**Introduction to Environmental Economics**
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**Lecture - 37**
**Market Efficiency and Optimality-I**

Dear students, today I will discuss with you about Market Efficiency and Optimality. In this topic you will study about, what is market? What are the different kinds of efficiencies and how to achieve efficiency in a competitive market in case of two different kinds of products; one is conventional products. So, first I will explain you, how to achieve optimality in case of production of two products which are conventional products like any production of car, toothpaste, detergent etcetera.

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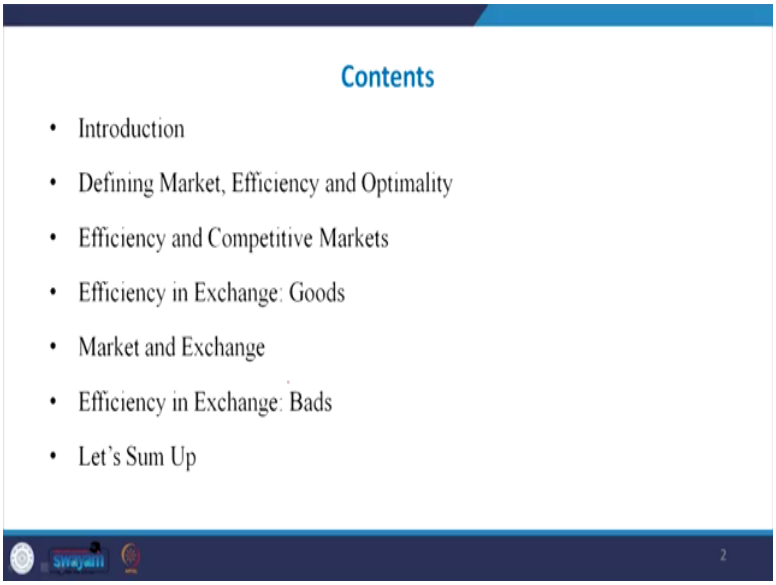

Then I will extend it taking one bad product or the environmental degradation that is called pollution or we can take one good product because, when a company produces any kind of product not only the good product is produced, but certain kind of waste are also released. So, if you take both production good product as well as bad product, how to achieve efficiency in the production will be discussed and finally, you will also study about how to determine the demand and supply curve for environmental bad products and then we will sum of the lecture.

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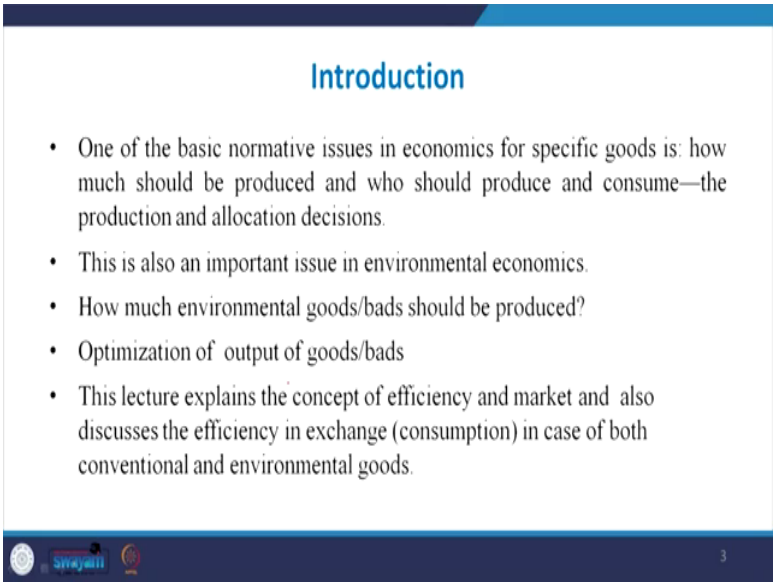


As you know that one of the main normative issues in economics for a specific good is, how much should be produced and who should produce and consume and this is actually known as how to allocative resources for production and once we get the production how to distribute these production means, we have two kind of issues one is how to achieve efficiency in the

production and once the product is produced, then it will be distributed among the consumer. So, how to achieve the efficiency in the consumption.

So, this is also that important issue in case of environmental resources. We know that environmental resources are also limited and these limited resources are to be utilized to get the maximum social benefits. So, how much environmental goods or bads should be produce. We know that certain kinds of waste are inevitable in any economy because they are kind of waste associated with the kind of activities they are very good activities because when a company is producing any kind of product that product is consumed.

