Introduction to Environmental Economics
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Lecture – 02
Basic Concepts and Tools from Micro and Welfare Economics

In the first lecture you have studied about what is economics, what are the rationales for studying environmental economics, and you have also studied how the subject has been evolved over a period of time. Now, you will study about the basic concepts and tools from micro economics, and also from welfare economics used in environmental economics.

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So, let you know this concept, because very frequently in the coming discussions you will be knowing all these concepts. So, we will frequently use all these concepts in the coming discussions. So therefore, it is better to understand this concept in the very beginning.

And here, before we discuss these concepts let you also know the relation between environmental economics and economics and how the concepts of economics are applied in environmental economics. So, we will discuss marginal concept, marginal cost, marginal revenue or incremental cost, incremental revenue; consumer surplus, producer surplus, externalities, subsidies, production possibility frontier, opportunity cost, carrying capacity, Pareto optimality and tragedy of commons.

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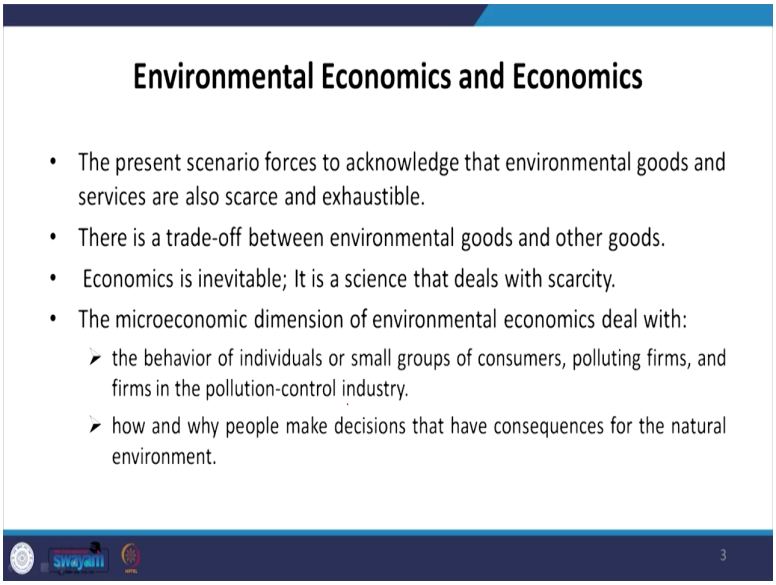

So, environmental economics as in the first lecture I discussed, is sub discipline of economics. And therefore, to understand environmental economics we should also know;

what is economics. And therefore, in the previous lecture you have studied the environmental economics and how the economics is related to environmental economics. So, briefly we also discuss here also. The present scenario forces to acknowledge that environmental goods and services are scarce and adjustable.

So, some of the resources are renewable some of the resources are non-renewable, but whether resources are renewable or non-renewable, they are scarce and limited and competitive uses. So therefore, there is a trade-off between environmental goods and other forms of goods like, toothpaste for example, colour TV and the kind of clean air; so clean air is environmental goods.

And if we are generating more industrial product, then our clean air products would be badly affected. So therefore, in environmental economics we study such kind of trade-offs. Economics is inevitable. And as I already discussed it is a science that deals with scarcity. Micro economic dimension of environmental economics also deals with the behavior of individuals, original group of consumers, polluting firms, and firms in polluting-control industries.

So, environmental economics also deals with such kind of things and economics also deals with the individual decision making units. How and why people make decision? That have the consequential for natural environment. So, that is studied in the economics, because in economics we study the different kinds of decision making. When we make an investment we take certain decision, whether this investment should be made in construction of a dam or whether it should be made in construction of rod.

So obviously, there is a trade-off if more or more investment is flowing in a particular activity less funds will be available for another activity. So, we had to take decision. And decisions are based on rationale choice. And rationale choice is nothing else, but the optimality of resources. So, we have to take optimum use of our resources. Environmental economics is one of the applied fields of micro economics. It contributes significantly in non-market valuation.

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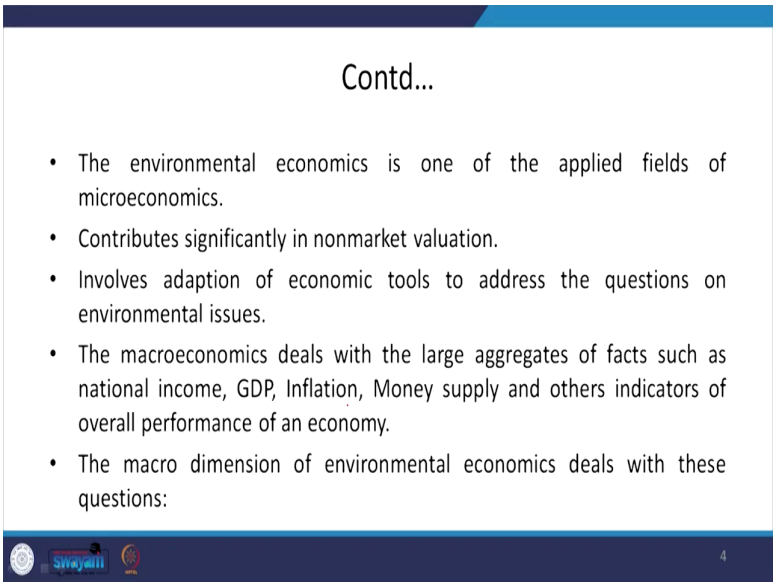

So, there are non-marketed goods or services, and how to deal with these non-marketable goods and services is studied in environmental economics. Environmental economics involves adaptation of economic tools, to address the question on environmental issues. Macroeconomic deals with large aggregates of facts such as, national income, GDP, inflation, money supply, and other indicators of overall performance of the economy. Macro dimensions of environmental economics deals various questions.

