Conservation Economics
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Module 8
Public sector and Conservation
Lecture 1
Externalities

Namaste! Today, we begin a new module which is Public Sector and Conservation. This module will have 3 lectures - Externalities, public goods and common resources, and the design of the tax system. This lecture is about externalities. But before we begin, let us have a look at this principle of economics that we are touching in this lecture. Markets are usually a good way to organize economic activity.

Why are markets good ways to organize economic activity? Well, there are several reasons. Things like, there is an option of a free will, the buyers and the sellers see for themselves what is in their best interest, and they act according to their own best interest.

There is an option of free will; there is an option of choice because the market is going to provide those goods and services or those variety of goods and services that are going to increase the welfare of the buyers and the sellers.

At the same time there is a quick transfer of information, there are prices that act in the market that provide information about the demand and supply in the market. So, if the price of something is high, it means that that particular good probably is in high demand, and that would give a signal to the sellers to manufacture more and more of that good, so that they can also have a share of the profits.

And at the same time all of these also increase the efficiency of the system. So, it increases the benefits of the majority of people in the society which is why we say that markets are a good way to organize economic activity. But the thing is they are not always. It says here markets are usually a good way, but not always. Why?

Because when the markets are working by themselves, we have observed or we have suffered from a number of environmental and ecological damages things such as the Minamata disaster of Japan. Now, we will look at this in greater detail in the 12th module, but in short the Minamata disaster occurred because there was a company producing acetaldehyde that was dumping the used catalyst into the oceans.

So, whenever there is a production process, there will be some kinds of waste that are generated. Now, in this case in the case of the Chisso factory that was manufacturing acetaldehyde the waste was they spent catalyst that was having mercury inside. Now, the company could have done two things. One, it could have treated the waste before it was disposed of which was the

right option, but it would have incorporated a certain cost to the company.
The cost of trading the cost of installing equipment in the company to treat the waste. That was the right approach, or the approach that we as a society would have preferred. But for the company it was something that was in it that would have led to an increase in the price or an increase in the cost of production.
What they did was, they did not treat any of the suspended catalyst and it was directly dumped into the seas. Now, when you add mercury into a system, mercury is a heavy metal and causes a number of neurological disorders. The nerves of the body do not function that well when somebody is fed with mercury.
In this case what happened was when the suspended mercury or the compounds of mercury when they were dumped into the seas, it started entering into the bodies of several organisms. And in a short while people started to observe that the fish in the seas were dying and they were coming on top. They were floating on top and Minamata happened to be a very good fishing village, fishing was the major occupation in this village.
And in a fishing village when you observe that so many fishes are dying off, it creates a problem of livelihood because if there are no fishes what will the fishermen do. Second thing that they started to observe was that the cats in the city started to show very bizarre symptoms. They started to show repeated movements, they started to commit suicides because of the neurological disorders.
After a few more years, people started to document that we were seeing all these symptoms in humans as well because the humans who were eating the fish from this sea that was contaminated with mercury were also getting mercury in their own bodies by means of this food - the fish. And so people also started showing a number of neurological disorders.
When the cost was computed of the extent of environmental damage, the extent of health damage, and the extent of social damage, it ran into a compensation of billions of years of billions of yens per year. So, that is the Minamata disaster of the 1950s. Now, in this case, the company could have treated the waste before it was being dumped.
In that way, this disaster could have been prevented. But then because the company was acting only in self-interest, it was not looking at the interest of the society, so it ended up committing such a big blunder that it ended up paying a huge amount of money out of the company's coffers as well. Now, this could have been prevented had this externality been internalized in some manner.
Another example is the London smog of 1952 in which so much pollutants were released that it created a big social menace. The release of dioxins from the Seveso plant in Italy in 1976. The Love Canal waste dump, now this is a very important waste dump story because in this case what was done was that these waste the industrial waste extremely toxic chemicals, they were just dumped into an area with no treatment at all.
After a while this dump yard was covered with a small bit of soil, and then it was sold off to be constructed into a school. So, a school was actually constructed on top of a dump yard that was having extremely toxic industrial chemicals.
When the pupils in the school started showing symptoms when the pupils started getting ill, then