But at the same time, when the company is producing good product a bad product is also produce. So, therefore, zero level of pollution in any economy or zero level of environmental degradation in any economy may not be feasible because pollution is associated with the good kind of activities. So, that is why optimization of pollution is very very important.

In this lecture I will explain you the efficiency market optimality and also discuss the efficiency in exchange and also later on efficiency in production. So, today, this lecture is basically limited to only efficiency in consumption and in next lecture I will discuss efficiency in production.

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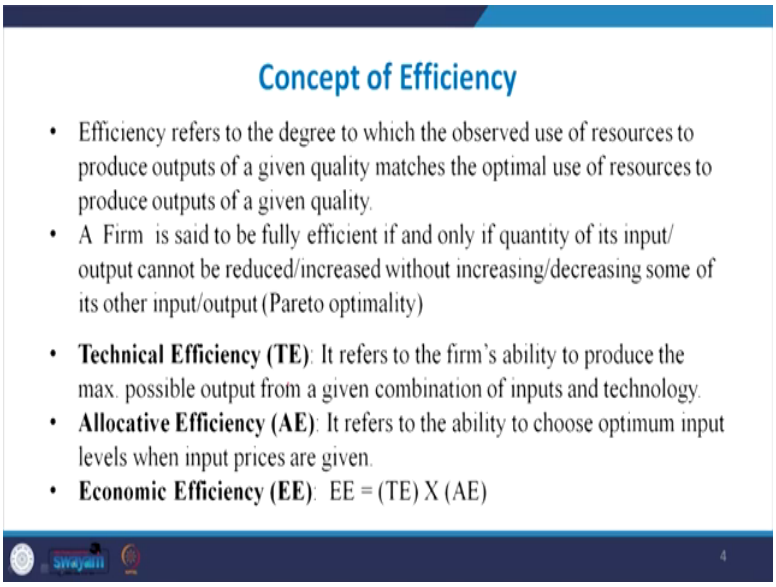


So, let me first explain you, what do we mean by efficiency. Efficiency refers to the degree to which observed use of resources to produce output of a given quality matches the optimum use of resources to produce output of a given quality. So, if we know the given level of quality, we decided the quality of the product. Then efficiency measures the ratio of what is being produced and what is the optimum level of output that can be produced. So, it is the ratio of the actual product to the maximum possible output that can be produced with the given set of input.

So, efficiency will range between 0 and 1. 1 means maximum efficiency is produced and 0 means no efficiency and that is why efficiency magnitude remain between the two. A firm is said to be fully efficient, if and only if the quantity of its inputs or output cannot be reduced or

increased without increasing or decreasing some of its inputs or output that is called Pareto optimality.

So, Pareto optimality means, if you cannot increase the output of one product without reducing the output of other product that is called Pareto optimality in case of, when we are taking output in the same manner if the level of output is given. So, given level of output can be produced, if you cannot reduce the input one input without reducing another input to achieve the given level of output then it is called Pareto optimality and this concept has been discussed in detail earlier. Now, efficiency can be classified into three categories, one is called technical efficiency, second is allocative efficiency and third is economic efficiency.

So, economic efficiency is actually the product of these two efficiencies, one is technical efficiency and other the allocative efficiency. So, first you should know, what is the technical efficiency? Technical efficiency refers to the firm's ability to produce the maximum possible output for a given combination of inputs and technology.

So, when technology is given and combination of various inputs are given. So, technical efficiency measures the maximum possible output that is produced by the firm with the given set of inputs and technology. And technology is very very important because, we can produce more output with the same inputs if level of technology is changed. So, if you are in increasing the level of technology or if you are using improved technology with the same level of inputs you can produce more output.

So, probably you might have studied about the production function and in production function, you have already studied that production function shows the pure engineering relationship between the physical quantity of inputs and outputs. So, therefore, when the firm is producing on the production frontier, then firm is called technically efficient and if firm is producing below the frontier then firm is called technically inefficient.

As far as allocative efficiency is concerned, allocative efficiency refers to the ability of a firm to choose optimum inputs level, when the prices of the different inputs are given. And

economic efficiency can be measured by taking these two efficiencies product, if you multiply technical efficiency score with allocative efficiency score you will get economic efficiency.