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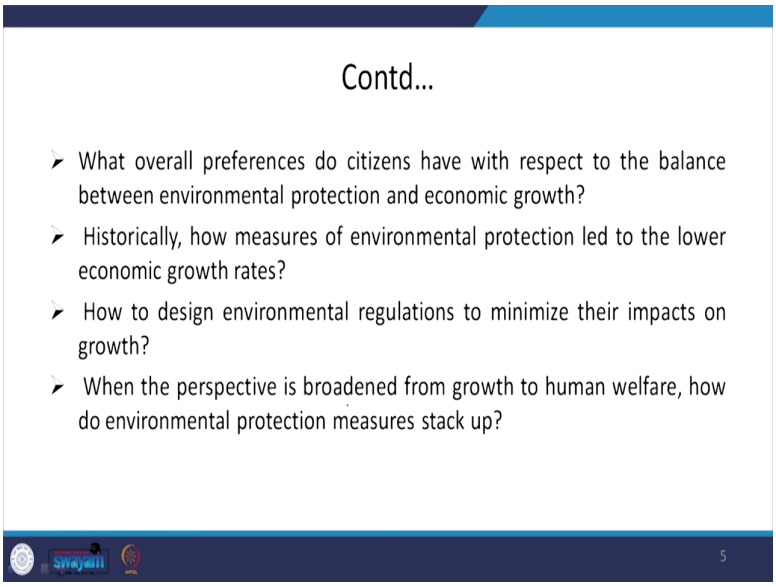

What overall preferences to do citizen have the with respect to the balance between environmental protection and economic growth? Historically, how the measures of environmental protection led to the lower economic growth rates? Are also answered. How to design environmental regulations to minimize their impact on the economic growth? They are also studied in macroeconomics. When the perspective is broaden from the growth to human welfare, how do environmental protection measures is take up? Are also studied.

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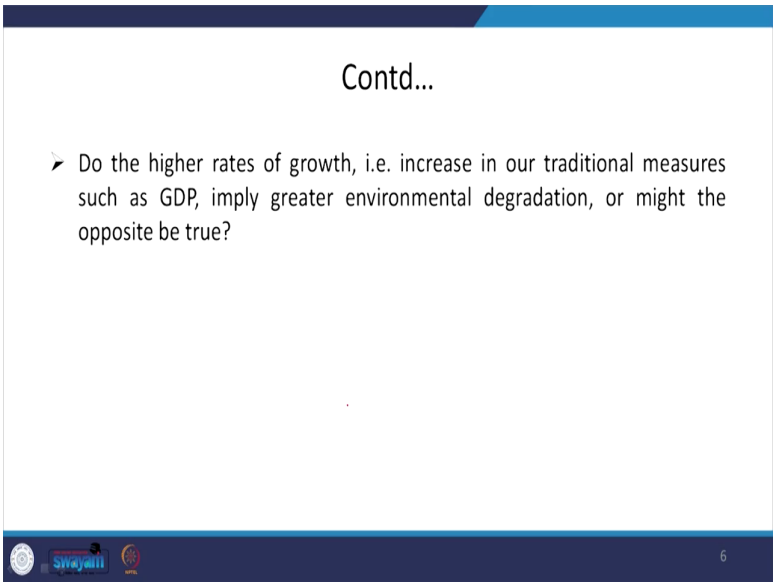

Do the higher rates of growth, that is increase in our traditional measures such as GDP, imply greater environmental degradation, or might be opposite true?

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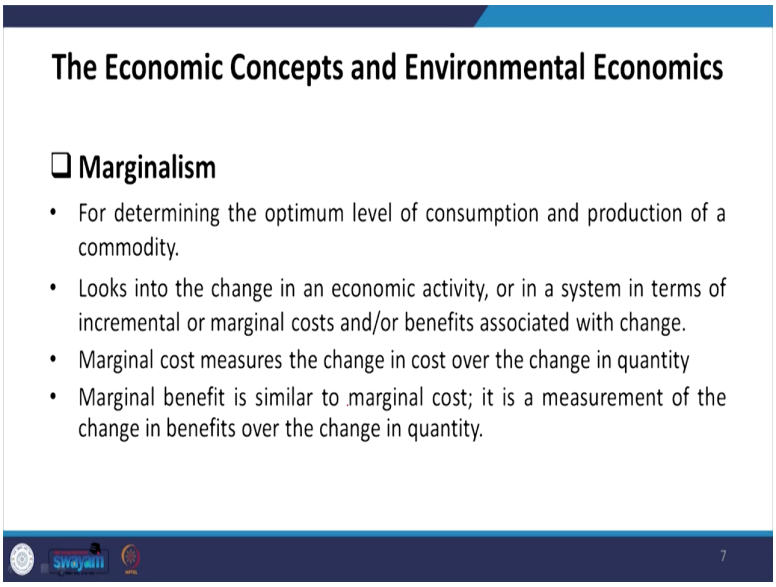

So, let me now explain the concept of marginal is. Marginal principle is used to optimize the level of production as well as consumption. And it is a very useful concept in order to optimize the level of consumption; we equate the marginal cost to marginal utility to market price of the product. Similarly, if we want to optimize the production, then we had to equate marginal cost with marginal revenue.

Marginal cost is a net addition in total costs due to the one unit change or it is simply an incremental cost. Similarly marginal revenue is incremental revenue, if we want to sell one additional unit in the market how much will be the net increase in revenue is known as marginal revenue. So, these concepts are very useful for the optimization of pollution also. For example: if we take the two firms producing a particular product; so how much the is the

marginal increase in pollution if one additional unit of production is done. so And if you want to abet that pollution how much is the marginal costs.