people came to know about this. Now, in this case as well there was a company that was dumping these waste to cut its costs, it is just a cost cutting approach nothing else.
If we have a look at the Bhopal gas tragedy in our country in 1984, in this case as well it was just a simple matter of cost cutting. What the company did in those days, the Union Carbide Corporation, what it did was that to cut costs it started accumulating the MIC liquid that was extremely toxic and should not have been accumulated in large quantities.
And then when it was accumulated, it was kept in those tanks that were not that well maintained. So, into those tanks water was able to seep in. The liquid had to be kept refrigerated because it was extremely reactive when the temperatures went up, but the refrigeration unit was shut down to cut costs.
Also when the gas got released because of this poor maintenance, the flare towers were not working, the chemical wash towers were not working. So, all of these things could have been prevented had the company actually spent some amount of money into proper maintenance.
Now, that was expected of them because as a society we do not want to have companies that release such toxic chemicals into the environment.
But a company that was only working on a profit motive, it did not consider these social costs that get involved. Again here is when there was an externality in pain. Or the Chernobyl nuclear accident or deforestation pollution global warming you name an environmental problem, and there are a number of externalities that are involved in most of them.
So, while markets are usually a good way to organize economic activity, they are not always because of a number of market failures. Now, what is the market failure? The markets have a big role to play in our society because they increase the welfare of the people, they increase the welfare of the buyers, they increase the welfare of the sellers. And theoretically they should bring the society to a level that is the optimum level.
So, you cannot increase the welfare of any particular person without reducing the welfare of someone else. hm In those situations, they say that it is an optimal level of welfare.
Markets, if they work well, should be able to bring the welfare to the optimum level because each seller will be able to get the highest profit for what he is making, and each buyer will be able to get all the products at the cheapest possible cost and at the best quality. Now, this is what the market is telling us. But a market failure occurs when through some processes this optimality or this level of welfare is not reached.
So, market failure is a situation in which a market left on its own fails to allocate resources efficiently, that is it fails to allocate the resources things like money, things like time, things like resources to those units or those companies that are acting in the best welfare of the society, so that is a market failure.
And two major causes of market failure are externality and market power. Externality is the impact of one person's actions on the well-being of a bystander. So, in the case of externality, what we are saying is that there is an actor who is doing something, and because he is doing that there is an impact on a bystander who has got nothing to do with that action.
For instance, the students who were studying in the school that was built on the Love Canal site, they had got nothing to do with the dumping of these toxic industrial waste into the Love Canal,

but still they had to suffer the consequences. So, that is an externality because the action was done by one company to put untreated toxic industrial waste into a Canal site, and to sell that off to for the construction of a school.

But the impacts were suffered by the students - small children who had got nothing to do with that. So, the small children in this case, the pupils were the bystanders. And the company who was dumping these chemicals was the actor in the case of Minamata disease as well.

The company Chisso Corporation was the actor who did the action of dumping untreated mercury laden industrial waste in the form of spent catalyst into the seas. The fishermen did not ask the company to dump that.

The fishermen were completely bystanders, the fishes were completely bystanders, the cats in the city were bystanders, the residents of the city or of nearby places were all bystanders. They did not ask the company to do that.

But the company made this mistake of dumping the chemicals, but the consequences were suffered by all of these. Or the Bhopal gas tragedy, in that case the people of Bhopal did not ask the Union Carbide Corporation to maintain its plants in a sub optimal level to store a large quantity of the MIC gas and to shut down all the safety precautions, the people of Bhopal did not do that.

They had got nothing to do with the action of the company which was to cut down the cost. And to blatantly flaunt all the good practices that are required in the storage of this chemical MIC. But then this suffered when this chemical got released. So, the people of Bhopal in this case were the bystanders.

All of these are examples of externalities and the impact of one person's actions on the well-being of a bystander. Another cause of market failure is market power. The ability of a single economic actor or a small group of actors to have a substantial influence on market prices. A good example is a person in a village that is suffering from drought conditions and this is the only person with a well.

So, you can charge any amount of money. Or another example is say a contractor that is purchasing sugarcane from a very large area, and he is the single contractor. Now, in that case whatever price he offers is the price that the farmers of sugarcane will get. So, he has a tremendous amount of market power.

