken into account as we just briefed in the in the introductory session that, we need to take into account or agreed all the values all the costs and all the all the benefits and that is why we are take into account or we are treating the time dimensions.

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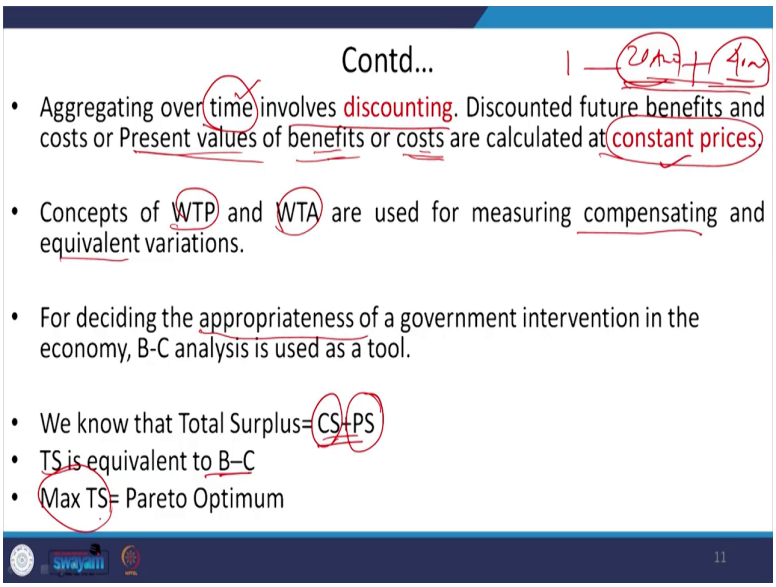

So, when we are saying we are treating dimensions; that means, it is involving the discounting factor. So, what is a discounting factor?

So, here when you are saying this discounting factor are taken into account so, it helps in converting the present values in sorry the future values value future benefits or costs in terms of the present one. And the present values of benefits and costs they are calculated in terms of constant prices so, that you can actually aggregate the benefits and costs otherwise you will be suffering from let say the problem of rising prices and falling prices and accordingly the

willingness to pay and willingness to accept the value of willingness to pay and willingness to accept will be different.

So, in order to nullify the price dimensions or change in price dimensions, we are also following the constant prices in order to convert this benefits and costs in order to convert this benefits and cost and we make this value the value of benefits or value of cost at a particular point of time. So, let say that suppose say some amount of benefits its to be accrued after 2 years. So; that means, we need to and somehow some amounts we are getting right now because the policy has been implemented.

So, how to aggregate these two amounts both are the benefits; obviously. So, if this is so, then we cannot say that for the let say for the first one for the first you are right now, we are getting some benefits of 20,000 rupees. And after 2 years it is likely that will be getting some amounts like 40,000 rupees. But this 20,000 and 40,000 it cannot be summed out it cannot be aggregated if you are if you are saying we are taking not the concern price, but their current price at their current prices.

So, in order to avoid this problem because after 2 years the prices the value of the particular unit of monitor units will be different, it may be more or it may be less. So, in order to nullify this factor the all the benefits and all the costs present values of all the benefits and all the cost they are calculated in terms of constant prices not the current prices.

So, the concepts of this willingness to pay as well as willingness to accept they are used for measuring the compensating as well as equivalent variations. So, I am not explaining what is compensating variations or what is equivalent variations, it is already explained in module 3 sorry module 4 and module 5 by Professor S P Singh.

So, that is why in order to save time I assume that, you have already gone through the concept of compensating variations and equivalent variations. So, for taking for deciding the appropriateness of a particular government intervention in terms of a particular policy or program, this benefit cost analysis is one of the best tool that can be that can be taken into account. Because it deals with almost all the factors that needs to be taken. And again when

you are saying that in this benefit cost analysis we need to maximize the net benefits, that is again we are we are saying the net benefits in terms of the summation of consumer surplus and producers surplus.

So, when the total surplus is maximized you can say that the net benefits can be maximized. So, again this total surplus is nothing, but this net benefits that is total benefits minus total cost. And when you are saying that out of a particular policy we are getting this total surplus, we are maximizing the total surplus. So, in that sense this condition is the Pareto optimum conditions. So, this is the background of that of the logic or the rationality as well as the history as well as theoretical underpinnings that are taken into account in order to exercise the tool of cost benefit analysis.

So, today we have discussed what is the CBA, we have defined CBA, then we discuss what are the rationality behind this CBA, then we also discussed what are the theoretical backgrounds of this CBA analysis and in this context we talked what are the basic concepts that are necessary in understanding the cost benefit analysis.

So, in the next class we will be discussing the what are the major steps we need to take into account for this cost benefit analysis and we will be also discussing what are the issues that we are facing in estimating the benefits and costs, then also we will be discussing what are the recent developments in this CBA analysis along with the taxonomy of values that will be discussing in the class.

Thank you very much.