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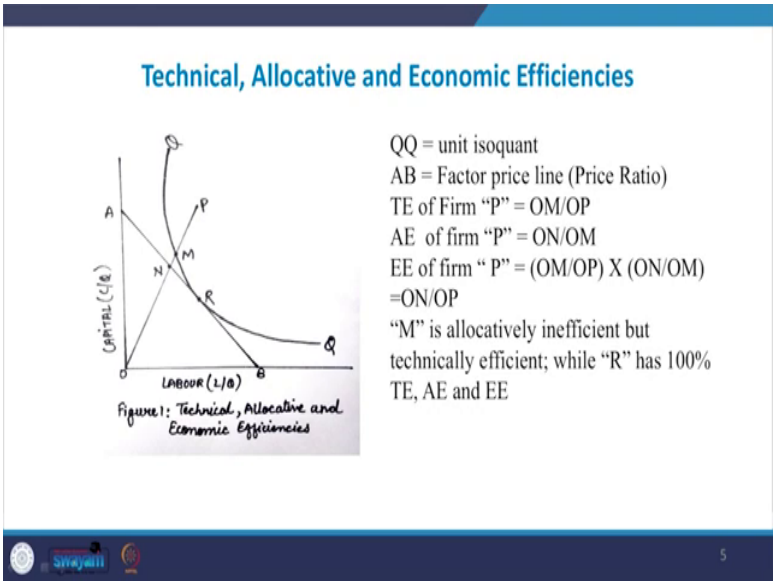


From this graph you can easily know the difference between these three kinds of efficiencies. In this graph, I have taken a unit isoquant; isoquant means, equal product curve and isoquant shows various combination of two inputs like capital and labor which provide the same level of output. So, one unit of output can be produced using different combination of labor and capital. So, how much labor and capital is used to produce a one unit of output is shown by the isoquant.

Now, any point on the isoquant is known as Pareto optimal or technical efficient. So, in this graph M and R they are the two points on the isoquant they are technically efficient, but when you compare M point which is on the frontier or isoquant with P point then P point is

inefficient, because to produce one unit of output Q at the point P both capital and labor quantity are higher than that is at point M. So, therefore, relatively you can say compared to M point which is on the isoquant or frontier P point is technically inefficient.

Now, you can estimate technical efficiency of P point and that is equal to OM that is the radial distance from origin to M. So, O M divided by O P and since O M is lesser than O P. So, at point P technical efficiency is lesser than 1. So, point P is inefficient because to produce one unit of output Q both labor and capital are higher than that are used at point M. So, O P divided by O M divided by O P is technical efficiency. Now, if you measure the distance for example, if O P is 7 inch and O M is 5 inch then technically efficiency will be 5 by 7. So, you can easily estimate the technical coefficient 5 by 7. So, this is called technical efficiency.

Now, if you turn to the allocative efficiency for allocative efficiency, you have to know how much is the prices of labor and capital. So, if resources prices are known and budget of the producer is also known, then you can also draw factor price line. So, A B is the factor price line and this factor price line or price ratio of labor and capital it tangent two point R. So, point R is on the isoquant which is technically efficient, but also the slope of isoquant is equal to the slope of the factor price line A B. So, point R is also allocatively efficient.

If you reallocate the resources of labor and capital under the given prices of labor and capital, you would not be able to optimize the output. So, allocatively the R point is efficient. Now, if you want to calculate the technical efficiency as well as allocative efficiency of point P, we have already calculated technical efficiency had point P say O M divided by O P. Now, look at the allocative efficiency had point P that should be equal to O N divided by O M because this A B line is below the M point indicating that M point is only technically efficient not allocatively efficient.

So, if a firm is producing output at point M, then it is called inefficient point from economic point of view, because allocative efficiency at point M is lesser than 1, because it is O N divided by O M. So, now, let it to P the P is not only allocatively technically inefficient, but it is also allocatively inefficient and allocatively inefficiency is O N divided by O M. Now,

multiply both then you will get O M divided by O P multiplied by O N divided by O M. So, economic efficiency is O N divided by O P.

So, O N divided by O P is the economic efficiency O point P and if you look at the point R at point R allocative efficiency as well as technical efficiency both are equal to 1 because R point is on isoquant as well as on the A B line. So, slope of A B line is equal to the slope of isoquant. So, R point is economically efficient. So, in this way, we can measure both technical efficiency and allocative efficiency and once, we know these two efficiencies or inefficiencies then we can easily calculate economic efficiency next is the concept of the market.