We can have market power in terms of the seller, for example, the owner of the well in the drought village or in the form of the buyer when you have only a single buyer such as the contractor of sugarcane from a very large number of villages.

If you have buyers or sellers who are in a very small number, in those circumstances it is very much possible that one or a few buyers or sellers may influence the market prices, and that is known as market power. So, they are having power over the market in terms of the price that the market brings up.

Now, in this lecture, we will focus on externality, the uncompensated impact or the impact of one person's actions on the well-being of a bystander. And when we talk about externalities, we can have negative externalities or positive externalities.

Negative externality is when the bystander is impacted in a negative manner such as if there is a

company that is releasing pollutants, the people in the surrounding area have to suffer the health consequences and so it is a negative externality.

And so in certain other cases we have a positive externality such as things like vaccination. So, if people get vaccinated, they are not only protecting themselves, but they are also providing herd immunity for the community which means that the diseases will not be able to spread that easily in a community where a large number of people are already vaccinated.

So, they are providing a positive impact through their vaccination, through their action of vaccination, they are providing a positive impact to the bystanders in the community who did not ask these people to get vaccinated, who did not pay money for them to get vaccinated, but they also receive a benefit because their community and from that they themselves are now less prone to getting the disease. That is the positive externality.

We can also talk about production externality and consumption externality. The production externality is something that occurs when there is a production of a good. Consumption externality is something that occurs when there is a consumption of a good. When the company is producing something and is releasing pollutants this is a production externality.

If somebody is buying those products, then through this process of buying or through the process of using certain products if they are releasing pollutants, then it is known as a consumption externality. A very good example is those vehicles that release a large amount of smoke.

The people who are consuming these vehicles, who are using these vehicles, are spreading pollution into their communities by means of consuming this pollution spreading vehicle.

In this case, they will say that it is a consumption externality. So, let us now look at these four combinations. So, we have negative or positive, and we have production and consumption.

So, we can have negative with production, negative production externality. Negative consumption externality, positive production externality, and positive consumption externality. And we look at all four of these.

Let us begin with the negative production externality. There is a production that is going on and it is leading to a negative externality or negative consequences. When a firm's production reduces the well-being of others who are not compensated by the firm. When a firm's production, there is a production that is going on and this production reduces the well-being, which is negative of others who are not compensated by the firm.

Good examples are industrial pollution and loss of ecosystem services due to mining. Now, in the case of mining, there is a company that is doing a production of these minerals or coarse. And because of this activity there is a loss of ecosystem services in the form of say clean air or clean water in this area. So, this is a negative production externality.

Industrial pollution also is another negative production externality because the industry by means of producing something the producing goods it is creating pollution in the surroundings that is reducing the well-being of others who are not compensated by this particular industry.

In the case of negative production externality, we can differentiate between the private marginal cost and the social marginal cost. What is that? Private marginal cost is the direct cost to the producers of producing an additional unit of a good. It means that suppose there is an industry that is manufacturing pens. And in the manufacture of pens, they are using a process that releases

a large amount of smoke to take a hypothetical example.

The cost that it takes the company directly to manufacture one additional unit of a pen is the private marginal cost. So, it is a private cost. So, this is a cost that is being paid by the company. So, it is a direct cost to the producers. And at the same time, this is a marginal cost which means that it is the cost of producing an additional unit of a good, just one more pen. How much does it cost the industry to manufacture just one more piece of pen?

Now, this is marginal, because we are not talking about an average cost, we are not talking about the cost of manufacturing a hundred pens, we are just asking the question what is the cost of one more unit of production. And direct cost because it is the cost that will be paid by the company.

Another cost that is involved is the social marginal cost. When society uses this good, now when the producer is making it, it is the producer who is making it for somebody. So, somebody is going to purchase this good.

Now, the buyers who are going to purchase these goods will pay the company a certain amount of money which is the price of this particular product, but they are not just paying the company, but they are also paying the doctor or the healthcare system.

Why? The pollution that was created by the production of one extra pen is also causing a negative side effect on a number of people in their community who will have to pay for their own health costs because the company is not compensating them for the pollution.