So, marginal abatement and marginal benefit these two concepts can be used in order to optimize the pollution. When taking two firms: one firm may produce the same output with lesser generation of pollution, others may produce the same level of output by generating more pollution. And therefore, we can also use the eco marginal principle in order to optimize the pollution generated by the two firms producing the similar kind of product.

So, marginal principle is used frequently in dealing with the various kinds of environmental issues.

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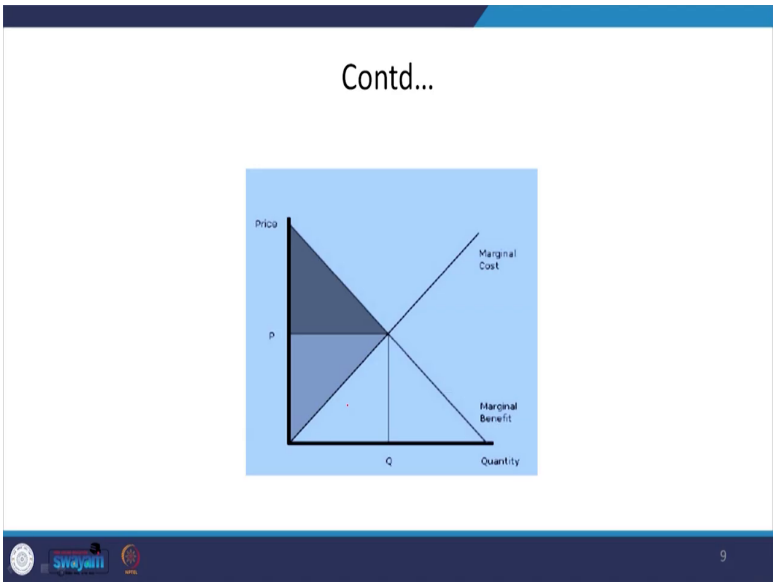

We can see marginal costs and marginal benefit in this diagram. And in this diagram the price of the product is determined at the point where marginal cost is intersecting the marginal revenue. On the horizontal axis we are taking quantity, on the vertical axis we are taking prices. And at the point where these two curves intersect each other market price is determined.

Now, the same things can also be explained by taking the similar curve for supply and demand. So, marginal cost can also be known as the supply curve and marginal benefit can also be known as the demand curve. And at the point where supply and demand intersect each other market price of the product will be determined. And that price is equilibrium level of price or you can say the optimum level of price

If we deviate from this inflection point then, either there would be less demand of the product or less supply of the product depending upon. Whether price is above the equilibrium level or price is below the equilibrium level. If price is below the equilibrium level then there would be excess demand, and the price is above the equilibrium level then there would be access supply. So, supply and demand are the very important concept. And similarly the marginal cost and marginal benefits are also important to know how the price of the product in the market is determined. And these concepts are used in environmental economics.

Next concept is consumer surplus. In fact, this consumer surplus can also be explained by the same graph which I had shown you previously, that at the point where supply and demand curve intersect each other the equilibrium price of the product is determined. And the portion about the equilibrium level a point in the triangle is generally known as consumer surplus.

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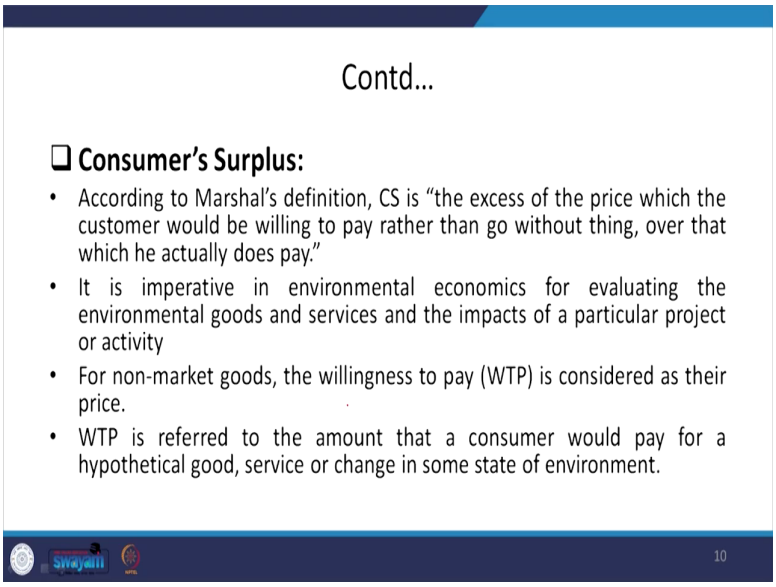

And consumer surplus as defined by Professor Marshal is the excess of the price which the customer would be willing to pay rather than go without things or that which he actually does pay. Or simply you can say: the marginal consumer surplus is the difference between what you are willing to pay for the price of a particular product and how much actually you pay, the difference between the two is called Consumer Surplus.

And it is imperative in environmental economics for evaluating the environmental goods and services and impact of a particular project or activity. So, very important concept in environmental economics is marginal willingness to pay or marginal willingness to accept. So, marginal willingness to pay means how much you are willing to pay for a particular service or product. And if you get that particular service or product at a lesser price, then you will realize consumer surplus.

For non-marketed goods the willingness to pay is considered also as price of the product. So, marginal willingness to pay is preferred to the amount that a consumer would pay for a hypothetical goods services or change in the state of environment. So, this consumer surplus is used in environmental economics. And we discuss how much we are willing to pay for a particular product, and how much is actually paid. The difference between the two is consumer surplus.

