Energy Resources, Economics and Environment
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Lecture 13
Aggregation of Demand Curves

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Let us look at how we aggregate demand curves in the case of a private good. So, if we have two individuals and if we can prove this for two individuals, we can just extend it to n individuals in the society. So, if we have the marginal willingness to pay represent that on the Y axis and the quantity demanded on the X axis, so if the goods are rival then at any price we will sum up the total amount of goods that the consumers are willing to consume.

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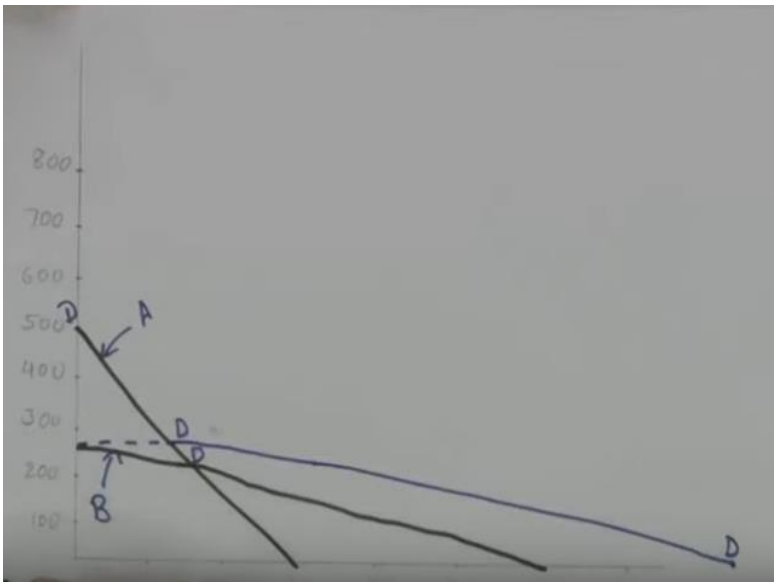