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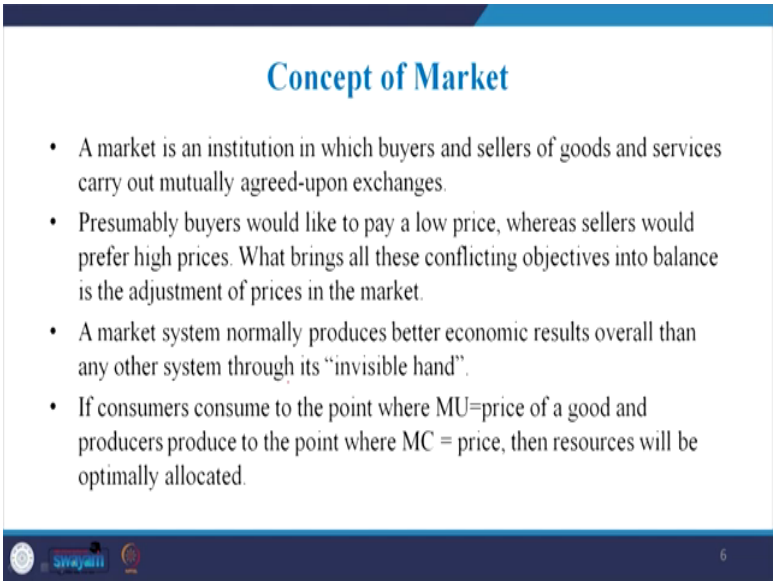


So, what do we mean by market? A market is an institution in which buyers and sellers of various goods and services carry out mutually agreed upon exchanges. So, in a market, we

have buyers as well as sellers buyers are willing to buy certain products sellers are willing to sell or supply various kinds of goods and product and the price of the product is determined at the point, where these mutual agreements occurs in terms of willingness to pay and willingness to accept.

Presumably, buyers would like to pay a low price whereas, sellers would prefer high prices; obviously, because when we as a consumer would like to buy a particular product, we would like to pay less of the price, but the seller would like to get higher price. So, what brings all these conflicting objectives into balance is the adjustment of prices in the market and that is known as price mechanisms. So, in a market price mechanism is supply and demand and price.

So, at the point where supply and demand of various kinds of goods and services intersect each others the market price of their product or services is determined and that is how the market allocate resources in the economy. So, a market system normally produces better economic results overall, than any other system through its invisible hands Adam Smith use this word invisible hands. So, how the invisible hand of the market allocate resources in the economy through the adjustment of supply and demand and price mechanism.

If consumer consumes to the point, where marginal utility of consumer is equal to the market price of the product and producers produce to the point where the marginal cost of the product is equal to the price of the product, then the resources in any economy will be allocated optimally.

So, optimum allocation in any economy will occur, when there is actually the efficiency in both efficiency in production as well as efficiency in consumption or you can say, if consumers consume to the level where or demand the product to the level where the marginal utility of the product for the consumer is equal to its price and producers produces the quantity of the product at the point, where the marginal cost of the product is equal to the market price of the product.

So, if these two conditions are met in any economy, then resources will be optimally utilized. Here, when we talk about the market mechanism or market role.

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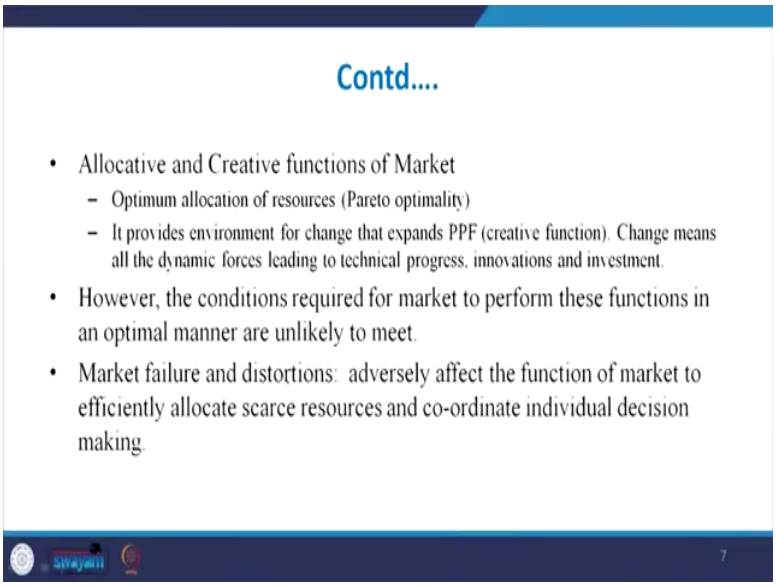


It has actually two kinds of functions that can be done by the market first is optimum allocation of resources. So, one of the main function of the market is to allocate the resources optimally in the economy and that is called Pareto optimality. It provides an environment for change that expand the production possibility frontier that is called creative function of the market.