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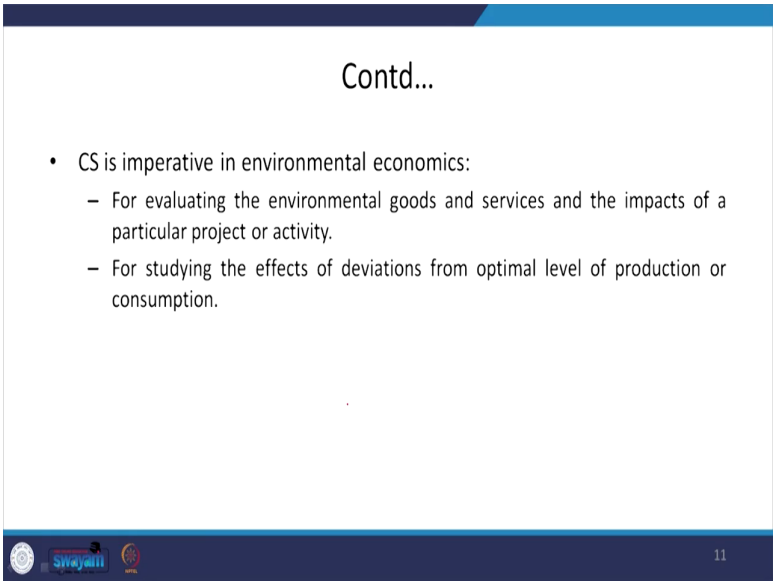

Then consumer surplus is imperative in environmental economics. For evaluating the environmental goods and services and impact of a particular project or activity we can also know or we can use the concept of consumer surplus. For studying the effects of deviation from optimum level of production and consumption we can also use the concept of consumer surplus.

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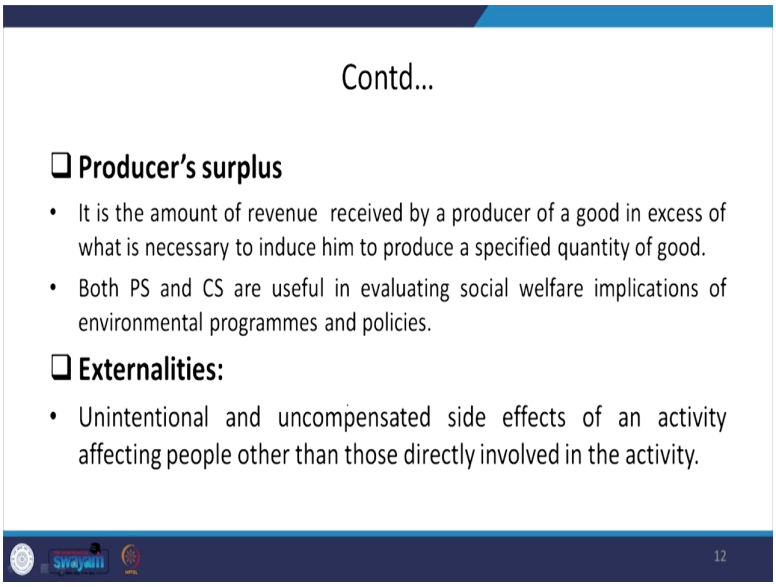

Similarly, we also have the producer surplus. And producer surplus means how much the producer is willing to accept the price of the product and how much actually he received, that difference between the two is called Producer Surplus. And these two can be explained by the graph. In this graph this dark portion above the P is known as consumer surplus and the slightly gray color area is known as producer surplus. So, both producer surplus and consumer surplus can be explained by using the marginal cost and marginal benefit.

And at the point of interaction of these marginal cost and marginal benefit or supply and demand you can also estimate the consumer surplus as well as producer surplus. Then another important concept is externalities. This is a very useful concept in environmental economics. Unintentional harm or benefit received by a person not directly involved in the activity is called Externality. And externality maybe positive externality and externality may be negative

externalities. I can give one example like bee keeping an (Refer Time: 16:49). This is the best example of positive externalities.

When a farmer is raring bees then bees get help in pollination of the (Refer Time: 17:05) and then apple productivity increases. Similarly bees also get nectar from the flowers, from the gardens. So, it is a win-win situation for both the parties and that is called positive externality. But here do you know any intention of any of the party to get a benefit. So, it is an unintentional benefit received by a person not directly involved in the activity that is known as positive externalities.

Similarly, we can have a negative externality, and more most of the externalities are negative in nature. For example, if you are using your own car, so you are enjoying your car, but a person walking on the road is inhaling the smoke. And his health may be badly affected, he may go to the doctor, he may spend more money on health. So, that is a kind of external cost imposed on the people or a person walking on the road inhaling the bad air is smoke generated by a person driving a car. But here, there is no intention of that owner of the car to harm the person. So, it is an unintentional harm received by the person and that is called negative externality.

Actually why we are more concerned about the negative externality is because in the absence of regulations companies generally do not bother about the externalities. Companies producers they produce the good product, but they also release the bad product. And cost of dumping these bad product in the absence of the regulation may be negligible to this company, but it cost a lot to the society. It costs a lot to the third person, not directly involved in the activity.

So, how to internalize externality; is an important issue which you will study in environmental economics later on.