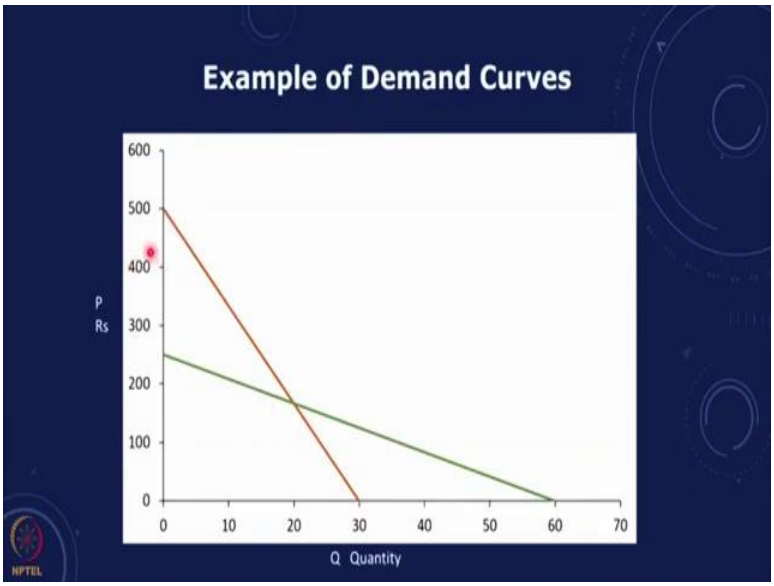

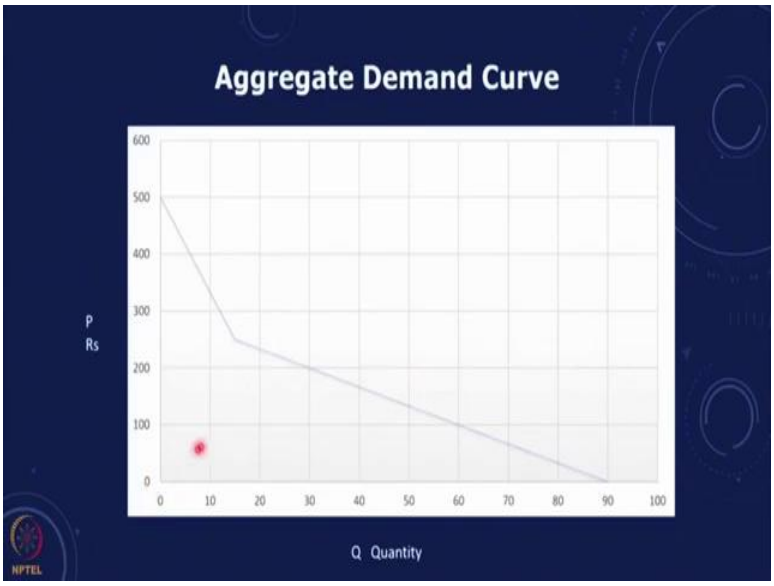

So let us look at this, let us sketch, let us consider a person who has a demand curve like this, which for a particular commodity, if the price goes beyond 500 we do not want to buy any of it and if the price reduces, the demand will increase, the maximum that we require for this customer is 30 units even if the, and if the price is 0, we are not going to consume more than that.

So, this is one particular demand profile, and let us look at another individual who has a demand profile where the consumer will only buy if the price is less than 250 rupees and at 0, at a 0 price the maximum amount that consumption would be 60. So, if we take this, you have these two demand profiles.

Now, we want to create the aggregate demand profile of these two consumers A and B so, at each price, we would see how much is the total demand. So, between 500 and 250 the total demand is just this, it is just that of A, here its B and beyond 250, when we see 250 and less than 250 at each price, we add up the demand of A and the demand of B. And so, what is going to happen is that beyond this point of 250, we are going to have a different slope.

At each of these points we will, at any point we will take the QA and QB and this will be the total demand. So, this is now going to go to about 90 over here okay, so this is our aggregate demand curve, this is the shape. So, just let us look at it whenever we are looking

at something a good that is rival at any price we will sum up all the quantities demanded by the individual demand curve and that is how we get the aggregate demand curve.

Now, on this if we superimpose a supply curve will get an equilibrium point, so for a private good this is fairly simple, you can take a look at it this is what we have drawn, this is the demand curve of A, demand curve B at each price then we aggregate sum it up from 500 to 250, it is only that of A and beyond 250 then we sum them up and this is what we get.

So, when we look at the then if we look at a particular supply curve, we will get an equilibrium. So, in the case of a rival good and a rival private good, this is fairly simple, each price just sums up all the quantities, we get the aggregate demand curve, combine this with this aggregate supply curve, so, that we can then get the equilibrium points. So, this is a fairly straightforward aggregation and this is how we can do this for the market.

Let us now look at what we can do for public goods. So, in the case of the public good what would happen is that we would consume, let us redraw this.

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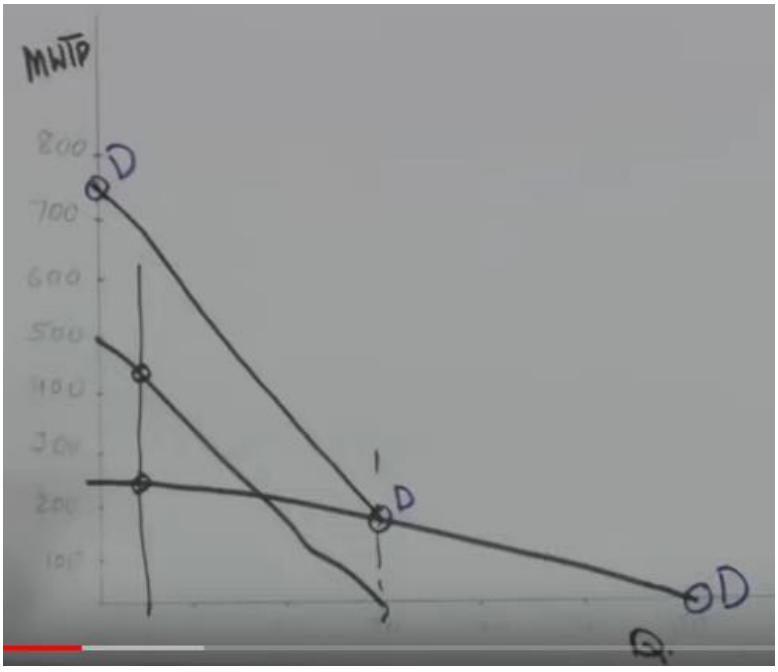

