Introduction to Environmental Economics

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Lecture – 39
Market Efficiency and Optimality – III

Dear students, in this lecture I will explain you efficiency in production. In the preceding lecture, you have studied about the efficiency in exchange in case of two conventional products initially. And, then I extended it by taking one good product and other bad product and then we see how the optimality can be achieved when a consumer is consuming one good product and other bad product.

In our real life, we also do this. When we consume good product, but at the same time we also inhale bad air, we also consume dirty air, we also consume waste etcetera. So, in our life our welfare is directly affected due to the different kinds of pollution we consume when we also consume some good products.

So, when we are consuming more good product and less bad product our welfare improves, but if we wanted to maintain a given level of welfare then if some good product quantities increase in our consumption we have to increase some quantity of bad product in order to keep the utility constant. So, this aspect have been discussed in the preceding lecture.

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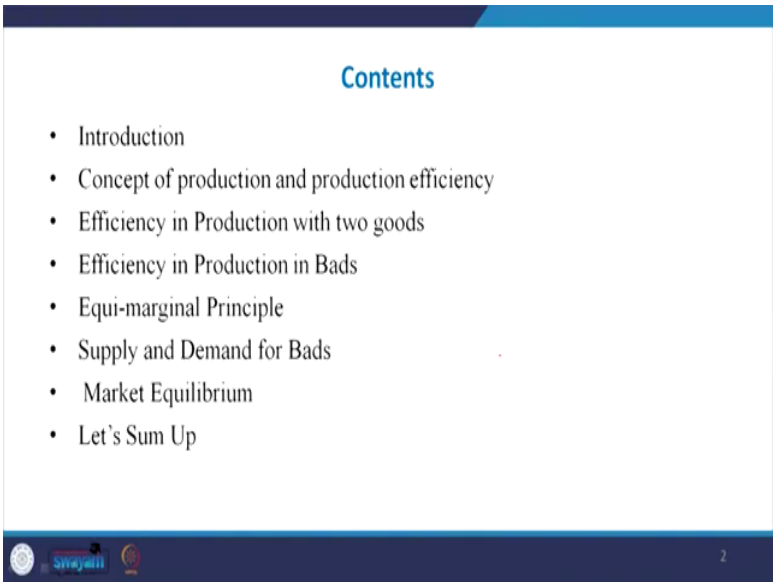

In this lecture, you will study about the concept of the production, what do we mean by production, what is production efficiency and then you will also study about the efficiency in production when both the goods in the isoquant are good products. Then, we take one good product and other bad product like garbage and after that I will explain you the equi-marginal principle and then how to determine the demand and supply curve for the bad product and finally, how the market equilibrium is achieved.

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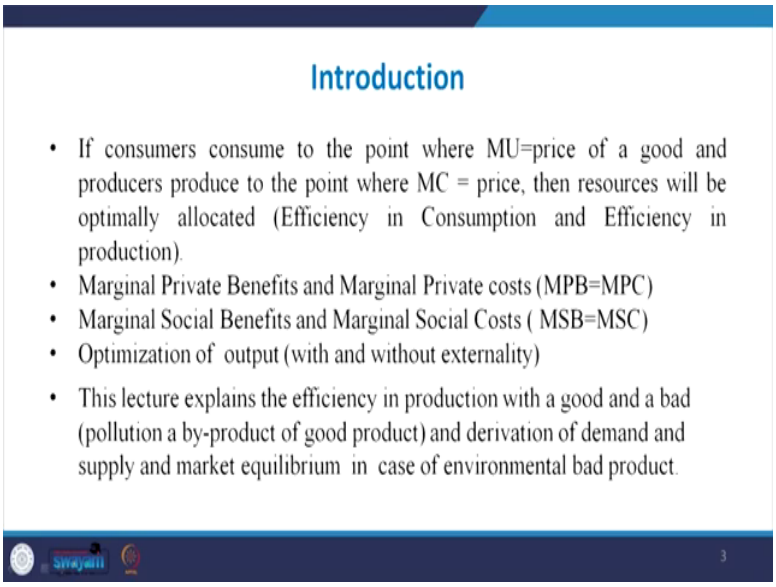

Let me first discuss about the optimization in consumption which we already studied and then production. As I already told you that if consumer consumes to the point where marginal utility is equal to price of the product and producers produce to the point where marginal cost is equal to the price of the product then resources will be optimally utilized and that is what is known as efficiency in consumption and efficiency in production.