Now, if we add that cost to the price that is actually paid for the purchase of one pen that is the social marginal cost. So, it is the private marginal cost to the producers plus any cost associated with the production of the goods that are imposed on the others, so that is the social marginal cost: the cost to the society of one extra unit of something. Now, that cost is paid to the company, and it is also paid to overcome the side effects of production.

In the case of a negative production externality, the social marginal cost is greater than the private marginal cost because there is a marginal damage that is also included. So, the social marginal cost is equal to the private marginal cost plus the marginal damage because the society is not just paying the private marginal cost, but it is also paying the marginal damage because of the use of this particular good.

So, MD here is the marginal damage. So, SMC or the social marginal cost is a private marginal cost plus the marginal damage. Now, why are we incorporating this private marginal cost? Because the society will be paying this amount for the production. Now, when we talk of production we are not just saying that the industry is producing things the society is also producing something.

Ultimately this is a decision that has to be taken by the society at large. Do we want pens to be manufactured by this particular process? Now, remember that we had said that a society's level of being or the living standards are decided by the amount of production in that particular society.

So, the society wants this particular good to be manufactured because it wants to raise the standard of living of the people who are living in this particular society. Now, to raise the standard of living, they will have to produce more. And when they are producing more, there is a cost involved in production and there is a cost of the marginal damage that is being made.

How does it look on the equilibrium curve? Now, this is our normal equilibrium curve. So, we have a demand curve and we have a supply curve. And where the demand and supply are needed we have the equilibrium point that gives us the equilibrium price, and that also gives us the equilibrium quantity that is demanded or supplied by this market.

In the case of a negative production externality, if we do not consider the externality at all, then this curve will tell us the market equilibrium. So, here s is the private cost or the cost of production. Now, you will remember that the supply curve is given by the cost of production of the goods to the seller which is what we are seeing here. The cost of production is giving us the supply curve.

The demand curve is given by the private value that people are putting for this particular good. Now, in this example, the value is given by the amount a person is willing to pay for this particular pen. So, here we are observing that we have the private cost, and we have the private value that is giving us the demand and supply.

But when we consider the externality, then this private cost becomes the private marginal cost for each point on the curve. And there is a marginal damage that is also incorporated. And so we have a social marginal cost. Now, the social marginal cost at any point is the private marginal cost plus the marginal damage. So, the cost at this point plus the damage will give us the social marginal cost.

Because there is an increase in the cost because we are also looking at the cost of marginal damage. So, whenever there is an increase of cost, the supply curve shifts to the left which is what we are observing here. So, the supply curve in this case has shifted to the left. And the amount of this shift is given by the marginal damage that we have. So, in the case of the equilibrium considering the negative production externality, there is a shift in the supply curve.

Now, let us have a look at the benefits. Here we can talk about the private marginal benefit, and the social marginal benefit. Private marginal benefit is the direct benefit to the consumers of consuming an additional unit of the good by the consumer which means that as a buyer if I purchase this pen, what is the amount of benefit that I am getting is the private marginal benefit, the direct benefit to the consumers of consuming an additional unit of the good by the consumer.

And we also have the social marginal benefit, the private marginal benefit to the consumers minus any cost associated with the consumption of that good that is imposed on others. Now, in the case of the negative production externality such as manufacturing a pen with the polluting process, if I am purchasing a pen, I am not putting a cost on others by using this pen because the cost has already been imposed during the manufacture.

When I am using this pen and we in this case we are not talking about the pollution that will be spread, then I throw this pen out into the dustbin. But while I am consuming the goods, from the time that I purchase this pen and till the time I am writing with this pen, I am not imposing any cost on others because of this consumption.

If there is a cost that is involved, then we will have a difference between the social marginal benefit and the private marginal benefit. But in this case because it is a negative production externality only the social marginal benefit is equal to the private marginal benefit because no costs are imposed by the consumption of the good. So, in this case, the benefit curve and the

demand curve is given by this D where private marginal benefit is equal to the social marginal benefit.

And there is a deadweight loss that is involved. So, what are we observing here? If we for instance take a quantity of this much, now what we are observing is that the benefit of this particular quantity of goods is given by this point where the quantity line the vertical line is intersecting with the demand curve. Now, the demand curve is giving us an indication of the value of this particular good.