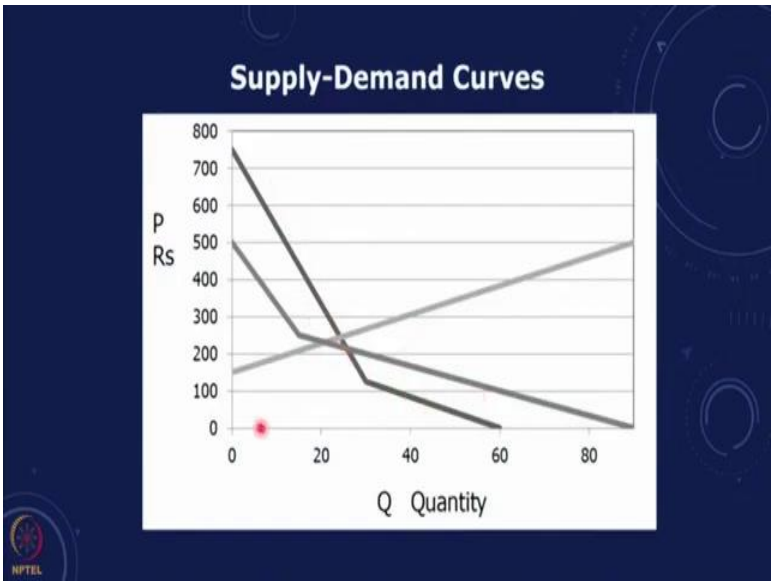

At every, this is the marginal willingness to pay, this is the marginal willingness to pay and this is the quantity. So now, what happens is that, in this society when we are talking of a non-rival good, all consumers will consume the same amount of good.

So, what would happen is that at every value of Q, we have to just sum up the total amount of price which we people are willing to pay. So, in this case, here when Q is 0, then at any Q value, we would then just add up the amounts of price which is being paid. So, here it would be 500 and so, you basically start at any Q we take and we add up this and then go ahead.

And so, this is the kind of, which starts from 750 and beyond Q is 30 it will come to here. So, this is how it is going to look, this will be a demand curve. So, the problem then becomes that when we try to get the kind of if you look at this curve which we have drawn, if we have a.

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In the case of the private goods, when the supply and demand curves intersect the marginal cost of production will be equal to the price.

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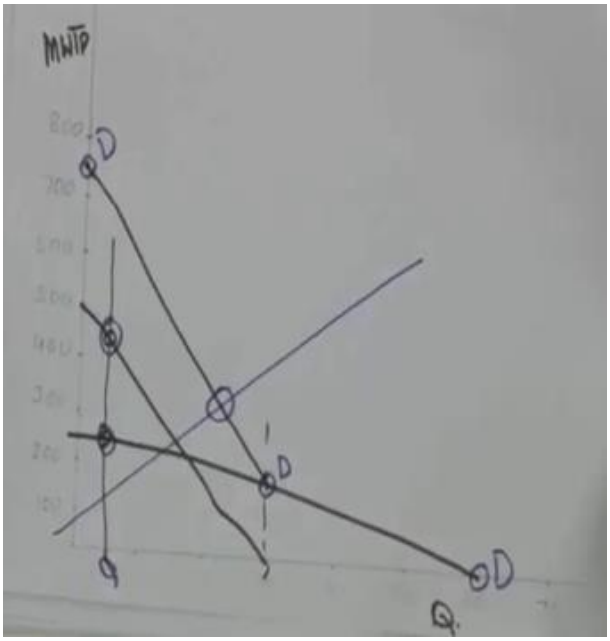

But in the case of the public good, which is non-rival, we will not be able to infer the market price from the intersection of the supply and demand curves for a non-rival good. For instance, if you look at, if the quantity supplied is here, we have two consumers who have

different, who are actually seeing different prices and so this is the problem when we have any, when we have an intersection of the supply curve and we get this, we do not know what will be the individual prices.

And then so, this is an issue when it comes to the non-rival or the public goods. So, let us look at how do we talk about an efficient public good pricing and let us look at an example where we are trying to see if we can get a Pareto optimal solution. So, consider a non-rival good. Let us say that there is a park with a fence around it and so it is non-rival, let us assume that it is a large park so, there is no congestion.

So, that means even if more people are coming in, it will not affect the quality of the enjoyment of the park by the people who are there. We can have a fence, we can have an entrance which we can control so, it can be made excludable.