When we talk about the cost, there are two different kinds of cost – one is private costs and other is social costs. So, generally when a company tried to optimize the output private marginal benefits are equated to private marginal costs or equilibrium is achieved at the point where marginal private benefit is equal to marginal private cost. But, marginal social benefits and marginal social cost are equally important, especially in contest of the welfare of the

consumers when a company are producing good product as well as releasing different kinds of waste.

So, in that case externality is very important to be included in the private benefits as well as private cost. So, if you include private including private benefits the external benefit then you will get marginal social benefit and if you also include the marginal external cost in the marginal private cost then you will get marginal social cost. So, welfare in any economy must be achieved at the point where the marginal social benefit are equal to marginal social cost and that is actually done with externality.

So, equilibrium optimization can be done with externality or without externalities. So, company's takes into account in the absence of the regulation only the cost they incurred and the price of the product they realize after selling goods in the market. So, externality is not included. But, when we include the externality in the entire process then output will equilibrium level of output will be at lower level of prices and higher level of; higher level of prices and low level of output.

So, in this lecture I will explain the efficiency in production with a good product and bad product that is actually the by-product of the good product when a company is production good product a by-product of it is pollution, waste etcetera and then derivation of demand and supply curve and market equilibrium.

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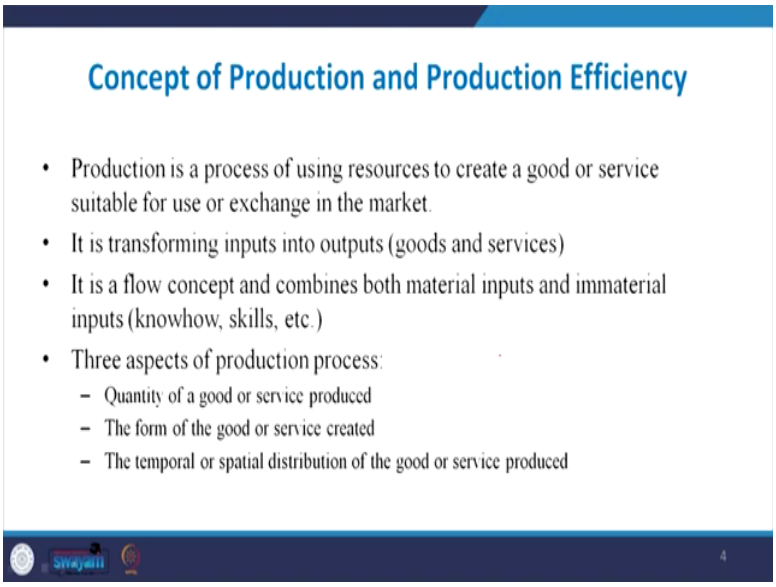

Concept of production and production efficiency. What do we mean by production? Production is a process of using resources to create a good or service suitable for use or exchange in the market. So, production means transforming inputs into outputs output maybe quantitative to output like goods or output of services. So, when we convert inputs into output that is called production process.

And, production is a flow concept and it combines, both material as well as immaterial inputs. So, what are the material inputs like we use raw materials, we use machines, we use labor etcetera, but at the same times output is also affected by immaterial inputs like intellectual capital, technical knowhow skills etcetera.

So, production has three key important aspects, first is the quantity of output or services produced. So, quantity of output that is the first point you can see here and then second is the

form of goods or services created and third is temporal and spatial distribution of goods and services produced. Actually, we know that matter cannot be produced matter cannot be destroyed. So, what we do in the production is we put value as well as utility to the matter by three possible ways by changing the shape of the and in that case we convert in input into output like all manufacturing output is a part of the production process.