So, there are two kinds of role of the market one is optimum allocation of resources can be done by the market, if market is really working, if there is no market distortion and market also plays an important role in shifting the production frontier through its creative function.

Here, these conditions required for the market to perform these functions in an optimal manner are rarely met.

This is the major problem especially in environmental products that market fails to deliver these product efficiently. So, these are the ideal situations and if certain conditions are met, then market can allocate the efficiency resources efficiently. And that is why market failures and distortions may occur in real markets that will adversely affect these two functions of market. I can explain this through this graph both allocative and creative functions of the market.

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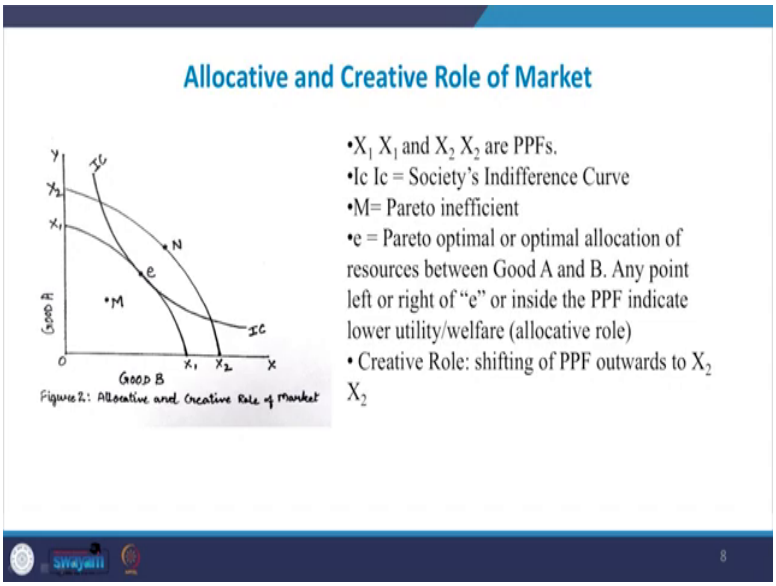


Here, we take two products goods A and goods B quantity of goods A is taken on Y axis vertical axis and quantity of B product is taken on horizontal axis or X axis and this production possibility curve X 1 X 1 shows that you can take any combination of two

products on this production possibility curve the these combinations will be treated as Pareto optimal, because on this production possibility frontier, you can increase the production of say B product if you reduce the production of A product.

So, production of B product can only be increase by reducing the production of A products and that is exactly known as Pareto optimality, but if you look at the M point which is in the interior of this production possibility curve this M point is inefficient combination of two products A and B. And here if you move from M to e then you can improve the efficiency and you can increase the production of both A and B without reducing the production of other.

So, that is called Pareto improvement. So, Pareto improvement means, moment of or shifting of M point towards the production possibility frontier. And we also take indifference curve or utility curve utility curve, we already discussed and indifference curve shows the various combination of two products say A and B which provide the same level of satisfaction to the consumer. So, at the point where the slope of I C curve it tangent to the slope of production possibility curve optimization will occur and that is e point and this is known as allocative function of market.

And creative function means that through the innovations production or change in technology production frontier may shift from X 1 X 1 to X 2 X 2. So, shifting of production frontier production possibility frontier from X 1 X 2 X 2 X 2 is actually expansion of the output which is due to change in technology innovations etcetera and that is called creative roll of the market.

So, creative roll of the market means, shifting of the production possibility curve upward to X 2 X 2.