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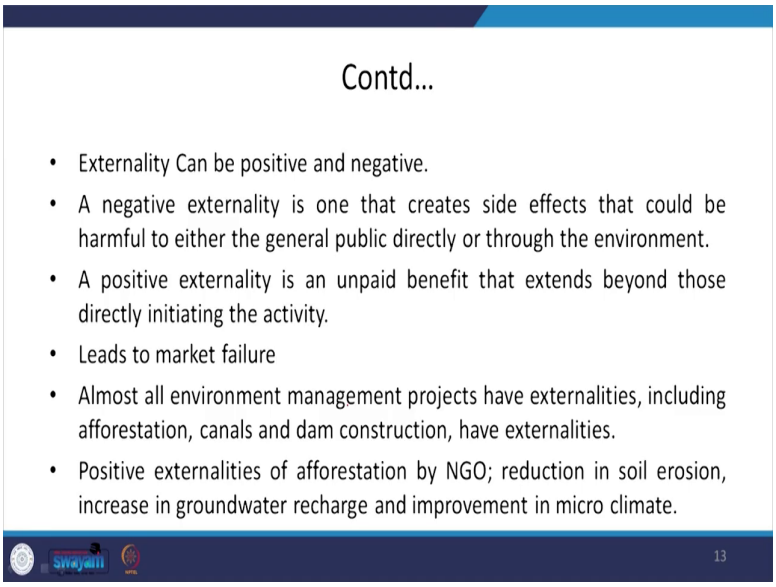

Externality also lead to market failures. So, why do market fails in case of various goods and services and mostly in environmental goods, but market may also fail in case of conventional goods. So, one of the major reason is externalities. So, when there is no regulation, then these external costs are imposed on the society and they are not internalized. And due to externalities the price of the product will be lower and companies are encouraged to produce more output, then the optimum level of output and that generate a negative externality in the economy.

So, regulations are used to internalize the externalities. Moreover property rights is also the important things that can be done to internalize the externality. So, how to create market and how to remove market failure; in that sense we can have property rights and also the regulations, which will be discussed later on.

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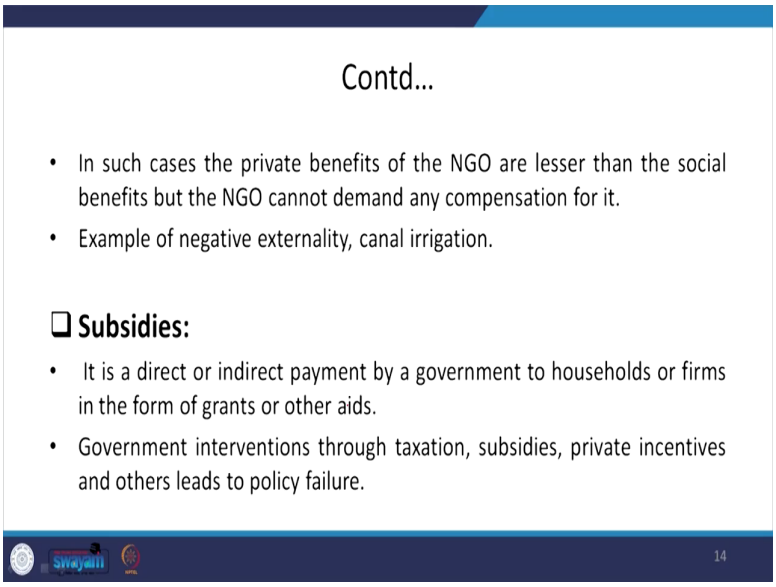

Then next concept is subsidies. Subsidies it is a direct or indirect payment given by the government to any agent of the economy maybe household, firm in the form of grants or aids, government intervention through taxation subsidy, private incentives, and others lead to policy failure.

Here, subsidy is given with a purpose. For example, if government of a country want to promote clean source of energy, then the subsidy may be given on the alternative sources of energy like solar energy. And when subsidy is given then producers cost of producing these clean source of energy will come down and it will be an incentive to produce more clean source of energy. And, then consumer will be benefited by this and overall environmental objectives can also be achieved. So, sometimes subsidies are targeted to achieve the intended goal, sometimes subsidies are given to the poor people to improve their welfare. But one

important aspect regarding the subsidy is; that subsidies create market failures, create the market distortions.

So, sometimes subsidies distorted the market and that is why many economists are critical about providing subsidies to different agents of the economy, a different section of the society because, sometimes subsidies may also crowd out the real investment in the economies. When more or more subsidies are given to the people, to the consumer, to the producers, then less money will be available with the government to make real investment in infrastructure etcetera.

So, sometimes subsidy may crowd out the real investment, but sometimes subsidy also crowd in the real investment. For instance: if subsidy is given on such kind of inputs which encase the private players to make more investment. So, sometimes subsidy given to a particular sectors of the economy or particular industry may also encase the private players to invest more. So, that may be in a kind of encouragement to the private players to make an investment. But, subsidy may also crowd out the real especially the public investment.

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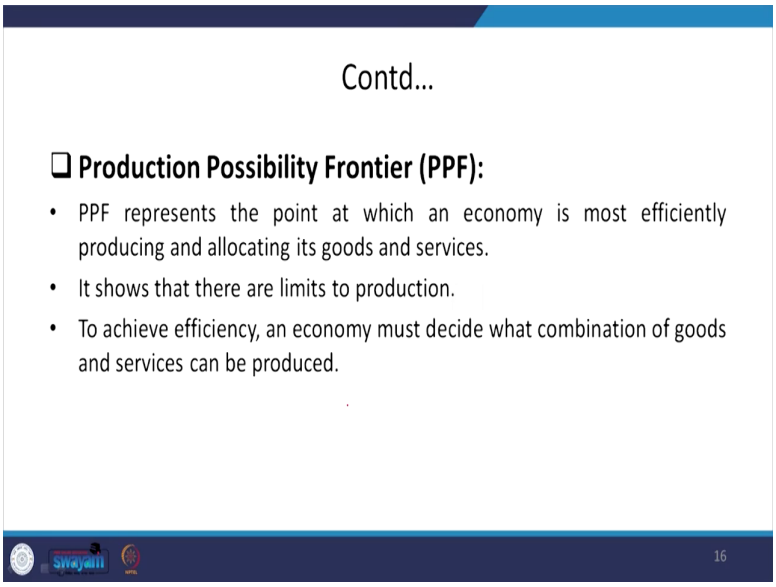

Then, production possibility frontier; production possibility frontier will be used in many topics which will be discussed later on. What exactly the production possibility frontier? Production possibility frontier shows the maximum possible output that can be produced with a given set of inputs. So, production possibility frontier represent the point at which an economy is most efficiently producing and allocating its goods and services.