Similarly, by changing the time of the matter like sometimes some goods may be put in the go down or quality storage and release the supply when they needed most. So, by changing the time period of various goods value addition is done and that is also the part of the production. Similarly, by transporting goods from one place to other place also the value addition is done so, that is also the part of the production.

So, that is why we had a three sectors of the economy – one like agriculture where primary products are done; then second is manufacturing or construction etcetera were inputs are converted into outputs and services where most of the inputs are created in the form of services also trade commerce all these are the part of the production process.

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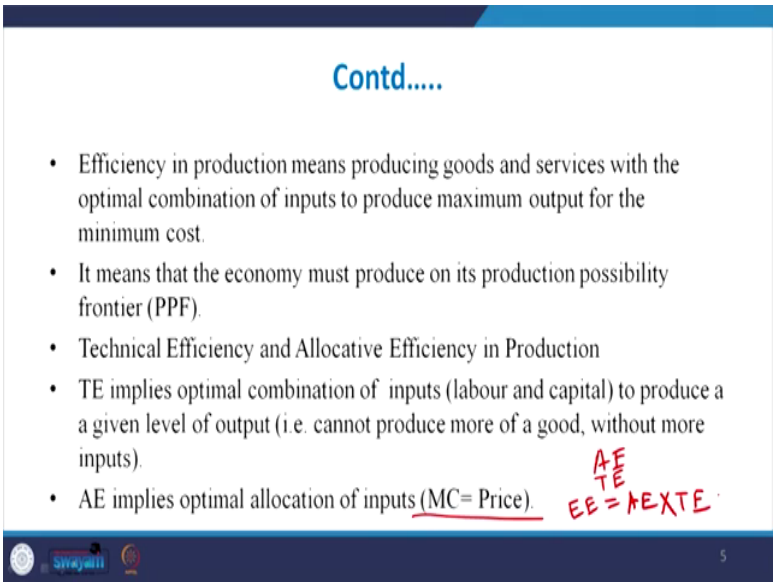

Then efficiency in production means producing goods and services with the optimum combination of inputs to produce maximum output from the minimum cost. It means that the economy must be produced on it is production possibility frontier. So, production possibility frontier source the maximum possible output that can be produced with a given or available resources. And, here I already discussed in the preceding lecture technical efficiency and allocative efficiency.

And, technical efficiency implies optimum combination of inputs and that is actually a pure engineering relationship or physical relationship between the quantity of outputs and inputs. So, production function shows the maximum possible output that can be produced with a given set of inputs when price of the various inputs and outputs are not taken into consideration, but level of technology is given. So, it actually shows the technical relationship

between the physical quantitative inputs and output while allocative efficiency clearly indicate how the inputs are allocated when the price of their and their prices are known.

That is why at the point where MC marginal cost is equal to price of the product allocative efficiency is measured. So, you have two kinds of efficiencies allocative efficiency then also the technical efficiencies and economic efficiency is equal to a locate efficiency multiplied by technical efficiency. And, that we discuss it is done at the already that you are at the point where the isoquant is tangent to the factor price line.

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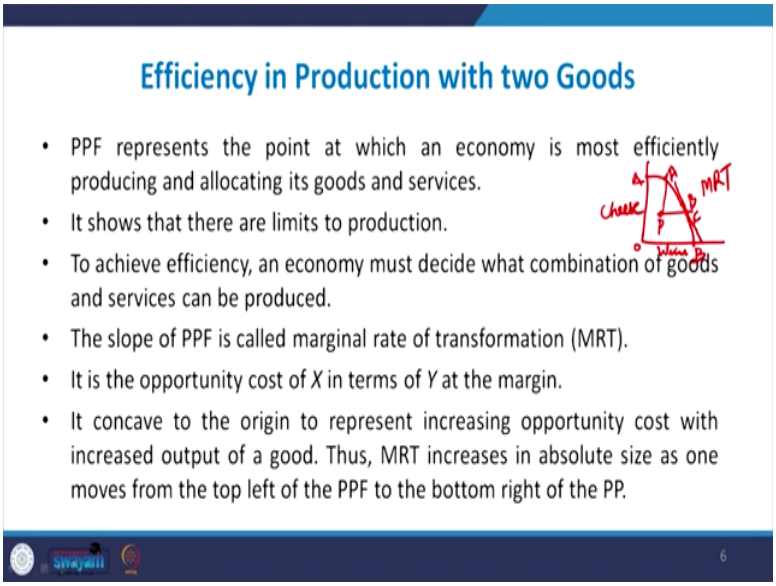