It is giving us an indication of the welfare or the surplus that it will provide to the buyer. Now, in this case, the cost to the society is given by this point where the quantity curve which is the vertical line is intersecting with the social marginal cost curve. In this case, this is the benefit and this is the cost. So, it means that the benefit is greater than the cost.

So, the benefit is greater than the cost. Now, if we consider a point, say here, so this is the quantity that we are looking at Q. Now, at this quantity, the cost to society is this much. This is the cost to society. And the benefit to the society is given by this point, where it is intersecting with the demand curve and this is the benefit.

What we are observing here is that the cost is greater than the benefit. So, for this point, we have here we have cost greater than benefit. Now, in the case of economics, we had begun with our assumption that everybody is a rational decision maker which means that if the benefit is greater than the cost, then the decision to manufacture the good should be taken, but if the cost is more and the benefit is less than the society should not allow the manufacture of that particular good because it will cost the society more, but the benefit that the society gets is less.

Essentially, what we are saying here is that at this equilibrium quantity which is the optimal equilibrium quantity, this is the amount of goods that should be made or demanded or supplied, where the social marginal cost line is cutting the benefit line. But in actuality what is happening is that we are having this much amount of good that is being demanded or supplied, because this quantity we were getting when we were internalizing the externality.

This is the point which we are getting when we are not internalizing the externality. So, what is happening is that there is a deadweight cost involved. The deadweight loss is created for the society because some units are being produced and consumed for which the cost to the society is greater than the benefit to the society, or the social marginal cost is greater than the social marginal benefit.

This is the deadweight loss that gets created because of the negative production externality because for all of these units the cost given by the social marginal cost is greater than the social marginal benefit. So, this is the deadweight loss in the case of a negative production externality.

We can also have a negative consumption externality. When an individual's consumption reduces the well-being of others who are not compensated by the individual such as consumption of cigarettes. So, if somebody is consuming cigarettes, the people who are sitting around him or her are also becoming passive smokers, they will also suffer the health consequences of inhaling the smoke that is arising because our actor is consuming the cigarettes.

These people have got nothing to do with this person having the cigarettes, but they will have to suffer the consequences. So, it is a situation where an individual's consumption is reducing the

well-being of others who are not compensated by the individual. So, in this case, the people who are becoming passive smokers and who will have to suffer the health consequences, they will not be paid by the person who is consuming the cigarettes.

It becomes an uncompensated loss to others which is why it is a negative externality, and it is arising because of consumption. It is a negative consumption externality. Partying with a loud noise, now, in this case the people who are doing the party, they are having all the fun.

They are consuming the loud noise, but the consequences are suffered by the people who reside nearby because they do not want to have that loud music and a number of those people might also suffer because of the loud noise.

They will not be able to sleep properly if it is their sleeping time or they might suffer from certain health impacts. It is an increased hypertension. Now, this is a cost that the people who are doing the party are imposing on others and they are not compensating for it. So, they are not going to go to the others' homes, and pay the same amount for the cost of their treatment of hypertension.

Or consumption of SUVs - the sports utility vehicles. Now, these are large size vehicles that emit a large amount of pollution. So, they impose a cost on the society in terms of global warming, because they are consuming more fuel. And this fuel will get burnt and it will increase the amount of greenhouse gases that we have in the atmosphere. So, each SUV is doing a small bit to increase global warming.

Now, this cost is being imposed - the cost of global warming or the cost of climate change - is being imposed on the society by the people who are using these gas guzzling vehicles, but these people are not paying the society back or they are not compensating for the damages. So, it is an externality.

It causes damage to the roads because of a higher weight, but then these people are not going to pay extra for the maintenance of the roads. They lead to more insecurity to other vehicles due to their higher momentum. So, if there is an accident with two light vehicles, then the amount of damage that anybody suffers is less. In the case of an SUV because of its large weight, the momentum is higher.

And so the damage that it can cost to another vehicle is also higher. Now, this cost of the probability of having a higher damage is not being compensated by the owner or by the user of the SUV. So, this is a negative consumption externality. Now, in this case, again we can talk about the private marginal cost and the social marginal cost.

And the definitions are the same. The direct cost to the producers of producing an additional unit of the good is the private marginal cost. And the private marginal cost to the producers plus any cost associated with the production of that good that is imposed on the others is the socio marginal cost.