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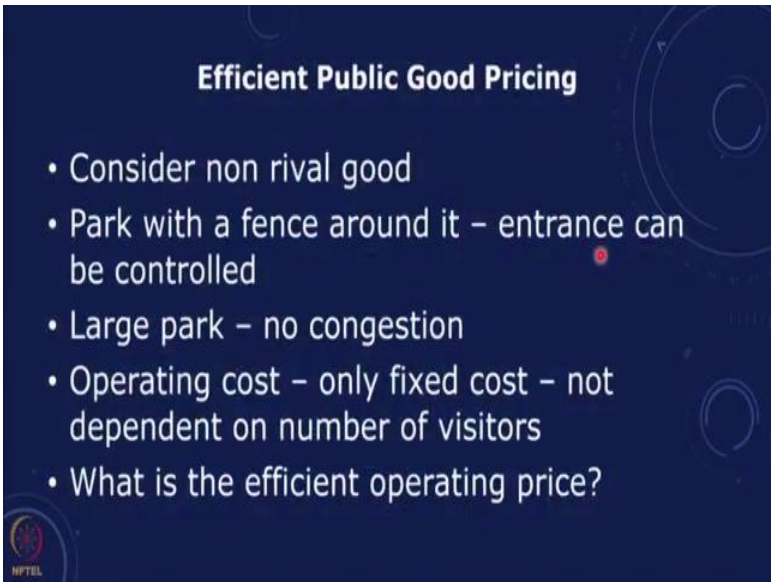

Now, let us make another simplifying assumption that the operating cost is only a fixed cost and it is not dependent on the number of visitors. So, if that, and that fixed cost which is there, let us say is subsidized or provided by some company as a part of its CSR or by the government and we want to know what is the efficient operating price.

So, let us look at a situation where we have the demand for this park in terms of number of visitors, that is the demand. Now, obviously, the number of visitors if the, if we look at the

price to be charged, price of entry, that some price there will be no one willing to come to the park. And as the price reduces, the number will increase so you will have something like this, this is the sort of demand curve for the park.

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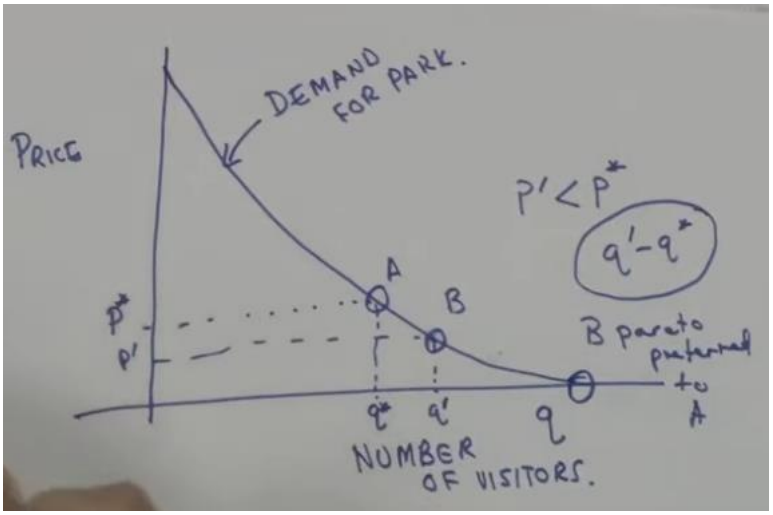

Now let us look at a situation where we put a certain price of entry okay. Let us assume as we said, let us say it was a fixed cost which is taken care of so, we do not have a problem in terms of providing some minimum costs, we want to know what is the solution, what is the price at which we should allow entry, so that we are getting the Pareto efficient frontier, what is an efficient operating price?

So, let us say that this is P star, now let us look at a situation where we have this P star, at P star, there are q star people who are willing to take this and come into the park. The question is this a Pareto efficient solution or would it be better to reduce the price? If you reduce the price then there will be more people so, now there are all these people who are not coming for the park.

But if I reduce the price and make it q dash and make it P dash, P dash less than P star you will find that at that price there are now more people, there is this q dash minus q star, these people from the point of view of these people that price reduction is better for the people who are anyway going to come at q star, for them also the this is a good option.