Let me discuss now the efficiency in production with two conventional product two good product from say in our preceding example cheese and wine. So, let us take two product cheese and wine and draw production possibility frontier. So, production possibility frontier represents the point at which the economy is more efficiently produce and allocate it to

resources and services. So, let me just see this is the production possibility curve AB and we have here two products a cheese and wine.

So, this production possibility curve actually show the tradeoff between the two product and any point on this production function like A point, B point they are called power to optimal. But, any point within the production possibility frontier is called Pareto inefficient if you move say point C from point D then it is called Pareto improvement because in this case the production of wine is increased without reducing the production of cheese. So, that is called Pareto improvement.

Similarly, if you move from point b to point a then it clearly indicate that the production of wine is constant, but is not reduce about production of cheese is increase. So, that is called Pareto improvement. But, when you move from A point to B point then quantity of cheese is reduced to increase the quantity of wine. So, that is called Pareto optimality means production of cheese can only be increased by reducing some quantity of wine. And, the slope of this production possibility frontier say like this is called MRT marginal rate of transformation between the two product cheese and wine.

To achieve the efficiency and economy must decide what combination of goods and services to be produced. So, for this you have to know how much is the cost of resources in holds. So, if we know the production possibility frontier and also the cost function then we would be able to know the optimum level of output. So, slop of production possible curve is known as the marginal rate of transformation between the two products.

It is also known as the opportunity cost of X in terms of Y or cheese in terms of wine. And, production possibility curve it is concave to the origin to represent increasing opportunity cost with increased output of goods. So, MRT marginal rate of transformation between the two products in this graph actually increases in absolute size as one move from the top left of the production possibility frontier to the bottom.

Like this if you move from A point to B point to C point then on this production possibility frontier that marginal rate of transformation will increase indicating that opportunity cost of producing more unit of wine in terms of cheese increases.

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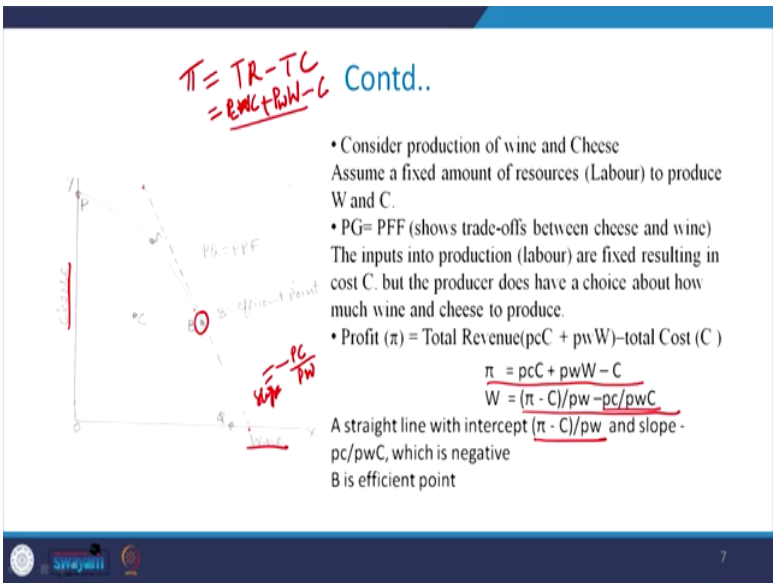

So, this can be solved by this production possibility frontier. So, we are taking in this graph cheese and wine on vertical axis we have cheese this is taken and on horizontal axis we are taking wine and we draw the production possibility frontier and that is PQ. So, PQ this is the production possibility frontier which shows the tradeoff between the production of cheese and wine.