Now, in this particular case, we are not talking about the cost caused by the production of the SUV. We are only concentrating ourselves with the damage that is caused by the consumption of the SUV. And so in this case, we will say that the social marginal cost is equal to the private marginal cost because there are no costs that are being imposed by the production of goods.

We are not considering any cost in the production of the SUV, we are only concentrating on the

cost of consumption, and so we will say that for our analysis SMC is equal to the PMC. Which means that when we talk about the equilibrium and when we are not considering the externality, we have a private cost and we have a private value.

And in the case of the negative consumption externality, we are saying that the private marginal cost is equal to the social marginal cost. There is no change in the cost of production which means that there is no change in the supply curve. We are saying that there is no change in this green line.

On the other hand, when we look at the private marginal benefit and the social marginal benefit, the private marginal benefit is the direct benefit to consumers of consuming an additional unit of a good by the consumer that is the benefit that the person who is using the SUV is deriving out of using the SUV is the private marginal benefit. The social marginal benefit is the private marginal benefit to the consumers minus any cost associated with the consumption of the goods that are imposed on the others.

What we are saying here is that we have the social marginal benefit which is the private marginal benefit minus the marginal damage that is being caused by the consumption of an extra unit of SUV or by the consumption of an extra cigarette, or by consumption of an extra minute of loud noise. So, all of these are leading to marginal damage. And if we subtract that marginal damage from the private marginal benefit, we get the social marginal benefit.

What we are saying here is that the benefit to society in this case is not equal to the sum of the private benefit of everybody. It is the sum of the private benefit of everybody minus the marginal damage that this consumption has caused. So, if you look at the society in total, there is a benefit because of the use of the SUVs, there is a cost because of the use of these SUVs. And if you subtract the cost from the benefit, you get the net benefit which is the social marginal benefit.

In this particular case the margin because the social marginal benefit is less than the private marginal benefit. So, the curve will shift to the left. So, here we are observing that there is a change in the demand. And the demand is shifting to the left. And how much will this curve shift to the left is given by the marginal damage that is being caused by the consumption of an extra unit of this particular good.

So, we have a situation where the social marginal benefit is equal to the private marginal benefit minus MD. The social marginal benefit is less than the private marginal benefit and the difference is MD or the marginal damage. Now, when you have such a situation when the social marginal benefit is less than the private marginal benefit, then it creates a situation where you are having more amount of consumption than is the socially optimal level of consumption.

What do we mean by that? If we look at this curve and if we consider a point here, now the cost to the society is given by this point, the benefit to the society is given by this point. So, in this case, the benefit is greater than the cost. And for all the points to the left of this point, we will find that the benefit is greater than the cost. But at all the points to the right of this point, we will have a situation where the cost is given by this point which is there on the S-curve or the social marginal cost curve.

This is the cost, and this is the benefit that the society is getting. Now, in this case for all the points to the right of this point, we will have a situation where the cost is greater than the benefit.

What does that mean? Remember that in economics we say that people are rational decision makers.

As a society, consumption of an extra good is leading to a cost which is greater than the benefit. In that case, that amount of goods should never have been produced because by not producing that good or by not consuming that good, the society can increase its total surplus.

The aim of the market was to enhance the social surplus of all the buyers and of all the sellers together. But, in this case, we are observing that we are consuming certain goods for which the cost is greater than the benefit. This leads to a deadweight loss situation.

A deadweight loss is created for the society because some units are being produced and consumed for which the cost to the society exceeds the benefit to the society. So, the social marginal cost is greater than the social marginal benefit.

And the quantum of this grade weight loss is given by this gray colored triangle. The actual social optimum quantity should have been this much, but the quantity that is being produced is given by this point when we are not considering the externality. All of these gray portions become deadweight loss.

We can also have situations of positive production externality. Positive production externality occurs when a firm's production increases the well-being of others, but the firm is not compensated by those others. Examples: a firm digging canal is paid for digging, but also benefits the farmers.

When they give a firm a contract to dig a canal, then we will only pay the firm on the basis of the amount of earth work that the firm is doing. The amount of earth that it has dug and removed to create the canal is the amount that we are going to compensate the firm.