So, it shows that there are limit to production. So, if all resources are available and utilize to produce certain kinds of goods and services; how much will be the maximum possible output that can be produced with the available resources is represented by production possibility frontier. But one things is very important here in regard of production possibility frontier, that this frontier is not static it is dynamic. With the same set of inputs you can produce more output.

So, you can shift the production frontier by the using new technology. So, R and D; research and development, exploration of new form of production, methods innovations, they can help to increase the production capacity of the economy.

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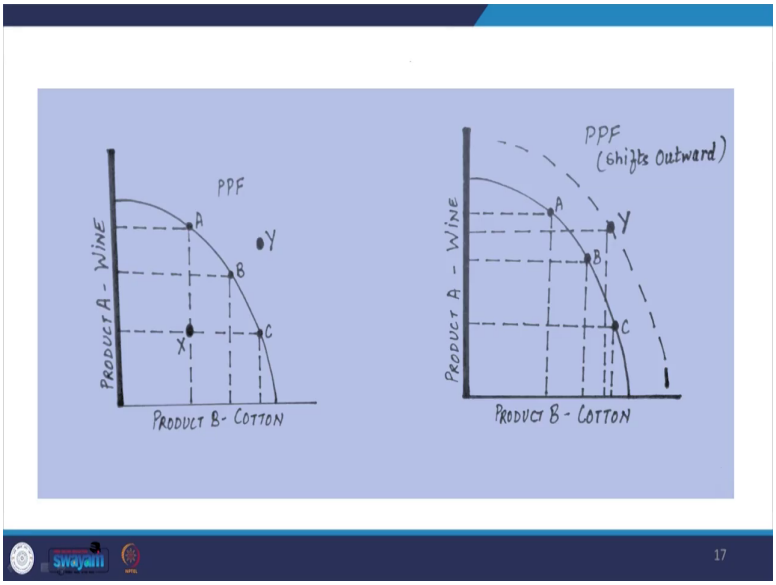

So, production frontier can be sifted. And these two you can see from this graph that we have this production possibility frontier. And the point A B and C lie on the production possibility frontier they are called optimum point or optimum combination of two factors of two products; wine and cotton. For instance if in any economy all available resources are utilized to produce wine and cotton, then the maximum possible output of wine and cotton can be represented by production possibility frontier.

So, any point lying on the production possibility frontier is called efficient point. And if the economy is producing in the interior point of the production possibility frontier that will be

called inefficient point. So, if we move from X to A in the first graph then it will be called Pareto improvement, because Pareto improvement means that we are improving the production of wine without reducing the production of cotton. Similarly if we move from X to C, then it is also again improvement in the production. So, it is called Pareto improvement, because here we are able to produce more cotton without reducing the production of wine.

So therefore, X point is inefficient point. And moving from X to B or X to A or X to C means improvement in the production or improvement in the efficiency, and that is called Pareto improvement. But if you look at the interior point of this production possibility frontier Y point that is not receiving with the existing resources. So, we cannot achieve this Y point. But, in another time period if we do some more research and development, if new technology is used then we can see the production frontier and we may be able to achieve Y point. And using these production possibility frontier we can also explain the next concept which I will discuss later on, and that is called Pareto optimality.

So, Pareto optimality can also be examined, can also be discussed using the production possibility frontier.

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Then next concept is opportunity cost. Opportunity cost of any resource is the cost that is used in its next best use, if it is not using the current activity. And this opportunity cost is also known as replacement cost. It is also known as replacement costs. And the it has significance in economic analysis. Why opportunity cost is so significant? so significant Because, resources are limited, resources are scarce and they have competitive uses. So, if we are using our resources to produce a particular product, then same resources cannot be used in other production. So therefore, we have to use our resources in best possible manner.

So, if a particular resource is using this activity, then the same resource cannot be used for other activities. So, how much is the output of that resource produced in the another activities if it is not used in the current activity; that is actually known as opportunity costs. That we take an example: if a piece of land is used to produce say wheat, same piece of land at the

same time cannot be used to produce gram. So, if a farmer is using that piece of land for growing wheat, it means that the farmer is thinking that this is the best option available.

But, what was the next best option sacrificed by the farmer to grow wheat is the production of gram? So, if n quintals of wheat is produced; if the piece of the land is used to produce wheat, but if the land is used to produce gram and 5 quintals gram might be produced then opportunity cost of production of 10 quintals of wheat is 5 quintals of gram. So, in that sense when you apply this opportunity cost in environmental resources it becomes a very useful concept. Take an example: if a tree is cut from the forest and it is sold as timber in the market; how much the owner of the tree is receiving as a revenue. But if that tree is not cut and that tree is also providing certain other services; how much is the economic value of that these services.

So, opportunity cost of selling timber in the market is the best option second best option sacrificed by the owner of that tree; that is say that tree can be used for carbon sequestration etcetera. So, that is called opportunity cost although it is a very tricky, very complex kind of things, because the carbon sequestration or many kind of services which are provided by a tree are not subject to the market conditions. But if someone is able to evaluate the market value of the tree in terms of various kinds of eco system services that is provided by the tree, then that is actually the opportunity cost.