As I already discussed a point from in the interior C is called inefficient Pareto inefficient, point A and B are Pareto optimal. But, efficiency will occur allocative efficiency as well as

technical efficiency will occur at point B because point at point B the resources are optimally utilized and they are also efficiently allocated.

So, let me now tell you how to maximize profit you already know and in economics that two condition must be satisfied for optimization. First is that marginal costs should be equal to marginal price and slope of marginal costs should be greater than slope of marginal price. So, total profit if I say pi is the total profit is equal TR total revenue minus total cost.

Now, total profit in case of these two products cheese and wine will be equal to here how much is the price market price of cheese say pc is the market price of cheese and I use the term W for the this C I will take C the quantity of cheese. So, if you multiply market price of cheese to the quantity of cheese you will get the total revenue received from cheese plus second product is wine. So, price of one unit of wine is pw multiplied by the quantity of wine. So, this is actually the total revenue.

Now, total cost we assume that only labor is used to produce. So, quantity of labor multiplied by wage rate is total cost. So, minus say C in this equation like this pi is, pi is the total profit equal to market price of cheese multiplied by cheese plus market price of wine multiplied by quantity of wine minus C is a total cost and that is equal to total profit.

Now, you can convert this equation of total profit in terms of quantity of wine. So, quantity of wine here is equal to bracket pi minus C divided by pw minus pc divided by pc multiplied by quantity of C. Now, you can see that this is actually the intercept of this line you can see here this line. So, this is the intercept of this line, this is intercept and you can also calculate the slope; slope is pc divided by pw into C. So, pc minus pc divided by pw is the slope of this price line and slop is in this case positive.

Why it is positive? Slope is negative sorry; slope is negative indicating that if you want to spend more money in the production of wine less money will be available for production of cheese. So, in this case the slope of this factor prior this line straight line is tangent to at point

B. So, this point B is the equilibrium point where the slope of production possibility curve is equal to the slope of this price line.

And, that is the efficient point or you can say economic efficiencies achieved at the spine because it is both allocative efficient as well as technically efficient because B point is on the production possibility frontier. And, when you introduce the prices then the slope of this price ratio is tangent to the budget so, optimization is occurred. So, B is the efficient point and here pc divided by pw is the slope which is negative indicating the tradeoff between the quantity of cheese and wine.

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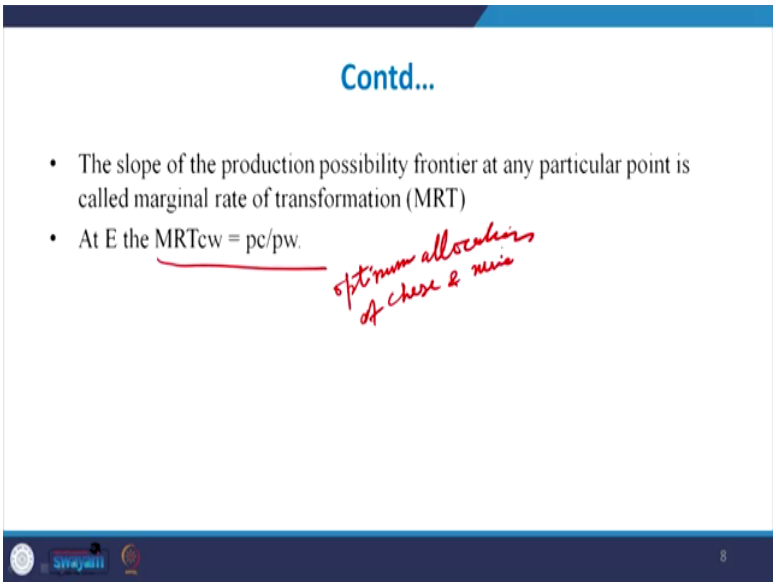

The slope of the production possibility frontier at any particular point is called as I already told you MRT marginal rate of transformation and at the equilibrium point this MRT c for w means marginal rate of transformation between cheese and wine should be equal to their

prices so, how much is the price of cheese and wine. So, this is actually called the optimum allocation, allocation of cheese and wine. This is the case of two good product because wine and cheese both are the conventional product.