But when the canal is dug then it also increases the agricultural productivity of the surroundings because now people have more water for irrigation of their crops. Now, this has an effect on the bystanders - in this case the bystanders are the farmers of the surroundings.

Now, those farmers were not paying for the digging of this canal, they did not pay the firm. But they are reaping out the benefits because of the action that the firm did. And the firm did not receive any compensation for the benefits that it provided to the farmers. This is an example of a positive production externality. It is positive because it is providing a positive impact on the bystander.

It is a production externality because this externality arises because of the creation of something, the production of the good. So, this is a positive production externality. Now, when the firm income increases, the standard of living in the surroundings may increase which will then also reflect in the nutritional status of children.

It will reflect itself in the educational status of the surroundings. Now, all of these positive benefits are being provided for by this company, but it is not receiving any um compensation for these positive impacts so which is why this is a positive production externality.

Another example is a firm that is doing mineral exploration because it also paves way for other firms once the mineral is found. In this case, there is a firm that is doing mineral exploration, and it is being paid for only the amount of exploration that it does, that is it is being paid for how many square kilometers of area it has explored.

But when there is the discovery of an important mineral in that area and important ore in that area, then it will also result in huge amounts of employment because there will be other firms that will come to this area once the ore has been found. And they will extract this ore and in the process, they will also provide a large quantum of employment.

Now, the firm that was doing the exploration is not getting paid for the development of a surrounding that will happen if it is able to find out an ore so which is why this is a positive production externality it is bringing in a positive impact in the terms of employment or in terms of the total production of a country or in terms of the living standards in a country. So, these are the positive impacts that are being brought about by the firm that is in mineral exploration.

And this is a production externality because it has got nothing to do with the consumption aspect. The firm is only doing a production activity in terms of the service that it is providing. But because of this production it is giving a positive impact on the bystanders that is to say the people who will get jobs because of the extraction of these minerals, and the firm is not getting paid for that it is not getting compensated for that which is why it is an externality.

In such cases, we can talk about the private marginal cost and the social marginal cost. Now, private marginal cost as we have seen before is the direct cost to the producers of producing an additional unit of a good which means that in the case of the firm that was digging the canal, it is the cost of how much does it take to say dig an extra kilometer of the canal.

The direct cost to the producer is the direct cost to the company that is digging the canal of producing an additional unit which is say 1 kilometer of the canal. Then we also have the social marginal cost. The private marginal cost to the producers plus any cost that are associated with the production of the goods that are imposed on the others.

Now, in this case, the positive in the case of positive production externality we have social marginal cost equal to the private marginal cost plus the cost of production of goods that is imposed on others, in this case this is a negative figure. So, we get SMC is equal to PMC minus the marginal cost or plus the marginal benefit.

What we are saying here is that the social marginal cost is equal to the private marginal cost plus the marginal cost that is imposed on others. In this case, the cost is negative because it is a benefit, it is actually not a cost. So, this becomes a private marginal cost minus the marginal benefit that this production is providing to others. So, SMC is PMC minus the marginal benefit.

In this case, the society has to pay less of a cost because it is paying for the cost of taking minus there should be also a deduction for the benefit that this activity is given to the society. For instance, if I were to purchase this pen, and I am paying 30 rupees for the purchase of this pen, but I am getting 10 rupees back. So, in that case, the cost that I am paying for this pen is 30 rupees that I am paying minus the 10 rupees that I am getting back in the form of the benefit.

The social marginal cost in this case is the private marginal cost minus the marginal benefit. So, how does that affect the equilibrium? So, this is our normal equilibrium. And when we are not considering the externality, we are only talking about the private cost and the private value. But, in this case, the cost to society is less. The social marginal cost is equal to the private marginal cost minus the marginal benefit. It is costing society less to manufacture this good.

Now, if you look at the benefit or the demand side, then we have the private marginal benefit and

the social marginal benefit which is what were defined as before. But, in this case, there is no cost that is imposed by the consumption of the good. So, if the society is consuming an extra kilometer of the canal, then there is no cost involved in consuming the canal or in getting water from the canal.