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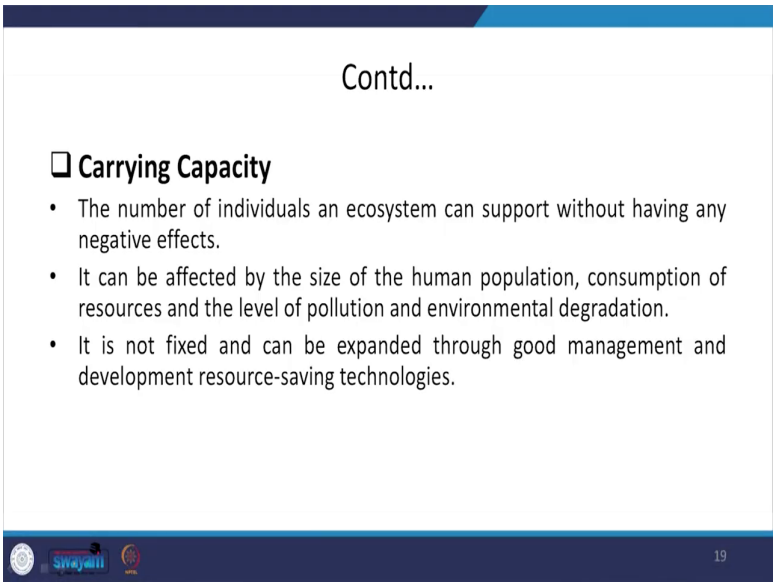

Then carrying capacity; the number of individuals an ecosystem can support without having any negative impact is known as Carrying Capacity. It can be affected by size of the human population, consumption of resources, and level of pollution, and environmental degradation.

But one thing is regarding the carrying capacity is that it is not fixed. Carrying capacity of environment can be augmented. Carrying capacity can be increased, and again you had to use technology. Technology and research and development can help to augment the carrying capacity.

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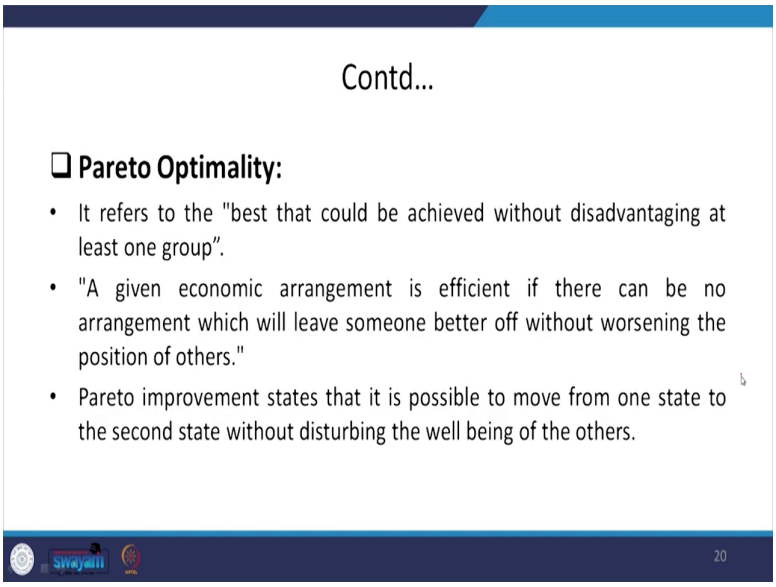

Next concept is Pareto optimality. Pareto optimality is a condition under which no one can be made better off without adversely making the welfare of at least one person. It refers to the best that could be achieved without disadvanting, at least one group or one person. Pareto improvement states that it is possible to move from one state to secondary state without disturbing the well-being of the others.

So, Pareto optimality concept can be explained by the same graph which we have used to explain the production possibility frontier.

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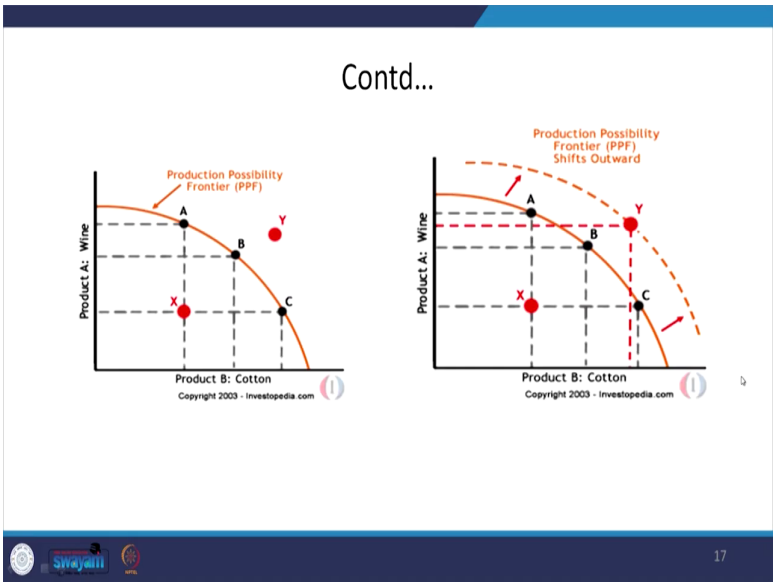

So, lake let us take the first graph and any point on the production possibility frontier is known as Pareto optimal. For instance, in this figure if you move from A to B it means that the production of wine is reduced to increase the production of cotton. So, production of cotton can only be increased on the production possibility frontier if some quantity of wine is reduced. So, this is a kind of situation which is known as Pareto optimality.

And, if you take the same graph in terms of welfare and if you take that two: person one person is taking on Y axis and other person is taking X axis and if you take certain kinds of policies and if a production possibility curve is used as a Pareto frontier. And, on the Pareto frontier if we moved from A point to B point then, welfare of X person can only be increased if welfare of Y person is reduced. So, production possibility frontier can be used as a Pareto optimality frontier to explain the Pareto improvement as well as Pareto optimality.

So, any point on production possibility frontier is called Pareto optimality. And point below the frontier is called inefficient combination of two products and they are called the point is called inefficient combinations and that is now called Pareto optimal. So, so solution is below optimal. And when we move from interior point to words any point on the frontier that is called Pareto improvement.