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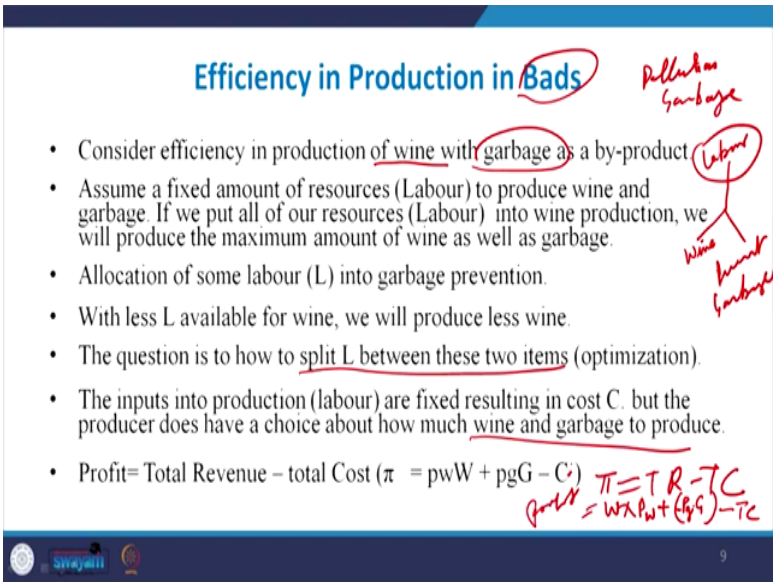

Now, if you we introduce the same concept in achieving the production efficiency when we have bad product; bad product means like pollution, pollution or garbage. So, when any company is producing good product, then waste are also generated. So, consider the efficiency of production of wine; suppose we take now only the production of wine. So, a company is producing wine, but when wine is produced garbage is also produced as a by-product.

Now, if the company has a limited resources labor that can be used to produce wine and if entire labor is use is used to produce wine then maximum wine can be produced, but at the

same time maximum garbage will also be produced. So, what the company can do a part of this labor can be produced can be used to produce wine and part of labor can be used to prevent garbage. So, if garbage is to be prevented some resources will be diverted from production of wine to the treatment of the waste.

So, since resources are limited so, obviously, you can see if more resources are diverted from production of wine towards production waste disposal then less resources will be available for production of wine. So, you can see that allocation of labor can be done efficiently between wine and prevention of waste or waste disposal. So, with less labor available for wine we will produce less wine. So, obviously, and the question is how to split labor into these two products so, that is a the question of optimization of resources.

So, how to allocate available resources in the production of wine and waste disposal is the basic issue for discussion. The input into the production we know are fixed resulting into the fixed cost resulting into the cost of using these available resources, but producer does not have a choice does have a choice between how much wine and how much garbage to be produced.

So, now a producer has to take decision how much quantity of wine and how much quantity of garbage should be produced in order to make the efficient use of available resources. Here also we know the total profit pi total profit is equal to TR minus TC and in this case here what is the total revenue of the company companies producing wine? So, w is the quantity of wine multiplied by p price of wine that is the revenue received by the company plus p g market price of one unit of garbage generated by that company multiplied by G and since this is negative.

So, company is getting some revenue in the production of wine, but when the company selling garbage in the market it is fetching negative price. So, the total revenue will be here lesser when you add p g into g minus total cost. So, that is actually the profit. So, profit is equal to the total revenue received by the company by selling wine in the market as well as selling garbage which is having a negative price in the market.