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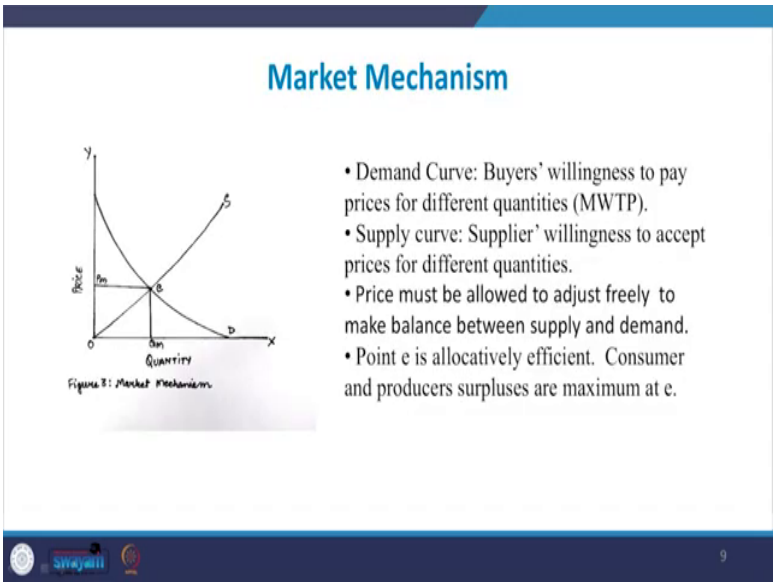


Now, main roll of the market is to allocate the resource is efficiently and that is done through the market mechanisms and market mechanisms is supply and demand. So, in this graph you know price is taken on vertical axis and quantity of goods supplied and demand are taken on X axis. Supply is positively associated with price means, if market price of the product increases producer or sellers would be willing to supply more.

Just opposite is demand curve which shows the inverse relationship between the price of the product and quantity demanded. So, when the price of the product increases demand or quantity demanded of the product declines. So, when these two opposite forces supply and demand cancel each others, equilibrium level of prices determined. So, at the point where the supply curve intersect the demand curve market price of the product it determined and equilibrium level of quantity of demand and supply determined.

Now, why it is called Pareto optimal or efficient point? Because, if you deviate from e point then the consumer surplus will decline producers surplus will also decline. So, this is the point where the consumer surplus as well as producer surplus are maximized, I will take this topic later on in detail what are the consumers surpluses and producer surpluses etcetera. But right now, consumer welfare and producer welfare are maximized only at point P if you shift from e point to any point for example, if quantity is greater than O Q M then there would be mismatch between demand and supply.

Producers or a price is above the O P M producer would be willing to supply more, but consumers are not willing to take more. So it means that the equilibrium level of price will not be determined. So, consumer and producer surplus are maximized at point e.

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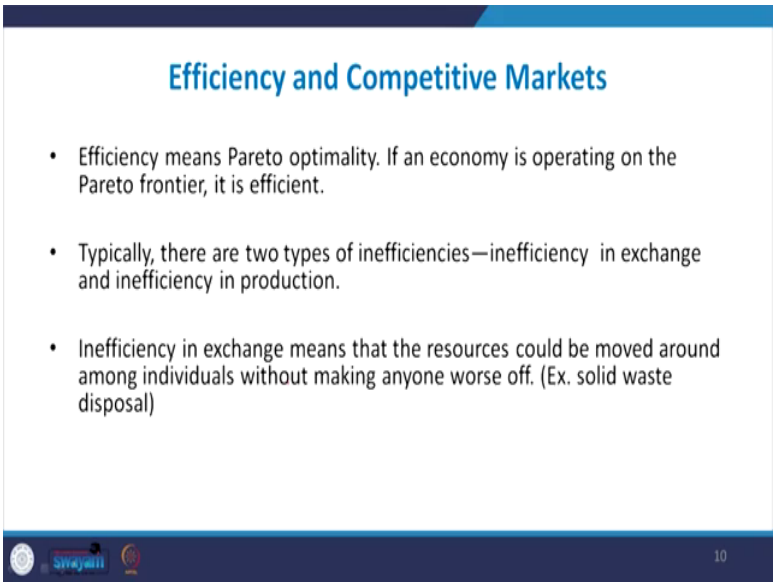

Next point is efficiency and competitive markets. When we talk about market, market can allocate resources efficiently only when market is competitive. If there is market imperfections then resources will not be optimally allocated. So, efficiency here means Pareto optimality which I already discuss that Pareto optimality means, no one can be made better off without making at least one person worse off.