So, this point clearly is a Pareto preferred point, if we look at A, B is Pareto preferred to A. So, as you can see, what that means is that you can basically go down and the efficient price is when there is no charge for this public good and so this is a very interesting and useful result and so, the q0 then and this is where we will get the maximum number of visitors q0. So, it is efficient for a non-rival excludable good, the optimal price from the consumers viewpoint is 0.

Similarly, the optimal compensation for a bad is zero and that is an interesting kind of thing.

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For instance, if you look at an airport and you say that the airport has noise and should we compensate people who are staying in the vicinity and give them some benefit, because they have to face that noise. So, from an economic viewpoint and the optimal compensation is 0, because if we put a compensation this will adjust the tradeoff between noise and the other benefits of being near the airport.

And this can be shown that basically, even for the bad is a non-rival bad in the case of noise it is non-rival then it is not from an economic viewpoint, this compensation is not desirable. However, if the people were staying initially, and then you had an airport which is being built in terms of an equity and a fairness consideration, there could be a case for compensation and so, but from an economic viewpoint, as we said, the efficient public good pricing is 0.

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So, the next thing that we would like to look at is an example from Kolstad. So, as we just summarize what we have seen, the optimal producer price, efficient consumer price is 0, producer of course must have sufficient revenue to meet the cost and if the producer raises the prices, demand will get reduced and too little of the public good will be produced and so that is the kind of situation.

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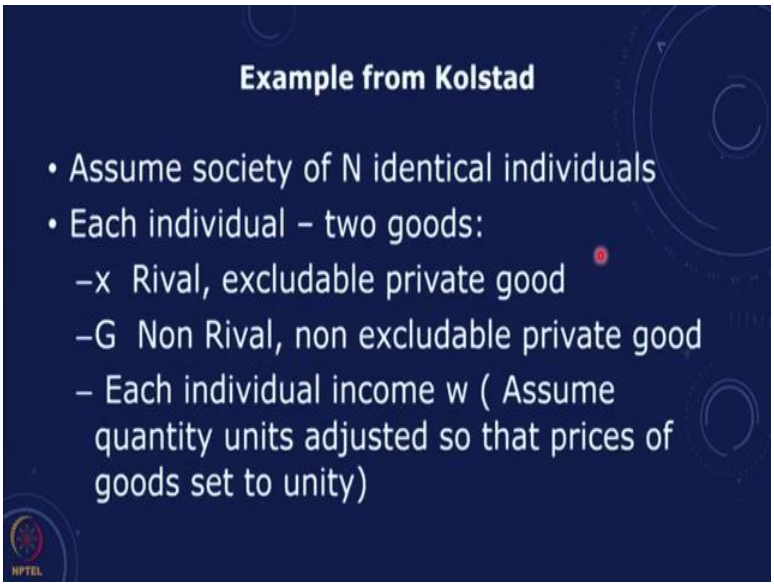

So, now we would like to see some logic in terms of, we would like to look at an example in terms of what can we talk, say about the market and the provision of public goods.

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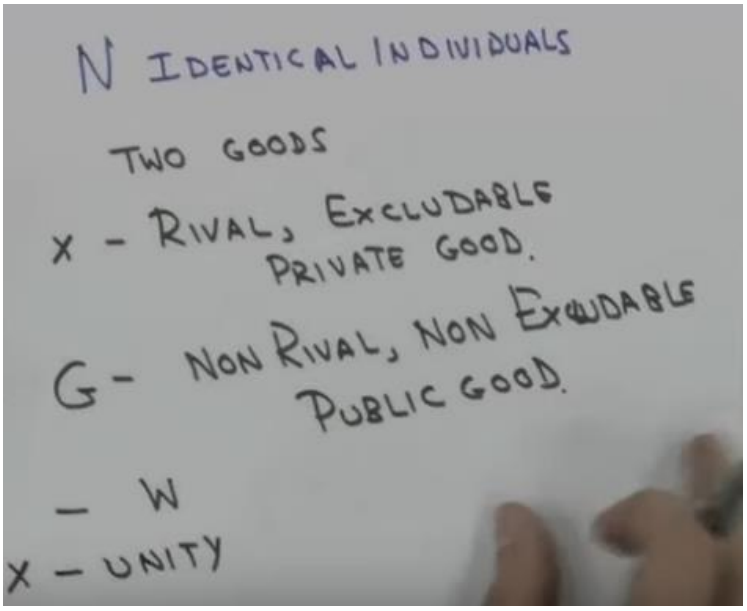

So, we have a hypothetical example, this example is from Kolstad, we assume that there are n identical individuals. this is you know hypothetical example, is created in order to illustrate an important concept.