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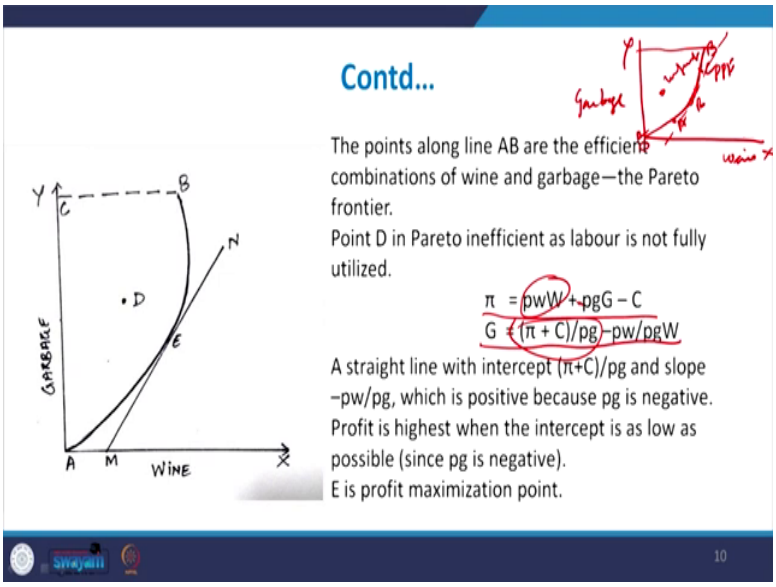

So, this can be explained by the production possibility frontier. Now, look the earlier production possibilities frontier which was having a negative slope indicating a tradeoff between production of cheese and wine. But, when we have a good product say wine and other is the bad product how to draw production possibility curve?

So, in that case the production possibility curve you can simply see is since we are taking say wine on horizontal axis x-axis and garbage, garbage on y-axis. So, garbage is a negative product and wine is good product. So, obviously, if you wanted to increase the production of wine you have to increase the production of garbage. So, both are going in the same direction more production of wine means more production of garbage.

So, production possibility curve shows that if you wanted to allocate some resources in the production of wine then and not allocating resources in the waste disposal then more garbage

will be generated. So, you can say this say AB is the production possibility; production possibility frontier and any point on this production possibility frontier is known as like A point, B point, C point they are Pareto optimal. But, all points cannot be called allocatively efficient.

Allocatively efficient will be only when we know the how much the price of garbage that is negative price and how much is the price of wine. Any point on in the interior of the production possibility frontier is called inefficient or Pareto inefficient point like this.

And, now if you wanted to know the efficient allocation of wine or production of wine and garbage by the firm what you had to do is you have to first draw the price ratio of or price line of cheese and sorry, this wine and garbage and that is in terms of G you can calculate like pi is total profit is p pw W p pw is the price of one unit of wine and W is the quantity of wine.

So, this is the total revenue received by the firm and pg divided by pg is the per unit of garbage and actually this is the negative since this you can say pg is negative and multiplied by. So, therefore, pg multiplied by W, this is the revenue received by the company after selling wine in the market minus how much is the negative value of garbage and minus cost will be the profit. And, if you convert this equation in terms of garbage then you will get this equation and this portion is intercept this intercept you can see intercept of the this price line and pw divided by pg is the slope.

Slope is you can see here the slope and this is the point where the slope of this MN line is tangent to the production possibility curve; for example, if you draw this line then this will be the efficient point so, where the slope of the line is equal to the slope of the production possibility frontier. So, optimization will occur at this point and since the slope is positive. Why it is positive? Because pg is negative.

So, negative multiplied by negative becomes positive. So, slope of MN line is positive and this clearly indicate lower the intercept more will be the profit earned by the company. So, E

point is the profit maximizing point or efficient allocation of output. Let us now sum up this topic. In this lecture you studied about production efficiency in case of two products.

First I explained using two good products wine and cheese, and efficiency in production achieved at the point where the slope of production possibility frontier it tangent at tangent to the price ratio of the two products. And, then I also explained the efficiency in production using one good product and one bad products; good product we have used is wine and bad product is garbage.

And, the position of the production possibility frontier is different because now there is a positive relationship between the garbage and wine production, if you want it to produce more wine more will be the garbage generated by the company while producing the garbage. So, therefore, more wine production can be done by generating the more pollution in the economy.

And, finally, I can conclude that the overall optimization in the economy will occur at the point where the consumer consumes at the level where their marginal utility is equal to a price and producer produces the product at the point where the marginal cost of the product is equal to price of the product. Now, in economy overall efficiency in consumption as well as production can be achieved if equal marginal principle is applied and this concept of equal marginal principle will be discussed in the next lecture.

Thank you.