In this case, the social marginal benefit is equal to the private marginal benefit because there is no change in the demand curve which is what we are showing here. What is happening in this case is that the society is paying for the taking of the canal, but it is also receiving a value in terms of the positive externality that is accruing because of the taking of the canal.

So, the society paid 30 rupees, but it got 10 rupees back in terms of the other benefits. Another example is if I purchase this pen for 30 rupees, I get this pen which is worth 10 rupees free with it. So, the cost that I am paying for this pen is 30 rupees minus this 10 rupees is what we are saying here.

The social marginal cost reduces by this amount of marginal benefit, but there is no change in the social marginal benefit because of an extra unit of the canal. So, the demand curve remains the same. The supply curve shifts to the right. Now, why is it shifting to the right? Because it is costing society less to manufacture the canal. So, if the cost of production goes down, then the supply curve shifter shifts to the right.

Now, in this case as well we can observe certain deadweight loss. A deadweight loss is created for the society because some units are not being produced and consumed for which the benefit to the society exceeds the cost to the society which means that if we consider the externality then the optimum quantity is this much where the red curve and the demand curve are intersecting.

But when we do not consider the externality, the optimum quantity is given by this intersecting point. So, these products from here to here are not being manufactured. Even though for each of these the cost to the society, say, if we consider a point here the cost to the society is this and the benefit to the society is this.

So, we have a benefit that is greater than the cost, but still we are not manufacturing this because we did not consider the impact of the positive externality. So, this is a deadweight loss given by this gray colored triangle. Then we also have a positive consumption externality. When an individual's consumption increases the well-being of others but the individual is not compensated by those others.

The individual is consuming something. This is a consumption externality where an individual is consuming something, but through it his or her consumption there is also an increase in the society's well-being or in the well-being of a bystander which is why it is an externality. And this is a benefit, so it is a positive impact. So, it is positive consumption externality, externality.

Examples include vaccination because they stop the spread of infections to even those people who are not getting themselves vaccinated. Or education of children because when children are educated when people in a country are educated, then it also has benefits to all the members of the society in terms of not just a better political thought process, but also because these educated people will probably later on start other industries that provide jobs to more people.

So, education is also a positive consumption externality. But then the society in most cases does not pay for this education, there are very few instances in which education is subsidized by the

society. Now, when the society subsidizes, then it will become internalization of the externality, but it hardly happens.

Or, landscaping of one's garden. If you keep your garden clean, if you keep your garden landscaped, then that increases the value of the property of others in the society as well because it looks like a more beautiful society to live in. But then others do not pay you for landscaping your garden. So, this is a positive consumption externality because you are consuming by having a better garden, so that is your consumption. It is causing an externality which is positive.

So, it is a positive consumption externality. Now, in this case, because we are only considering consumption, the cost of production or the supply curve will not change which means that SMC is equal to PMC as before. So, this is the equilibrium not considering the externality. So, we have the private cost and we have the private value.

Now, in the case of positive consumption externality, there is no change in the cost of production. So, there is no change in the supply curve. The supply curve remains as before which is given by S is equal to PMC is equal to SMC. But, in the case of the demand curve, we have the social marginal benefit is equal to the private marginal benefit plus a marginal benefit that this externality is providing.

The society is getting this extra benefit from this activity or this good that is being consumed, and so the total benefit of the society increases. When that happens, we can observe that there is a shifting in the demand curve that should occur towards the right given by this difference of marginal benefit.

Once this happens, what we can observe is that earlier this much amount of equilibrium quantity of goods was being produced, whereas, if we internalize the externality, this much amount should be produced. Because if we consider any point in between let us say this quantity, now at this quantity the benefit is given by this point. This is telling us the amount of benefit that the society is getting. This is telling us the cost to society.

Now, if benefit is greater than the cost, then this good should have been produced, but what is happening is that because we are not considering that into the equation. We are not producing these or consuming these quantities. So, a deadweight loss is created for the society because some units are not being produced and consumed for which the benefit to the society exceeds the cost to the society. And here the deadweight loss is given by this curve in gray color.

To summarize, the externality is the uncompensated impact of a person's actions on the well-being of a bystander. And we have four different kinds. We can have negative or positive externality, and we can have production, or consumption externality.

That is all for today. Thank you for your attention. Jai Hind!