All of these assumptions that are made can be relaxed when you talk of a generic context, but we start off do this for simplified assumptions and then we get some very interesting result. So, each individual we are saying each individual can consume two goods. One is x, which is a rival, excludable private good and the second one is G which is a non-rival, non-excludable public good, it should be public.

And though it is a public good, it is possible when it is being provided, it can be provided in the way of a market and it can be bought for. So, each individual has an income, maximum income W and we assume that the quantities are adjusted so, that the prices of the goods are set to unity that means, we will set the price of good x to unity and then the good G also can be taken as unity.

We can of course, adjust the quantities so that both have the same unit price and with this example, assumption, each individual will have a utility function.

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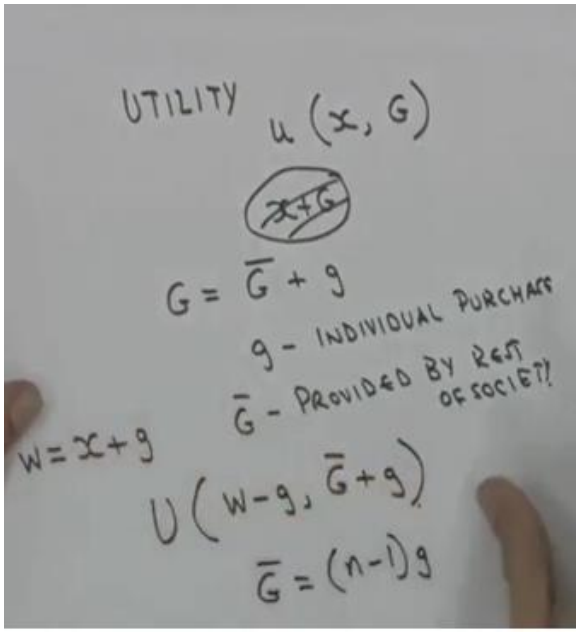

Remember this was a n identical individuals, each utility has an, individual has a utility function, which is a function of both these goods which are being consumed, x and G, x is the private good, privately produced, privately manufacture, the public good is public good.

But it can be produced and can be also bought privately, in the sense that, for instance, if you are looking at a park, an individual can contribute to the park management and pay money so, that you can have more features in the park. So, if we look at G being, let us say air quality.

Let us say some facilities which are being provided, which are enjoyed by everyone, which are non-rival, non-excludable and the total income that we have, which we are paying is going to be x plus G is what we are spending, sorry, x plus G are the other two benefits that we are getting.

In the case of G, G is provided by the provision from society, from all the other individuals and what each individual is paying, where g, small g is the individual purchase, individual purchase or payment for the public good and G dash is provided by the rest of society. So, the utility that you will have will be now, the total income that we are paying W will be equal to x plus small g. So, that x is W minus g and so this is in terms of the variables, W minus g, G plus small g

And now with this, you will see that if there is cooperative action, where I know that if I am making an investment, there is an agreement between all the n individuals, which says that if I increase my investment in the public good everyone else will cooperate and increase their investment. If we know that then what will happen is that this G bar will be n minus 1g.

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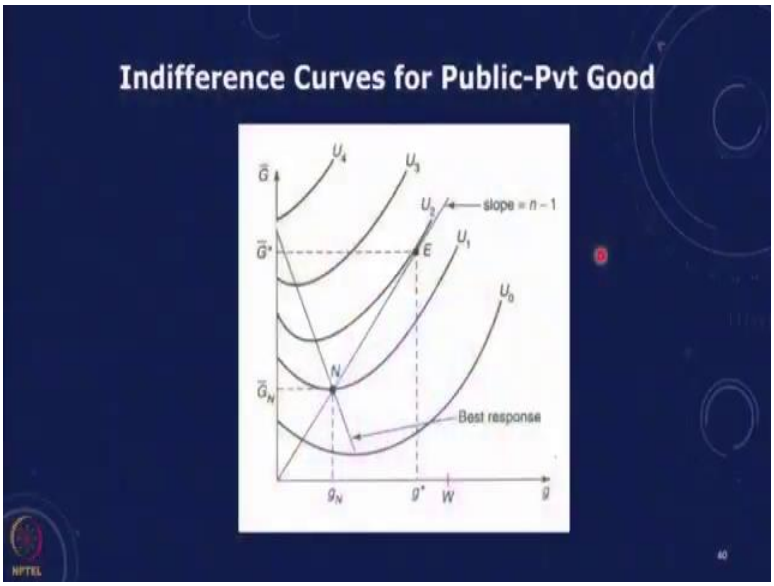