So, Pareto improvement means in this graph moving from X point to B it is Pareto improvement, because in that case production of wine is increased without reducing the production of cotton. So, production of cotton is to remain same, but production of wine is increased so that is called Pareto improvement. Similarly when we move from X to C, then in that case production of cotton is increased without reducing a production of wine. So, again it is called Pareto improvement.

So, Pareto improvement is a situation where we can make a at least one person better off without adversely making the welfare of other person. So, but at the optimal point of the frontier no one can be made better off without making at least one person worse off. So, that is called Pareto optimality.

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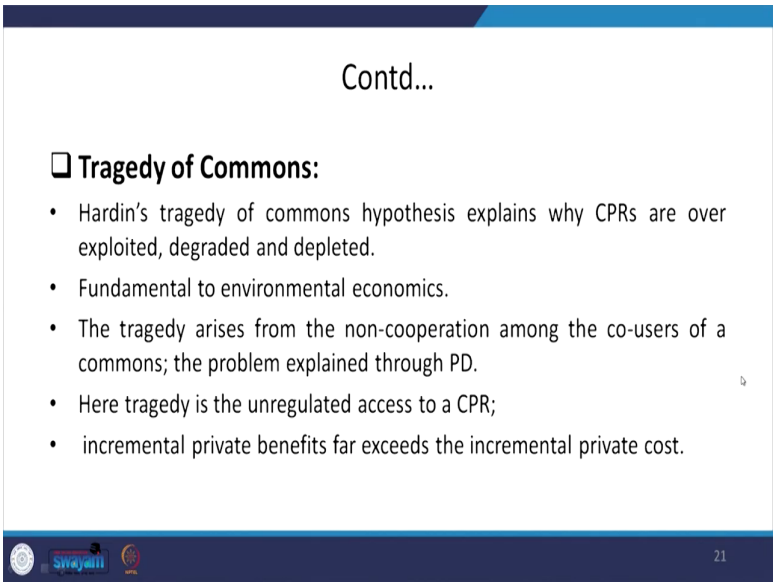

Next concept is tragedy of commons. This is also a very famous concept: Hardin wrote this thesis tragedy of commons, and that thesis is used to explain why common property resources are over exploited degraded and depleted. And here this is this is fundamental to environmental economics because, in case of such kind of products which are having access to all they can be over exploited due to the fact that these resources have common access.

Tragedy arises from the non-cooperation among, the core users of a commons. The problem explained through present dilemma also which will be discussed later on. Here tragedy is the unregulated access to common property resources and incremental private benefit may exceed the incremental private cost. So, what happens in case of tragedy of commons like grassland common grassland where every farmers have access to their cattle grazing. So, in order to optimize their own returns they bring more or more kettles. And when they are bringing more

or more cattle to incur their own private interest private returns, then everybody is bringing more cattle's and then over grazing will deplete these resources.

So therefore, tragedy of common is taking as a very important concept towards property rights. Because common if everybody is having right to common properties then these common resources may disappears. So therefore, as a policy tools, as a policy action you may think to allocate these resources among the private players. So, that they can protect the resources and can create market. And there are many successful example in India and with the better allocation of these properties among the users efficiency and productivity of these common resources can be increased.

So, therefore, this is a kind of initiatives taken by many economists that these common property resources should be given rights individual rights, so that they can be protected and market can be created for even common property. But it is a debatable issue whether community on the resources or whether they should be privatized, this is a debatable issue and sometimes we will make discuss on such kind of issues during the course of this subject.

But, as far as common property resources are concerned one point I would like to mention here is; that they are not exactly the open access resources. These resources have been controlled by the communities and outside the communities these resources cannot be utilized. So, whether it is a Panchayat land or grassland all these common property resources are not open access resources, they are managed control by the communities. And communities have only access to use these resources, not the people outside the communities.

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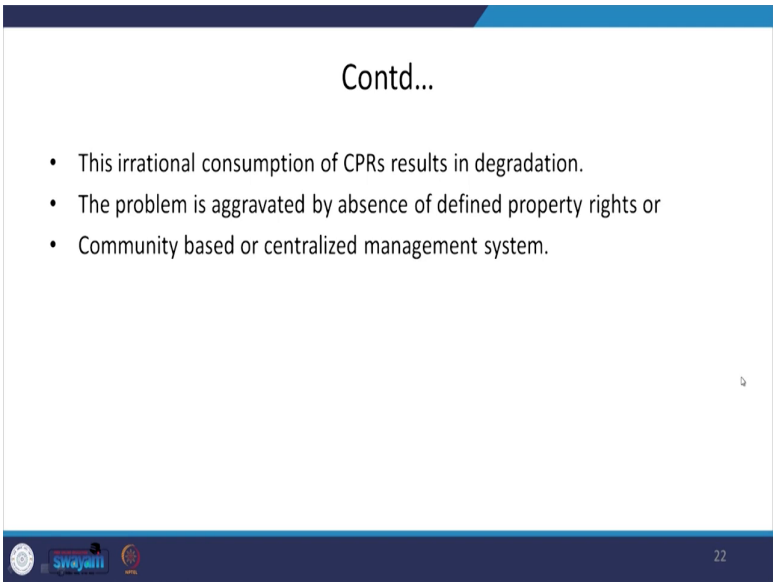

This irrational conjunction of common property resources may lead to environmental degradation. The problem is aggregated by absence of defined property rights or community based or central management system. So therefore, many argue that these resources can be protected, can be managed efficiently if proper property rights are given to the users.

So, thank you very much. In this unit or in this lecture, I explained some of the key concepts of economics which will be very frequently used by us in the coming discussion.

Thank you.