So, this is a situation or production of one goods can only be increased by reducing the production of at least another quantity of another product. So, that is called Pareto optimality. If an economy is operating on the Pareto frontiers it is called efficient. Typically there are two types of inefficiencies, one is inefficiency in exchange and other is inefficiency in production. Inefficiency in exchange means, their the resources could be moved around among individuals without making any body worse off.

Let me take a simple example suppose in a municipality there is some solid waste and municipality want to dispose of that solid waste, but there is a high cost of disposing of these waste because of high price of land in the urban area, but there may be nearby a Gram Panchayat a village, where land is not as scares as in the urban area.

So, a Gram Panchayat maybe willing to take these waste for shapely dispose of in and can get some money from the municipalities then, it will be a kind of win situation and overall welfare of both the party will be improved. So, that is called improvement in efficiency in exchange because there is a cleared between the two party; municipality is willing to supply the solid waste to the Gram Panchayat and Gram Panchayat is willing to take at the mutually determined price per unit of waste disposal.

So, in this way a welfare of both the person, both the parties or both the institutions municipalities as well as Gram Panchayat will increase, the other type of inefficiency occurs in production.

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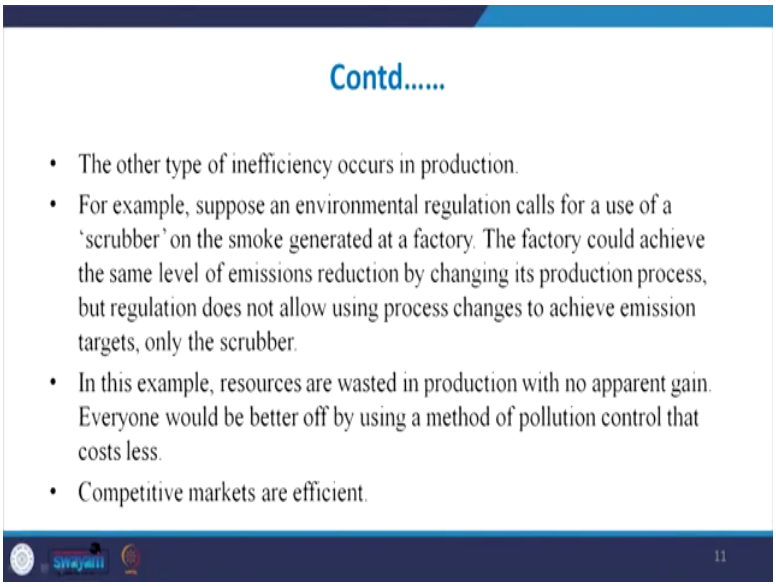


For example, in case of an environmental economics, we know suppose and environmental regulation calls for a use of a scrubber on the smoke generated at a factory. The factory could achieve the same level of emission reduction by changing its production process. But regulator does not allow using the process change to achieve the emission target only the scrubber. So, this is how we observe in case of environmental regulation under the command and control system of environmental regulation.

A regulator can dictate the factory that you have to use a specific device to reduce the emission level, but there may be a better option available to the producer to achieve the same level of emission target, but under the regulation system that is not allowed by the regulator so, inefficiency occurs. So, efficiency can be improved, if the producer is allowed to use any kind of device any kind of technology to achieve the set it target. So, in this example resource

are actually wasted in production with no apparent gain and everyone would be better off by using a method of pollution control that is providing less costs.

So, therefore, competitive markets are considered efficient. Let me now, conclude this lecture. In this lecture, I have discussed three concept of efficiency allocative efficiency, technical efficiency and economic efficiency. Economic efficiency is the product of technical efficiency and allocative efficiency. I also explained, what is market and how market works what is market mechanism etcetera and I also introduced two types of efficiency in exchange and efficiency in production.

Efficiency in exchange maybe studied in terms of two kinds of products; one product is bad product and other is the good product and how the efficiency occurs when a consumer is consuming one good product or one bad product. So, we can assess the efficiency in exchange, when both the goods are good products, but we can also study efficiency in exchange when one product is bad product.

I also introduced the concept of efficiency in production. As you know the resources are limited and limited resources have competitive uses. So, therefore, efficiency in production is need of the our and how to do efficiency in production will be discussed in separate lecture.

I also discuss how to achieve efficiency in both kind of products and a conventional products as well as environmental products. So, in next lecture, I will explain efficiency in exchange by taking indifference curve approach.

Thank you.