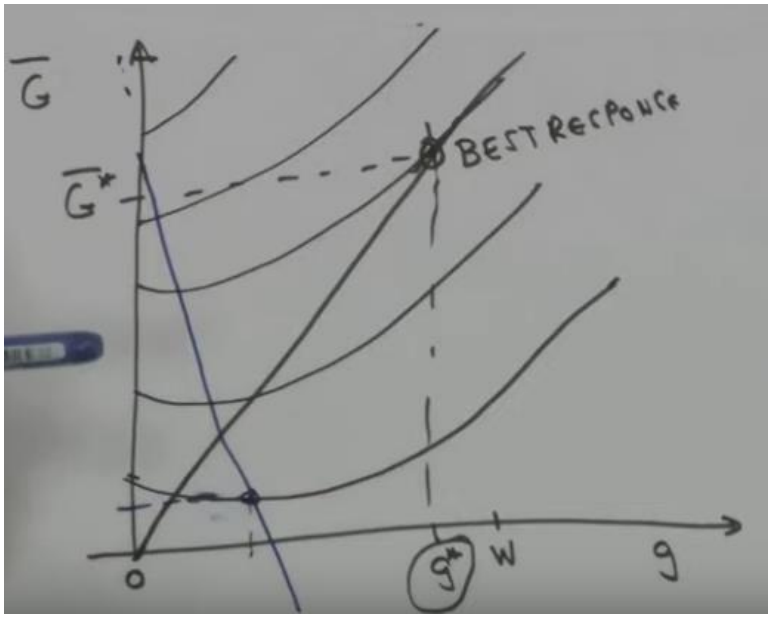

And we can make a plot, you can see this plot this is from Kolstad on the x axis, we can see the amount which we are investing and this will go from 0 to W on the public good. And on this side the amount which rest of society is investing in the public good.

Now, if you look at this, you will find that we are going to have utility functions as a function of as we had just now seen, this is a function of W minus g, G plus g, we can write, draw the utility function in terms of G bar and g and you will find that something like this where its increasing, while it is increasing. Now, if we have a situation where we know that there is cooperative action, then we will have a line with the slope.

This is the response that we will get with the slope of n minus 1 and the point where this is tangential to the utility function, this will be the best response and this point essentially is the optimal amount that we should be paying for the public good with the optimal amount by everyone else and this is if we know that there is cooperative action, where if we increase the amount that we are going to pay, others will also increase and then we get this kind of optimal and if you see on this point, this is where this will look like.

This is the line which is showing that this is the slope is n minus 1 and this is the, on the other hand if we do not know that this is going to be the case, and if we are given a fait accompli that others are going to, we know that others are paying a fixed amount, if others are paying a fixed amount we will essentially take any case and then take the amount g that we are doing.

So, accordingly if you keep increasing, we will get something like, we get a best response line like this, which is shown here, that means, take a fixed amount which is known and then you pay for that given that others are paying that, what is the maximum utility that we can get by paying? We will pay gN and this is the maximum utility and this of course, if this quantity increases this goes up.

But the interesting thing that we see is that the total amount of the good that we are producing gN plus GN cap is lower than the optimal amount g star and G star cap. And that is an interesting kind of thing which tells us that when we talk in terms of public good,

the market provision of the public good is not efficient, market will always under produce or under provide a public good.

And that is the reason why we need to have government intervention, we need to have policies and there is a case for looking at government provision and societal provision of public goods otherwise we will under produce, under provide.

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So, in concept if you think about it, this can also be explained with the fact that if I look at a public bad, it will be in the other way where the market will over provide public bad. And the reason for that is very simple. When we look at this, when we are making an investment, we are getting some benefit, but others are benefiting proportionately much more and if we are making a loss, we are taking a fraction of the loss, but we are taking the total fraction of the cost.

So, for instance, in this same thing is happens when we think in terms of this is the classic tragedy of commons example, if you look at Garrett Harding's original paper, if we look at a situation where there is a commons, which is enjoyed by different farmers, where the cattle are grazing on that farm and the question is that the commons can be sustained if the grazing is regulated.

But if each farmer is trying to maximize the revenue by having more cattle, it comes to a point where the commons actually gets depleted. Because if I add one more cow, I get the benefit in terms of the revenue directly, the loss is distributed amongst all the people and so this is the classic tragedy of commons case and then the climate change problem essentially is amenable to the same situation.

So basically, the number of polluters are injured somewhat by polluting most of the damage accrues to someone else, and that is the reason why we actually over produce public bads or under produce public goods.

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And typically, what we are looking at is the market typically under provides public goods and over provides public bad. So now the question then is that how do we decide what is the price for a public good.

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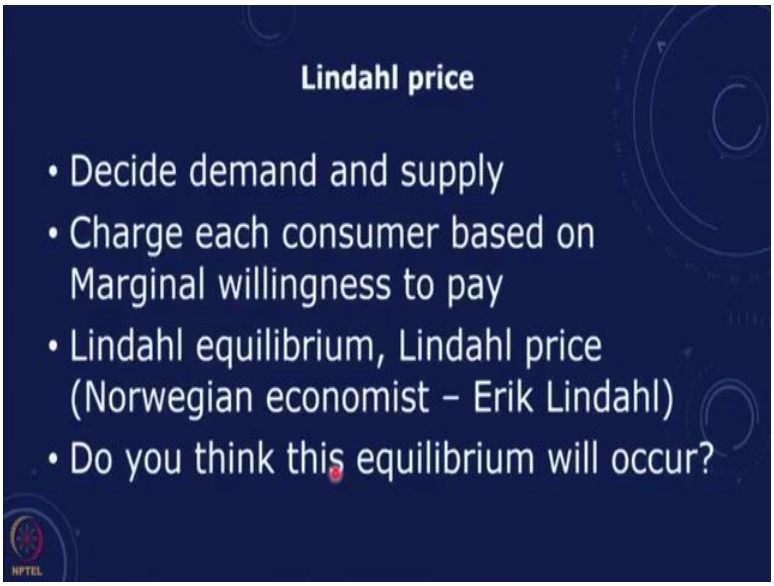

So, there is a Swedish economic, Lindahl, who proposed the Lindahl price and the Lindahl, sorry Norwegian economist, Erik Lindahl, and the Lindahl equilibrium or the Lindahl price is done in this fashion.

We look at individual demands and marginal willingness to pay. We presume that we asked each consumer what he or she is willing to pay for a certain quantity of goods or services and then get the marginal willingness to pay. We then add up all the marginal willingness to pay to get the total willingness to pay at any quantity and that is what we saw in the earlier graphs when we did that, and with the result that we then get an equilibrium.

Now, what you will understand in this case is that there is a problem, do you think this equilibrium will occur? Think about a situation where everyone is contributing for something. And everyone has been asked to state at what is your willingness to pay for that good. You will clearly see that there is an incentive to understate your willingness to pay.

Because you have a benefit by not disclosing your actual willingness to pay and there is no way of finding out the real willingness to pay and this is the biggest problem in terms of the Lindahl equilibrium but as a concept this is possible if you have a way if there is a society where people can disclose their willingness to pay and this is an honest disclosure, we can then sum this all up and get the total marginal willingness to pay.

And then we can get a Lindahl equilibrium and then find the intersection of the demand curve and the supply curve, but remember, then, what will happen there is that at that same quantity, which is being supplied, different individuals will be paying different prices based on their own willingness to pay and this is practically difficult to enforce.

So, what we have done today is we have looked at the classification between public goods and private goods. We have then seen when we talk in terms of demand aggregation for private goods and public goods. How do we make that aggregation, we looked at what is an optimal price, if we are looking at let us say, how do you set a price for a park or a public good?

And then we said, if we look at the marginal willingness to pay is there any way in which we can find an equilibrium and that is how we got, we talked about the Lindahl equilibrium and the Lindahl price. Thank you.